California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

December 9 & 10, 2009

REVISED

LOCATION:
Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

This facility is accessible by public transit. For transit information, call (916) 321-BUSS, website: http://www.sacrt.com
(This facility is accessible to persons with disabilities.)

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING GO TO: http://www.arb.ca.gov/lispub/comm/bclist.php

December 9, 2009
9:00 a.m.

CONSENT CALENDAR:

All items on the consent calendar will be voted on by the Board immediately after the start of the public meeting. Any item may be removed from the consent calendar by a Board member or by someone in the audience who would like to speak on that item. The following items are on the consent calendar:

Consent Item#

09-10-1: Public Meeting to Consider 8 Research Proposals

1. *"Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the Los Angeles Basin," University of California, Los Angeles, $299,968, Proposal No. 2684-265.*

2. *"Improved Characterization of Primary and Secondary Carbonaceous Particles," University of California, San Diego, $255,000, Proposal No. 2681-265.*

3. *"Hourly In-situ Quantitation of Organic Aerosol Marker Compounds during CalNex 2010," University of California, Berkeley, $249,999, Proposal No. 2680-265.*

4. *"Determining Nitrogen Oxide Emissions from Soil in California Cropping Systems to Improve Ozone Modeling," University of California, Davis, $83,500, Proposal No. 2683-265.*

5. *"Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," University of California, Davis, $82,000, Proposal No. 2682-265.*

6. *"Three-Dimensional Measurements of Aerosol Mixing State During CalNex Using Aircraft Aerosol Time-of-Flight Mass Spectrometry," University of California, San Diego, $400,000. Proposal No. 2689-265.*

7. *"Health Effects of Central Valley Particulate Matter," University of California, Davis, $496,429, Proposal No. 2688-265.*

8. *"AMAX-DOAS Trace Gas Column Observations from Research Aircraft Over California," University of Colorado at Boulder, $549,999, Proposal No. 2687-265.*
   Attached are the Proposed Resolutions. Please go to http://www.arb.ca.gov/board/ma/2009/ma120909.htm for resolution attachments.

09-10-2: Public Hearing to Consider Proposed Amendments to the Regulation for Limiting Ozone Emissions from Indoor Air Cleaning Devices

Staff has proposed amendments to the regulation to extend the labeling compliance date, incorporate refinements to the ozone emissions test method, and make other minor revisions to the regulation.
Attached is the Proposed Resolution. Please go to http://www.arb.ca.gov/board/ma/2009/ma120909.htm for resolution attachments.

DISCUSSION ITEMS:

Note: The following agenda items may be heard in a different order at the Board meeting. Also, **agenda item 09-10-7** may not be heard until Thursday, December 10, 2009, or may start on December 9 and then conclude on December 10, 2009, depending on the length of the other agenda items.

Agenda Item #

09-10-8: Public Meeting to Update the Board on the Truck and Bus Regulation and the In-Use Off-Road Diesel-Fueled Fleet Regulation

Staff will present the Board with an update on a number of items related to the implementation of the In-Use On-Road Diesel Vehicle (Truck and Bus) regulations, including: an assessment of the health risks posed by agricultural trucks exempted from the truck and bus regulation, information on funding assistance, outreach efforts, and other items. Staff will also brief the Board on staff's assessment of the effects of the economy on emissions from In-Use On-Road and In-Use Off-Road regulations. These updates were requested by the Board at the December 2008 and July 2009 meetings, respectively. After staff's update, the Board may direct staff to return to the Board with proposed modifications to these regulations.

09-10-5: THIS ITEM HAS BEEN POSTPONED TO THE JANUARY BOARD MEETING
Public Meeting to Update the Board on the Low Carbon Fuel Standard

Staff will update the Board on the status of the Low Carbon Fuel Standard (LCFS), which the Board approved in April 2009. At that hearing, the Board directed staff to do additional work for the implementation of LCFS. Staff will provide a status update on the additional work.

[See note above on scheduling for this agenda item]
09-10-7: Public Hearing to Consider the Adoption of a Proposed Regulation for the Management of High Global Warming Potential Refrigerants for Stationary Sources

Staff will propose a new Refrigerant Management Program, an Assembly Bill 32 early action measure, which will mitigate high-global warming potential (GWP) greenhouse gas emissions from stationary refrigeration and air conditioning equipment. The regulation is proposed to: 1) reduce emissions of high-GWP refrigerants from stationary, non-residential refrigeration equipment, 2) reduce emissions resulting from the installation and servicing of refrigeration and air-conditioning appliances using high-GWP refrigerants, and 3) verify emission reductions. This regulation would result in significant greenhouse gas emission reductions in a cost effective manner.

December 10, 2009
8:30 a.m.

Note: Regarding **agenda item 09-10-7**, see scheduling notes on this item above.

09-10-4: Public Meeting to Provide an Informational Update on the Zero Emission Vehicle Regulation Revisions

Staff will update the Board on the development of Zero Emission Vehicle (ZEV) technologies, the role these technologies may play in achieving the State's 2050 greenhouse gas emission goal, how the ZEV regulation could be modified to help achieve this goal, and what other policies may be beneficial or necessary to assure adequate and timely fueling infrastructure and to incentivize consumers to buy ZEVs. This is an informational item and no regulatory action will be taken at this time. A regulatory update of the ZEV program is planned in late 2010.

CLOSED SESSION – LITIGATION

The Board will hold a closed session, as authorized by Government Code section 11126(e), to confer with, and receive advice from, its legal counsel regarding the following pending or potential litigation:

Central Valley Chrysler-Jeep, Inc. et al. v. Goldstene, U.S. Court of Appeals, Ninth Circuit, No. 08-17378 on appeal from U.S. District Court (E.D. Cal. - Fresno).

Fresno Dodge, Inc. et al. v. California Air Resources Board et al., Superior Court of California (Fresno County), Case No. 04CE CG03498.

General Motors Corp. et al. v. California Air Resources Board et al., Superior Court of California (Fresno County), Case No. 05CE CG02787.

Green Mountain Chrysler-Plymouth-Dodge-Jeep, et al. v. Crombie, 508 F.Supp.2d 295, U.S. District Court Vermont (2007), appeal to U.S. Court of Appeals, Second Circuit, Nos. 07-4342-cv(L) and 07-4360-cv(CON).

California Business Properties Association, et al. v. California Air Resources Board, et al., Superior Court of California (Sacramento), Case No. 34-2009-80000232.

Pacific Merchant Shipping Association v. Goldstene, U.S. District Court, EDCA, Case No. 2:09-CV-01151-MCE-EFB.

American Trucking Association, et al. v. U.S. Environmental Protection Agency, et al., U.S. Court of Appeals, District of Columbia Circuit, Case No. 09-1090.

Yamaha Motor Corporation, USA v. James Goldstene, et al., Superior Court of California (San Diego County), Case No. 37-2009-00094919-CU-MC-CTL.

OPPORTUNITY FOR MEMBERS OF THE BOARD TO COMMENT ON MATTERS OF INTEREST

Board members may identify matters they would like to have noticed for consideration at future meetings and comment on topics of interest; no formal action on these topics will be taken without further notice.

OPEN SESSION TO PROVIDE AN OPPORTUNITY FOR MEMBERS OF THE PUBLIC TO ADDRESS THE BOARD ON SUBJECT MATTERS WITHIN THE JURISDICTION OF THE BOARD

Although no formal Board action may be taken, the Board is allowing an opportunity to interested members of the public to address the Board on items of interest that are within the Board's jurisdiction, but do not specifically appear on the agenda. Each person will be allowed a maximum of three minutes to ensure that everyone has a chance to speak.

THE AGENDA ITEMS LISTED ABOVE MAY BE CONSIDERED IN A DIFFERENT ORDER AT THE BOARD MEETING. BOARD ITEMS NOTED ABOVE WHICH ARE NOT COMPLETED ON DECEMBER 9, WILL BE HEARD ON DECEMBER 10 BEGINNING AT 8:30 A.M.

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING GO TO:
http://www.arb.ca.gov/lispub/comm/bclist.php

IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT THE CLERK OF THE BOARD:
OFFICE: (916) 322-5594
1001 I Street, Floor 23, Sacramento, California 95814
ARB Homepage: www.arb.ca.gov

To request a special accommodation or language needs for any of the following:

- An interpreter to be available at the hearing.
- Have documents available in an alternate format (i.e. Braille, large print) or another language.
- A disability-related reasonable accommodation.

Please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled Board hearing. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

Para solicitar alguna comodidade especial o si por su idioma necesita cualquiera de los siguientes:

- Un intérprete que esté disponible en la audiencia.
- Documentos disponibles en un formato alternativo (es decir, sistema Braille, letra grande) u otro idioma.
- Una acomodación razonable relacionados con una incapacidad.

Porfavor llame a la officina del Consejo a (916) 322-5594 o envie un fax a (916) 322-3928 lo mas pronto possible, pero no menos de 10 dias de trabajo antes del el dia programado para la audencia del Consejo. TTY/TDD/ Personas que nesessitan este servicion pueden marcar el 711 para el Servicio de Retransmisión de Mensajes de California.

SMOKING IS NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

LOCATION:
Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

INDEX

This facility is accessible by public transit. For transit information, call (916) 321-BUSS, website: http://www.sacrt.com
(This facility is accessible to persons with disabilities.)

December 9, 2009 at 9:00 a.m.
&
December 10, 2009 at 8:30 a.m.

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-57

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 38700 through 39705;

WHEREAS, a research proposal, number 2684-265, entitled "Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the LA-Basin," has been submitted by the University of California, Los Angeles;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2684-265 entitled "Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the LA-Basin," submitted by the University of California, Los Angeles, for a total amount not to exceed $299,968.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 38500, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2684-265 entitled "Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the LA-Basin," submitted by the University of California, Los Angeles, for a total amount not to exceed $299,968.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $299,968.

ATTACHMENT A

"Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the LA-Basin"

Background

Assembly Bill 32 (AB 32), which requires a reduction in emissions of greenhouse gases (GHG) in California to 1990 levels by 2020, presents a challenge to the existing observational network. The current network was designed to monitor air pollutants at ground level with the aim of estimating human exposures. New technologies are required for long-term monitoring of spatial concentrations and emissions of GHGs. The proposed research will develop novel remote sensing methods to map out three dimensional concentrations of trace gases and, combined with new inverse modeling techniques, to monitor emissions of air pollutants and GHGs in the South Coast Air Basin (SoCAB).

Objective

The primary objective of the proposed research is to develop remote sensing methods to measure three-dimensional concentrations of nitrogen dioxide (NO_2), formaldehyde (HCHO), glyoxal, sulfur dioxide (SO_2), dimer of oxygen (O_4), aerosol extinction, as well as GHGs carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) over the SoCAB. Combined with new inverse modeling methods, these long-term measurements will form the basis for a better spatio-temporal description of air pollutants and GHGs in the SoCAB.

Methods

The proposed research is based on remote sensing of the SoCAB by two different spectrometers from a site on Mt. Wilson overlooking the basin (NASA's Jet Propulsion Laboratory's California Laboratory for Atmospheric Remotes Sensing site). Observations will be integrated with new inverse modeling techniques that resolve trace gas and aerosol concentration fields and emissions.

A UV-vis MAX-DOAS instrument, which has been used by the PI in several previous field studies, will measure scattered solar radiation from different viewing directions (upward and downward towards the basin). These measurements in combination with radiative transfer calculations will allow determination of vertical profile concentrations of NO_2, HCHO, glyoxal, SO_2, O_4, and aerosol extinction. The MAX-DOAS will be operated automatically every day from sunrise to sunset; these measurements will be supplemented by pictures of the atmosphere taken by a CCD camera.

A high-resolution near-IR Fourier Transform Spectroscopy (FTS) instrument, which has recently been constructed, will measure absorption paths CO, and GHGs CO_2, CH_4, and N_2O in the near infrared and visible spectrum. As for the MAX-DOAS, the near-IR FTS will scan the basin, but in a 5X5 grid.

Expected Results
The proposed research will develop new remote sensing methods on a unique observational platform - Mt. Wilson - to measure three-dimensional concentrations and emissions of air pollutants and GHGs in the SoCAB. These observations will help improve the GHG emission inventory and greatly expand the range of possible monitoring stations.

Significance to the Board
The product will be a unique spatio-temporal description of concentrations and emissions within the SoCAB. This data will help support and improve the GHG emission inventory for AB 32 and lay the foundation for a next generation air quality monitoring network.

Contractor:
University of California, Los Angeles (UCLA)

Contract Period:
36 months

Principal Investigator (PI):
Professor Jochen Stutz

Contract Amount:
$299,968

Cofunding:
The proposed project is an ARB contribution to CalNex 2010, which is a collaborative study with the National Oceanic and Atmospheric Administration (NOAA) to address scientific questions which bear upon the ability to formulate policy related to mitigation of air pollution and climate change. NOAA is contributing resources and direct funding to CalNex conservatively estimated at $15,000,000. The NOAA contributions include a dedicated research vessel and multiple research aircraft, ground support, planning, and direct funding of contracted measurements.

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Staff had very good interactions with the PI, Professor Jochen Stutz, on an ARB-funded project that was recently completed (05-307 titled, "Impact of Reactive Halogen Species on the Air Quality in California Coastal Areas"). In this work, the PI successfully completed all proposed tasks and wrote a detailed final report synthesizing data from several groups. In addition, Professor Jochen Stutz has carried out many field studies using remote measurements and has made significant contributions to differential optical absorption spectroscopy. For example, the PI is coauthor of a book on

differential optical spectroscopy, *Differential Optical Absorption Spectroscopy: Principles and Applications*.

Prior Research Division Funding to UCLA:

Year	2008	2007	2006
Funding	$70,347	$616,171	$348,990

BUDGET SUMMARY

Contractor: University of California, Los Angeles

Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the LA-Basin

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 252,156	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 3,000	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 4,300	
7.	Mail and Phone	$ 300	
8.	Supplies	$ 3,942	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 9,000	
	Total Direct Costs		$ 272,698
INDIRECT COSTS			
1.	Overhead	$ 27,270	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 27,270
TOTAL PROJECT COSTS			**$ 299,968**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-58

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2681-265, entitled "Improved Characterization of Primary and Secondary Carbonaceous Particles," has been submitted by the University of California, San Diego;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2681-265, entitled "Improved Characterization of Primary and Secondary Carbonaceous Particles," has been submitted by the University of California, San Diego, for a total amount not to exceed $255,000.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2681-265, entitled "Improved Characterization of Primary and Secondary Carbonaceous Particles," has been submitted by the University of California, San Diego, for a total amount not to exceed $255,000.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $255,000.

ATTACHMENT A

"Improved Characterization of Primary and Secondary Carbonaceous Particles"

Background
The Air Resources Board, National Oceanic and Atmospheric Administration, and California Energy Commission have coordinated a joint field study of atmospheric processes over California and the eastern Pacific coastal region in 2010 (CalNex 2010). The goal of the CalNex campaign is to conduct a short-term atmospheric sampling program through which climate change and air quality can be studied, as new integrated policies are needed to effectively and efficiently address both environmental issues. Since organic aerosol is a significant contributor to both aerosol air quality and radiative forcing in many parts of the Earth, assessing its atmospheric role requires observations of organic functional groups.

Objective
The objective of this proposed study is to quantify the mass fraction of organic functional groups to emission sources from combustion and biological processes using trace metal and organic molecular signatures. The organic aerosol sampling will be carried out in coordination with CalNex 2010 measurements in the southern San Joaquin Valley (SJV).

Methods
The investigators will use a combination of different sampling techniques and instrumentation to provide a broader understanding of inorganic and organic mass that makes up the overall particle mass contributing to the out-of-compliance levels in the California's Central Valley. This project will be collocated at the super-site in the southern SJV during the six-week CalNex 2010 field study. The investigators propose to: (1) collect and analyze data collected by Aerosol Mass Spectroscopy (AMS) and Fourier transform infrared spectroscopy (FTIR), as well as x-ray Fluorescence (XRF); (2) use factor analysis to attribute the measured mass of organic carbon functional groups to sources based on trace metal signatures; and (3) compare these results to gas-phase organic tracers and oxidants. AMS measurements will be continuous during the study while FTIR and XRF will be coordinated with local meteorology and collocated sampling to collect four-eight hour samples.

Expected Results
Since organic aerosol is a significant contributor to both aerosol air quality and radiative forcing in many parts of the Earth, assessing their atmospheric role requires observations of organic functional groups. Results of this research project are expected to improve our knowledge of organic aerosol in regions where there are currently only sparse data. Identifying organic functional groups will help us understand how these particles will behave in the atmosphere in terms of their thermodynamic, microphysical, and optical properties.

Significance to the Board
This research is expected to provide useful new measurements and statistical analysis for developing air quality attainment strategies in California. Better characterization of organic carbon will also improve our ability to identify organic functional groups in particles that reduce air quality and harm health.

Contractor:
Scripps Institution of Oceanography, University of California, San Diego (UCSD)

Contract Period:
24 months

Principal Investigator (PI):
Professor Lynn Russell

Contract Amount:
$255,000

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Professor Russell will serve as the principal investigator coordinating and synthesizing the effort for the overall project. Her 15+ years of experience in aerosol science and strong publication record make her ideal to fulfill this role.

Prior Research Division Funding to UCSD:

Year	2008	2007	2006
Funding	$591,261	$194,304	$174,998

BUDGET SUMMARY

Contractor: Scripps Institution of Oceanography, University of California, San Diego

Improved Characterization of Primary and Secondary Carbonaceous Particles

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 202,751	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 7,176	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 120	
7.	Mail and Phone	$ 1,446	
8.	Supplies	$ 13,110[1]	
9.	Analyses	$ 10,210[2]	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$234,813
INDIRECT COSTS			
1.	Overhead	$ 20,187	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$20,187
TOTAL PROJECT COSTS			**$255,000**

[1] The consumable supplies necessary for sample preparation, collection, and analysis. 360 samples and blanks will be collected during 30 days of sampling, with 40 filters allocated for calibration and testing. Additional items are required backup and replacement parts for field operations.

[2] X-Ray fluorescence analysis of the collection filters will be performed by Chester Laboratories. The total cost includes 150 samples at $67/sample plus $160 roundtrip shipping.

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-59

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2680-265, entitled "Hourly In-situ Quantitation of Organic Aerosol Marker Compounds during CalNex 2010," has been submitted by the University of California, Berkeley;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2680-265. entitled "Hourly In-situ Quantitation of Organic Aerosol Marker Compounds during CalNex 2010," submitted by the University of California, Berkeley, for a total amount not to exceed $249,999.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2680-265 entitled "Hourly In-situ Quantitation of Organic Aerosol Marker Compounds during CalNex 2010," submitted by the University of California, Berkeley, for a total amount not to exceed $249,999.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $249,999.

ATTACHMENT A

"Hourly In-situ Quantitation of Organic Aerosol Marker Compounds during CalNex 2010"

Background
Mass concentrations of particulate matter in the southern San Joaquin Valley routinely exceed ambient air quality standards established to protect public health. Organics comprise a significant but variable fraction (20-80 percent) of the particulate matter. This research will provide detailed hourly measurements of over 100 organic particulate species and use factor (and/or positive matrix factorization) analysis to characterize the contribution of various types of emission sources to the organic species in particulate matter.

Objective
The objective of this project is to identify the types of emissions contributing to the observed organic particulate matter in the southern San Joaquin Valley.

Methods
The investigators will make measurements that characterize many of the organic compounds in fine particulate matter, relate that information to measurements of gaseous volatile organic compounds in the air and to the mixture of organic species associated with various types of emission sources, and then conduct statistical analyses that can ascribe the mix of source types contributing to the observed composition of organic particulate matter in the air.

Expected Results
The investigators will provide uniquely detailed organic particulate matter data (hourly data for over 100 organic species for up to 6 weeks) at the CalNex super-site in the southern San Joaquin Valley during the CalNex field study (May-June 2010). These and additional collocated CalNex measurements (e.g., volatile organic compounds (VOC)) will be validated and subjected to factor analysis to identify the contribution of various emission sources (direct emissions and secondary formation from atmospheric gases).

Significance to the Board
The results will help ARB design efficient control strategies to reduce ambient PM in the southern San Joaquin Valley and thus improve the health and welfare of residents. The results will provide new insights into the chemical reactions occurring in the atmosphere and also into improving the chemistry modules of aerosol models.

Contractor:
University of California, Berkeley (UCB)

Contract Period:
24 months

Principal Investigator (PI):
Professor Allen Goldstein

Contract Amount:
$249,999

Cofunding:
The proposed project is an ARB contribution to CalNex 2010, which is a collaborative study with the National Oceanic and Atmospheric Administration (NOAA) to address scientific questions which bear upon the ability to formulate policy related to mitigation of air pollution and climate change. NOAA is contributing resources and direct funding to CalNex conservatively estimated at $15,000,000. The NOAA contributions include a dedicated research vessel and multiple research aircraft, ground support, planning, and direct funding of contracted measurements.

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Professor Goldstein is a well-known and respected research expert on anthropogenic and biogenic sources of VOCs. He is one of the premier experts on atmospheric chemistry in forests. He has conducted past research and staff have been pleased with Professor Goldstein's planning, execution, and reporting of results from his research projects. Two previous contracts with ARB that have direct pertinence to this project are 98-328 (Blodgett Forest VOCs) and 03-324 (TAG in SOAR).

Prior Research Division Funding to UCB:

Year	2008	2007	2006
Funding	$1,135,500	$1,372,484	$1,607,398

BUDGET SUMMARY

Contractor: University of California (Berkeley)

Hourly In-Situ Quantitation of Organic Aerosol Market Compounds During CalNEX 2010

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 91,452	
2.	Subcontractors	$ 94,845	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 8,000	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 2,000	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 13,736	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 25,947[1]	
	Total Direct Costs		$235,980
INDIRECT COSTS			
1.	Overhead	$ 14,019	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$14,019
TOTAL PROJECT COSTS			**$249,999**

[1] Miscellaneous line item represents remission of the tuition (in-state) and student fees for the two years that the Graduate Student Researcher will be working on this project.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Aerosol Dynamics, Inc.

Description of subcontractor's responsibility: Aerosol Dynamics, Inc. (ADI) staff will prepare, set-up, operate, maintain, trouble-shoot, and remove the TAG instrument from the monitoring site in the southern San Joaquin Valley during the CalNex field study. ADI will QA/QC the data. ADI will also participate in the integration and analysis of data sets and the presentation of results.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 49,936	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 3,106	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 6,848	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$59,890
INDIRECT COSTS			
1.	Overhead	$ 34,955[1]	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$34,955
TOTAL PROJECT COSTS			**$94,845**

[1] Overhead rate is only 70% of labor (line item #1 under Direct Costs). This is different from the standard methodology of applying the overhead rate to Total Direct Costs minus Equipment. This modified methodology results in savings to the ARB of about $7,000 compared to the standard methodology.

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-60

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat climate change, pursuant to Health and Safety Code sections 38700 through 38705;

WHEREAS, a research proposal, number 2683-265, entitled "Determining NO_X Emissions from Soil in California Cropping Systems to Improve Ozone Modeling," has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2683-265, entitled "Determining NO_X Emissions from Soil in California Cropping Systems to Improve Ozone Modeling," has been submitted by the University of California, Davis for a total amount not to exceed $83,500.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 38500, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2683-265, entitled "Determining NO_X Emissions from Soil in California Cropping Systems to Improve Ozone Modeling," has been submitted by the University of California, Davis for a total amount not to exceed $83,500.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $83,500.

ATTACHMENT A

"Determining NO_x Emissions from Soil in California Cropping Systems to Improve Ozone Modeling"

Background

As an ozone precursor, NO_X is considered one of the most important air pollutants in air quality management. Agricultural soils are known sources of NO_X, but there are few definitive studies on NO_X emissions from soils, especially in California. The lack of information on soil NO_X emissions not only creates a data gap in California's NO_X inventory, but also may restrict ARB's ability for accurate ozone modeling. This project will provide the much needed data on NO_x monitoring in the agricultural fields that may improve ozone modeling and ultimately lead to better control strategies of NOx emissions from agricultural soils. This proposed study is built on three other concurrent projects targeting N_2O emissions, funded by ARB, California Energy Commission (CEC), and California Department of Food and Agriculture (CDFA). The combined results of all the projects will provide a more complete account of nitrogen fate and transport in California's cropping systems.

Objective

The objectives of this project are to: (1) measure NO_X emissions from five California cropping systems under various management conditions; (2) characterize the dose-response relationship of NO_X fluxes to nitrogen fertilizer rates; and (3) identify key soil variables and management factors that influence NO_X emissions from soils.

Methods

The investigators will conduct field experiments to monitor NO_x fluxes from five California cropping systems: tomato, wheat, almonds, alfalfa, and corn. The emission data will be collected for one year during the summer season when ozone concentration is usually high. The monitoring periods will surround fertilization and irrigation events, starting before the events and extend until NO_X fluxes subside to background levels. All cropping systems will be managed under conventional practices. For wheat and tomato crops, experiments will also be performed to test the dose-response relationship of NO_X emissions and N fertilizer rates. NO_X fluxes will be monitored using a dynamic chamber method equipped with a LAM-3 NO_X analyzer. A TECO NO_X Anayzer (Model 42) will be collocated at selected sites to ensure comparative results.

Expected Results

As an ozone precursor, NO_X has historically drawn intense interests from the scientific and regulatory communities. However, due to scarcity of data, NO_X emissions from agricultural soils have not been quantified and are not considered in the current California emission inventory. The proposed project will determine NO_X emissions from a range of California cropping systems, examine their relationship with fertilizer application and other regulating factors, and provide much needed field measurement data for possible development of an ozone formation module for soil processes.

Significance to the Board
Understanding sources and the magnitude of NO_X emissions is important for accurately predicting ozone production. NO_X emissions from soils have been historically unavailable in the California inventory due to lack of emission data. This research will address the data gap and the outcome is expected to improve the current California NO_x inventory and potentially our capability of ozone modeling.

Contractor:
University of California, Davis (UCD)

Contract Period:
24 months

Principal Investigator (PI):
William R. Horwath, Ph.D.

Contract Amount:
$83,500

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
The research team of this project consists of known experts in the state on nitrogen management and cycling in agricultural ecosystems. The investigators have been involved in field studies of nitrogen fate, including N_2O, in many projects. Dr. Horwath is a professor in soil biogeochemistry and has published extensively in the leading journals regarding soil processes of nutrients management. He is currently engaged in several other projects involving monitoring of N_2O from alfalfa, wheat, rice, lettuce, and tomato fields.

Prior Research Division Funding to UCD:

Year	2008	2007	2006
Funding	$915,193	$935,020	$1,684,890

BUDGET SUMMARY

Contractor: University of California at Davis

"Determining NO_x Emissions from Soil in California Cropping Systems to Improve Ozone Modeling"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 68,944	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 2,506	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Printing	$ 70	
7.	Mail, Phone, and Fax	$ 78	
8.	Materials & Supplies	$ 3,433	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 878	
	Total Direct Costs		$75,909
INDIRECT COSTS			
1.	Overhead	$ 7,591	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$7,591
TOTAL PROJECT COSTS			**$83,500**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-61

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat climate change, pursuant to Health and Safety Code sections 38700 through 39705;

WHEREAS, a research proposal, number 2682-265, entitled "Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2682-265, entitled "Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," has been submitted by the University of California, Davis for a total amount not to exceed $82,000.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 38500, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2682-265, entitled "Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," has been submitted by the University of California, Davis for a total amount not to exceed $82,000.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $82,000.

ATTACHMENT A

"Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems"

Background
Nitrous oxide emissions from agricultural soils have been estimated using a bottom-up, emission factor approach. However, production of N_2O from agricultural soils is a microbial process, regulated by numerous environmental factors such as temperature, soil moisture content, and soil organic matter content. As a result, N_2O fluxes from soils are highly irregular both spatially and temporally, and can change extensively with crop, soil, or management practices. In intensively managed cropping systems, spikes of N_2O fluxes are often coupled with soil management events such as application of nitrogen fertilizers, irrigation/drainage, tillage disturbance, and incorporation of plant residues. Precipitation can also induce substantial N_2O fluxes. Therefore, field measurements are required to accurately characterize N_2O emissions from agricultural soils. There have been extensive studies performed measuring N_2O fluxes from crop and range land, but data are sparse in California's cropping systems, especially for those with inputs of dairy waste. Dairy waste is applied to approximately 400,000 acres of irrigated forage cropland in California, producing one of the highest annual throughputs of nitrogen of any cropping system in the world, leading to potentially substantial N_2O emissions. In addition, the soil conditions in the cropping systems receiving dairy waste tend to be more conducive to N_2O production because this N-containing waste has high levels of organic compounds, which could enhance both nitrification and denitrification - the major processes producing N_2O in soils.

Objective
The goal of this project is to determine N_2O emissions in typical California forage cropping systems receiving dairy lagoon waste and manure. The N_2O fluxes will be measured in three forage crops to: (1) determine the seasonal and annual emission rates of N_2O; (2) calculate crop system-specific N_2O emission factors; and (3) identify key environmental conditions that affect N_2O emissions.

Methods
The project is part of a coordinated effort with the California Energy Commission (CEC), and California Department of Food and Agriculture (CDFA) to determine baseline emissions of the greenhouse gas N_2O in the State. The project will conduct field experiments to monitor N_2O fluxes from corn forage fields in three selected dairy farms located in the San Joaquin Valley. Either PVC or stainless steel chambers will be placed in the fields and N_2O emissions will be monitored by taking periodic air samples from the enclosures and injecting them into a gas chromatograph for analysis. Sampling will be taken during a one year period. The sampling frequency will vary, depending upon the expected N_2O fluxes, and will be more intensive after manure and lagoon water inputs and during rainfall events. Short-term time series of N_2O fluxes will be monitored to characterize diurnal variation of emissions. Ancillary data on related environmental and crop parameters such as soil nitrogen availability, soil water content,

soil organic carbon content, soil and air temperatures, and crop yields will also be collected to facilitate data interpretation and determine their impacts on N_2O emissions. Finally, silage corn-specific emission factors will be calculated based on the N_2O emission data and will be used, together with those obtained from other cropping systems, to develop a more realistic estimate for baseline N_2O emissions from California agricultural soils.

Expected Results
The emission rates of N_2O measured in this project and other projects will be used to develop California-specific N_2O emission factors for estimating baseline N_2O emissions from agricultural soil management in the State. These results are expected to reduce uncertainties associated with the current N_2O inventory of California.

Significance to the Board
The California Global Warming Solutions Act of 2006 requires the State to reduce greenhouse gas emissions to 1990 levels by 2020. Agricultural soil management is recognized as the largest source of N_2O in California. However, there are enormous uncertainties in both the estimate of baseline N_2O emissions from agricultural soils and reductions achievable from potential mitigation measures. This project will help ARB to improve the estimate of baseline N_2O emissions and provide a basis for the development of a mitigation target.

Contractor:
University of California, Davis (UCD)

Contract Period:
24 months

Principal Investigator (PI):
William R. Horwath, Ph.D.

Contract Amount:
$82,000

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
The research team of this project consists of known experts in the state on nitrogen management and cycling in agricultural ecosystems. The investigators have been involved in field studies of nitrogen fate, including N_2O, in many projects. Dr. Horwath is a professor in soil biogeochemistry and has published extensively in the leading journals regarding soil processes of nutrients management. He is currently engaged in several other projects involving monitoring of N_2O from alfalfa, wheat, rice, lettuce, and tomato fields.

Prior Research Division Funding to UCD:

Year	2008	2007	2006
Funding	$915,193	$935,020	$1,684,890

BUDGET SUMMARY

Contractor: University of California at Davis

"Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 60,776	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 5,940	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Printing	$ 254	
7.	Mail, Phone, and Fax	$ 0	
8.	Materials & Supplies	$ 7,356	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 219	
	Total Direct Costs		$74,545
INDIRECT COSTS			
1.	Overhead	$ 7,455	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$7,455
TOTAL PROJECT COSTS			**$82,000**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-62

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2689-265, entitled "Three-Dimensional Measurements of Aerosol Mixing State During CalNex Using Aircraft Aerosol Time-of-Flight Mass Spectrometry," has been submitted by the University of California, San Diego;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2689-265, entitled "Three-Dimensional Measurements of Aerosol Mixing State During CalNex Using Aircraft Aerosol Time-of-Flight Mass Spectrometry," has been submitted by the University of California, San Diego, for a total amount not to exceed $400,000.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2689-265, entitled "Three-Dimensional Measurements of Aerosol Mixing State During CalNex Using Aircraft Aerosol Time-of-Flight Mass Spectrometry," has been submitted by the University of California, San Diego, for a total amount not to exceed $400,000.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $400,000.

ATTACHMENT A

"Three-Dimensional Measurements of Aerosol Mixing State During CalNex Using Aircraft Aerosol Time-of-Flight Mass Spectrometry"

Background
Particles in the atmosphere impact human health and climate, the former by inhalation, and the latter primarily by modifying radiative transfer in the atmosphere. Climate effects are modulated by particle concentration, chemical composition, size distribution, dry air light scattering by particles, the interaction between clouds and particles ("cloud brightening"), and by light absorption by particles. Unlike health effects, which are similar wherever the particles are inhaled, the location of the particles in the atmospheric column can modify the climate effects.

Objective
This project will help meet one of the goals of the CalNex program, which is examining both air quality and climate effects of air pollution over California. This project will conduct detailed measurements of the properties of individual particles as encountered by an aircraft. This will be the first time that these types of measurements will be made from an aircraft in California. The Addition of this project to CalNex will significantly enhance efforts to characterize the effects of particles on air quality and climate in California.

Methods
This study will conduct time-, size-, and chemical composition- resolved particle measurements using single-particle aerosol time-of-flight mass spectrometry (ATOFMS) aboard two third-party measurement platforms participating in CalNex, an aircraft operated by Center for Interdisciplinary Remotely-Piloted Aircraft Studies under the direction of Professor John Seinfeld of Caltech, and an oceanographic ship operated by the National Oceanic and Atmospheric Administration (NOAA) under the direction of Dr. Patricia Quinn of NOAA. In both cases, the motivation for adding particle characterization is to both directly observe particle composition, and to provide measurement support to interpretation of other instruments, including particle physical measurements and gas-phase observations already planned for these platforms.

Expected Results
There are two primary scientific targets of the ATOFMS sampling. The first is to determine the vertical variation of aerosol composition and aerosol optical characteristics over California for comparison with models and observations from other regions and to interpret the role of aerosols in climate processes. The second is to use the detailed aerosol data to characterize the chemical history of air masses encountered during sampling in order to identify pollutant sources and to observe the effects of aging on their physical and chemical states.

Significance to the Board
Aerosols exert strong influence on climate, either exacerbating or counteracting the effects of greenhouse gases, depending on their chemical composition and physical characteristics. Aerosols also have adverse health effects which need to be controlled. The data collected in this study will support both ARB's climate and health effects programs by clarifying the sources and effects of airborne particles over the state.

Contractor:
Scripps Institution of Oceanography, University of California, San Diego (UCSD)

Contract Period:
24 months.

Principal Investigator (PI):
Professor Kimberly Prather

Contract Amount:
$400,000

Cofunding:
The proposed project is an ARB contribution to CalNex 2010, which is a collaborative study with the National Oceanic and Atmospheric Administration (NOAA) to address scientific questions which bear upon the ability to formulate policy related to mitigation of air pollution and climate change. NOAA is contributing resources and direct funding to CalNex conservatively estimated at $15,000,000. The NOAA contributions include a dedicated research vessel and multiple research aircraft, ground support, planning, and direct funding of contracted measurements.

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
ARB has successfully worked with Professor Prather since the mid-1990s. The ATOFMS instruments to be used in this study and data analysis techniques for dealing with the very large data sets they produce have been largely developed under a series of contracts between ARB and Professor Prather. In addition, Professor Prather has participated in multiple field projects with ARB, including SCOS97, the Riverside Organic Aerosol Study (SOAR), and studies of roadway emissions in Southern California.

Prior Research Division Funding to UCSD:

Year	2008	2007	2006
Funding	$591,261	$194,304	$174,998

BUDGET SUMMARY

Contractor: Scripps Institution of Oceanography, University of California, San Diego

Three-Dimensional Measurements of Aerosol Mixing State During CalNex Using Aircraft Aerosol Time-of-Flight Mass Spectrometry

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 145,841	
2.	Subcontractors	$ 0	
3.	Equipment	$ 99,750[1]	
4.	Travel and Subsistence	$ 23,240	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 641	
8.	Supplies	$ 68,925[2]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 36,737	
	Total Direct Costs		$375,135
INDIRECT COSTS			
1.	Overhead	$ 24,865	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$24,865
TOTAL PROJECT COSTS			**$400,000**

[1,2] New components and backup parts for airborne and ship ATOFMS operations. ATOFMS are hand-built instruments for which spare parts are not commercially available on an "as needed" basis, thus reliable field operations require redundant major components (pumps, lasers, etc.) be kept on hand.

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-63

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2688-265, entitled "Health Effects of Central Valley Particulate Matter," has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2688-265 entitled "Health Effects of Central Valley Particulate Matter," submitted by the University of California, Davis, for a total amount not to exceed $496,429.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2688-265 entitled "Health Effects of Central Valley Particulate Matter," submitted by the University of California, Davis, for a total amount not to exceed $496,429.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $496,429.

ATTACHMENT A

"Health Effects of Central Valley Particulate Matter"

Background

Epidemiological studies have shown that respiratory and cardiovascular health effects are most associated with ambient PM concentrations one to three days previous to the advent of the adverse health response (lags 1 to 3), although respiratory and cardiovascular effects seem to have different lag structures. To date experimental human and animal studies have measured all respiratory and cardiovascular endpoints at the same time, even though the epidemiologic literature suggests that the greatest effects on the various endpoints examined to date do not peak at the same time. Consequently, it is possible that important information on the temporal pattern of respiratory and cardiovascular responses and their interrelationships has been missed.

As part of the San Joaquin Valley Health Effects Research Center, an EPA-funded PM center, the investigators have performed studies examining biological responses following exposure to concentrated ambient particles (CAP) in Fresno and Westside, California during both the summer and winter in several rodent species. The goal of these studies was to compare the relative toxicity of ambient PM in urban and rural locations in the Central Valley of California. The results to date have shown increased peripheral and systemic inflammation when measured at a single time point post-exposure, but the lag time between exposure and endpoint assessment was not investigated, leaving a key data gap related to whether inflammation peaks at a different time in the lung compared to the vasculature.

Objective

The objective of the project is to investigate the toxicity and inflammatory potential of urban and rural Central Valley PM on pulmonary, vascular and systemic health effects in a mouse model through the examination of health-related endpoints at 1, 2 and 4 days following the end of multi-day exposures to CAPs, which correspond to the time-relationship between exposure and effects in epidemiological studies.

Methods

The investigators will expose three groups of 16 Balbc mice each to filtered air (FA) or CAPs in a fully equipped mobile exposure trailer for six hours per day for 12 days during winter and summer. Animals will be acclimatized to the exposure site for one week prior to the beginning of exposure. One FA and one CAPs group of animals will be sacrificed at one, two and four days post-exposure. Half of the animals in each group will be used for analysis of lung inflammatory mediators, endothelial and platelet function, while tissues from the other half of each group will be used for studies of lung histopathology and anti-oxidant gene expression using standard methods. Endpoints will include lung and systemic markers of inflammation, inflammatory cell differential in the lungs, histology and gene expression of anti-oxidant genes in the lung tissue, and complete blood count, platelet activation and function studies to assess systemic procoagulant responses.

Expected Results
The results of this project will contribute to our understanding of how particulate matter influences cardiopulmonary function, and will support and help to explain epidemiological associations between particulate matter and adverse health effects.

Significance to the Board
The project will support the Board's activities in selecting and promulgating health protective ambient air quality standards for particulate matter.

Contractor:
University of California, Davis (UCD)

Contract Period:
36 months

Principal Investigators (PI):
Anthony S. Wexler, Kent E. Pinkerton, Fern Tablin, Dennis W. Wilson, and Laura S. Van Winkle

Contract Amount:
$496,429

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Each of the investigators involved in this project has more than 10 years of experience performing related work. Drs. Wexler, Tablin and Wilson have lead previous projects funded by ARB, and have produced high quality work.

Prior Research Division Funding to UCD:

Year	2008	2007	2006
Funding	$915,193	$935,020	$1,684,890

BUDGET SUMMARY

Contractor: University of California, Davis

Health Effects of Central Valley Particulate Matter

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 306,297	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 1,750	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 76,300[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 73,646[2]	
	Total Direct Costs		$457,993
INDIRECT COSTS			
1.	Overhead	$ 38,436	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$38,436
TOTAL PROJECT COSTS			**$496,429**

[1] The majority of supply costs will support molecular biology procedures ($24,900) such as RNA purification and reagents for ELISA and Bioplex testing ($24,900). The balance of supply costs will be used for mice, histopath supplies, imaging recharges, general laboratory expenses, and particle analysis.
[2] Miscellaneous costs comprise resident fees for two graduate student researchers during academic years 2009-2010, 2010-2011, and 2011-2012.

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-64

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2687-265, entitled "AMAX-DOAS Trace Gas Column Observations from Research Aircraft Over California," has been submitted by University of Colorado at Boulder;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval;

WHEREAS, the Air Resources Board will fund this proposal for a total amount $549,999; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2687-265 entitled "AMAX-DOAS Trace Gas Column Observations from Research Aircraft Over California,"," submitted by University of Colorado at Boulder, for a total amount not to exceed $549,999.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2687-265 entitled "AMAX-DOAS Trace Gas Column Observations from Research Aircraft Over California,"," submitted by University of Colorado at Boulder, for a total amount not to exceed $549,999.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $549,999.

ATTACHMENT A

"AMAX-DOAS Trace Gas Column Observations from Research Aircraft Over California"

Background

The proposed project is ARB support of a collaborative research effort with NOAA, the CalNex 2010 field campaign that will address scientific questions related to the mitigation of both air pollution and climate change.

Despite improvements in emission control technologies, fine particles remain a serious pollution problem in urban areas of California. Both the South Coast Air Basin (SoCAB) and San Joaquin Valley (SJV) frequently exceed California health-based particle concentration standards. Aerosols also significantly impact climate, visibility, and deposition of toxics and nutrients to the ground. Recent results show that secondary organic aerosol (SOA) is a larger fraction of particulate matter than had been recognized. The chemical species to be measured by this research are important to predicting rates of photochemical processing for both ozone and aerosols.

Motivation to study vertical column amounts of nitrogen dioxide (NO_2) is due to several gaps in understanding that limit ability to model the atmosphere. Atmospheric models may overpredict the amount of NO_2 in urban areas compared to satellite observations. At times, modeled NO_2 decreases much too rapidly downwind of urban source regions, either due to a lower effective NO_2 lifetime in models compared to the atmosphere or missing (regional) nitrogen oxides (NO_X) sources in the models.

The atmospheric chemistry of formaldehyde (HCHO) and glyoxol (CHOCHO) is also relevant to urban air quality and public health. Formaldehyde is a known carcinogen, and its photolysis produces radicals that lead to formation of secondary oxidation products. Glyoxal is mutagenic and forms HO_X radicals upon photolysis. Understanding sources of formaldehyde and glyoxal supports policy and planning to reduce concentrations of ozone and SOA through strategies that reduce production of radicals that contribute to their formation.

Objective

The objective of the proposed research is to provide horizontal and vertical distributions of nitrogen dioxide, formaldehyde, glyoxal, and aerosol optical depth primarily in the SoCAB and SJV of California during the CalNex 2010 field campaign. These measurements will be used to improve understanding of chemical processing leading to formation of ozone and aerosols, and to constrain and improve atmospheric models. In particular, the combination of formaldehyde and glyoxal concentration will be of value to constrain the modeled oxidative capacity of the atmosphere and the rate of formation of secondary organic aerosols. The results will also be used to validate and improve the utility of satellite data for air quality applications.

Methods
This proposed project is to deploy the University of Colorado Airborne Multi AXis Differential Optical Absorption Spectrometer (DOAS) instrument (CU AMAXDOAS) on the NOAA Optical Remote Sensing TwinOtter research aircraft during the eight-week CalNex period and following for an additional four weeks. The CU AMAXDOAS will measure pollutant concentrations in and above the boundary layer, probing directly the horizontal and vertical distributions of boundary layer columns of nitrogen dioxide (NO_2), formaldehyde (HCHO), and possibly glyoxal (CHOCHO) (or sulfur dioxide (SO_2) on selected flights) over the SoCAB, SJV, and ocean. The measurement results will be used to test and constrain atmospheric models, validate satellite measurements, and provide improvements for models and validated satellite data for better management of air resources.

Expected Results
The research results are expected to significantly improve our understanding of the composition, emission sources, and photochemical processing of ambient gases relevant to formation of ozone and organic aerosols throughout California. The information to be generated is needed for the development of optimal climate change and air pollution mitigation strategies.

Significance to the Board
Understanding sources of formaldehyde and glyoxal is relevant to policy decisions intended to reduce ozone and secondary organic aerosol formation. Glyoxal and other a-dicarbonyls, are deemed responsible for SOA production equal to the sum of SOA formed from monoterpenes, sesquiterpenes, isoprene, and aromatics also on global scales.

Contractor:
University of Colorado at Boulder

Contract Period:
36 months

Principal Investigator (PI):
Professor Rainer M. Volkamer

Contract Amount:
$549,999

Cofunding:
The proposed project is an ARB contribution to CalNex 2010, which is a collaborative study with the National Oceanic and Atmospheric Administration (NOAA) to address scientific questions which bear upon the ability to formulate policy related to mitigation of air pollution and climate change. NOAA is contributing resources and direct funding to CalNex conservatively estimated at $15,000,000. The NOAA contributions include a

dedicated research vessel and multiple research aircraft, ground support, planning, and direct funding of contracted measurements.

Basis for Indirect Cost Rate:
The University of Colorado is providing a ten percent (reduced) indirect cost rate, equal to the rate that University of California and the UC system have agreed to provide for ARB.

Past Experience with this Principal Investigator:
Professor Volkamer has conducted extensive research relevant to the proposed project, some of which has been sponsored the NOAA partner in CalNex 2010. Professor Volkamer has successfully deployed the CU AMAXDOAS on the NOAA Twin Otter research aircraft which will be used for CalNex 2010. His past theoretical and observational work has provided significant advances in understanding of atmospheric chemistry of the oxidative capacity of the atmosphere for ozone formation and formation of secondary organic aerosol. He has developed methods to observe glyoxol in the atmosphere and has conducted field measurements that provided new understanding of the precursors and sources of glyoxol formation.

Prior Research Division Funding to University of Colorado at Boulder:

Year	2008	2007	2006
Funding	$0	$0	$0

BUDGET SUMMARY

Contractor: University of Colorado, Boulder

"AMAX-DOAS trace gas column observations from research aircraft over California"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 395,008	
2.	Subcontractors	$ 12,870	
3.	Equipment	$ 21,000	
4.	Travel and Subsistence	$ 56,280[1]	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 200	
7.	Mail and Phone	$ 350	
8.	Supplies	$ 9,000	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 7,200	
	Total Direct Costs		$501,908
INDIRECT COSTS			
1.	Overhead	$ 48,091	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$48,091
TOTAL PROJECT COSTS			**$549,999**

[1] Because this is a field study with multiple campaigns to take place aboard an airborne research unit, it requires multiple airfares as well as per diem, car rental, and lodging for a total of 75 travel-days.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Original Code Consulting

Description of subcontractor's responsibility: The subcontractor will work in collaboration with Professor Volkamer to develop software and data acquisition and control hardware integration for the AMAX-DOAS instrument. In particular, their work will focus on integrating the existing code for control of a stepper motor into a new control system, assistance with development of analysis code to be used with the acquired data and ongoing routine maintenance of the data acquisition and control software.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 12,870	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 0	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$12,870
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$0
TOTAL PROJECT COSTS			**$12,870**

TITLE 17. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER PROPOSED AMENDMENTS TO THE REGULATION FOR LIMITING OZONE EMISSIONS FROM INDOOR AIR CLEANING DEVICES

The Air Resources Board (ARB or Board) will conduct a public hearing at the time and place noted below to consider amendments to the indoor air cleaner regulation adopted by the Board in September 2007, including an extension of the compliance date for the labeling requirements and refinements to the ozone emissions test method.

DATE: December 9, 2009

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., December 9, 2009 and may continue at 8:30 a.m., December 10, 2009. This item may not be considered until December 10, 2009. Please consult the agenda for the hearing, which will be available at least 10 days before December 9, 2009, to determine the day on which this item will be considered.

If you require special accommodation or need this document in an alternate format or language, please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, <u>but no later than 10 business days before the scheduled Board meeting</u>. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: Proposed adoption of amendments to California Code of Regulations, title 17, sections 94801, 94804, 94805, and 94806. Two Certification Requirement Decisions (CRD) issued by Underwriters Laboratories, Inc. (UL) in 2009, entitled Chamber Setup (issued July 8, 2009) and Definition of Steady State at Hours 7-8 (issued July 9, 2009) for the American National Standards Institute (ANSI)/UL Standard 867, will be incorporated by reference. A third CRD entitled Filter Test Iterations, soon to be issued by UL, will also be incorporated by reference.

Background

Some air cleaning devices generate large quantities of ozone, either purposely or as a byproduct of their design, and have been shown to produce unhealthful ozone concentrations that exceed the health-based state and federal ambient air quality standards for ozone. Exposure to such elevated levels of ozone is a public health concern. Ozone is highly reactive and can damage the lungs and airways. It inflames and irritates respiratory tissues, and can worsen asthma symptoms, including coughing, chest tightness and impaired breathing. Elevated exposures have the potential to induce permanent lung damage, and chronic ozone exposure can increase the risk of premature death in persons in poor health. Ozone can also damage plants, fabrics and building materials such as paint, walls, and flooring. Ozone has been recognized and regulated as an outdoor air pollutant for many years.

Because of concern for public health, Assembly Bill 2276 was signed into law in 2006 to enact Health and Safety Code sections 41985-41986, which directed ARB to regulate ozone emissions from portable air cleaners sold in California that are used in occupied spaces, by December 31, 2008.

Summary of Existing Regulation: On September 27, 2007, the Board approved a regulation, which became effective on October 18, 2008, that requires all portable indoor air cleaners sold in California after October 18, 2010 to be tested, certified, and labeled as complying with an ozone emission concentration limit of 0.050 parts per million. The air cleaners must also meet applicable electrical safety requirements. Electronic air cleaners must be tested according to the ANSI/UL Standard 867 for their ozone emissions and electrical safety. Testing for ANSI/UL Standard 867 must be conducted by a Nationally Recognized Testing Laboratory (NRTL) recognized by the United States Occupational Health and Safety Administration and approved by ARB to conduct the ozone emissions test specified in Section 37 of ANSI/UL 867. Air cleaners that use only filter materials to remove contaminants, called "mechanical filtration only" air cleaners, must be tested under ANSI/UL Standard 507 for their electrical safety; because they are known to emit little or no ozone, this type of air cleaner is not required to undergo ozone emissions testing.

Under the regulation, manufacturers must also notify all of their known distributors, retailers, and sellers about the regulation, provide them with a copy of the regulation, and send documentation of this notification and contact information for their distributors, retailers, and sellers to ARB, by October 18, 2009. Finally, manufacturers, distributors, retailers, sellers, and testing laboratories must maintain production, quality control, sales, and testing records for at least three years, and make them available to ARB upon request.

Testing and Certification Status: Air cleaner testing for ozone emissions for the regulation is available from two testing laboratories, UL and Intertek Testing Services (Intertek). The UL testing facility has been available for testing since the effective date of the regulation in October 2008, the Intertek facility was approved to provide testing on July 2, 2009. As of September 30, 2009, five manufacturers have applied and received certification for a total of 94 air cleaner models. Thirteen models required ozone testing and 81 were "mechanical filtration only" devices that did not require ozone testing. These totals do not include models currently in the certification review process.

The staff currently estimates that about 70 to 109 air cleaner models still need to obtain ozone testing by the compliance date. This estimate is lower than the original estimate of 136 models discussed in the 2007 staff report, and accounts for the models already tested, a reduced estimate for ozone generator models that are anticipated to be re-designed and certified, and a reduction in the number of manufacturers active in the California market.

Changes Needed: Early in 2009, manufacturers of air cleaners expressed concern regarding their ability to meet the compliance dates in the regulation due to the delay in the availability of a second laboratory to conduct the ozone emissions test and higher than expected testing costs. Manufacturers also indicated their concern that the slowdown in the economy has resulted in an increased number of unsold air cleaners in the distribution and retail inventories, which poses additional challenges in meeting the regulation's requirements for labeling. Accordingly, manufacturers requested an extension of the October 18, 2010 compliance date. To hear and consider concerns from all interested parties, ARB staff conducted a public workshop on June 12, 2009 to discuss the status of implementation of the regulation and possible amendments to the regulation, and to obtain comments. The workshop was followed by a three week written comment period, during which comments were received from nine individuals or organizations.

In July, 2009, the second laboratory, Intertek Testing Services, was approved to conduct the Section 37 ozone emissions test. Because of this addition of a second laboratory and the reduced estimate indicated above for the number of models expected to require the ozone test, staff concluded that an extension of the time allowed for testing and certification is not needed, and the manufacturers who made the original request concurred. However, additional time is needed for manufacturers to meet the labeling requirement for air cleaners already in the distribution or retail chain at the time the specific models are certified.

Additionally, early testing under the revised ANSI/UL Standard 867 Section 37 ozone emissions test identified areas in Section 37 where the test protocol was not clear, or unexpectedly caused the test for some models to take longer than anticipated. To clarify the test protocol, UL has issued two Certification Requirement Decisions to better specify steps that must be taken related to chamber set-up and meeting the steady state definition at hours 7 to 8 of the chamber test, and they will soon issue a third CRD on selecting the appropriate filters for testing for models marketed with multiple filter options.

Finally, ARB has become aware of multi-function appliances that include an air cleaning component (such as an electric heater with an ionizer) and must meet the requirements of the regulation, but are tested for electrical safety under industry test standards other than ANSI/UL Standards 507 and 867. A modification to the regulation is needed to allow such devices to undergo electrical testing under the appropriate ANSI/UL test standard, depending on the specific type of appliance.

Description of the Proposed Regulatory Action

In response to manufacturers' requests, ARB staff propose to extend the deadline for package certification labeling for one year, to October 18, 2011, and to allow the use of adhesive certification labels (rather than printing on the package) until October 1, 2012. These extensions apply only to air cleaner models that are tested and certified by the October 18, 2010 compliance date; all air cleaners must still be tested and certified by the current deadline of October 18, 2010. These measures will avoid the unnecessary costs of re-packaging certified air cleaners that are already in the distribution and retail chains at the time of certification, and will avoid loss of sales that would likely occur if re-packaging were required. The extension of the time allowed for use of adhesive labels rather than labels printed on the packaging will enable manufacturers to better time their design and printing costs for the new packaging and spread those costs over a longer period of time.

Several additional proposed amendments have also been identified by staff as necessary to improve implementation of the regulation. These amendments would: (1) allow the electrical safety tests to be conducted at additional facilities under the oversight of an NRTL; (2) incorporate the three clarifications described above to the ozone test protocol issued by UL; (3) allow alternate, appropriate electrical safety testing for multi-function appliances that include an air cleaning component; and 4) revise the definition of "mechanical filtration only" air cleaners.

The first of these amendments would allow electrical safety testing of air cleaners to be conducted not just by NRTLs, but also by facilities that meet the requirements of Supplemental Programs 2 through 6 of the United States Occupational Safety and Health Administration's Nationally Recognized Testing Laboratory (NRTL) recognition program (Federal Register 60:12980-12985). This amendment would, in effect, increase the number of allowable testing facilities for the electrical safety testing, but with testing and program oversight by an NRTL. This is consistent with current industry practice. Ozone emissions testing would continue to be limited to NRTL Program 1 and 2 facilities that have been audited and approved by ARB.

The next amendment would incorporate into the regulation the three CRDs issued by UL and described above, which clarify chamber set-up, steady state determinations, and filter selection for the ozone testing protocol of Section 37 of ANSI/UL Standard 867. These clarifications to the test protocol are minor refinements that would have the effect of increasing consistency of testing across laboratories and shortening the time necessary for some ozone tests.

The regulation also would be amended to allow the appropriate industry electrical safety tests other than ANSI/UL Standards 507 and 867 to be used for multi-function appliances that include an air cleaning component but are normally tested for electrical safety under industry standards other than ANSI/UL Standards 507 and 867.

Finally, staff propose a minor revision to the definition of "mechanical filtration only" in section 94801 of the air cleaner regulation to include all pollutants (not just particles) by replacing the phrase "suspended particles" with "contaminants". This will make the definition internally consistent, and consistent with the rest of the regulation.

There would be no negative public health or environmental impacts anticipated from any of these proposed amendments.

COMPARABLE FEDERAL REGULATIONS

Health and Safety Code section 41986 requires that the proposed regulation be consistent with federal law. The United States Food and Drug Administration has promulgated a maximum acceptable level of ozone of 0.05 ppm for medical devices, as well as certain labeling requirements for such devices (21 CFR § 801.415). The emission standard and labeling requirements in the existing regulation that apply to air cleaners that are medical devices are consistent with this federal standard and are not proposed for change.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

ARB staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the proposed regulatory action, which includes a summary of the potential environmental and economic impacts of the proposal and supporting technical documentation. The report is entitled: "Staff Report: Initial Statement of Reasons, Proposed Amendments to the Regulation for Limiting Ozone Emissions from Indoor Air Cleaning Devices."

Copies of the ISOR and the full text of the proposed regulatory language, in underline and strikeout format to allow for comparison with the existing regulations, may be accessed on ARB's website listed below, or may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, First Floor, Sacramento, California 95814, (916) 322-2990, at least 45 days prior to the scheduled hearing on December 9, 2009.

Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on ARB's website listed below.

Inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Ms. Peggy Jenkins, Manager of the Indoor Exposure Assessment Section, at (916) 323-1504 or Mr. Jim Behrmann, at (916) 322-8278.

Further, the agency representative and designated back-up contact persons, to whom nonsubstantive inquiries concerning the proposed administrative action may be directed, are Ms. Lori Andreoni, Manager, Board Administration and Regulatory Coordination Unit, (916) 322-4011, or Ms. Trini Balcazar, Regulations Coordinator, (916) 445-9564. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

This notice, the ISOR and all subsequent regulatory documents, including the Final Statement of Reasons, when completed, are available on ARB's website for this rulemaking at http://www.arb.ca.gov/regact/2009/iacd09/iacd09.htm.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred by public agencies, businesses, and private persons in reasonable compliance with the proposed regulatory action are presented below.

Pursuant to Government Code sections 11346.5(a)(5) and 11346.5(a)(6), the Executive Officer has determined that the proposed regulatory action would not create costs or savings to any state agency, or in federal funding to the State. The regulation would not create costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, or other nondiscretionary cost or savings to State or local agencies.

In developing the proposed amendments, ARB staff evaluated the potential economic impacts on representative private persons and businesses. The Executive Officer has initially determined that the proposed amendments are likely to produce small, but currently unquantifiable, time and cost reductions for manufacturers, distributors, and sellers of portable indoor air cleaners if the products are marketed for sale in California. Product costs to consumers are likely to either remain the same or decrease slightly. No costs to businesses and representative private persons or consumers to comply with the proposed amendments are expected.

The Executive Officer has made an initial determination that the proposed regulatory action would not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states or on representative private persons. Of an estimated 60 manufacturers of indoor air cleaning devices, only three manufacturers are based in California. All manufacturers of indoor air cleaning devices marketed for sale in California would be subject to the proposed amendments to the regulation, so there should be no effect on the business competitiveness of the California-based manufacturers.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action would not affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. A detailed assessment of the economic impacts of the proposed regulatory action can be found in the ISOR.

The Executive Officer has also determined, pursuant to California Code of Regulations, title 1, section 4, that the proposed regulatory action would affect small businesses. Impacts from the proposal are likely to be positive because the proposed amendments would more likely decrease, rather than increase, costs relative to the original regulation.

In accordance with Government Code sections 11346.3(c) and 11346.5(a)(11), the Executive Officer has found that the proposed amendments would establish no new reporting requirements.

Before taking final action on the proposed regulatory action, the Board must determine that no reasonable alternative considered by the Board, or that has otherwise been identified and brought to the attention of the Board, would be more effective in carrying out the purpose for which the action is proposed, or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

Interested members of the public may present comments orally or in writing at the meeting, and they may be submitted by postal mail or by electronic submittal before the meeting. To be considered by the Board, written comments or materials not physically submitted at the meeting must be received **no later than 12:00 noon, December 8, 2009,** and addressed to the following:

Postal mail: Clerk of the Board
Air Resources Board
1001 I Street
Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Please note that under the California Public Records Act (Government Code § 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

The Board requests, but does not require, 20 copies of any written submission. Also, ARB requests that written and electronic statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment.

The Board encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under the authority granted in Health and Safety Code section 41986. This action is proposed to implement, interpret, and make specific sections 41985, 41985.5, and 41986 of the Health and Safety Code; and sections 91000 et seq. of title 17, subchapter 4 (Disclosure of Records) of the California Code of Regulations; 29 CFR 1910.7, 21 CFR 801.415; section 201 U.S.C. 321.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, title 2, division 3, part 1, chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with non-substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action. In the event that such modifications are made, the full regulatory text, with the modifications clearly indicated, will be made available to the public for written comment at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from ARB's Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, First Floor, Sacramento, California 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: October 13, 2009

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.arb.ca.gov.

California Environmental Protection Agency

Air Resources Board

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PROPOSED AMENDMENTS TO THE REGULATION FOR LIMITING OZONE EMISSIONS FROM INDOOR AIR CLEANING DEVICES

Research Division
Health and Exposure Assessment Branch

October 23, 2009

To be considered by the California Air Resources Board
on December 9, 2009

at
California Environmental Protection Agency
1001 I Street
Sacramento, California 95814

State of California
AIR RESOURCES BOARD
P.O. Box 2815
Sacramento, CA 95812

Arnold Schwarzenegger
Governor

This page intentionally left blank

State of California
AIR RESOURCES BOARD

PROPOSED AMENDMENTS TO THE REGULATION TO LIMIT OZONE EMISSIONS FROM INDOOR AIR CLEANING DEVICES

Prepared by:

Research Division
California Air Resources Board

Authors

Jim Behrmann
Thomas J. Phillips
Ryan Johnson
Stephanie Parent

Legal Counsel

Kirk Oliver, Office of Legal Affairs

Reviewed by:

Peggy L. Jenkins, Manager, Indoor Exposure Assessment Section
Linda Tombras Smith, Ph.D., Chief, Health and Exposure Assessment Branch
Bart Croes, Chief, Research Division
Michael H. Scheible, Deputy Executive Officer

October 23, 2009

ACKNOWLEDGEMENTS

We wish to acknowledge the assistance and cooperation we received from many individuals and organizations. In particular we would like to thank:

Bonnie Holmes-Gen, American Lung Association of California; Wayne Morris, Association of Home Appliance Manufacturers; Chanté White Maurio, Joseph Musso, and Todd Lumpkin of Underwriters Laboratories, Inc.; Stephany Mason, Marilyn Black, and Tony Worthan of Air Quality Sciences; Chris Stone, Victor Loomis, and Gordon Guest of Intertek Testing Laboratory; Steve Yerden of Orange Computing; and all stakeholders who participated in the public workshops and provided comments to ARB. We especially thank ARB staff member Susan Lum for her excellent organization and assistance in maintaining the website for implementation of this regulation, management of comment documents, sending listserv notices, and many other key tasks.

DISCLAIMER

This report has been prepared by the staff of the California Air Resources Board. Publication does not signify that the contents reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute or imply endorsement or recommendation for use.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
AHAM	Association of Home Appliance Manufacturers
ANSI	American National Standards Institute
AQS	Air Quality Sciences (private laboratory)
ARB	California Air Resources Board
Cal/OSHA	California Department of Industrial Relations, Occupational Safety and Health
CEQA	California Environmental Quality Act
CRD	UL Certification Requirement Decision
DPH	California Department of Public Health
ESP	electrostatic precipitator
FDA	U.S. Food and Drug Administration
FSOR	Final Statement of Reasons
HSC	California Health and Safety Code
ISOR	Initial Statement of Reasons (Staff Report)
NRTL	Nationally Recognized Testing Laboratory
OSHA	U.S. Occupational Safety and Health Administration
SOP	standard operating procedure
UL	Underwriters Laboratories, Inc.
U.S.	United States
UV	ultraviolet
VOC	volatile organic compound

UNITS

ppb	parts per billion by volume (such as one grain of sand in a billion grains of sand)
ppm	parts per million by volume (such as one grain of sand in a million grains of sand)
%	per cent

This page intentionally left blank.

EXECUTIVE SUMMARY

Existing Regulation

Assembly Bill (AB) 2276 (Pavley, 2006; Health and Safety Code [HSC] § 41985 and 41986) directed the Air Resources Board (ARB) to develop and adopt regulations, consistent with federal law, to protect public health from ozone emitted by indoor air cleaning devices used in occupied spaces. Indoor air cleaning devices that produce ozone intentionally have been shown to produce unhealthful ozone concentrations well above the health-based state and federal ambient air quality standards (ARB, 2006). Extensive scientific research has shown that exposure to ozone above these standard levels can cause respiratory symptoms (such as cough, wheeze, and difficulty breathing), reduced lung function, increased airway hyperreactivity, and increased airway inflammation. Additionally, exposure to ozone above the California standards has been associated with asthma onset and exacerbation, increased school absences, hospitalizations due to respiratory diseases, and premature death.

On September 27, 2007, the Board approved a regulation, which became effective on October 18, 2008, that requires all portable indoor air cleaners sold in California after October 18, 2010 to be tested, certified, and labeled as complying with an ozone emission concentration limit of 0.050 parts per million. The air cleaners must also meet applicable electrical safety requirements. Electronic air cleaners must be tested according to the American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL) Standard 867 (ANSI/UL 2007) for their ozone emissions and electrical safety. Testing for ANSI/UL Standard 867 must be conducted by a Nationally Recognized Testing Laboratory (NRTL) recognized by the U. S. Occupational Health and Safety Administration (OSHA) and approved by ARB to conduct the ozone emissions test specified in Section 37 of ANSI/UL 867. Air cleaners that use only filter materials to remove contaminants, called “mechanical filtration only” air cleaners, must be tested under ANSI/UL Standard 507 for their electrical safety; because they are known to emit little or no ozone, this type of air cleaner is not required to undergo ozone emissions testing.

Under the regulation, manufacturers must also notify all of their known distributors, retailers, and sellers about the regulation, provide them with a copy of the regulation, and send documentation of this notification and contact information for their distributors, retailers, and sellers to the ARB, by October 18, 2009. Finally, manufacturers, distributors, retailers, sellers, and testing laboratories must maintain production, quality control, sales, and testing records for at least three years, and make them available to ARB upon request.

The regulation addresses portable air cleaning devices designed for room, whole house, whole floor, and in-vehicle use, and those designed to be carried on one’s person. Devices that are exempt from this regulation include in-duct devices that are an integrated component of a heating, air conditioning, and ventilation system, and industrial use air cleaners. Industrial use devices are defined in the regulation and are exempted as long as specified labeling and point-of-purchase requirements are met.

Testing and Certification Status

Air cleaner testing for ozone emissions for the regulation is available from two testing laboratories, UL and Intertek Testing Services (Intertek). The UL testing facility has been available for testing since the effective date of the regulation, and the Intertek facility was approved to provide testing on July 2, 2009. As of September 30, 2009, five manufacturers have applied and received certification for a total of 94 air cleaner models. Thirteen models were electronic air cleaners that required ozone testing and 81 were "mechanical filtration only" devices that did not require ozone testing. These totals do not include models currently in the certification review process. Staff estimate that about 70 to 109 models of air cleaners still needed ozone testing as of September 30, 2009.

Early in 2009, manufacturers expressed concern regarding their ability to meet the compliance dates in the regulation due to the delay in the availability of a second laboratory to conduct the ozone emissions test and the increased inventory caused by the slowdown of the economy. They requested an extension of the compliance date. To hear from all concerned stakeholders, ARB staff conducted a public workshop on June 12, 2009 to discuss the status of implementation of the regulation and possible amendments to the regulation, and to obtain stakeholder comments.

Shortly after the June workshop, the second laboratory, Intertek, was approved to conduct the Section 37 ozone emissions test. Because of this addition of a second laboratory and staff's reduced estimate for the number of models expected to require certification, staff concluded that an extension of the time allowed for testing and certification is not needed. The manufacturers that requested the extension generally concurred, as long as neither laboratory experiences significant down time in the coming year. However, additional time is needed for manufacturers to meet the labeling requirement for air cleaners already in the distribution or retail chain at the time the specific models are certified.

Additionally, early testing under the revised ANSI/UL Standard 867 Section 37 ozone emissions test identified areas in Section 37 where the test protocol was not clear, or caused the test for some models to take longer than anticipated. To clarify the test protocol, UL has issued two Certification Requirement Decisions (CRDs) to better specify steps that must be taken related to the chamber set-up, and for determination whether models meet the definition of "steady state" at hours 7 to 8 of the chamber test. UL anticipates release of a third CRD soon to clarify the selection of the appropriate filters for testing of models marketed with multiple filter options.

Proposed Amendments and Rationale

In response to manufacturers' requests, ARB staff proposes to extend the deadline for package labeling of certified models for one year, to October 18, 2011, and to allow the use of adhesive certification labels (rather than printing on the packaging) until October 1, 2012. These extensions apply only to air cleaner models that are tested and certified by the October 18, 2010 compliance date; all air cleaners must still be tested and certified by the current deadline of October 18, 2010 in order to be sold in California after that date. These labeling extensions will avoid the unnecessary costs of re-packaging or re-labeling certified air cleaners that are already in the distribution and retail chains at the time of certification, and will avoid loss of sales that would likely occur if re-packaging were required. The extension of the time allowed for use of adhesive labels rather than labels printed on the packaging will enable manufacturers to better plan their design and printing costs for the new packaging and/or spread those costs over a longer period of time.

These amendments are not expected to negatively impact public health because all testing and certification must still be completed by the original compliance date of October 18, 2010. Compliance with the testing and certification requirements would still be enforced beginning on that date, regardless of whether the packaging shows the required label.

Several additional amendments have also been identified by staff as necessary to improve implementation of the regulation. These amendments would: (1) incorporate three clarifications to the ozone test protocol issued by UL; (2) allow the electrical safety tests to be conducted at additional facilities under the oversight of an NRTL; (3) allow alternate, applicable electrical safety tests for multi-function appliances that include an air cleaning component that must meet the requirements of this regulation; and 4) revise the definition of "mechanical filtration only" air cleaners.

The first of these amendments would incorporate into the regulation the three CRDs issued by UL and described above, which clarify chamber set-up, "steady state" determinations, and filter selection for the ozone testing protocol of Section 37 of ANSI/UL Standard 867. These clarifications to the test protocol are minor but important refinements that would increase the consistency of testing across laboratories and shorten the time necessary for some ozone tests, thus increasing throughput at the testing laboratories.

The next amendment would allow electrical safety testing of air cleaners to be conducted not just by NRTLs, but also by facilities that meet the requirements of Supplemental Programs 2 through 6 of OSHA's NRTL recognition program (U. S. OSHA 1995, Federal Register 60:12980-12985). This amendment would increase the number of allowable testing facilities for the electrical safety testing, but with testing and program oversight by an NRTL. This is consistent with current industry practice. In fact, several manufacturers have submitted applications for mechanical filtration models tested at one of these NRTL Program facilities, because they assumed that the

Supplemental Program facilities were included in the definition of NRTL. Those applications have been put on hold pending the Board's decision on this amendment. The staff believes that electrical safety testing at these additional NRTL facilities is accurate and reliable and that the regulation should be amended to allow for the results of this type of testing to be accepted for certification. Ozone emissions testing would continue to be limited to NRTL Program 1 and 2 facilities that have been audited and approved by the ARB.

The regulation also would be amended to allow the applicable industry electrical safety tests other than ANSI/UL Standards 507 and 867 to be used for multi-function appliances that include an air cleaning component. Such appliances are normally tested for electrical safety under industry (UL) standards other than ANSI/UL Standards 507 and 867.

Finally, staff proposes a minor revision to the definition of "mechanical filtration only" in section 94801 of the air cleaner regulation to include all pollutants (not just particles) by replacing the phrase "suspended particles" with "contaminants". This will make the definition internally consistent and consistent with the rest of the regulation.

Economic and Environmental Impacts

The proposed measures are expected to result in no cost increases and will likely produce some (currently unquantifiable) time and cost reductions for manufacturers, distributors, retailers, and sellers. No significant changes in prices to consumers are expected; air cleaner prices are expected to remain the same or may decrease slightly in a few cases.

There would be no negative public health or environmental impacts anticipated from any of the proposed amendments.

Recommendation

Staff recommends that the proposed amendments be approved, because they would accommodate the needs of manufacturers, distributors, retailers, and sellers during this difficult economic period, and would have no negative impact on public health, or on the environment. The proposed amendments would clarify portions of the regulation that are not sufficiently explicit, or that require small but important refinements. Also, they will better assure consistency in conducting the ozone emission concentration test protocol and will maintain consistency with the industry test standards for air cleaners and for electrical safety of multi-function appliances.

STAFF REPORT

I. Introduction

A. Overview

On September 27, 2007, the California Air Resources Board (ARB/Board) adopted a regulation to limit ozone emissions from indoor air cleaning devices pursuant to AB 2276, Pavley (HSC § 41985 and 41986; see Appendix I). The regulation became effective on October 18, 2008. At the time the regulation was adopted, the Board asked that staff return to the Board with an update one year after the regulation took effect. This staff report provides that update and also recommends several amendments to the regulation to avoid excess costs for manufacturers, distributors, retailers, and sellers, and to facilitate the implementation of the regulation and improve its effectiveness.

This staff report provides background about the air cleaner regulation and the Board's action taken in 2007; summarizes the status of the ongoing testing and certification of indoor air cleaning devices required by the regulation; describes the proposed amendments and the rationale supporting them; and provides an analysis of the economic and environmental impacts of the proposed amendments. This report is part of the Initial Statement of Reasons (ISOR) for the Proposed Regulation Order amending Title 17 sections 94801, 94804, 94805, and 94806 of the California Code of Regulations. The proposed, revised regulation order is provided in Appendix II of this document.

B. Background

A number of manufacturers produce and sell devices represented to be air purifiers or air cleaners, but which purposely generate large quantities of ozone, the primary component of photochemical smog. Also known as "ozone generators," these devices can produce sufficient concentrations of ozone indoors to cause unhealthful exposures, that is, room concentrations several times greater than the health-based state and federal ambient air quality standards for ozone (ARB, 2005; ARB, 2006; ARB, 2007).

Other common types of air cleaners include electrostatic precipitators (ESPs), ionizers, mechanical filtration air cleaners, and other types that include mixed technologies. ESPs and ionizers may emit ozone as a byproduct of their design and technology, but the ozone levels are usually much lower than those produced by intentional ozone generators. Mechanical filtration air cleaners most often use a pleated fiber filter to remove particles, and emit little or no ozone.

Exposure to ozone is a serious public health concern. Ozone is a highly reactive molecule and can damage the lungs and airways. Ozone inflames and irritates respiratory tissues, and can worsen asthma symptoms. Exposure to ozone can cause coughing, chest tightness, and impaired breathing. Exposures to elevated levels of ozone have the potential to induce permanent lung damage, and chronic exposure to ozone can increase the risk of premature death in persons with poor health. For these reasons, California and the U.S. have regulated outdoor levels of ozone for decades by setting ambient air quality standards and implementing various plans and strategies to reduce public exposure to ozone and meet the state and federal standards. Additional information on the health effects of ozone is available in the Initial Statement of Reasons for the current regulation (ARB, 2007).

C. Requirements of the Existing Regulation

Because of concern for public health, AB 2276 was signed into law in 2006 to enact Health and Safety Code sections 41985-41986. The bill directed ARB to regulate ozone emissions from portable air cleaners sold in California that are used in occupied spaces, by December 31, 2008. The legislation specified that the ozone emission concentration limit should be equivalent to that of the U.S. Food and Drug Administration (FDA, 2007a) which is 0.05 parts per million (ppm) and applies only to medical devices. The legislation also specified that ARB may ban from sale in California air cleaners emitting more than this level of ozone.

On September 27, 2007, the Board approved a regulation, which became effective on October 18, 2008, that requires all portable indoor air cleaners sold in California after October 18, 2010 to have been tested, certified, and labeled as complying with an ozone emission concentration limit of 0.050 ppm. The air cleaners must also meet applicable electrical safety requirements. Ozone generators, ESPs, ionizers, and other electronic air cleaners must be tested according to the ANSI/UL Standard 867 for their ozone emissions and electrical safety. Testing for ANSI/UL Standard 867 must be conducted by a Nationally Recognized Testing Laboratory (NRTL) recognized by the U.S. Occupational Health and Safety Administration (OSHA). Laboratories also must be audited and approved by ARB to conduct the ozone emissions test specified in the revised Section 37 of ANSI/UL 867. Air cleaners that use only filter materials to remove contaminants, called "mechanical filtration only" air cleaners in the current regulation, must be tested under ANSI/UL Standard 507 for their electrical safety; because they are known to emit little or no ozone, this type of air cleaner is not required to undergo ozone emissions testing.

After October 18, 2010, all indoor air cleaning devices (that are not exempt) must display a certification label on the product packaging prior to sale within California (Section 94806 of the regulation). For non-medical air cleaners (those not approved by the FDA as medical devices), the label must be displayed after successfully completing the required testing and receiving ARB certification. Label dimensions must be at least one inch by two inches in size, be easily readable, and must state: "This air cleaner complies with the federal ozone emissions limit. ARB certified". Medical devices must be labeled to comply with federal law (by satisfying the requirements of Section 801.415 of Title 21 of the Code of Federal Regulations; see FDA, 2007b) and the label must also state that the device is "ARB certified".

In response to manufacturers concerns that two years may not be enough time to allow them to test, certify, and label all of their air cleaners, the regulation includes a 180 day labeling extension for devices submitted to an approved laboratory for testing within one year of the effective date of the regulation (by October 18, 2009) but not certified by the end of the 18th month after the effective date of the regulation (April 1, 2010).

Under the regulation, manufacturers must also notify all of their known distributors, retailers, and sellers about the regulation, provide them with a copy of the regulation, and send documentation of this notification and contact information for their distributors, retailers, and sellers to the ARB, by October 18, 2009. Finally, manufacturers, distributors, retailers, sellers, and testing laboratories must maintain production, quality control, sales, and testing records for at least three years, and make them available to ARB upon request.

The regulation applies to portable air cleaning devices designed for room, whole house, whole floor, and in-vehicle use, and those designed to be carried on one's person. Two types of air cleaners were exempted from the regulation. Those used for certain industrial uses, as defined in the regulation, are exempt, provided they are marketed solely through industrial supply outlets or businesses and are prominently labeled "Solely for industrial use. Potential health hazard: emits ozone." The definition of "industrial use" in the regulation limits such uses to certain industrial processing uses and to specified commercial uses in unoccupied settings. "In-duct" air cleaners – those designed, marketed, and used solely as a physically integrated part of a central heating, air conditioning, or ventilating system – also are exempt.

D. Implementation of the Regulation

Staff held a public workshop on December 4, 2008 to explain the final regulation, including the specific deadlines for compliance, to manufacturers and others affected by the regulation, and to respond to questions. Staff also responded to many questions received from manufacturers by phone and email, and developed responses to Frequently Asked Questions and questions from the December 2008 workshop, which are available at http://www.arb.ca.gov/research/indoor/aircleaners/aircleaners.htm. Additionally, multiple listserv notices were sent to those registered on the air cleaner regulation listserv initiated during the development of the regulation as new materials and information became available.

Staff developed a certification application form and instructions which were posted on ARB's website to assist manufacturers in supplying all of the information required in Section 94804 of the regulation, such as the ozone test results and manufacturer contact information. Staff also developed a database for recording receipt of certification applications and tracking their progress. As required in Section 94804 of the regulation (CCR, title 17), ARB is required to notify applicants whether their application is complete within 30 days of receipt, and to approve or disapprove an application within 30 days after notification that the application is complete. Thus, an effective tracking system was needed to assure that all applications are handled in the required timeframes.

Finally, staff spent substantial time developing audit procedures for laboratories interested in conducting the ANSI/UL Section 37 ozone emission concentration test for the regulation. When each laboratory was ready, staff conducted both a paper audit and an onsite audit, checking first for proper written Standard Operating Procedures (SOPs), and then traveling to the laboratory to inspect the test chamber and review all related procedures and conditions. As a result of these audits, corrections and additions to the laboratories' SOPs were made. An annual audit review process was also developed.

II. Current Status of Testing and Certification of Air Cleaners

A. Testing Facilities

Prior to development of ARB's regulation, ozone emissions from air cleaners were tested under a previous version of Section 37 of the ANSI/UL Standard 867. Due to problems with inconsistent results across test laboratories and the test's general lack of robustness, ARB staff joined a UL committee to revise the Section 37 ozone test. The revised Section 37 test is required under ARB's regulation. The revised version requires a room-sized chamber that meets specific temperature, humidity, airflow, clean air, and other requirements, and is made of specified (nonreactive) materials.

The current regulation requires ARB to audit and approve laboratories for the Section 37 ozone emissions concentration test. Two laboratories – UL and Intertek – indicated interest in conducting the Section 37 test for compliance with ARB's regulation. Because UL did not have a chamber suitable for the revised Section 37 test protocol, they contracted with Air Quality Sciences (AQS), a private testing laboratory that has an appropriate chamber available that meets the revised Section 37 requirements, to provide the Section 37 ozone emission concentration testing as a Program 2 facility, with UL providing the NRTL oversight. ARB staff audited UL/AQS and approved them for Section 37 testing by the effective date of the regulation.

At the time the Board adopted the regulation, it was expected that two testing facilities would be certified and available soon after the regulation became effective. However, the second test facility, Intertek, determined that their old chamber also could not meet the Section 37 requirements, and so constructed a new test chamber for the Section 37 test. Intertek was audited and approved by ARB on July 2, 2009 to perform the Section 37 ozone test.

A few other laboratories, such as ONSpeX/CSA International and QPS Certification, Testing and Inspection have inquired about requirements for obtaining approval, but none has pursued formal approval. There are several reasons for this; some do not have a suitable chamber for conducting the test, some are not an NRTL as required, and some do not see a sufficient market for the test once the initial testing is completed.

B. Testing and Certifications Completed to Date

The status of air cleaner certifications as of September 30, 2009 is shown in Table II-1, below. A total of 94 air cleaner models have been certified by ARB.

Table II-1. Air Cleaner Certification Progress as of September 30, 2009

	Models That Require Ozone Testing (ANSI/UL 867)	Mechanical Filtration Models (ANSI/UL 507)	Total
Manufacturers with Approved Models [a]	1	5	5
Applications Approved	5	23	28
Total Models Certified [b]	**13**	**81**	**94**

Notes:

a. Manufacturers may have some models requiring ozone testing and others (mechanical filtration air cleaners) that do not require ozone testing. Here, one manufacturer had both types of devices, and therefore, the total is not the sum of all the entries in the row.

b. The number of models certified is greater than the number of applications approved because additional models may be certified along with the model tested when they belong to the same model group as the model tested, i.e. they share the same design, operational features, device output, and performance characteristics and are produced by the same manufacturer, but may have minor cosmetic differences for marketing purposes.

Five manufacturers have completed the testing and certification process and have at least one approved air cleaner model. To date only one manufacturer has models certified that required ozone emissions testing, but several others have either completed ozone emissions testing and have applications pending with ARB, or are in the process of having their models tested for ozone emissions.

A total of 28 applications have been approved by ARB. An additional 20 applications are in various stages of processing and approval. Of the 28 approved applications, five have been for devices that required the ozone test outlined in Section 37 of ANSI/UL Standard 867, and 23 have been for devices that use only mechanical filtration for pollutant removal. More mechanical filtration models have been approved because the regulation allows manufacturers of such models tested before October 18, 2008, the effective date of the air cleaner regulation, to submit documentation of the models having previously passed the electrical safety test in ANSI/UL Standard 507; a new electrical safety test is not required.

In addition to the 28 tested and certified air cleaners, many more air cleaner models have been certified by ARB. The regulation allows additional air cleaners in the same "model group" to be certified without further testing. (A model group includes models that are identical to the model that has been tested except for minor, usually cosmetic, differences that do not impact their safety or ozone emissions.) As a result of this provision, a total of 94 air cleaners have been certified to date, of which 13 are ionizers, electrostatic precipitators, or other electronic technologies used for pollutant removal, and 81 are mechanical filtration only models.

C. Remaining Models to Be Tested and Certified

In the Initial Statement of Reasons (Staff Report) for the air cleaner regulation dated August 10, 2007, staff estimated that 61 manufacturers would be affected by the regulation. It was also estimated that 136 air cleaner models would require ozone emissions testing prior to being sold in California. This estimate was based on ARB's knowledge of existing ozone generators, ionizers, and electrostatic precipitators on the market (from a consumer survey previously funded by ARB; see Piazza *et al.*, 2006) and input from a limited number of manufacturers who responded to an ARB manufacturer survey. Based on recent conversations with industry stakeholders and news reports, staff now expect fewer applications to be submitted due to lower than expected consumer demand with the slowdown in the economy, a more rapid phasing out of older models by some manufacturers, the higher than expected cost of testing relative to manufacturers' expectations, and the loss or merging of some manufacturers due to bankruptcy or legal proceedings.

We estimate that about 70 to 109 air cleaner models still need to complete the ozone testing and certification process. Since the effective date of the air cleaner regulation, the two testing facilities for the Section 37 ozone test have tested a combined total of 27 air cleaners for their ozone emissions (this figure is greater than those in Table II-1 because some manufacturers have not yet submitted their certification applications or the certification process is not yet complete). Subtracting this number from the 136 models in the 2007 staff report for the regulation yields an upper bound estimate of 109 models yet to be tested. The lower bound of 70 was estimated by adjusting for several factors that have changed since the original staff report was prepared in 2007. First, the number of ozone generator models to be tested has been reduced from the original estimate of 42 models, because few ozone generator manufacturers appear to be redesigning their models to meet the regulation, and only one ozone generator manufacturer has requested a certification application number. Also, at least one ozone generator company has merged with another company. Accordingly, staff now estimate that only about one-fourth (10) of the 42 ozone generator models identified in 2007 will be re-designed or replaced with non-ozone generator models for certification and sale in California. This reduces the current estimate of air cleaner models still to be tested by 32, to 77. Another six models were subtracted because the air cleaner manufacturer with the largest market share in California in 2007 is no longer producing air cleaners due to legal proceedings; while other brands will fill the gap, those are not expected to be new models relative to the

2007 estimate. Finally, staff has noticed that some manufacturers have reduced the number of air cleaners advertised on their websites compared to offerings in 2007, and it is assumed that this is in response to the general economic contraction. Thus staff's final lower bound estimate is 70 or fewer.

In light of this revised estimate, manufacturers should have no problem meeting the regulation deadline as long as they submit their applications for existing models soon. This scenario assumes that: 1) the testing needs to be completed by October 14, 2010 in order to have time to process the paperwork and submit the application to ARB; 2) there are 48 weeks (240 days) in a year during which testing can occur in each laboratory (allowing for holidays and down time); 3) both laboratories will be fully utilized for testing; and 4) each model will require 3 to 4 days, on average, to be tested under the new UL CRDs (see CRD discussion in Section IV.C.). Under these assumptions, testing of all air cleaner models for ozone would be completed several weeks prior to October 18, 2010. To account for unforeseen problems or significant setbacks in testing, a conservative estimate that allows a full week for each air cleaner to be tested, on average, shows that at least 100 models (50 weeks X 2 laboratories X 1 model per week per laboratory = 100) could be tested from October 1, 2009 to October 14, 2010. Because staff believes the upper bound estimate of 109 models to be tested is unlikely, and that the most realistic number is closer to the lower bound estimate of 70, staff concluded that there is sufficient capacity for testing of all air cleaners that require testing prior to October 18, 2010. The manufacturers that requested extension of the testing and certification compliance date generally concurred that an extension of this date should not be necessary, as long as the laboratories do not experience any significant down times.

III. Development of Proposed Amendments to the Regulation

A. Public Outreach and Participation

Effort has been made to obtain input from manufacturers, the general public, and interested stakeholders throughout the regulation implementation process. Staff continued to provide information to the public via an email listserv and Internet webpage at http://www.arb.ca.gov/research/indoor/aircleaners/aircleaners.htm initially created during the regulation development process in order to facilitate public involvement. There are approximately 3,400 individuals or companies registered for the listserv. Also, as discussed above in Section I. D., a workshop was held on December 4, 2008 to explain the requirements of the final regulation to manufacturers and other interested parties, and to respond to questions. Staff also responded to many questions from manufacturers either by phone or email, and developed responses to Frequently Asked Questions and questions posed at the December 2008 workshop, which are available on the regulation website.

On June 12, 2009, ARB staff held a public workshop to discuss possible amendments to the air cleaner regulation requested by manufacturers and to respond to questions. While the public was able to attend the workshop in person, ARB staff encouraged participation via teleconference and/or Webcast to reduce the economic burden of traveling on participants and to reduce negative impacts on climate change. Comments were received from nine stakeholders, including manufacturers, professional organizations, environmental consultants, and representatives from government agencies.

This report and associated materials have been released for public review 45 days prior to the planned Board public hearing date of December 9, 2009, as required for proposed regulations. Staff will fully consider all comments received during that period, and respond to those comments as part of the regulatory process. An oral report summarizing the staff recommendations for amending the air cleaner regulation may be presented to the Board at the December 9th hearing.

Staff is conducting additional outreach to retail associations, large retail chains, and other distributors and sellers to assure that all affected parties are aware of the regulatory changes. Under the current regulation, manufacturers are required to notify their distributors and retailers about this regulation, and provide contact information for those businesses to ARB. Staff plans to follow up to assure that all stakeholders on such lists are notified regarding any changes to the regulation adopted at the December 9, 2009 hearing, and to respond to any questions they may have.

B. Comment Period and Board Hearing

Release of this Staff Report opens the official 45-day public comment period required by the Administrative Procedure Act prior to the public meeting of the Air Resources Board to consider the staff's recommendations. The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions not physically submitted at the meeting must be received no later than 12:00 noon, December 8, 2009 and addressed to one of the following:

Postal mail: Clerk of the Board
Air Resources Board
1001 I Street, 23rd floor
Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Facsimile submittal: to the Clerk of the Board at (916) 322-3928

Information on the public workshop, as well as summaries of the presentations from past workshops and meetings are available by calling (916) 445-0753 or by visiting http://www.arb.ca.gov/research/indoor/aircleaners/aircleaners.htm. Inquiries concerning the substance of the proposed regulation amendments may be directed to the designated agency contact persons, Ms. Peggy Jenkins, Manager of the Indoor

Exposure Assessment Section, at (916) 323-1504 or by email at mjenkins@arb.ca.gov, or Mr. Jim Behrmann, at (916) 322-8278 or by email at jbehrman@arb.ca.gov.

The agency representative and designated back-up contact persons to whom non-substantive inquiries concerning the proposed administrative action may be directed, are Ms. Lori Andreoni, Manager, Board Administration and Regulatory Coordination Unit, (916) 322-4011, or Ms. Trini Balcazar, Regulations Coordinator, (916) 445-9564. Requests for copies of the proposed regulation amendments also should be directed to these contacts. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

C. Evaluation of Alternatives

Staff considered several alternatives to the proposed action, including taking no action. The assessment of these alternatives is discussed below.

1. Extend the Compliance Date for Testing and Certification

Early in 2009 when the economy had slumped, and when only one laboratory was available for conducting the ozone testing, some manufacturers requested an extension of the October 18, 2010 compliance date for testing and certification, in addition to labeling. This alternative was considered by ARB staff and discussed as an option at the June 12, 2009 workshop discussed in Section III. A., above. Soon after the workshop, the second laboratory, Intertek, was approved to conduct the ozone emissions test, which alleviated a portion of the concern regarding manufacturers' ability to obtain testing and have their air cleaners certified by the October 2010 compliance date. Also, staff's subsequent reassessment of the number of models requiring ozone testing showed a reduced number compared to the staff estimate in the 2007 staff report for several reasons: most ozone generator manufacturers are not expected to try to obtain certification for their models; the manufacturer with the largest market share in California had stopped producing air cleaners due to a lawsuit and other factors; several manufacturers had indicated that they would not certify some older models that they were phasing out of production; and other reasons discussed in Section II. C., above. In light of these and other factors, the manufacturers requesting an extension agreed that they expect to meet the original compliance date for testing and certification, but not for labeling.

Additionally, staff is aware that there were months when the first test laboratory approved for conducting the ozone test, UL, was idle because manufacturers had not submitted their models for testing. This was reportedly due to the weak economy and because testing costs were higher than anticipated by some manufacturers (however, UL's costs were consistent with ARB staff's estimates in the 2007 staff report). As of the date of this report, the queues for ozone testing at the two laboratories continue to be very short. Finally, extension of the testing and certification compliance date, unlike staff's proposal to extend just the labeling deadline, could have a serious impact on public health, because high ozone-emitting air cleaners could continue to be sold in California.

For these reasons, there does not appear to be a real need for extension of the testing and certification compliance deadline, and such an action could adversely impact public health. Accordingly, this alternative was rejected.

2. Allow a Shorter Extension for the Labeling Requirements

ARB staff considered allowing a shorter extension time for compliance with the labeling requirements, because this would reduce the additional time that consumers would not be able to identify ARB-certified air cleaners based on package labeling. However, manufacturers have indicated several reasons why they need the flexibility of a full year's extension when no label would be required, and an additional year when an adhesive label would be acceptable. A key factor is that the weak economy has resulted in a large inventory of product in the distribution and retail chains, and while those products are nearly all expected to be certified, the logistics of recalling and re-packaging them would be onerous and costly. Small businesses especially would be heavily impacted, and because of their more limited turnover, are anticipated to most need the additional time to sell their compliant products that are already on the shelves. Manufacturers are concerned that some sellers would return their stock to the manufacturer or distributor, resulting in unnecessary cost to them and disruption of the market. Additionally, sales of air cleaners are seasonal, and production involves a lead time of more than a year; production and packaging changes can be costly.

Staff believes that providing relief by extending the labeling time as proposed will help avoid unnecessary costs to manufacturers, distributors, retailers, and sellers, especially small businesses, and will have no impact on consumer costs or public health. Interested consumers currently consult ARB's list of certified air cleaners on our webpage, and would be able to continue to do so. One representative of manufacturers has indicated that most larger manufacturers expect to meet the labeling requirements very close to the original compliance date; thus, we expect some compliant packages to be properly labeled well before the extended compliance date, and consumers should be able to find labeled products soon after the original compliance date.

3. Take No Action

This alternative would retain the *status quo*, that is, ARB would continue to implement the indoor air cleaner regulation as originally approved. Because the proposed amendments are relatively minor, the argument can be made that they are not really necessary and that no action should be taken. However, as discussed elsewhere in this staff report, the labeling extension date is critical to manufacturers, distributors, retailers, and sellerd, especially in this weak economy, and not taking that action would cause unnecessary hardship on some (especially small) businesses. Similarly, expanding the types of supplemental program facilities that can conduct electrical safety testing to include those facilities currently used by some manufacturers simply corrects an oversight in the original regulation. The impacts on manufacturers if this correction is not made could be significant. Not allowing the use of Supplemental Program 2 through 6 facilities would likely increase manufacturers' testing costs by a small amount, but most importantly, could result in significant time delays in manufacturers obtaining testing and certification. According to one manufacturers association representative, this delay could result in possible fines on the order of tens of thousands of dollars if the product cannot be delivered to retailers on time. Similarly, the CRDs, while relatively minor refinements to the ozone emissions test protocol, are necessary clarifications to the current wording of the ozone test protocol that will assure consistency among the laboratories as they conduct the test, improve the efficiency of the test, and save time and possibly reduce testing costs. Additionally, because UL has issued two CRDs and will soon issue a third, ARB's test method would be somewhat inconsistent with the industry standard if no action were taken.

The intent of the original legislation and the regulation is to reduce the adverse health impact resulting from the unnecessary exposure to ozone emitted from ozone-generating air cleaners. Ideally that should be achieved in the most cost-effective manner. The proposed amendments would improve the clarity and cost effectiveness of the regulation, and thus staff rejected the "no action" alternative.

D. Potential Regulation Benefits

The air cleaner regulation provides significant public health benefits by greatly reducing the exposure of Californians to indoor ozone. The regulation was estimated to prevent the routine exposure of well over 500,000 Californians to ozone concentrations above the 8-hour CAAQS of 0.070 ppm resulting from the use of an indoor air cleaning device that emits ozone. Most importantly, many of these California residents could be exposed to ozone levels several times greater than the health-based standard.

Adoption of the proposed amendments would not affect the public health benefits from the air cleaner regulation, but would assure that they are achieved on the timetable adopted by the Board in 2007 and not delayed. Additionally, the amendments will reduce the economic burden on manufacturers and retailers who will have certified, but unlabelled, inventory.

IV. Proposed Changes to the Regulation and the Rationale for Each

This chapter discusses the proposed amendments to the air cleaner regulation, and the rationale or need for each amendment.

A. Summary of the Proposed Changes

The amendments being proposed to the air cleaner regulation include two requested by manufacturers and four amendments requested by staff, based on our initial experience with the testing and certification activities conducted to date. The amendments requested by manufacturers are to: 1) extend the deadline or compliance date for the package labeling requirement by one year, to October 18, 2011 (while retaining the current testing and certification deadline of October 18, 2010); and 2) allow the use of adhesive certification labels (as opposed to printing on the package) for an additional 18 months past the current 6-month allowance for adhesive labels, to October 1, 2012. These amendments would effectively allow no labeling for the first year after the compliance date of October 18, 2010, and would allow adhesive labels to be used for two years after that date. The October 18, 2010 compliance date for testing and certification would still be enforced beginning on that date, regardless of whether the packaging shows the required label.

The staff's proposed amendments would: 1) incorporate three clarifications issued by UL for the ozone test protocol used by our regulation; 2) allow air cleaners to be tested for their electrical safety at other test facilities currently utilized by approved testing laboratories to conduct the ANSI/UL Standards 507 and 867 electrical safety tests; 3) allow alternate, applicable (UL) electrical safety testing for multi-function appliances that include an air cleaning component; and 4) refine the definition of "mechanical filtration only" to be fully consistent with other portions of the regulation.

B. Amendments Requested by Manufacturers

1. Extend the Labeling Compliance Date for One Year

The manufacturers' first requested amendment is to extend for one year the package labeling requirement that currently must be met by October 18, 2010; however, air cleaners would still have to be tested and certified by that date. In other words, all indoor air cleaners for sale and use in occupied spaces in California would still have to be tested and certified by the original compliance deadline (October 18, 2010), but they would not be required to show the certification label on their product packaging until October 18, 2011.

The downturn in the economy has created a large inventory of unsold air cleaners in the manufacturing, distribution, and retail pipelines, and many of these are expected to be in the retail and distribution chains past the October 2010 compliance date. According to some manufacturers, units that are at distribution centers and retail stores are effectively outside the manufacturers' control, and it is difficult and costly to try to label those packages post-certification due to lack of access at distribution centers and resistance of local retailers. Manufacturers want to avoid having retailers send back large numbers of air cleaners that comply with the ozone emission limit, but do not bear the required label, because this would be very costly and could result in the unnecessary disposal of units and packaging cartons.

The delay in having the second testing facility available for conducting the ozone test may result in some models being tested and certified right up to the certification deadline in 2010, so there will be insufficient time to have labels applied. This amendment would allow time for manufacturers and retailers with large inventories to be able to sell those air cleaners. Small businesses that experience slower turnover could especially be affected, because they are likely to have older products.

This amendment is not expected to negatively impact public health because all testing and certification must still be completed by the original compliance deadline, and only certified devices could be sold. This amendment could potentially make it easier for uncertified devices to continue to be sold during the year labels are not required. Enforcement of the regulation during the first year would require inspectors to check models for sale against the ARB list of certified air cleaners rather than relying on product packaging, but inspectors would typically open the package and verify it is on the compliant product list anyway.

2. Allow the Use of Adhesive Certification Labels for Two Years

The regulation's definition of "label" [Section 94801(a)(16)] currently allows manufacturers to use adhesive certification labels on product packaging (in lieu of immediately requiring the printing of new packaging) for air cleaners manufactured prior to April 1, 2011, i.e. approximately six months beyond the current labeling deadline. The manufacturers' second requested amendment is to allow the use of adhesive labels on product packaging for an additional 18 months beyond the current April 1, 2011 deadline, to October 1, 2012. If the first amendment above is adopted, devices must have a certification label after October 18, 2011, and the practical effect of this second amendment is to allow manufacturers to use adhesive labels as certification labels for up to another year after that, i.e., until October 1, 2012.

Some air cleaner manufacturers have lengthy production cycles from manufacture to the point of consumer purchase. Most air cleaners are manufactured overseas, and orders are submitted about six months in advance. Manufacturers whose models are tested and certified near the compliance deadline will have units in production that will not be labeled as certified on the package. This amendment is being requested by manufacturers to address the time needed for some manufacturers to exhaust their existing product packaging stockpiles and to have new artwork added to their packaging to show ARB certification. This amendment also will allow time for those retailers who are not able to sell their existing inventory of certified models by October, 2011 to obtain and apply the adhesive labels to certified models. According to a representative of the Association of Home Appliance Manufacturers (AHAM), its members have committed to move to pre-printed packaging as quickly as they can, and some expect to meet the current compliance date for labeling.

This amendment would reduce the regulatory burden on manufacturers with little risk of harm to public health, because products must still be tested and certified by October 18, 2010 in order to be sold in California after that date. It also reduces the amount of packaging that has to be recycled or discarded and postpones costs to manufacturers for new packaging materials. On the downside, the potential for abuse with the use of stickers on non-complying products sold online or through direct marketing would be greater if the adhesive labels are allowed for a longer time.

C. Incorporate Into the Regulation Three Clarifications to the Ozone Test Protocol

The first of three staff-recommended amendments to the air cleaner regulation is the incorporation into the regulation of three Certification Requirement Decisions (or "CRDs") issued by UL that clarify the Section 37 ozone test protocol in ANSI/UL Standard 867. Underwriters Laboratories periodically publishes clarifications to testing standards, including Standards 507 and 867 that apply to indoor air cleaners. Certification Requirement Decisions are written clarifications or interpretations that address specific questions or relatively minor issues relating to testing procedures and are intended to provide guidance and direction to testing laboratories that use the UL standard.

The three CRDs recommended at this time relate to parts of the Standard 867 Section 37 ozone test protocol that include chamber setup, the definition of steady state, and filter tests. Prior to running any ozone test, the technician must check to make sure that the testing chamber continues to meet specific requirements, i.e., adequate air tightness, air mixing, and ozone half-life. This is accomplished by running several characterization or verification tests. The Chamber Setup CRD (see Appendix III) clarifies that only one of the chamber characterization tests (the ozone half-life test) needs to be repeated before the testing of each new model begins; the other tests to verify chamber performance only need to be conducted at less frequent intervals, specifically twice a year, or when any chamber modification or maintenance activities have occurred. Previously, about one to two days were required between model tests to conduct the chamber verification tests, which was not the intention when the protocol was originally drafted. Incorporating this CRD will reduce the time needed to verify the performance of the chamber between model tests by about one to one and a half days.

The second CRD, the Definition of Steady State CRD (see Appendix IV), slightly revises the definition of "steady state" for the ozone test to avoid the situation where very low emitting air cleaners (that emit just a few ppb ozone) must go through a full 24-hour test rather than an 8-hour test as originally intended. In early testing, the very low emitting air cleaners had to be tested for the full 24 hours because the definition of "steady state" was not appropriate for such low measurements and "steady state" as defined was not achieved, even though levels remained very low the entire time. This added time and cost to the testing. The CRD clarifies the definition of "steady state" and describes what should be done when air cleaners emit very low levels of ozone, and this will allow very low emitting devices to require only the 8-hour, rather than the 24-hour, test, which will shorten test time, reduce costs, and enable faster throughput.

The third CRD, the Filter Test Iterations CRD (see Appendix V), will clarify testing protocols when multiple types of filters are offered as alternate or optional filters with an air cleaner model. When the least reactive filter combination can be identified, that combination will be tested under the high and low fan speeds, and the test will be conducted using the settings determined in preliminary tests to produce the highest ozone levels. This approach will assure that the "worst case" filter combination and operational setting is being tested. As before, if the air cleaner can be operated with the filters removed, it will also be tested with filters removed. For some air cleaners that are offered for sale with multiple filter choices, this CRD will reduce the number of tests required, saving one or more days of testing for each such model.

Staff thus recommends that these three CRDs be incorporated into the regulation. They will better assure that all laboratories conduct the testing in the same manner, thus improving the consistency of results across laboratories. Taken together, the CRDs are expected to reduce the testing time required for the Section 37 ozone test by at least one day, and sometimes by several days. Accordingly, this will speed up throughput in the test chambers and may allow reduction of test costs for some models in the future. Incorporation of the CRDs into the regulation test method will maintain consistency with the industry test protocol and standard. And finally, none of the proposed CRDs will result in negative health impacts because the tests will be conducted with the configurations and settings that would produce the highest potential ozone emissions.

D. Allow Electrical Safety Testing at Additional NRTL Program Test Facilities

Staff recommends that the Board amend the regulation to allow air cleaner models to be tested for electrical safety under ANSI/UL Standards 507 and 867 by test facilities that can perform the testing under the oversight of NRTLs. As explained below, such testing arrangements are formally part of U.S. OSHA's NRTL Program. The effect of this amendment would be to increase the number of test facilities available to manufacturers of "mechanical filtration only" air cleaners, and in many cases allow them to use the test facilities they currently use for their electrical safety test. By increasing the numbers of available testing locations, the testing of these low ozone risk air cleaners could be expedited. This amendment may be less utilized for air cleaners being tested under ANSI/UL Standard 867, because ozone testing must be conducted by one of the two NRTLs approved by the ARB, and they are not required to accept electrical safety testing data from other parties. In order for a certification mark to be placed on a product (which is required by our regulation), either the laboratory conducting the ozone test or the laboratory conducting the electrical safety test must be willing to accept the other's test data.

The air cleaner regulation currently requires that compliance testing for ANSI/UL Standard 507 be conducted by a recognized NRTL. Testing facilities apply to federal OSHA to be certified or "recognized" as being qualified and capable of performing the necessary testing for one or more product safety standards, including ANSI/UL Standard 867 (for electrostatic air cleaners, including an ozone testing protocol in Section 37) and Standard 507 (for mechanical filtration air cleaners). The OSHA NRTL Program also includes a number of supplemental programs where an NRTL controls and audits, but does not itself generate, the test data relied on for product certification. The OSHA Program allows these testing arrangements (including subcontracting and witnessed testing) as long as there are safeguards related to training, oversight of testing, and the independence of the NRTL.

Further details about the supplemental programs are described in a formal notice published March 9, 1995 in the Federal Register (U.S. OSHA, 1995; U.S. OSHA, 1999). Staff recommends that the regulation be amended to allow air cleaner manufacturers to submit, as part of their certification application, electrical safety test data from an NRTL where the data were generated under Supplemental Programs 2, 3, 4, 5, or 6. In Program 2 the testing data are from an independent organization under contract to the NRTL. In Program 3, both testing and evaluation is conducted by an independent organization. Program 4 involves technical personnel from the NRTL witnessing the product testing, which is generally carried out at a location other than at the NRTL. Programs 5 and 6 mirror Programs 2 and 3, but the outside parties are not independent and may have a vested interest in the outcome of the test results. However, for all of these programs, the NRTL is required to retain control of, and responsibility for, all aspects of the product certification process under the specific standard, including procedures and records which demonstrate that the test data are unbiased.

ARB's original regulation specifies that Program 2 facilities may conduct the Section 37 (ozone test) portion of the ANSI/UL Standard 867 test, but only following an ARB audit of the ozone test facility. However, the regulation is silent on the NRTL arrangements for "mechanical filtration only" air cleaners for Standard 507. This was unintended and the regulation as written is therefore more stringent for "mechanical filter only" air cleaners in spite of the fact that they do not emit ozone. Some manufacturers have assumed that all program testing facilities under NRTLs could test for Standard 507 as they have always been able to do, and have submitted certification applications containing such documentation. Amending the regulation to allow testing under OSHA Supplemental Programs 2 through 6 for any NRTL recognized to conduct Standard 507 testing would remedy the situation and make this requirement more equitable relative to devices that emit ozone. The amended regulation will also allow Standard 867 electrical safety testing to be conducted under Programs 2 through 6; however, as explained above, the ozone test can only be performed at the two test facilities approved by the ARB, and those laboratories are not required to accept electrical safety test data from other parties.

This amendment facilitates the electrical safety testing of low risk air cleaners, and will not result in any negative public health impact. It potentially reduces the cost of complying with the regulation by enabling many manufacturers to continue obtaining testing services from facilities that presently conduct their safety testing for air cleaners, especially in Asia. This could save time and avoid possible fines in the tens of thousands of dollars that are imposed by retailers if certified product is not delivered by the time specified in delivery contracts, according to one manufacturers' representative. Finally, this amendment would reduce the burden on manufacturers of mechanical air cleaners with no public health impact, because "mechanical filtration only" air cleaners emit little or no ozone.

E. Allow Alternate Electrical Safety Tests for Multi-function Appliances

Some portable, multi-function appliances include an air cleaning technology and must therefore meet the requirements of this regulation. However, they are typically tested for electrical safety under industry (UL) test standards other than ANSI/UL Standards 507 and 867. For example, portable electric heaters or portable air conditioners that include an ionizer or other technology for cleaning the air, and that claim to clean the air, meet the definition of indoor air cleaning device, and must therefore meet the requirements of this regulation. Normally, they would be required to meet ANSI/UL Standards 1278 and 484, respectively. A modification to the regulation is needed to allow such devices to undergo electrical safety testing under the appropriate ANSI/UL test standard that is typically used for them, which varies depending on the primary purpose of the appliance. Such devices with air cleaning technologies that may emit ozone and that do not meet the definition of "mechanical filtration only" would be tested for their ozone emissions under Section 37 of ANSI/UL Standard 867, but would be tested for their electrical safety under the industry standard that is appropriate for the primary function of the device.

This amendment will correct an oversight of the original regulation, which did not address the different tests needed for electrical safety testing of multi-function appliances that include an air cleaning technology.

F. Refine the Definition of "Mechanical Filtration Only"

The final recommended amendment is a minor one: to revise the definition of "mechanical filtration only" in Section 94801(a)(20) of the regulation by replacing the phrase "suspended particles" with the phrase "contaminants", thereby making the overall regulation internally consistent and more accurate. Some mechanical air cleaners have carbon filters, for filtration of VOCs, not particles. Activated charcoal is included in the list of possible materials used in "mechanical filtration only" air cleaners in the second sentence of the definition of "mechanical filtration only" air cleaners. This inconsistency within the definition itself has caused some concern when staff had to determine whether certain air cleaners met the definition of "mechanical filtration only" air cleaners.

This proposed revised definition of "mechanical filtration only" also will remove an inconsistency in the regulation between the definition in section 94801(a)(20), which refers only to suspended particles, and section 94804(b) which refers to "pollutant removal." The 2007 staff report used the term "pollutant removal" as well in discussing the definition, and it was staff's intent to refer to more than particles, as evidenced by the fact that activated carbon filters, which remove VOCs, are listed as one of the types of materials included in the current definition of "mechanical filtration only" device. This proposed amendment would have no impact on public health.

V. Economic Impacts

A. Economic Impacts of Proposed Measures

The proposed measures are expected to result in no cost increases and likely some small, but currently unquantifiable, time and cost reductions for manufacturers, distributors, retailers, and sellers. No significant changes in consumer prices of air cleaners are expected; these prices are expected to remain the same or decrease slightly in a few cases. The proposed measure to use a consistent definition of mechanical-only devices would not have any economic impacts.

Over the past year since the original regulation went into effect, some manufacturers complained that ozone testing laboratories had raised their prices from their quotes originally given. Some manufacturers complained that these prices were too high in general, especially for a manufacturer with several models. For the original regulation, staff used information from testing laboratories to estimate the cost of testing ozone emissions from an air cleaner. The cost estimated by staff for ozone testing of three different device settings without any pre-testing of ozone emissions was $10,000 (ARB, 2007, p. 36). Current prices for ozone testing at the two ARB-approved laboratories – $8,200 to $9,500 for ozone testing and certification – are not markedly different than the previous staff estimate.

For the proposed amendments, quantification of potential cost reductions from individual measures is not currently feasible. Some of the proposed measures will apply only to a limited number of the air cleaner models and manufacturers, but those numbers are not available. Staff has requested data from ozone testing laboratories and manufacturers on how the proposed amendments may affect their costs and the costs to distributors, retailers, and consumers; staff has received very limited information in response. For mass-produced appliances with small profit margins, such as air cleaners, it is not expected that any cost savings to manufacturers will be passed on to distributors, retailers, or consumers, except possibly in a few niche markets for specialized air cleaners. Therefore, the following analysis mainly discusses the direction of the expected economic impact on manufacturers for each measure in the proposed amendment.

1. Extend Deadlines for Labeling and Use of Adhesive Labels

The postponement of the deadlines for package labeling and the use of adhesive certification labels will allow most manufacturers to spread their costs for labeling out over a longer period of time. This measure will also allow manufacturers to avoid additional costs because more of the excess inventory that has built up in the supply chain due to the economic recession could be sold. In addition, they will not have to replace original packaging material for products already in the supply chain. Distributors, retailers, and sellers will be able to avoid the additional time and costs of putting on adhesive labels themselves or returning excess inventory. Many of these are small businesses that would benefit substantially from the extension. The actual economic impact of this measure will depend on how many manufacturers, distributors, retailers, and sellers take advantage of the extended labeling deadlines. The economic impact of this measure is expected to be positive (reduced costs to manufacturers, distributors, sellers, and retailers), but cannot be quantified at this time.

2. <u>Incorporate Clarifications to the Ozone Test Protocol</u>

The incorporation of the three new CRDs that clarify the ozone test protocol in Section 37 of ANSI/UL 867 is expected to reduce the time and potentially the cost of testing ozone emissions for most air cleaners, as discussed above in Section IV. The *Chamber Setup* CRD streamlines the preliminary testing of chamber performance. It is estimated to reduce the time for chamber performance verification by about one and a half days for each air cleaner model group. However, it is not clear how testing laboratories will factor this into their price schedule, or whether this will significantly affect the time to market for manufacturers. The economic impact of this CRD is expected to be neutral and may reduce costs for manufacturers.

The CRD entitled *Definition of Steady State at 7-8 Hours* will reduce the number of air cleaners that require the full 24 hours of testing and instead require only eight hours of chamber testing. This will result in faster throughput for some air cleaner models. The actual impact of this measure will depend on how many air cleaner models would meet the revised definition of steady state ozone levels. One testing laboratory has estimated that this CRD would affect 90 percent of the air cleaner models, based on units they have tested so far. However, the actual number of models affected cannot be known until the devices are actually tested. The economic impact of this CRD is expected to be a reduction in costs for manufacturers whose products are affected by it, but this potential benefit cannot yet be quantified.

The *Filter Test Iterations* CRD will clarify how testing laboratories should identify the filter that is least reactive with ozone for use in the ozone testing protocol when testing air cleaner models for which optional or alternate filters are available. For air cleaners with multiple types of filters available, this measure will reduce the number of repeated tests needed in the test chamber, thereby reducing the required test time by one to several days. For each day of repeat chamber testing of a different filter that is eliminated, the avoided cost would be about $1,800, based on current pricing by one testing laboratory. The number of air cleaner models and manufacturers and the potential number of filter repeat tests that will be affected by this CRD is unknown, but staff are aware of at least a few models that would be affected. The economic impact of this CRD is expected to be cost reductions for the manufacturers whose products are affected.

Both testing laboratories estimate that the CRDs would nearly double their throughput in the best case. The CRDs would not necessarily result in significant cost reductions, though – both laboratories have indicated that they do not plan to modify their pricing. However, manufacturers who use the laboratory with a scaled pricing structure would experience a reduced cost since their models would require fewer days of testing than is currently be required. Each day of testing eliminated would reduce costs to manufacturers by $1800.

3. Allow Electrical Safety Testing at Additional NRTL Program Test Facilities

The increased options for NRTL Program 2-6 test facilities should increase the number of laboratories available for electrical safety testing. This will help provide manufacturers with more scheduling flexibility, and thereby expedite the testing process. According to one representative of manufacturers, this expedited testing is expected to provide substantial cost reductions by reducing the time to market for new models, and it will also help reduce the risk of fines on manufacturers when they miss deadlines for product delivery to retailers; such fines can cost on the order of tens of thousands of dollars per day. In addition, this measure may help reduce product shipping costs, especially where suitable testing facilities are at distant locations. However, the number of models and manufacturers affected by this measure cannot be quantified. The economic impact of this measure is expected to be reduced costs for manufacturers whose products are affected.

4. Allow Multi-function Devices to Utilize Appropriate Electrical Safety Tests

Allowing multi-function appliances to utilize the applicable UL (or ANSI/UL) electrical safety test normally used for such devices ensures the safety of the device and avoids the costs of additional, and possibly inappropriate, electrical safety testing for the manufacturer. Most such multi-function devices already receive electrical safety testing appropriate for the type of appliance; thus, this amendment avoids any costs for additional or duplicative electrical safety testing for the manufacturer. Those devices with air cleaning technologies that may emit ozone must continue to undergo the Section 37 portion (ozone emission test) of ANSI/UL Standard 867; however, this is not a new requirement. Only a small number of manufacturers would be affected by this amendment.

B. Affected Businesses and Agencies

The proposed regulation will affect the manufacturers, distributors, retailers, and sellers of portable air cleaners for use in occupied spaces if the products are marketed for sale in California. For the original regulation, staff estimated that approximately 60 manufacturers would be affected, including 23 manufacturers of "mechanical filtration only" air cleaners (ARB, 2007). Since adoption of the original regulation in 2007, the major manufacturer with the largest market share in California no longer manufactures air cleaners, another manufacturer has been bought out, and a few others appear to have either entered or left the air cleaner manufacturing industry. Staff estimates that the total number of manufacturers that could potentially be affected by the proposed amendments remains close to 60. The number of manufacturers likely to be affected immediately by the proposed amendments cannot be quantified. However, in the long term, the proposed amendments to clarify the ozone testing protocol and expand the types of NRTL labs for electrical safety testing are expected to produce time and cost savings for many of the manufacturers as discussed above in Sections IV and V.A.

Only three manufacturers are based in California: Aqua Sun Ozone International, Zojirushi America Corporation, and Wein Products. Based on our assessment in the 2007 ISOR, these companies are small share manufacturers of air cleaners. A large majority of the actual manufacturing is done under contract with manufacturers in Asia, according to industry representatives.

Data on the number or percent of all air cleaner manufacturers, distributors, and retailers that are small businesses are not available. In the staff report (ARB, 2007, p. 34) for the original regulation, staff used recent survey data on household air cleaner purchases to estimate that 53 (87%) of the 61 manufacturers were "small share" manufacturers. Most, but not all, of this group would be small businesses as well. For the proposed amendments discussed in this document, distributors, retailers and sellers will also be affected. To estimate the current number of small businesses affected by the proposed regulation, staff assumed that the survey data have not changed significantly since the 2006 survey, and that national sales values parallel California sales values for indoor air cleaners. Staff adjusted the 87% value downward to 50% to reflect the substantial portion of distributors, retailers, and sellers that are estimated to be small businesses. While many large regional and national distributors and large discount and hardware store chains carry air cleaning devices, many air cleaners are also sold through small family businesses.

No government agency will be directly affected by this proposed regulation. Minimal ARB staff time would be needed to finalize the proposed amendments to the regulation, but this is covered by existing resources. The 2007 staff report (ARB, 2007) previously estimated ongoing costs of approximately $175,000 per year for one additional staff person and contract funds to implement the current regulation and enforce compliance; the proposed amendments do not change that estimate. Other state agencies such as the California Department of Public Health and local health departments and district attorneys are not expected to be affected by the proposed amendments.

C. Potential Impacts on Business Competitiveness

Because the proposed amendments to the regulation are expected to produce cost savings to manufacturers, they are expected to reduce the risk of business elimination and jobs elimination. They are not expected to have a noticeable impact on: 1) the ability of California manufacturers to compete with manufacturers of similar products in other states; 2) other California State or local agencies; or 3) business creation or expansions.

D. Costs and Benefits of Alternatives to the Regulation

1. Alternative 1, Extend the Compliance Date for Certification and Testing

This alternative is not currently needed, but if adopted, it would allow manufacturers to spread out their testing and certification costs over a longer time period, potentially resulting in a cost reduction. However, this alternative would adversely impact public health by permitting the sale of high ozone-emitting air cleaners to continue in California for an additional time period.

2. Alternative 2, Shorter Extension of Labeling Deadlines

This alternative would provide little or no economic benefits to manufacturers, distributors, or retailers. Manufacturers have stated that anything less than the proposed one-year extension would not adequately address the problem of inventory build up and long lead times for production and packaging. Therefore, it would not provide potential cost reductions for those affected parties. In addition, it would not affect consumer prices or public health.

3. Alternative 3, Take No Action

This alternative would not produce any significant benefits to the affected groups, and could increase the likelihood that small manufacturers and distributors would go out of business or be unable to sell their products in California. The failure to extend the labeling deadlines would retain anticipated manufacturer, distributor, and retailer costs for re-packaging and re-labeling, and thus create an unnecessary hardship, especially on small businesses. In addition, the lack of clarified and streamlined test procedures for the ozone test protocol and of additional facilities for electrical safety testing would prevent manufacturers from achieving reasonable time and cost reductions. Furthermore, failure to act could produce a shortage of ARB-certified devices on the California market. This would create an incentive for the marketing of counterfeit devices and the mislabeling of non-certified air cleaners, which would harm public health.

VI. Summary of Environmental Impacts

The existing regulation protects public health by avoiding any increases in human exposure to, and the health impacts of, ozone from portable indoor air cleaning devices. The regulation also provides public health benefits by avoiding any increases in human exposures to chemical reaction products of indoor ozone such as formaldehyde, a known human carcinogen, as well as ultrafine particles and other irritant compounds. In consideration of the analyses performed herein, staff has determined that no significant adverse environmental impacts or loss of benefits from the existing regulation should occur as a result of adopting these proposed amendments. This chapter assesses the potential impacts that the proposed amendment may have on the environment.

A. Legal Requirements

The California Environmental Quality Act (CEQA) and ARB policy require that an analysis be performed to determine the potential adverse environmental impacts of proposed regulations. To meet this requirement, ARB must assess the extent and severity of reasonably foreseeable environmental impacts, and respond (in writing) to all significant environmental issues raised in the public review period and at the Board hearing. Presently, ARB's regulatory program is certified by the Secretary of Resources (cf. Public Resources Code §21080.5), which allows ARB to include an environmental analysis in the ISOR instead of preparing an environmental impact report or negative declaration. Written responses to significant environmental issues raised by the public will be included in the Final Statement of Reasons (FSOR) for the proposed regulation. Public Resources Code §21159 requires that the environmental analysis prepared by ARB include analyses of the following "reasonably foreseeable" items:

- Impacts of the methods of compliance.
- Feasible mitigation measures.
- Alternate means of compliance with the proposed regulation.

With respect to mitigation measures, CEQA requires state agencies to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

B. Foreseeable Environmental Impacts

1. Changes in Exposure to Ozone and Public Health Impacts

As discussed in Chapter IV, the proposed amendment is not expected to increase indoor ozone exposures from the use of indoor air cleaning devices, relative to the regulation currently in place. In addition, the amendment is not expected to significantly impact the level of electrical safety for "mechanical filtration only" devices. Therefore, staff expects the proposed regulation to produce a small public health benefit by clarifying the ozone testing procedures, which should result in more consistent and efficient testing procedures that still consider realistic worst-case operating conditions of the indoor air cleaning devices.

2. Other Potential Environmental Impacts

As discussed in the Staff Report for the original regulation (ARB, 2007), ozone reacts chemically with terpenes, common fragrance compounds found in cleaning products and deodorants. The by-products of these chemical reactions include formaldehyde, a known human carcinogen and Toxic Air Contaminant, as well as ultrafine particles, and other airborne irritant compounds. The proposed amendment is not expected to significantly affect ozone emissions from indoor air cleaners, and hence, any resultant production of toxic and irritant by-products, either indoors or outdoors. Therefore, staff does not expect the proposed regulation to have a significant impact on indoor or outdoor air quality.

C. Reasonably Foreseeable Feasible Mitigation Measures

Staff has concluded that no significant adverse environmental impacts would occur from implementing the proposed amendments to the regulation. Thus, no mitigation measures would be needed.

D. Alternate Means of Compliance

Not Applicable.

E. Environmental Justice

Environmental justice is a core consideration in ARB's efforts to provide clean air for all California communities (ARB, 2001). The proposed amendment would not adversely affect human exposure to ozone emissions from indoor air cleaning devices or increase the cost of such devices to consumers. Therefore, impacts on low income consumers or population groups that are sensitive to ozone's health effects, such persons with respiratory disease or allergies, are not expected.

VII. Staff Recommendation

Staff recommends that the proposed amendments be approved. The amendments would avoid unnecessary costs and onerous logistics for manufacturers, distributors, retailers and sellers during this difficult economic period, and would have no negative impact on public health or the environment. The proposed amendments would clarify portions of the test method that are not sufficiently explicit, which would better assure consistency in conducting the ozone emission concentration test protocol across laboratories and retain consistency with the industry test standards for air cleaners. Finally, they would incorporate small but important refinements into the regulation that would allow manufacturers to continue to utilize the test facilities and electrical safety tests they have always used for electrical testing, and clarify certain other provisions in the regulation.

REFERENCES

ANSI/UL, 2007. Standard 867 of Underwriters Laboratories Inc. for Electrostatic Air Cleaners.

ARB, 2001. Policies and Actions for Environmental Justice. http://www.arb.ca.gov/ch/programs/ej/ejpolicies.pdf

ARB, 2005. Review of the California Ambient Air Quality Standard for Ozone, vols. 2 and 3. http://www.arb.ca.gov/research/aaqs/ozone-rs/rev-staff/rev-staff.htm#Summary

ARB, 2006. Evaluation of ozone emissions from portable indoor "air cleaners" that intentionally generate ozone. Staff Technical Report to the California Air Resources Board, May 2006. http://www.arb.ca.gov/research/indoor/o3g-rpt.pdf

ARB, 2007. Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Regulation to Limit Ozone Emissions from Indoor Air Cleaning Devices, August 10, 2007.
http://www.arb.ca.gov/regact/2007/iacd07/isor.pdf

FDA (U.S. Food and Drug Administration), 2007a. 21 CFR 801.415, Maximum acceptable level of ozone. Revised April 1, 2007.
http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=801.

FDA, 2007b. 21 CFR 801. Medical Devices. Labeling. Revised April 1, 2007.
http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=801.

Piazza T., R.H. Lee and J. Hayes, 2006. Survey of the use of ozone-generating air cleaners by the California public. Final report prepared for the California Air Resources Board, contract no. 05-301.

U.S. OSHA, 1995. United States Occupational Safety and Health Administration, Department of Labor. "Nationally Recognized Testing Laboratories; Clarification of the Types of Programs and Procedures" Federal Register, Vol. 60, Pages12980 – 12985, (March 9, 1995).
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=13454&p_text_version=FALSE

U.S. OSHA, 1999. United States Occupational Safety and Health Administration, Department of Labor. "NRTL Program Policies, Procedures, and Guidelines" Program Directive Number CPL 01-00-003 (December 2, 1999)
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2004&p_text_version=FALSE

This page left intentionally blank.

APPENDIX I: ASSEMBLY BILL 2276

This page left intentionally blank.

Assembly Bill No. 2276

CHAPTER 770

An act to add Article 8 (commencing with Section 41985) to Chapter 3 of Part 4 of Division 26 of the Health and Safety Code, relating to air pollution.

[Approved by Governor September 29, 2006. Filed with Secretary of State September 29, 2006.]

LEGISLATIVE COUNSEL'S DIGEST

AB 2276, Pavley. Ozone: indoor air cleaning devices.

(1) Existing law imposes various limitations on emissions of air contaminants for the control of air pollution from vehicular and nonvehicular sources, including emissions of volatile organic compounds from consumer products. Existing law generally designates the State Air Resources Board as the state agency with the primary responsibility for the control of vehicular air pollution, and air pollution control districts and air quality management districts with the primary responsibility for the control of air pollution from all sources other than vehicular sources. Existing law requires each district to attain ambient air standards for specified air pollutants, including, but not limited to, ozone. Existing law classifies emissions of ozone in nonattainment areas as moderate, serious, severe, or extreme. Existing law generally sets forth crimes and penalties for violations of air pollution laws and any rule, regulation, permit, or order of the state board.

This bill would require the state board, on or before December 31, 2008, to develop and adopt regulations, consistent with federal law and including specified elements, to protect public health from ozone emitted by indoor air cleaning devices, including both medical and nonmedical devices, used in occupied spaces. Because a violation of these regulations would come within the existing provision making a violation of state board regulations a crime, this bill would create a state-mandated local program by expanding an existing crime. The bill would make related legislative findings and declarations. The bill would authorize the state board to seek a preemption waiver from the federal government to authorize the state board to adopt regulations that are more stringent than federal law.

(2) The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

93

The people of the State of California do enact as follows:

SECTION 1. Article 8 (commencing with Section 41985) is added to Chapter 3 of Part 4 of Division 26 of the Health and Safety Code, to read:

Article 8. Indoor Air Cleaning Devices

41985. The Legislature finds and declares all of the following:

(a) Ozone is a harmful air pollutant and lung irritant that has serious health impacts at current levels in outdoor air. The state board has determined that each year exposure to ozone results in significant numbers of premature deaths, hospitalizations due to respiratory and cardiac illnesses, emergency room visits for asthma for children under 18 years of age, school absences, and restricted activity days.

(b) Ozone exposure poses a serious health hazard, whether exposure is from outdoor or indoor sources.

(c) Research has demonstrated that long-term exposure to ozone may permanently damage lung tissue and reduce a person's breathing ability.

(d) According to recent studies, ozone-generating air cleaning devices have produced harmful levels of ozone indoors, up to three times the state outdoor air quality standard of 90 parts per billion within an hour or two of operation.

(e) Ozone is not an effective cleaner for indoor air when operated at levels that are safe for human occupation. Independent studies cited by the United States Environmental Protection Agency and the Consumers Union have shown that ozone-generating air cleaning devices do not destroy microbes or reduce indoor air pollutants effectively enough to provide any measurable health benefits.

(f) The state board, the State Department of Health Services, and other governmental agencies have issued warnings to advise the public not to use devices that are specifically designed to generate ozone indoors and advertised or marketed as air cleaning devices.

(g) Ozone emitted from indoor air cleaning devices poses an unnecessary risk to public health, and, therefore, it is the intent of the Legislature that the state board establish regulations to promote improved public health by restricting ozone emissions generated by these devices.

41985.5. For purposes of this article, the following terms have the following meanings:

(a) "Federal ozone emissions limit for air cleaning devices" means the level of generation of ozone above which the device would be considered adulterated or misbranded pursuant to Section 801.415 of Title 21 of the Code of Federal Regulations, specifically the generation of ozone at a level in excess of 0.05 part per million by volume of air circulating through the device or causing an accumulation of ozone in excess of 0.05 part per million by volume of air when measured under standard conditions at 25 degrees Celsius (77 degrees Fahrenheit) and 760 millimeters of mercury in the atmosphere of enclosed space intended to be occupied by people for extended periods of time.

(b) "Medical device" means "device" as defined in subsection (h) of Section 321 of Title 21 of the United States Code.

41986. (a) On or before December 31, 2008, the state board shall develop and adopt regulations, consistent with federal law, to protect public health from ozone emitted by indoor air cleaning devices, including both medical and nonmedical devices, used in occupied spaces.

(b) The regulations shall include all of the following elements:

(1) An emission concentration standard for ozone emissions that is equivalent to the federal ozone emissions limit for air cleaning devices.

(2) Testing procedures for manufacturers to utilize to determine ozone emissions from devices. In developing the procedures, the state board shall consider existing and proposed testing methods, including, but not limited to, those developed by the American National Standards Institute and Underwriters Laboratory.

(3) Certification procedures that enable the state board to verify that an indoor air cleaning device meets the emission concentration standard for ozone emissions using the testing procedures adopted by the state board.

(4) (A) Package labeling requirements that indicate that an indoor air cleaning device is certified as meeting the emission concentration standard for ozone emissions.

(B) The state board shall consider recommendations of affected industries and the public in developing the labeling requirements.

(C) The label for an indoor air cleaning device that is not a medical device shall include the following statement: "This air cleaner complies with the federal ozone emissions limit."

(D) The label for an indoor air cleaning device that is a medical device shall be labeled in compliance with federal law, including Section 801.415 of Title 21 of the Code of Federal Regulations.

(c) The regulations may include any or all of the following elements:

(1) A ban on the sale of air cleaning devices that exceed the emission concentration standard for ozone emissions from indoor air cleaning devices adopted by the state board.

(2) Procedures for authorizing independent laboratories or other approved certification organizations to verify products as meeting the emission concentration standard for ozone emissions from indoor air cleaning devices adopted by the state board. Any authorization shall ensure that verification shall be conducted consistent with the testing procedures adopted by the state board.

(3) An exemption for indoor air cleaning devices that, by design, emit de minimis levels of ozone during their operation, as determined by the state board.

(4) Any other element the state board determines to be necessary to protect the public health from emissions of ozone from indoor air cleaning devices that exceed the emission concentration standard for ozone emissions from air cleaning devices and are used in occupied spaces.

(d) Devices verified by the state board or the United States Food and Drug Administration as meeting the emission concentration standard for ozone emissions from indoor air cleaning devices and the labeling requirements adopted by the state board shall not be subject to further regulatory requirements for ozone pursuant to this article.

(e) It is the intent of the Legislature that this section be interpreted and applied in a manner that is consistent with federal law. The regulations adopted by the state board pursuant to this section shall be consistent with federal law. The state board may, to the extent a waiver is required, seek a preemption waiver from the federal government to authorize the state board to adopt regulations that are more stringent than federal law.

SEC. 2. No reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution because the only costs that may be incurred by a local agency or school district will be incurred because this act creates a new crime or infraction, eliminates a crime or infraction, or changes the penalty for a crime or infraction, within the meaning of Section 17556 of the Government Code, or changes the definition of a crime within the meaning of Section 6 of Article XIII B of the California Constitution.

O

APPENDIX II: PROPOSED REVISIONS TO LANGUAGE

This page left intentionally blank.

[Note: Proposed amendments are shown in <u>underline</u> to indicate additions and ~~strikeout~~ to indicate deletions.]

Proposed Amendments to the
REGULATION FOR LIMITING OZONE EMISSIONS FROM INDOOR AIR CLEANING DEVICES

Subchapter 8.7 Indoor Air Cleaning Devices

<u>Amend sections 94801, 94804, 94805, and 94806, title 17, California Code of Regulations, as follows:</u>

Article 1. Indoor Air Cleaning Devices

§ 94800. Applicability.

Except as provided in Section 94803, this article shall apply to any person who manufactures, sells, supplies, offers for sale, or introduces into commerce in the state of California indoor air cleaning devices, including both medical and non-medical devices, used or intended for use in occupied spaces.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code.

§ 94801. Definitions.

(a) For the purpose of this article, the following definitions apply:

(1) "Air exchange rate" means the rate at which outdoor air replaces the volume of indoor air within a given space.

(2) "ANSI" means American National Standards Institute.

(3a) "ANSI/UL Standard 507" means the version of ANSI/UL Standard 507 for Safety for Electric Fans, Ninth Edition, published on September 27, 2007 by Underwriters Laboratories, Inc. (UL).

(3b) "ANSI/UL Standard 867" means the version of ANSI/UL Standard 867 for Electrostatic Air Cleaners, Fourth Edition, published on December 21, 2007 by Underwriters Laboratories, Inc. (UL), and the associated Certification Requirement Decisions published by UL on March 4, 2008; April 17, 2008; ~~and~~ April 18, 2008<u>; July 8, 2009; July 9, 2009; and (date to be determined), 2009</u>.

(3c) "ANSI/UL Standard 484" means the version of UL's Standard for Room Air Conditioners, 8th Edition, published December 21, 2007, and most recently approved by ANSI on March 26, 2009.

(3d) "ANSI/UL Standard 1278" means the version of UL's Standard for Movable and Wall- or Ceiling-Hung Electric Room Heaters, 3rd Edition, published June 21, 2000, and most recently approved by ANSI on July 30, 2008.

(4) "ARB" means the California Air Resources Board.

(5) "Certification mark" means the symbol used by a recognized testing organization to indicate that a representative sample of the product bearing the symbol meets certain quality or safety criteria. For this regulation the organizations of interest are the nationally recognized testing laboratories that verify compliance with the applicable ANSI/UL Standards for indoor air cleaning devices.

(6) "CCR" means the California Code of Regulations.

(7) "CFR" means the U. S. Code of Federal Regulations.

(8) "Concentration" means the amount of a specified substance in a unit amount of another substance.

(9) "de minimis" refers to a quantity so little, small, miniscule or tiny that the law does not refer to it and will not consider it.

(10) "Distributor" means any person to whom an indoor air cleaning device is sold or supplied for the purposes of resale or distribution in commerce.

(11) "Emission" means the release or discharge of a substance into the environment.

(12) "Executive Officer" means the Executive Officer of the Air Resources Board or the Executive Officer's designee.

(13) "Half-life" means the time required for the concentration of a substance to be reduced to half of its initial value.

(14) "Indoor air cleaning device" means an energy-using product whose stated function is to reduce the concentration of airborne pollutants, including but not limited to allergens, microbes (e.g., bacteria, fungi, viruses, and other microorganisms), dusts, particles, smoke, fumes, gases or vapors, and odorous chemicals, from the air inside an enclosed space. Such devices include, but are not necessarily limited to, portable devices of any size intended for cleaning the air nearest a person, in a room of any size, in a whole house or building, or in a

motor vehicle; and stand-alone devices designed to be attached to a wall, ceiling, post, or other indoor surface.

(15) "Industrial use" or "industrial application" means the use of ozone in the following manner:
- (A) purification of water in an industrial plant, water treatment facility, municipal water facility, or similar facility, and swimming pools and spas
- (B) the destruction of microbes on produce in an agricultural processing plant, refrigerated transport truck, or related facility
- (C) chemical oxidation and disinfection in the electronics, pharmaceutical, biotechnology and chemical industries
- (D) bleaching and other processing purposes in the pulp and paper industry
- (E) odor control from industrial stack gases or wastewater treatment facilities
- (F) odor and smoke control in the hotel industry, provided no people are physically present
- (G) mold remediation, provided no people are physically present
- (H) fire and smoke damage remediation, provided no people are physically present
- (I) odor control in the motor vehicle reconditioning and detailing industry provided no people are physically present.

(16) "Label" means an area containing the required statement in an easily readable format, separate from unrelated text. This is printing on the product packaging, or, for air cleaners ~~manufactured~~ sold prior to ~~April 1, 2011~~ October 1, 2012, may be an adhesive sticker.

(17) "Listing mark" means the symbol used by Underwriters Laboratories, Inc. to indicate that a representative sample of the product bearing the symbol meets certain UL safety criteria. The safety criteria are found in UL nationally recognized Standards 867 and 507 for air cleaning device safety.

(18) "Manufacturer" means any person who imports, manufactures, assembles, produces, or packages an indoor air cleaning device.

(19) "Medical device" means "device" as defined in subsection (h) of Section 321 of Title 21 of the United States Code.

(20) "Mechanical filtration only" means removal of ~~suspended particles~~ contaminants from air only via filtration with physical barrier, non-electronic techniques, i.e. air is forced through a filter medium. Materials used in the construction of the filter media may include substances such as activated charcoal, paper, foam, synthetics, ceramics, or natural fibers.

(21) "Model group" means indoor air cleaning devices sharing the same design, operational features, device output, and performance characteristics, and

manufactured by the same manufacturer. Units in the same model group may be marketed under different brand names. Units that differ only in decorative treatments such as color, remote control, or other cosmetic features not related to ozone output would belong to the same model group.

(22) "NIST" means the U. S. National Institute of Standards and Technology.

(23) "Non-medical device" means any indoor air cleaning device that does not meet the definition of "medical device" above.

(24) "NRTL" means Nationally Recognized Testing Laboratory, as recognized by U. S. OSHA per section 1910.7 of Title 29 of the Code of Federal Regulations.

(25) "Occupied space" means an enclosed space intended to be occupied by people for extended periods of time, e.g., houses, apartments, hospitals and offices.

(26) "OSHA" means U. S. Occupational Safety and Health Administration.

(27) "Packaging" means the materials around the consumer or institutional product which serve only to contain, enclose, incorporate, deliver, dispense, wrap or store the product. "Packaging" includes any article onto or into which the principal display panel and other accompanying literature or graphics are incorporated, etched, printed or attached. "Packaging" does not refer to a secondary container used for shipping purposes.

(28) "ppm" is a unit of concentration measure meaning parts per million by volume. For the purposes of this regulation the volume considered is air and the substance of interest is ozone.

(29) "Retailer" means any person who sells, supplies, or offers for sale, indoor air cleaning devices, directly to consumers.

(30) "Supply" means to make available for purchase or use.

(31) "UL" means Underwriters Laboratories, Inc.

(32) U. S." means United States of America.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code; 21 C.F.R. § 801.415; 29 C.F.R. § 1910.7; and 21 U.S.C. § 321.

§ 94802. Standards for Indoor Air Cleaning Devices.

Except as provided in Section 94803 (Exclusions and Exemptions), title 17, California Code of Regulations, no person shall manufacture for use in California 24 months after the effective date of this regulation, or sell, supply, offer for sale, or introduce into commerce, any indoor air cleaning device for use or intended for use in occupied spaces unless the device is certified by ARB to produce an ozone emission concentration not exceeding 0.050 ppm, as specified in Section 94804; is labeled as required in Section 94806; meets all requirements of this article; and continues to meet all requirements of this article, including the ozone emissions limit as determined by the test procedure in Section 94805.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code; 21 C.F.R. § 801.415.

§ 94803. Exclusions and Exemptions.

(a) *Industrial use*: The provisions of this article do not apply to indoor air cleaning devices manufactured, advertised, marketed, labeled, and used solely for industrial use as defined in Section 94801(a)(15) above, provided that they are marketed solely through industrial supply outlets or businesses and prominently labeled as "Solely for industrial use. Potential health hazard: emits ozone."

(b) *In-duct systems:* Air cleaning devices designed, marketed, and used solely as a physically integrated part of a central heating, air conditioning, or ventilating system, such as an "in-duct system," are exempt from this regulation.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code.

§ 94804. Certification Requirements.

(a) Each manufacturer of an indoor air cleaning device subject to Section 94802 is required to submit an application for certification to the ARB Executive Officer, P.O. Box 2815, Sacramento, CA 95812, Attn: Indoor Air Cleaning Device Certification. Information submitted on the certification application must be true and correct. Applications may be submitted by a professional association or certification organization on behalf of a manufacturer, as long as all required information and signatures from the manufacturer and test laboratory representatives are included. Upon verification of compliance with the test methods described in Section 94805, from a laboratory meeting the performance specifications in Section 94805(d), the ARB will issue an Executive Order that the indoor air cleaning device has completed certification for sale of the device within

California. Certification will be granted to manufacturers, who have the responsibility to comply with all provisions of this article.

(b) Any indoor air cleaning device using only mechanical filtration for pollutant removal is exempt from the testing requirement for the ozone emission standard of 0.050 ppm as determined in Section 94805, based on their known de minimis ozone emissions. Verification of this mechanical-filtration-only exclusion from ozone emission testing will be made by the ARB Executive Officer based on the submission of product design specifications and documentation by the manufacturer, distributor, or retailer. Documentation to the ARB shall include a description of the air cleaning performance technology employed, as well as a block diagram and schematic of the model. Indoor air cleaning devices qualifying as "mechanical filtration only" devices shall be certified under ANSI/UL Standard 507, which is hereby incorporated by reference as defined in Section 94801. Multi-function devices that include an air cleaning component that would qualify as "mechanical filtration only" but would normally be tested for their electrical safety under another ANSI/UL Standard shall be tested for electrical safety under the applicable ANSI/UL Standard . Mechanical filtration only d~~D~~evices certified to ANSI/UL Standard 507 or to another applicable ANSI/UL Standard for their electrical safety prior to the enactment of this regulation are eligible for certification without further testing provided documentation of compliance with ANSI/UL Standard 507 or the relevant ANSI/UL Standard is submitted and the model continues to comply with requirements of that standard. To be certified under this regulation, manufacturers of such indoor air cleaning devices must submit the information required in Sections 94804(c)(1) through 94804(c)(3) below, and Sections 94804(c)(4)(A) and 94804(c)(4)(F) below. These products are still subject to the labeling requirements specified in Sections 94806(b) and 94806(d).

(c) The application for certification of air cleaning devices other than those covered in Section 94804(b) above must include the information in subsections (c)(1) through (c)(5) below, and any other information deemed necessary by the ARB Executive Officer. If the requested information is not applicable to the indoor air cleaning device in question, the applicant must indicate "not applicable". If the Executive Officer concurs with the applicant's judgment, the Executive Officer may waive the requirement to provide the information requested.

(1) Manufacturer name, mailing address, physical address, phone number, email address, and website, and name and phone number of the primary contact person for purposes of this certification;

(2) Applicant or representative name, mailing address, physical address, phone number, and email address, if different from manufacturer;

(3) Indoor air cleaning device information:

(A) Brand name
(B) Model name
(C) Model number
(D) Serial number of devices submitted for testing (where applicable)
(E) Manufacture date of devices submitted for testing
(F) Model group, and other models included in model group, where applicable
(G) Discussion of the principles of operation and design
(H) Device schematics depicting operation
(I) Maintenance requirements
(J) Operations manual, if available
(K) Marketing materials, if available

(4) Indoor air cleaning device test information:

(A) Test facility identification and proof of current Nationally Recognized Testing Laboratory (NRTL) accreditation
(B) Ozone emission concentrations for all units tested, as measured according to Section 94805, including both the 24-hour measurement as well as information regarding whether any transitory measurements exceeded 0.050 ppm
(C) Whether a device failed the ozone emission test for any reason during final certification testing, and if so, the reason (e.g., excess transitory excursions, motor failure during the test, device not received with packaging intact, electrical part overheated/unsafe to continue, etc.)
(D) Chain of custody of test device(s)
(E) Statement from the testing laboratory that the ozone emissions were determined in accordance with the protocols in the December 21, 2007 Revision of Section 37 of ANSI/UL Standard 867, and the associated Certification Requirement Decisions published by UL
(F) Notification by a testing laboratory or certification organization of compliance with the electrical safety provisions of ANSI/UL Standard 867, ~~or~~ ANSI/UL Standard 507, or other applicable ANSI/UL Standard, where applicable, for all units tested.

(5) Any additional information the laboratory needs to communicate.

(d) A written notification will be provided within 30 days of receipt indicating whether the certification application has been accepted for review or, if incomplete, what additional information is required. Within 30 days after application acceptance, written notification of certification approval or disapproval will be provided. These time periods may be extended by the Executive Officer if deemed necessary because of extenuating circumstances.

(e) Notification must be provided to the Executive Officer within 30 days if the indoor air cleaning device fails any post-certification testing conducted to verify compliance with ANSI/UL Standard 867 or ANSI/UL Standard 507, whichever is applicable.

(f) ARB may revoke certification for any device deemed noncompliant in the future when tested according to procedures described in Section 94805, or if any other ARB certification requirements are no longer met.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code; 21 C.F.R. § 801.415.

§ 94805. Test Method.

(a) For the purpose of compliance with this regulation only a single model of indoor air cleaning device within a model group, if one exists, must be evaluated under the test methods.

(b) Testing to determine compliance with the requirements of this article, shall be performed following the ANSI/UL Standard 867 or ANSI/UL Standard 507, whichever is applicable, in their entirety, which are hereby incorporated by reference as defined in Section 94801. Appliances with a primary purpose other than air cleaning that include an air cleaning component that meets the definition of an indoor air cleaning device given in Section 94801 shall meet the applicable ANSI/UL electrical safety standard for its primary purpose, including but not limited to ANSI/UL Standards 484 and 1278, which are hereby incorporated by reference as defined in Sections 94801(3c) and 94801(3d).

(c) Ozone emissions will be determined using Section 37 of ANSI/UL Standard 867 and the associated Certification Requirement Decisions, which are hereby incorporated by reference as defined in Section 94801.

(d) Testing of indoor air cleaning devices must be conducted by a laboratory currently recognized as an NRTL by the U. S. Occupational Safety and Health Administration (OSHA), to perform testing for the entire ANSI/UL Standard 867, ~~or~~ ANSI/UL Standard 507, or other UL or ANSI/UL Standard, ~~where~~ as applicable. If included within its scope of recognition, ~~S~~such an NRTL may also utilize OSHA Supplemental Programs #2, 3, 4, 5, and 6, as published in Volume 60, Federal Register, pages 12980 to 12985 (March 9, 1995), which is hereby incorporated by reference, for the ANSI/UL Standard 507, 867, or other ~~ozone testing~~electrical safety testing required in this regulation. ~~Laboratories, including those qualifying for use in OSHA Program #2, also must pass~~ However, the ANSI/UL Standard 867 Section 37 ozone testing required in this regulation may only be performed by an NRTL or an NRTL utilizing a Supplemental Program 2 testing laboratory that has passed an ARB audit to verify their ability to accurately perform the ozone emissions testing procedure as described in ANSI/UL Standard 867 Section 37. The ARB audit may include, and is not necessarily limited to, review of written test protocol operating procedures, test chamber and analyzer configuration, background ozone measurements, air exchange rate, ozone half-life test results, equipment calibration and maintenance records, and other related information; and an onsite review. The audit may also include a requirement for annual submittal of internal audit reports on the ANSI/UL Standard 867 Section 37 test protocol and the performance of the chamber(s) in which ANSI/UL Standard 867 Section 37 tests are conducted, and any related follow up internal audit reports.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code.

§ 94806. Labeling and Safety Mark Requirements.

(a) All indoor air cleaning devices are required to display an ozone emissions certification label [as defined in Section 94801(a)(16)] on the product packaging after completion of requirements of Section ~~95804~~94804 prior to sale in California, unless satisfying the requirements for exemption as specified in Section 94803. Indoor air cleaning devices submitted to an approved laboratory for certification testing within 12 months of the effective date of this regulation, but unable to obtain certification pursuant to Section 94804 by the end of the 18th month after the effective date of this regulation, shall be allowed an additional 180 days after the postmark date of notification of product certification by ARB to meet the labeling requirements of this section. Indoor air cleaning devices that have been certified by October 18, 2010 may still be sold without the required labeling on the package until October 18, 2011, and may use an adhesive label until October 1, 2012.

(b) For non-medical devices, the label shall be at least 1 inch by 2 inches in size, easily readable, and shall state "This air cleaner complies with the federal ozone emissions limit. ARB certified" in bold type whose uppercase letters are not less than 3 mm high.

(c) For medical devices, the label shall be in compliance with federal law, including Section 801.415 of Title 21 of the Code of Federal Regulations. The label shall also state "ARB certified".

(d) All indoor air cleaning devices (both medical and non-medical) are required to display the ANSI/UL Standard 867 safety certification or listing mark on the device, consistent with the ANSI/UL Standard 867 requirements of the appropriate NRTL safety certification organization, after completion of requirements of Sections 94804 and 94805 and prior to sale in California, unless the device satisfies the requirements for exemption as specified in Section 94803. Devices qualifying as "mechanical filtration only" devices as described in Section 94801(a)(20) and Section 94804(b) shall display the ANSI/UL Standard 507 certification mark.

(e) Any indoor air cleaning device for non-industrial use that is advertised or sold via the Internet or by catalog but that has not been certified according to Section 94804 must display the following advisory in a prominent place on the primary web pages, catalog pages, and related materials where such device is advertised or displayed for sale: "Does not meet California requirements; cannot be shipped to California."

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code; 21 C.F.R. §§ 801 and 801.415.

§ 94807. Notice to distributors, retailers, and sellers.

Within 12 months of the effective date of this regulation, manufacturers of indoor air cleaning devices manufactured, sold, supplied, offered for sale, or introduced into commerce in California must submit documentation that they have provided to all of their known distributors, retailers, and sellers true and accurate copies of the final regulation adopted by the ARB and filed with the California Secretary of State. Accepted documentation of a mailed notification will include a hard copy of the materials mailed and the associated mailing list with complete contact information for each address submitted to the ARB Executive Officer. Accepted documentation of an email notification will include a copy of the email and the complete contact information for each email address submitted to the ARB Executive Officer. Such information may be kept confidential upon request as specified in Sections 91000 et seq. of title 17, chapter 1, subchapter 4 (Disclosure of Records) of the California Code of Regulations. For new distributors, retailers and sellers who become known to manufacturers after manufacturers' initial notification to their distributors and retailers, manufacturers must provide similar notice to them and provide contact information to the ARB. Non-compliance with this provision may result in rejection or revocation of certification.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code; Sections 91000 et seq. of title 17, chapter 1, subchapter 4 of the California Code of Regulations.

§ 94808. Recordkeeping Requirements.

Manufacturers, distributors, retailers, sellers, and test laboratories are required to maintain production, quality control, sales, or testing records for products sold, supplied, offered for sale, introduced into commerce, or manufactured for sale within California for at least three years, and to make them available to the ARB upon request. Such information may be kept confidential upon request as specified in Sections 91000 et seq. of title 17, chapter 1, subchapter 4 (Disclosure of Records) of the California Code of Regulations.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code, Sections 91000 et seq. of title 17, chapter 1, subchapter 4 of the California Code of Regulations.

§ 94809. Rejection, Revocation, Recall, and Penalties.

An application for certification may be denied, or a certification may be revoked or suspended, for failure to comply with any provision of this article. If the Executive Officer determines that a violation of this article has occurred, he or she may order that the products involved in or affected by the violation be recalled and replaced with products that comply with this article. In the event of a violation of this article, all other penalties authorized by law apply as well.

NOTE: Authority cited: Sections 41986 and 42300 et seq., Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code.

§ 94810. Severability.

Each part of this article shall be deemed severable, and in the event that any part of this article is held to be invalid, the remainder of this article shall continue in full force and effect.

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 1985, 41985.5, and 41986, Health and Safety Code.

This page left intentionally blank.

APPENDIX III: CHAMBER SETUP CRD

July 8, 2009

This page left intentionally blank.

UNDERWRITERS LABORATORIES INC. CERTIFICATION REQUIREMENT DECISION

This Certification Requirement Decision is prepared and published by Underwriters Laboratories Inc. (UL). It is normative for the applicable UL Product Certification Program(s); however, it is currently not part of the UL Standard(s) referenced below.

Product Category (CCN): AGGZ, OETX
Standard Number: UL 867
Edition Date: October 9, 2000
Edition Number: 4
Section / Paragraph Reference: 37.2.3
Subject: Chamber Setup

DECISION:

37.2.3 Performance of the test chamber shall be verified prior to each test and after any modification or cleaning through:

a) Determination of the chamber ozone half-life at 0 forced air changes,

b) Calculation of the chamber deposition velocity under these conditions using the equation defined in 37.2.4,

c) Calculation of the air exchange rate necessary to maintain an overall chamber ozone removal rate (Napparent) value of 1.33 using the equation defined in 37.2.5,

d) Verification of the chamber ozone half-life of 31 ± 2 minutes under the air exchange rate calculated in c), and if necessary, adjustment of the air exchange rate to achieve an ozone half-life of 31 ± 2 minutes, repeating the verification as needed after adjustment of the air exchange rate.

The chamber ozone half-life is determined using an initial steady state concentration of 0.100 to 0.200 ppm ozone. For the purpose of this measurement, steady state is defined as a fluctuation not greater than ± 10 percent or 0.0020 ppm, whichever is greater, during a fifteen minute period.

Exception: If the chamber has initially demonstrated compliance with the requirements of steps a) through d), and with step d) in three or more consecutive tests over a two-day minimum timeframe, only step d) need be repeated immediately prior to the testing of each model. However, steps a) through d) and three or more consecutive step d) tests shall be repeated, at a minimum, bi-annually or after any chamber modification or maintenance activities.

RATIONALE FOR DECISION:

Steps a) through c) of paragraph 37.2.3 allow the test laboratory to easily dial in the necessary chamber air exchange rate based upon theoretical calculations. These steps are intended to assist laboratories during initial chamber setup and following routine maintenance, and are not considered necessary prior to individual test runs.

Additionally, if the laboratory can demonstrate a stable ozone half-life, via compliance with the standard specification over three or more consecutive tests, it can be assumed that the chamber will typically remain stable over the course of testing an air cleaner model at various settings and samples. Also, any significant change in chamber performance would become evident during the next ozone half-life test and would be corrected to meet the standard specifications. This CRD clarifies, under stable chamber conditions, only step d) as necessary between the testing of air cleaner models.

APPENDIX IV: STEADY STATE DEFINITION CRD

July 9, 2009

This page left intentionally blank.

UNDERWRITERS LABORATORIES INC. CERTIFICATION REQUIREMENT DECISION

This Certification Requirement Decision is prepared and published by Underwriters Laboratories Inc. (UL). It is normative for the applicable UL Product Certification Program(s); however, it is currently not part of the UL Standard(s) referenced below.

Product Category (CCN): AGGZ, OETX
Standard Number: UL 867
Edition Date: October 9, 2000
Edition Number: 4
Section / Paragraph Reference: 37.4.6
Subject: Definition of Steady State at Hours 7- 8

DECISION:

37.4.6 The emission of ozone is to be monitored for 24 hours to determine the concentration.

Exception: : The monitoring of ozone can be stopped after 8 hours if the measured chamber ozone concentration has reached steady-state. *For the purpose of this measurement steady state is defined as:*

a) Negative or zero slope for the plot of chamber ozone concentration vs. time ([C(t)] vs. t), during hour 7 to 8 of monitoring, and fluctuation not greater than ± 10 percent or 2 ppb around the mean, whichever is greater during the same time period.

b) Positive slope for the plot of chamber ozone concentration vs. time([C(t)] vs. t), during hour 7 to 8 of monitoring, mean ozone concentration less than 20 ppb, and fluctuation not greater than ± 2 ppb around the mean, during the same time period, or

c) Positive slope for the plot of chamber ozone concentration vs. time ([C(t)] vs. t), during hour 7 to 8 of monitoring, mean ozone concentration greater than or equal to 20 ppb and less than 38 ppb, a normalized slope (slope divided by hourly mean) for hour 7- 8 less than or equal to 0.0153 (ppb/hr)/mean ppb, and fluctuation not greater than ± 10 percent around the mean during the same time period.

RATIONALE FOR DECISION:

Throughout the ozone test development process, the steady state reference of paragraph 37.4.6 assumed steady state to be defined as: 1) no positive slope for the plot of concentration versus time for Hour 7 to 8, and 2) a fluctuation of less than 10% Relative Standard Deviation (RSD) during any 15 minute period for Hour 7 to 8.

In practice, however, the specified laboratory measurement precision (+ 2%) is such that it is inevitable that there will be random variation about the mean (i.e. some positive slope). Additionally, % RSD is equal to 100 x Standard Deviation / Mean, so it increases as the mean ozone level decreases. At low ozone concentrations, the ratio of standard deviation and mean may result in disproportionate increase in RSD. That could result in a very low-emitting device to failing to achieve steady state, leading to extended test times without any clear benefit.

This clarification establishes criteria for determining steady state that is consistent with the original intent, addresses the identified concerns and assures that variance about the mean will not result in a maximum ozone concentration that exceeds 0.050 ppm.

UL, in performing its functions in accordance with its objectives, does not guarantee or warrant the correctness of Certification Requirement Decisions it may issue or that they will be recognized or adopted by anyone. Certification Requirement Decisions are the opinion of Underwriters Laboratories Inc. in practically applying the requirements of the standard. They do not represent formal interpretations of the standard under American National Standards Institute (ANSI) processes. UL shall not be responsible to anyone for the use of or reliance upon Certification Requirement Decisions by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use or reliance upon Certification Requirement Decisions. The electronic version of the Certification Requirement Decision is the current version and previously printed copies may be outdated.

This document is published as a service to UL's certification customers

APPENDIX V: FILTER TEST ITERATIONS CRD

UL has not yet issued their final Filter Test Iterations Certification Requirement Decision (CRD), but is expected to do so soon. A copy will be posted on our website as soon as it is available. Assuming approval of the amendments by the Board in December, 2009, ARB will release the final CRD language for a 15-day public review and comment period early in 2010. Below is a summary of the refinements that this CRD is expected to make to the test protocol.

Currently, when a model of air cleaner to be tested under ANSI/UL Standard 867 comes with optional or alternate main and/or pre-filters, the Section 37 protocol would require several repeat chamber tests to be conducted to test most or all possible combinations of filters. This is so because filters can affect the ozone emissions of the device in some cases. If the air cleaner can be operated with its filters removed, a test with all filters removed also is required, since this would represent the operational condition that would likely result in the highest ozone emissions. For models with more than one or two filter combination options, all of the required tests together could take substantial time and increase the cost of testing a single device by several times the base cost

To clarify which filter combinations should be tested in cases where multiple filters are available for a given model of air cleaner, and to gain efficiencies in testing while not impacting the ability of the test protocol to identify any possible ozone emission exceedances above the allowable limit of 0.050 ppm, UL is developing a third 2009 CRD. It is expected that the CRD will retain the requirement for air cleaners to be tested with all filters removed when the device can be operated with filters removed, because that is likely the highest ozone-emitting operating condition. It also is expected that UL will indicate that the combination of filters considered least reactive to ozone be tested (because such a combination would result in the highest ozone emissions from that device when filters are in place.) Paper filters would generally be considered least reactive to ozone, with HEPA filters next, and then carbon filters considered most reactive to ozone. Filter coatings typically make filters more reactive to ozone, so UL would request an uncoated filter for testing, if available. If only coated filters are available, then all filter combination would be tested, because the relative levels of reactivity to ozone amongst coatings is not currently known.

For air cleaner models with several pre-filters and several main filters, then, the CRD would greatly reduce the number of repeated tests needed for most such air cleaners. Only a few models would be expected to require several repeat tests for multiple filter combinations. ARB staff has reviewed drafts of UL's anticipated CRD and are generally in agreement with their approach. UL is working on the final details of the CRD, and ARB staff will review it to assure it maintains adequate testing and assessment of each model, and is consistent with the regulation's intent.

PROPOSED RESOLUTION WITH 15-DAY MODIFICATIONS

State of California
AIR RESOURCES BOARD

Resolution 09-65

December 9, 2009

Agenda Item No.: 09-10-2

WHEREAS, sections 39600 and 39601 of the Health and Safety Code authorize the Air Resources Board (ARB or Board) to adopt standards, rules and regulations and to do such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, sections 41985 – 41986 of the Health and Safety Code direct ARB to regulate ozone emissions from indoor air cleaning devices sold in California;

WHEREAS, exposure to ozone continues to be a significant public health concern because ozone is a highly reactive molecule that can damage the lungs and airways. Ozone can inflame and irritate respiratory tissues, and can worsen asthma symptoms. It can cause coughing, chest tightness and impaired breathing. Exposure to elevated levels has the potential to induce permanent lung damage, and chronic exposure can increase the risk of premature death in persons with poor health. Some air purifiers emit levels of ozone several times the ambient air quality standard levels for healthful air;

WHEREAS, at the September 27, 2007 public hearing the Board adopted Resolution 07-40 in which the Board approved adoption of a regulation to limit ozone emissions from indoor air cleaning devices as detailed in sections 94800 through 94810, title 17, California Code of Regulations, including the incorporated test methods, American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL) Standard 867 (Fourth Edition, December 21, 2007) and ANSI/UL Standard 507 (Ninth Edition, September 27, 2007) for "mechanical filtration only" devices, and the Certification Requirement Decisions (CRDs) associated with Standard 867 and issued by UL on March 4, 2008, April 17, 2008, and April 18, 2008;

WHEREAS, at the September 27, 2007 public hearing the Board directed the Executive Officer to take final action to adopt the regulatory amendments and other conforming modifications considered by the Board, after making the changes available to the public for a period of at least 15 days and after considering any submitted public comments;

WHEREAS, after two 15-day public comment periods, the regulation was formally adopted by the Executive Officer on August 7, 2008. The final regulation order was subsequently submitted to the Office of Administrative Law, approved, and became effective October 18, 2008;

WHEREAS, the regulation requires that (1) any air cleaner sold in California for use in occupied spaces after October 18, 2010, must be tested and certified as having an emission concentration limit of not more than 0.050 ppm; (2) the air cleaner package must be labeled as being in compliance with the regulation also by October 18, 2010 (adhesive stickers may be used for an additional six months until April 1, 2011); and (3) manufacturers must, by October 18, 2009, notify all of their known distributors, retailers and sellers about the regulation and provide them with a copy of the regulation;

WHEREAS, the Board directed the staff in Resolution 07-40 to report to the Board one year into the certification period, on the status of the implementation of the regulation, including: the progress of the test laboratories in developing test capabilities for the 2007 revised Section 37 of ANSI/UL Standard 867; the number of manufacturers that have requested testing and submitted applications for certification; the number of air cleaning devices tested and certified by that time; and an assessment of testing laboratory capability and a recommendation regarding the need for further extension of the manufacturer effective date;

WHEREAS, two testing laboratories (UL and Intertek Testing Services) are currently approved by ARB to conduct testing, and as of September 30, 2009, a total of 94 air cleaner models from five manufacturers have been certified. Thirteen of these models required ozone testing and the remainder were "mechanical filtration only" devices that did not require ozone testing. In addition to the models already certified, six manufacturers have submitted 20 applications for 43 additional models that are being reviewed and are pending certification at this time;

WHEREAS, in early 2009 air cleaner manufacturers expressed concern that the weakened economy has slowed consumer demand for air cleaners, resulting in an increased number of unsold air cleaners in the distribution and retail inventories that may not be able to be sold by October 18, 2010;

WHEREAS, a public workshop was held on June 12, 2009 to obtain input from manufacturers and other stakeholders regarding the need for possible extensions and other amendments to the regulation, and additional concern was expressed by manufacturers regarding the availability of only one laboratory (UL) to conduct the ozone testing required in Section 37 of ANSI/UL Standard 867;

WHEREAS, Intertek Testing Services was approved to conduct that required ozone emission concentration test on July 2, 2009;

WHEREAS, the delay in certifying the second testing facility and the slowed economy may have contributed to a slow start in compliance testing and certification of air cleaners;

WHEREAS, ARB staff and the manufacturers who previously expressed concern have now determined that air cleaners intended for sale in California can comply with the emission concentration limit in the regulation and be certified by the October 18, 2010 compliance date, but some will not be properly labeled as required if they were shipped prior to the compliance date;

WHEREAS, in response to concerns over having sufficient time to change packaging to meet the labeling requirement, ARB staff are proposing to extend the deadline for package labeling of certified air cleaners for one year, to October 18, 2011, and to allow the use of adhesive certification labels (rather than printing on the package) for an additional 18 months beyond the original adhesive label compliance date, to October 1, 2012;

WHEREAS, four additional amendments have been identified by staff as necessary to improve the implementation of the regulation; the first amendment would incorporate three clarifications issued by UL for the ozone test protocol used by the air cleaner regulation. The clarifications (1) address specifications for test chamber set-up prior to running an ozone test; (2) revise the definition of "steady state" for the ozone test to avoid the situation where very low emitting air cleaners (that emit just a few parts per billion ozone) must go through a full 24-hour test rather than an 8-hour test as originally intended; and (3) specify filter testing when multiple types of filters are offered as alternate or optional filters with an air cleaner model;

WHEREAS, a second amendment identified as necessary by staff would increase the number of allowable testing facilities for electrical safety testing by allowing electrical safety testing of air cleaners to be conducted not just by Nationally Recognized Testing Laboratories (NRTLs), but also by facilities that meet the requirements of Supplemental Programs 2 through 6 of the federal Occupational Safety and Health Administration's NRTL recognition program. These test facilities are currently used by approved testing laboratories to conduct the ANSI/UL Standards 507 and 867 electrical safety tests;

WHEREAS, the third amendment identified by staff would allow alternate, applicable (UL) electrical safety testing for multi-function appliances that include an air cleaning component;

WHEREAS, the last amendment would refine the definition of "mechanical filtration only" in section 94801 of the regulation to include all pollutants (not just particles) by replacing the phrase "suspended particles" with "contaminants" in order to be fully consistent with other portions of the regulation;

WHEREAS, the Board has considered the impact of the proposed amendments on the economy of the State and the potential for adverse economic impacts on California business enterprises and individuals;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project which may have significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available to reduce or eliminate such impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with the provisions of Chapter 3.5 (commencing with section 11340), part 1, division 3, title 2 of the Government Code;

WHEREAS, in consideration of the Initial Statement of Reasons and written comments it has received, the Board finds that:

> The potential economic impacts of the proposed amendments have been analyzed as required by California law, and the conclusions and supporting documentation for this analysis are set forth in the Initial Statement or Reasons for this regulatory action;
>
> No reasonable alternative considered or that has otherwise been identified and brought to the attention of ARB would be more effective in carrying out the purpose for which the regulations are proposed, or be as effective and less burdensome to affected private persons and businesses than the proposed regulations; and
>
> The proposed amendments will not result in any significant adverse environmental impacts.

WHEREAS, the Board further finds that:

> The proposed amendments will provide manufacturers with the necessary time to comply with the requirements of the regulation, in part made necessary by the delay in certifying a second testing facility and the slowing economy;
>
> The additional amendments provide for the proper level and type of testing according to the ANSI/UL Standards in the regulation.

NOW, THEREFORE, BE IT RESOLVED that the Board affirms the original intent of the regulation to reduce public exposure to ozone emitted by certain types of air cleaners, and notes that ozone is a highly reactive molecule that can, among other effects, seriously damage the lungs and airways and worsen asthma symptoms;

BE IT FURTHER RESOLVED that the Board hereby approves the adoption of amendments to sections 94801, 94804, 94805, and 94806, title 17, California Code of Regulations, as set forth in Attachment A hereto, with the proposed modifications set forth in Attachment B hereto.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to take final action to adopt the amended sections set forth in Attachment A, with the proposed modifications set forth in Attachment B hereto, and such other conforming modifications as may be appropriate, after making the modified regulatory language and any additional supporting documents and information available for public comment for a period of 15 days, provided that the Executive Officer shall consider such written comments regarding the modification and additional supporting documents and information as may be submitted during this period, shall make modifications as may be appropriate in light of the comments received, and shall present the regulations to the Board for further consideration if he determines that this is warranted.

Resolution 09-65

December 9, 2009

Identification of Attachments to Board Resolution 09-65

Attachment A: Proposed Regulation Order for the Regulation for Limiting Ozone Emissions from Indoor Air Cleaning Devices," as set forth in Appendix II to the Initial Statement of Reasons, released October 23, 2009.

Attachment B: Staff's Suggested Modifications to the Original Proposal, presented at the December 9, 2009 public hearing.

ATTACHMENT B TO RESOLUTION 09-65

PUBLIC HEARING TO CONSIDER PROPOSED AMENDMENTS TO THE REGULATION FOR LIMITING OZONE EMISSIONS FROM INDOOR AIR CLEANING DEVICES

STAFF SUGGESTED MODIFICATIONS
PRESENTED AT THE DECEMBER 9, 2009 HEARING
OF THE AIR RESOURCES BOARD

Note: *This document contains staff's suggested modifications to the originally proposed regulatory text set forth in Appendix II to the Staff Report: Initial Statement of Reasons, released on October 23, 2009. The originally proposed language is shown in ~~strikeout~~ to indicate proposed deletions and underline to indicate proposed additions. The proposed modifications to the originally proposed language are shown in ~~double strikethrough~~ to indicate proposed deletions and "italics" to indicate proposed additions. The text of all proposed modifications will be made available to the public for a comment period of at least 15 days.*

§ 94801. Definitions.

(a) For the purpose of this article, the following definitions apply:

......

(3b) "ANSI/UL Standard 867" means the version of ANSI/UL Standard 867 for Electrostatic Air Cleaners, Fourth Edition, published on December 21, 2007 by Underwriters Laboratories, Inc. (UL), and the associated Certification Requirement Decisions published by UL on March 4, 2008; April 17, 2008; ~~and~~ April 18, 2008; July 8, 2009; July 9, 2009; and (*date to be determined*), 2009.

(3c) "ANSI/UL Standard 484" means the version of *the ANSI/*UL~~'s~~ Standard for *Safety for* Room Air Conditioners, *Eighth* ~~8th~~ Edition, ~~published~~ *dated* December 21, 2007 *with revisions through March 27, 2009*, and most recently approved by ANSI on March ~~26~~ *27*, 2009.

(3d) "ANSI/UL Standard 1278" means the version of *the ANSI/*UL~~'s~~ Standard for *Safety for* Movable and Wall- or Ceiling-Hung Electric Room Heaters, *Third* ~~3rd~~ Edition, ~~published~~ *dated* June 21, 2000 *with revisions through July 30, 2008*, and most recently approved by ANSI on July 30, 2008.

(3e) "ANSI/UL Standard 1017" means the version of the ANSI/UL Standard for Safety for Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines, Seventh Edition, dated December 7, 2001 with revisions through June 15, 2006, and most recently approved by ANSI on June 15, 2006.

(3f) "ANSI/UL Standard 1993" means the version of the ANSI/UL Standard for Safety for Self-Ballasted Lamps and Lamp Adapters, Third Edition, dated August 28, 2009.

...

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code; 21 C.F.R. § 801.415; 29 C.F.R. § 1910.7; and 21 U.S.C. § 321.

...

§ 94805. Test Method.

(b) Testing to determine compliance with the requirements of this article, shall be performed following the ANSI/UL Standard 867 or ANSI/UL Standard 507, whichever is applicable, in their entirety, which are hereby incorporated by reference as defined in Section 94801. Appliances with a primary purpose other than air cleaning that include an air cleaning component that meets the definition of an indoor air cleaning device given in Section 94801 shall meet the applicable ANSI/UL electrical safety standard for its primary purpose, including but not limited to ANSI/UL Standards 484*, 1017,* ~~and~~ 1278, *and 1993,* which are hereby incorporated by reference as defined in Sections 94801*(a)*(3c)*, 94801(a)(3e),* ~~and~~ 94801*(a)*(3d)*, and 94801(a)(3f), respectively.*

...

NOTE: Authority cited: Section 41986, Health and Safety Code. Reference: Sections 41985, 41985.5, and 41986, Health and Safety Code.

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO UPDATE THE BOARD ON THE TRUCK AND BUS REGULATON AND THE IN-USE OFF-ROAD DIESEL-FUELED FLEET REGULATION

The Air Resources Board (ARB or Board) will conduct a public meeting at the time and place noted below to hear an update on the multiple topics identified below that the Board directed staff to report on at its December 12, 2008, and July 23, 2009, Board hearings.

DATE: December 9-10, 2009

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item will be heard at a two-day meeting of the Board, which will commence at 9:00 a.m., December 9, 2009, and will continue at 8:30 a.m., on December 10, 2009. This item may not be considered until December 10, 2009. Please consult the agenda for the meeting, which will be available at least 10 days before December 9, 2009, to determine the day on which this item will be considered.

On December 12, 2008, the Board approved a regulation to reduce emissions of diesel particulate matter (diesel PM), oxides of nitrogen (NOx), and greenhouse gases from in-use diesel trucks and buses that operate in California. This regulation is commonly referred to as the Truck and Bus regulation. The Truck and Bus regulation establishes requirements for in-state and out-of-state motor carriers, California-based brokers, vehicle owner operators, and any California resident who hires or dispatches vehicles subject to the regulation.

The Board approved the Truck and Bus regulation for adoption in Resolution 08-43 and directed staff to return to the Board in December 2009 to update the Board on the status of implementation of the regulation, including:

- Monitoring the state of the economy and its impact on the trucking industry and affected vehicle emissions;
- The ability of the school bus transportation industry to comply with the regulation, whether compliance will possibly affect school district decisions to reduce or eliminate school transportation services, and the availability and use of public incentive funding for district-owned and private school bus fleets;

- Availability of financing for trucking fleet owners affected by the regulation and the results of staff's efforts to fund projects;
- Health risk analysis of diesel particulate matter emissions associated with the agriculture vehicle provisions of the regulation.

The In-Use Off-Road Diesel-Fueled Fleet Regulation which became operative on June 15, 2008. The Board subsequently approved amendments to the regulation on December 12, 2008, January 22, 2009, and July 23, 2009. In approving the July 23, 2009 amendments in Resolution 09-50, the Board directed staff to report back in December 2009 on:

- A summary of available data regarding in-use off-road vehicle fleet activity.

After staff presents the update at the December 9-10, 2009 hearing, the Board may direct staff to return to the Board with proposed modifications to these regulations.

Interested members of the public may also present comments orally or in writing at the meeting, and comments may be submitted by postal mail or by electronic submittal before the meeting. To be considered by the Board, written comments or submissions not physically submitted at the meeting must be received **no later than 12:00 noon, December 8, 2009,** and addressed to the following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Please note that under the California Public Records Act (Government Code section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

To request a special accommodation or language needs for any of the following:

- An interpreter to be available at the hearing.
- Have documents available in an alternate format (i.e. Braille, large print) or another language.
- A disability-related reasonable accommodation.

Please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled Board hearing. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

Para solicitar alguna comodidade especial o si por su idioma necesita cualquiera de los siguientes:

- Un intérprete que esté disponible en la audiencia.
- Documentos disponibles en un formato alternativo (es decir, sistema Braille, letra grande) u otro idioma.
- Una acomodación razonable relacionados con una incapacidad.

Porfavor llame a la officina del Consejo a (916) 322-5594 o envie un fax a (916) 322-3928 lo mas pronto possible, pero no menos de 10 dias de trabajo antes del el dia programado para la audencia del Consejo. TTY/TDD/ Personas que nesessitan este servicion pueden marcar el 711 para el Servicio de Retransmisión de Mensajes de California.

The Board requests, but does not require 20 copies of any written submission. Also, ARB requests that written and e-mail statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment.

Further inquiries regarding this matter should be directed Tony Brasil, Chief, Heavy-Duty Diesel Implementation Branch, (916) 323-2927, or Warren Hawkins, Manager, In-Use Control Measures Section, (916) 445-6017.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: November 25, 2009

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.arb.ca.gov.

TITLE 17. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER THE ADOPTION OF A PROPOSED REGULATION FOR THE MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES

The Air Resources Board (ARB or Board) will conduct a public hearing at the time and place noted below to consider adoption of a proposed regulation for the management of high global warming potential refrigerants for stationary sources.

DATE: December 9, 2009

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m. on December 9, 2009, and may continue at 8:30 a.m., on December 10, 2009. Please consult the agenda for the meeting, which will be available at least ten days before December 9, 2009, to determine the day on which this item will be considered.

If you require special accommodations or language needs, please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, <u>but no later than 10 business days before the scheduled Board hearing</u>. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

<u>INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW</u>

Sections Affected: Proposed adoption of new subarticle 6, sections 95380, 95381, 95382, 95383, 95384, 95385, 95386, 95387, 95388, 95389, 95390, 95391, 95392, 95393, 95394, 95395, 95396, and 95397 of subchapter 10, article 4, title 17, California Code of Regulations (CCR).

Background:
The California Global Warming Solutions Act of 2006 (Assembly Bill 32 (AB 32); Stats. 2006, Chapter 488) created a comprehensive, multi-year program to reduce greenhouse gas (GHG) emissions in California. ARB staff is proposing a regulation that would reduce GHG emissions associated with stationary, non-residential refrigeration equipment and resulting from the installation and servicing of refrigeration and air-conditioning (R/AC) appliances.

While not a discrete sector of the California economy, the high-GWP GHG sector consists of a broad range of sources that emit gases that have hundreds to thousands of times the climate impact as carbon dioxide (CO_2). High-GWP refrigerants serve an important purpose as refrigerants in stationary heating, ventilation, and air conditioning (HVAC), mobile vehicle air conditioning (MVAC), and refrigeration. High-GWP gases are also used as foam-blowing agents, in electrical transmission, as fire suppressants, in consumer products, and in the semiconductor industry.

For the purposes of the proposed regulation, high-GWP refrigerants include: 1) any refrigerant with a global warming potential value equal to or greater than 150, or 2) any refrigerant that is an ozone depleting substance (ODS). High-GWP refrigerants include chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), hydrofluorocarbons (HFC) and perfluorocarbons (PFC). CFC and HCFC are classes of ODS. Hydrofluorocarbon refrigerants are non-ozone depleting substitutes for ODS refrigerants. PFC are also non-ozone depleting compounds and may be in use in industrial refrigeration applications. Generally, all of these classes of chemicals have very high global warming potentials, with potencies in the range of 500 to 10,000 times greater than that of CO_2.

The proposed regulation focuses on the largest source of emissions from the high-GWP sector – large commercial refrigeration systems, which have extensive GHG emission potential. Refrigeration systems are a primary source of emissions from the stationary source high-GWP GHG sector; the United States Environmental Protection Agency (U.S. EPA) estimates that 37 percent of the stationary refrigeration and air-conditioning related emissions of high-GWP gases are from stationary, large commercial refrigeration systems.

Of all refrigeration systems using more than 50 pounds of a high-GWP refrigerant that were reported to the South Coast Air Quality Management District (SCAQMD) under their Rule 1415, on average, 29 percent leak annually. These leaking refrigeration systems lost, on average, 65 percent of their refrigerant charge annually. In many cases owners and operators of refrigeration systems can benefit financially from using the refrigerant best management practices required by the proposed regulation, because these systems would ultimately consume less refrigerant.

As a result of the Montreal Protocol's phaseout of ODS, these gases have typically been replaced with ODS substitutes such as hydrofluorocarbons (HFC) and perfluorocarbons (PFC). For example, HFC blends with higher GWPs are currently being used to replace HCFC-22 as a refrigerant. While ODS have negative impacts for both climate change and stratospheric ozone, ODS substitutes do not deplete the ozone but are typically potent GHG.

The majority of ODS substitutes are Kyoto gases and are thus included in the California AB 32 GHG inventory. Emissions of Kyoto Protocol gases are increasing as ODS are phased out and are replaced by ODS substitutes. In total, the high-GWP sector, based on an average 2002 -2004 emissions inventory, is estimated to represent approximately three percent of the statewide anthropogenic GHG inventory. However, the sector is growing rapidly primarily due to the increased use of ODS substitutes. Under a business-as-usual scenario high-GWP gases are expected to be the fastest growing GHG sector in the California GHG inventory and are anticipated to more than triple to reach over 46 $MMTCO_2E$ by 2020 – 8 percent of the total estimated California GHG inventory.

The low cost of many high-GWP refrigerants, as well as a lack of incentives for emission control, have resulted in the common practice of re-charging leaky, poorly designed, and/or poorly maintained systems without attempting repair. Although ODS refrigerant prices are expected to rise as they are phased out of production, currently low costs and the lack of enforced regulations limiting releases have led to low recovery and reclamation rates for many high-GWP refrigerants. As a result, refrigerant venting occurs during maintenance or end-of-life disposal. In sum, the Refrigerant Management Program's leak detection and monitoring, leak repair, and retrofit and retirement components offer an integrated strategy for achieving significant reductions from the commercial refrigeration sector.

DESCRIPTION OF THE PROPOSED REGULATORY ACTION

The proposed regulation is designed to: 1) reduce emissions of high-GWP refrigerants from stationary, non-residential refrigeration equipment, 2) reduce emissions resulting from the installation and servicing of refrigeration and air-conditioning (R/AC) appliances using high-GWP refrigerants, and 3) verify emission reductions.

The proposed regulation applies to: 1) any person who owns or operates a stationary refrigeration system that uses more than 50 pounds of a high-GWP refrigerant; 2) any person who installs, repairs, maintains, services, replaces, recycles, or disposes of a R/AC appliance; and 3) any person who distributes or reclaims high-GWP refrigerants.

The proposed regulation specifies: 1) stationary refrigeration refrigerant management practices, 2) R/AC appliance required service practices, and 3) refrigerant distributor, wholesaler, and reclaimer requirements.

Stationary Refrigeration Refrigerant Management Practices

The proposed stationary refrigeration management practices apply to any refrigeration system that uses more than 50 pounds of a high-GWP refrigerant. The applicable requirements vary based on the amount of high-GWP refrigerant used by a refrigeration system, known as the refrigerant charge size. Refrigeration systems are categorized based on the refrigerant charge size as a large refrigeration system, medium refrigeration system, or small refrigeration system.

All facilities with a refrigeration system with a refrigerant charge size greater than 50 pounds will be required to register, with the initial registration due date based on the refrigeration system with the largest refrigerant charge size in operation at a facility. Facilities with a refrigeration system in operation with a refrigerant charge of 200 pounds or greater will be also required to pay an annual implementation fee at the time of registration, which is also based on the refrigeration system with the largest refrigerant charge size in operation at a facility.

All owners or operators of facilities with a refrigeration system(s) in operation with a refrigerant charge size greater than 50 pounds will be required to comply with refrigerant leak detection and monitoring, refrigerant leak repair, and refrigeration system retrofit or retirement requirements.

Under the proposed regulation, owners or operators of facilities with a refrigeration system(s) in operation with a refrigerant charge size greater than 50 pounds will be subject to recordkeeping and reporting requirements. Requirements include maintaining records on refrigeration system service and leak repair and refrigerant purchase and use. Owners or operators of facilities with a refrigeration system(s) in operation with a refrigerant charge of 200 pounds or greater will be required to annually report this information to ARB.

Refrigeration and Air-Conditioning Appliance Required Service Practices

The proposed regulation includes required service practices that apply to any person installing, maintaining, servicing, repairing, modifying, or disposing of a R/AC appliance that uses a high-GWP refrigerant.

The majority of required service practices are based on rules promulgated by the United States Environmental Protection Agency (U.S. EPA) under the federal Clean Air Act (CAA). These rules forbid intentional venting and require refrigerant recovery using approved equipment and procedures and refrigerant evacuation. These existing federal requirements currently apply only to ODS refrigerants, except for the prohibition on intentional venting, which is applicable to ODS substitute refrigerants. The proposed regulation would extend these requirements to all high-GWP refrigerants. Required service practices not based on existing rules promulgated by U.S. EPA include restrictions on adding refrigerant to a R/AC appliance, use of approved refrigerants, and refrigerant recovery from refrigerant cylinders.

Refrigerant Distributor, Wholesaler, and Reclaimer Requirements

The proposed regulation includes prohibitions that are based on rules promulgated by U.S. EPA that apply to refrigerant distributors, wholesalers, and reclaimers. These existing federal requirements currently apply only to ODS refrigerants; the proposed regulation would extend the requirements to all high-GWP refrigerants. Prohibitions not based on existing rules promulgated by U.S. EPA include sale of only approved refrigerants and refrigerant recovery from refrigerant cylinders.

Under the proposed regulation, refrigerant distributors, wholesalers, and reclaimers will be subject to recordkeeping and reporting requirements. Requirements include maintaining records of high-GWP refrigerant purchases, sales, shipments, and reclamation for refrigerant reclaimers. Refrigerant distributors, wholesalers, and reclaimers will also be required to annually report this information to ARB.

EMISSION REDUCTIONS

Staff estimates that implementation of the proposed regulation would reduce emissions of Kyoto gases by 7.1 million metric tonnes of carbon dioxide equivalent ($MMTCO_2E$) annually by 2020. In addition, this regulation is anticipated to reduce emissions of ozone-depleting substances by an additional 0.9 $MMTCO_2E$ annually by 2020, as compared to business as usual.

COMPARABLE FEDERAL REGULATIONS

A primary goal in the development of the proposed regulation is to ensure that its requirements are consistent with existing rules applicable to ODS refrigerants in U.S. EPA regulations (Code of Federal Regulations, Title 40, Part 82, Subpart F) and the SCAQMD regulations (Rule 1415). The proposed regulation builds on the existing rules and expands their applicability to include all high-GWP refrigerants.

The management of refrigerants is currently covered by rules promulgated by U.S. EPA under the federal CAA. Section 608 of the CAA includes requirements applicable to refrigerant use during stationary heating, ventilation, and air conditioning (HVAC) servicing, while Section 609 includes requirements specific to refrigerant use during mobile vehicle air conditioning (MVAC) servicing. These sections were included in the CAA in order to address stratospheric ozone depletion from ODS.

Section 608 of the CAA specifies required service practices that maximize the recycling of ODS during the service of stationary HVAC systems. Section 608 includes requirements specific to venting, approved equipment, technician training and certification, recordkeeping, certification requirements, and sales restrictions.

Section 609 of the CAA is similar to Section 608, but is specific to management of refrigerants while maintaining, servicing, repairing, or disposing of MVAC systems. Section 609 includes requirements specific to venting, evacuation, reclamation, equipment certification, refrigerant leaks, technician certification, sales restrictions, certification by owners of recycling and recovery equipment, reclaimer certification, safe disposal, and recordkeeping.

Final rules promulgated by U.S. EPA under section 608 of the CAA were published on May 14, 1993 (58 Federal Register (FR) 28660) and establish a recycling program for ozone-depleting refrigerants recovered during the servicing and maintenance of R/AC appliances. Together with the prohibition on venting during the maintenance, service, repair, and disposal of class I and class II ODS (January 22, 1991; 56 FR 2420), these rules were intended to substantially reduce the production and emissions of ozone-depleting refrigerants. The final rule on venting and sales of refrigerant substitutes (March 12, 2004; 69 FR 11946) sustained the prohibition against venting HFC and PFC refrigerants.

Federal rules specific to refrigerant cylinder management are based on the CAA and U.S. Department of Transportation (DOT) cylinder specifications. The CAA prohibits the sale of ODS refrigerants, except to a U.S. EPA certified technician or the employer of a certified technician. DOT regulations applicable to refrigerant management include: 1)

Title 49: Transportation, Part 173, Shippers, General Requirements of Shipments and Packaging; and 2) Title 49, Transportation, Part 178, Specifications for Packagings, Subpart C, Specifications for Cylinders. These regulations outline requirements specific to cylinder type, size, service pressure, test pressure, size limitation, maximum water capacity, pressure of contents, material (steel or aluminum), and markings.

Similar to U.S. EPA's requirements under Section 608 of the CAA, the SCAQMD has adopted Rule 1415 which is aimed at reducing emissions of ozone-depleting refrigerants from stationary R/AC systems. The Rule 1415 requires any person within SCAQMD's jurisdiction, who owns or operates a refrigeration or air-conditioning system, to minimize refrigerant emissions. A refrigeration system is defined for the purposes of the rule as any non-vehicular equipment used for cooling or freezing which holds more than 50 pounds of any combination of Class I and/or Class II refrigerant, including, but not limited to, refrigerators, freezers, or air-conditioning equipment or systems. Equipment found to be leaking any ODS refrigerant must be repaired within 14 days.

Rule 1415 requires biennial reporting from owners and operators of stationary R/AC systems holding more than 50 pounds of an ozone-depleting refrigerant. Specific information to be collected includes: number of R/AC systems in operation; type of refrigerant in each refrigeration system; amount of refrigerant in each R/AC system; date of the last annual audit or maintenance performed for each R/AC system; and the amount of additional refrigerant charged to each R/AC system every year.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

The Board staff has prepared a Staff Report – Initial Statement of Reasons (ISOR) - for the proposed regulatory action, which includes a summary of the economic and environmental impacts of the proposal. The report is entitled "Initial Statement of Reasons for Adoption of a Proposed Regulation for the Management of High Global Warming Potential Refrigerants for Stationary Sources." The Executive Summary provides an overview of the proposed regulation.

Copies of the ISOR and the full text of the proposed regulatory language may be accessed on the ARB's website listed below, or may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, First Floor, Sacramento, California 95814, (916) 322-2990, at least 45 days prior to the scheduled hearing on December 9, 2009.

Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons identified in this notice, or may be accessed on ARB's website listed below.

Inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons: Pamela Gupta, Manager of the Greenhouse Gas Reduction Strategy Section, at (916) 327-0604 or Chuck Seidler, Air Pollution Specialist, at (916) 327-8493.

Further, the agency representative and designated back-up contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Lori Andreoni, Manager, Board Administration and Regulatory Coordination Unit, (916) 322-4011, or Amy Whiting, Regulations Coordinator, (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR, when completed, are available on ARB's website for this rulemaking at www.arb.ca.gov/regact/2009/gwprmp09/gwprmp09.htm

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the cost or savings necessarily incurred in reasonable compliance with the proposed regulatory action are presented below.

The ARB's Executive Officer has determined that the proposed regulatory action would impose a mandate on State and local agencies and would create costs, as defined in Government Code section 11346.5(a)(6), to state and local agencies. Any such costs should be minimal, and affected State and local agencies should be able to absorb these costs within existing budgets and resources. Because the requirements imposed by the regulation are generally applicable to all entities subject to the regulation, the proposed regulatory action imposes no costs on local agencies that are required to be reimbursed by the State pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, and does not impose a mandate on local agencies that is required to be reimbursed pursuant to Section 6 of Article XIII B of the California Constitution.

The Executive Officer has also determined that the proposed regulation will not create costs or savings in federal funding to the State, costs or mandate to any school district whether or not reimbursable by the State pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code. The proposed regulation may create non-discretionary savings for some State or local agencies because reduced refrigerant leaks will translate into less refrigerant being purchased, resulting in an overall cost savings.

The Executive Officer has determined that the proposed regulatory action would create a total potential cost impact to the ARB (including cost of agreements with local air districts to help enforce the regulation) of $ 0.4 million starting in fiscal year 2010-11, an additional $0.7 million starting in fiscal year 2012-13, and an additional $1.2 million starting in fiscal year 2014-15 to reach a total of $2.3 million in fiscal year 2014-15 and each year thereafter. The annual implementation fees specified in the regulation are set to ensure that anticipated expenses equal anticipated revenue derived from the fees.

The costs of the program are associated with new ARB staff positions as well as funds for fee-for-service agreements with local air districts for administration and enforcement activities. ARB staff has conducted a preliminary survey of air districts to determine how each air district is likely to participate in the Refrigerant Management Program. Air districts representing approximately 94 percent of the State's population responded that they are likely to enforce the regulation within their jurisdictions.

In developing this regulatory proposal, ARB staff evaluated the potential economic impacts on representative private persons or businesses and has estimated that this regulation would primarily affect approximately 26,000 facilities that use stationary refrigeration systems. Approximately 12,000 additional businesses may be impacted in the industries of refrigeration and air-conditioning maintenance and service, and refrigerant distribution, wholesale, and reclamation.

It is estimated that the proposed regulation will impact the affected facilities at a total gross cost, on average, of $49.0 million per year, based on estimated 2020 costs in terms of 2008 dollars. However, cost savings are expected to be $68.1 million per year for a net total savings of $19.1 million per year. These savings would result because reduced leaks translate into less refrigerant being purchased, and the reduced refrigerant cost would more than offset the cost of compliance. Estimated average cost to refrigeration and air-conditioning maintenance and service contractors and refrigerant distributors, wholesalers, and reclaimers is anticipated to be a total of $0.2 million per year.

The Executive Officer has made an initial determination that the proposed regulatory action would not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action would not negatively affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. A detailed assessment of the economic impacts of the proposed regulatory action can be found in the ISOR.

The proposed regulation requires that all refrigerant leak repairs be performed by a U.S. EPA certified technician. Industry stakeholders have stated that there is currently a limited number of certified technicians, so the proposed regulation may have a positive business creation impact by creating greater demand for businesses and employment that requires U.S. EPA certified technicians.

The Executive Officer has also determined, pursuant to title 1, CCR, section 4, that the proposed regulatory action will affect small businesses.

In accordance with Government Code sections 11346.3(c) and 11346.5(a)(11), the Executive Officer has found that the reporting requirements of the regulation which apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

Before taking final action on the proposed regulatory action, the Board must determine that no reasonable alternative considered by the Board, or that has otherwise been identified and brought to the attention of the Board, would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

Interested members of the public may also present comments orally or in writing at the meeting and may be submitted by postal mail or by electronic submittal before the meeting. To be considered by the Board, written comments, not physically submitted at the meeting, must be received **no later than 12:00 noon, December 8, 2009,** and addressed to the following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Please note that under the California Public Records Act (Government Code section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

The Board requests but does not require that 20 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The board encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under the authority granted in Health and Safety Code, sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. This action is proposed to implement, interpret, and make specific sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, title 2, division 3, part 1, chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with non substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text, with the modifications clearly indicated, will be made available to the public, for written comment, at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, First Floor, Sacramento, California 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: October 13, 2009

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs see our website at www.arb.ca.gov.

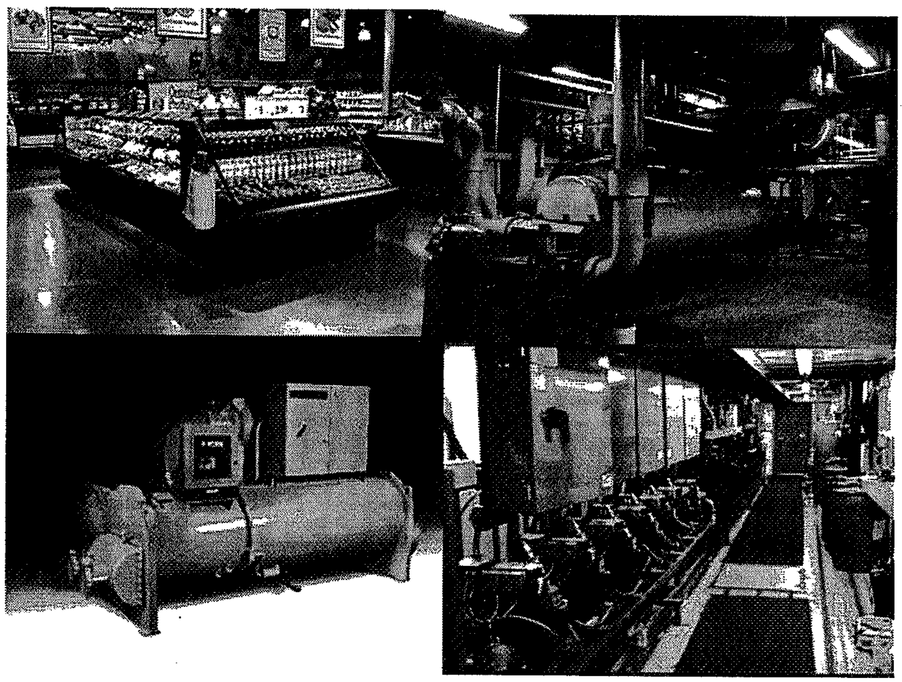
STATE OF CALIFORNIA

California Environmental Protection Agency

Air Resources Board

INITIAL STATEMENT OF REASONS FOR PROPOSED REGULATION FOR

THE MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES



Research Division

Release Date

October 23, 2009

This page is intentionally left blank

State of California
AIR RESOURCES BOARD

INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

ADOPTION OF THE PROPOSED REGULATION FOR THE MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES

To be considered by the California Air Resources Board
On December 9-10, 2009

at

Cal/EPA Headquarters
1001 I Street
Sacramento, California

Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

This page is intentionally left blank

State of California
AIR RESOURCES BOARD

PROPOSED REGULATION FOR THE MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES

Prepared by:

Research Division
California Air Resources Board

Lead Authors

Chuck Seidler
Brooke Baythavong
Glenn Gallagher
Ken Bowers

Reviewed by:

Pamela Gupta, Manager, Greenhouse Gas Reduction Strategy Section
Anthony Andreoni, Chief, Research and Economic Studies Branch
Richard Corey, Assistant Chief, Research Division
Bart Croes, Chief, Research Division
Mike Scheible, Deputy Executive Officer, Executive Office

October 23, 2009

This page is intentionally left blank

ACKNOWLEDGEMENTS

We wish to acknowledge the assistance and cooperation we received from many individuals and organizations. In particular we would like to thank representatives of:

- Air Conditioning, Heating and Refrigeration Institute
- Airgas
- Alliance for Responsible Atmospheric Policy
- Arkema Inc.
- California Air Pollution Control Officers Association, Climate Protection Committee
- California Citrus Growers Association
- California Energy Commission
- California Grocers Association
- California Retailers Association
- California Small Business Association
- Carrier Corporation
- E. I. du Pont de Nemours and Company (DuPont)
- Environmental Defense Fund
- Governor's Office of Planning and Research, Office of the Small Business Ombudsman
- Greenpeace
- Heating, Air Conditioning & Refrigeration Distributors International
- Honeywell International Inc.
- Hudson Technologies
- Hussman Company
- Ingersoll-Rand Company
- Kroger
- Lennox International Inc.
- Natural Resources Defense Council
- Raleys Company
- Safeway Inc.
- Small Business California
- South Coast Air Quality Management District
- SuperValu Inc.
- Trane Inc.
- University of California, Davis
- U.S. Environmental Protection Agency
- Wal-Mart Stores, Inc

We also thank Jeff Cohen, previously of the U.S. Environmental Protection Agency; ARB staff members Terone Preston, Judy Lewis, and Mark Stover of the Enforcement Division and Karin Donhowe of the Office of Climate Change; prior Research Division staff Bill Dean, Whitney Leeman, and Yachun Chow; and the program's prior student assistant Satapana Buthken for their assistance on the development of this regulation.

DISCLAIMER

This page is intentionally left blank

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

A. Proposed Refrigerant Management Program Regulation
B. California Facilities and Greenhouse Gas Emissions Inventory
C. Economic Impact Estimates
D. Summary of the Public Process in Development of the High-Global Warming Potential Stationary Source Refrigerant Management Program
E. South Coast Air Quality Management District Rule 1415
F. Code of Federal Regulations, Title 40, Part 82, Subpart F – Recycling and Emissions Reductions

ABBREVIATIONS AND ACRONYMS

AB 32	Assembly Bill 32, California Global Warming Solutions Act of 2006
Air District	Air Quality Management District or Air Pollution Control District
AC	Air Conditioning
APA	Administrative Procedures Act
APCO	Air Pollution Control Officer
ARB	Air Resources Board
AHRI	Air-Conditioning, Heating and Refrigeration Institute
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BAU	Business-As-Usual
Btu	British Thermal Units
CAAA	Clean Air Act and its Amendments
CAPCOA	California Air Pollution Control Officers Association
CAR	Climate Action Reserve
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CO_2E	Carbon Dioxide Equivalents
CEC	California Energy Commission
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
DX	Direct Expansion (Refrigeration Systems)
CO_2	Carbon Dioxide
EOL	End-of-life
EU	European Union
F-Gas	Fluorinated Gas
FR	Federal Register
GHG	Greenhouse Gas or Greenhouse Gases
GWP	Global Warming Potential
HARDI	Heating, Air Conditioning & Refrigeration Distributors International

HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HVAC	Heating, Ventilation, and Air Conditioning
ICLEI	International Council for Local Environmental Initiatives
IPCC	Intergovernmental Panel on Climate Change
ISOR	Initial Statement of Reasons
LCCP	Life Cycle Climate Performance
$MTCO_2E$	Metric Tonnes of Carbon Dioxide Equivalent
$MMTCO_2E$	Million Metric Tonnes of Carbon Dioxide Equivalent
MVAC	Motor Vehicle Air Conditioning
NAICS	North American Industry Classification System
ODS	Ozone Depleting Substance
PFC	Perfluorocarbon
ppm	parts per million
R/AC	Refrigeration or Air Conditioning or Refrigeration and Air Conditioning
SCAQMD	South Coast Air Quality Management District
SNAP	U.S. EPA Significant New Alternatives Policy
SIC	Standard Industrial Classification
TEAP	Technology and Economic Assessment Panel
UNFCC	United Nations Framework Convention on Climate Change
U.S. EPA	U.S. Environmental Protection Agency
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY

I. Introduction

This report presents the California Air Resources Board (ARB) staff's proposed regulation for the management of high global warming (GWP) potential refrigerants from stationary sources (Regulation), which is generally referred to as the Refrigerant Management Program to 1) reduce emissions of high-GWP refrigerants from leaky stationary, non-residential refrigeration equipment, 2) reduce emissions resulting from the installation and servicing of refrigeration and air-conditioning (R/AC) appliances using high-GWP refrigerants, and 3) verify greenhouse gas(es) (GHG) emission reductions. High-GWP refrigerants are potent GHG, trapping heat in the atmosphere at many times that of carbon dioxide on a pound-for-pound basis. These gases are also used in many applications, with refrigeration and air conditioning among the most important for society and the economy. In many cases, however, the systems that contain these gases, or the practices used in servicing those systems, allow refrigerants to be emitted into the atmosphere, contributing to the overall effect of global warming. The United States Environmental Protection Agency (U.S. EPA) estimates that 37 percent of the stationary source refrigeration and air-conditioning related emissions of high-GWP gases are from stationary, large commercial refrigeration systems

To address this situation, ARB staff has developed the proposed Regulation to mitigate the emissions of high-GWP refrigerants from stationary sources. Specific objectives of the proposed program and accompanying Regulation include:

- Reduce refrigerant emissions from existing refrigeration systems annually by 8 million metric tonnes of carbon dioxide equivalent ($MMTCO_2E$).
- Improve service practices for existing and future systems to reduce refrigerant leaks and maximize reclamation and recycling of high-GWP refrigerants from the servicing of stationary R/AC appliances.
- Improve refrigerant management by restricting sales of high-GWP refrigerants to properly trained personnel and improve disposal practices to provide for refrigerant recovery from R/AC appliances and refrigerant storage cylinders.
- Minimize administrative requirements on business while crafting a program that leads to significant emission reductions of GHG at low cost or a net savings for most businesses impacted.
- Provide clear best management standards of practice for managing refrigeration systems to meet the objectives of the proposed Regulation and complement existing federal, state, and local laws and regulations.

The Regulation provides annual emission reduction of 8 $MMTCO_2E$. Currently ozone depleting substances (ODS) are regulated under the Clean Air Act and Amendments (CAAA) to a limited degree, but non-ODS, high-GWP refrigerants are not managed other than by way of a federal restriction on venting.

For this reason, the Refrigerant Management Program is designed to not only complement federal regulations but also to present a template for a management framework for all high-GWP refrigerants that can be used by other states and the U.S. EPA.

What is the Source of Authority to Regulate Stationary Refrigeration and Air Conditioning?

In 2006, The California Global Warming Solutions Act (AB 32)[1] was signed into law, creating a comprehensive, multi-year program to reduce GHG emissions in California.

What are the Environmental Benefits of Reducing Greenhouse Gases?

Greenhouse gases remain in the atmosphere for many years, decades, and even centuries. As a result, the climate change effect of gases emitted years ago may not yet be fully realized. The primary environmental benefit of reducing GHG emissions is the potential mitigation of future environmental and health risks that accompany global warming.

California's landscape and geography make it particularly vulnerable to climate change. Climate change affects the high Sierra Nevada snowpack. Throughout the 20th century annual April to July spring runoff has been decreasing, with total water runoff declining by about ten percent over the last 100 years. "Average spring snowmelt from the Sierra Nevada into the Sacramento River has decreased by about 12 percent since 1906."[2] This observation has direct consequences - less spring runoff for hydroelectric power production, agricultural irrigation, and human consumption.

California has seen a sea level rise of 3 – 8 inches in the last century. This can lead to serious consequences such as flooding of low-lying property, loss of coastal wetlands, erosion of cliffs and beaches, saltwater contamination of drinking water, and damage to roads and bridges.[3] Research on sea level changes indicates that the mean sea level rise values, determined from a survey of several climate models, range from approximately 10–80 cm (3.9–31 in) between 2000 and 2100. The middle to higher end of this range would substantially exceed the historical rate of sea level rise of 15–20 cm (5.9–7.9 in) per century observed at San Francisco and San Diego during the last 100 years.[4]

Climate change will also adversely affect the public health of Californians. ARB modeling indicates that even with very effective programs to clean up the remaining sources of criteria pollutants, we will have to pay a 'climate penalty' since elevated temperatures will affect our cities, raising ozone levels.

---

[1] California Global Warning Solutions Act of 2006, Statutes of 2006, Chapter 488. Health & Safety Code 38500 - 38599.
[2] California Environmental Protection Agency and California Resources Agency, Environmental Protection Indicators for California, 2004 update.
[3] Air Resources Board, Fact Sheet – The Greenhouse Effect and California. http://www.arb.ca.gov/cc/factsheets/ccbackground.pdf. (accessed September 14, 2009.
[4] California Climate Change Center, Projecting Future Sea Level, March 2006.

What Are the Requirements of the Proposed Regulation?

The proposed Regulation focuses on the largest refrigeration sources of GHG emissions. The Regulation would establish requirements by category of refrigeration system: large (uses 2,000 pounds or more of refrigerant; medium (uses between 200 and 2,000 pounds of refrigerant); and small (uses between 50 and 200 pounds of refrigerant).

Below is a brief summary of the key requirements of the Regulation. There are additional administrative requirements in the proposed Regulation. For details on the proposed regulatory provisions, see the Refrigerant Management Program Proposed Regulatory Provisions section (Section VI) of this report.

1. **Registration Requirements for Facilities with Stationary Refrigeration Systems (Section 95383)**: registration will be required in 2012, 2014, and 2016 based on the refrigerant charge size category of the largest refrigeration system in operation at a facility.
2. **Implementation Fees for Facilities with Stationary Refrigeration Systems (Section 95384):** an initial and annual fee to cover the costs of administering and enforcing the Regulation will be required for facilities with large and medium refrigeration systems - $370 for a facility with a large refrigeration system starting in 2012 and $170 for a facility with a medium refrigeration system starting in 2014. There is no fee for a facility with a small refrigeration system.
3. **Leak Detection and Monitoring Requirements for Facilities with Stationary Refrigeration Systems (Section 95385)**: starting in 2011, an automatic leak detection system or quarterly or annual leak inspections will be required for large, medium, and small refrigeration systems, respectively.
4. **Leak Repair Requirements for Facilities with Stationary Refrigeration Systems (Section 95386):** a refrigerant leak repair is generally required by a U.S. EPA certified technician within 14 days of leak detection. Under specified conditions up to 45 or 120 days after leak detection are allowed.
5. **Requirements to Prepare Retrofit or Retirement Plans for Facilities with Leaking Stationary Refrigeration Systems (Section 95387):** this plan is required if a refrigerant leak cannot be repaired.
6. **Reporting Requirements for Facilities with Stationary Refrigeration Systems (Section 95388)**: annual reporting of refrigeration system service and leak repair and refrigerant purchases and use will be required for facilities with large and medium refrigeration systems starting in 2012 and 2014 respectively. There is no annual reporting for a facility with a small refrigeration system.
7. **Recordkeeping Requirements for Facilities with Stationary Refrigeration Systems (Section 95389):** to document compliance, recordkeeping is required with records retained for a minimum of five years.

8. **Required Service Practices for High-GWP Appliances (Section 95390)**: will be specific to all high-GWP refrigerants and are based on existing U.S. EPA regulations specific to ODS refrigerants.
9. **Prohibitions (Section 95391)**: will be specific to sales of all high-GWP refrigerants and are based on existing U.S. EPA regulations specific to ODS refrigerants.
10. **Reporting Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers (Section 95392):** annual reporting of refrigerant purchased and sold, or reclaimed for certified reclaimer reporting, will be required on a company-wide basis.
11. **Recordkeeping Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers (Section 95393):** to document compliance, recordkeeping is required with records retained for a minimum of five years.

Who Will Be Impacted By the Regulation?

The proposed Regulation will apply to:

- anyone operating a facility with a refrigeration system charged with more than 50 pounds of a high-GWP refrigerant.
- anyone who maintains or repairs a R/AC appliance using a high-GWP refrigerant.
- anyone who distributes or reclaims a high-GWP refrigerant.

What Types of Stationary, Non-residential Refrigeration Systems are Covered?

The proposed Regulation will apply to any non-residential facility that has a refrigeration system that requires more than 50 pounds of a high-GWP refrigerant for the registration, leak detection and monitoring, leak repair, retrofit or retirement plan, and recordkeeping provisions. The implementation fee and facility reporting provisions of the proposed Regulation will additionally apply to any non-residential facility that has a refrigeration system that requires 200 pounds or more of a high-GWP refrigerant.

Some of the types of facilities that are likely to have these types of refrigeration systems include: cold storage warehouses; food preparation and processing service facilities; grocery stores and supermarkets; hotels and recreational facilities; and facilities with process cooling equipment. Many facilities that tend to be owned or operated by small businesses such as bars and restaurants, gas stations, bakeries, and liquor stores are not expected to be subject to the proposed Regulation as research conducted for the ARB indicates that the refrigerant charge size for refrigeration systems used by these facilities are generally below 50 pounds.

Further, facilities using ammonia-based refrigeration systems, or refrigeration systems using any refrigerant with a GWP less than 150, are not subject to the proposed Regulation.

What Are the Current Emissions and Expected Reductions?

Under the proposed Regulation, the total estimated GHG emission reductions in 2020 are 8.1 $MMTCO_2E$, as compared to the estimated 2020 business-as-usual (BAU) emissions of 15.8 $MMTCO_2E$. This proposed strategy will provide the sixth largest quantity of GHG reductions as outlined in the approved Scoping Plan, and is an essential part of ARB's efforts to meet the 2020 emissions reduction target as required under AB 32.

As described in Appendix B, BAU emissions and potential emission reductions were determined based on empirical emissions data reported by businesses to the South Coast Air Quality Management District (SCAQMD) pursuant to Rule 1415. BAU emissions were based on existing average leak rates determined for specific categories of refrigeration systems. The potential emission reductions are equal to the difference in the statewide emissions estimated using the average BAU leak rates and the statewide emissions estimated using the leak rates obtainable using best management practices.

Why Focus on High-GWP Refrigerants from Stationary Refrigeration Systems?

The proposed Regulation is the largest component of a suite of sector-specific measures and is necessary to mitigate emissions from the stationary source high-GWP GHG sector. The Regulation focuses on the largest source of emissions from this sector – large commercial refrigeration systems, which, in aggregate, have extensive GHG emissions. As previously noted, the U.S. EPA estimates that 37 percent of the stationary source R/AC related emissions of high-GWP gases are from stationary, large commercial refrigeration systems.

Of all refrigeration systems using more than 50 pounds of a high-GWP refrigerant that were reported to the SCAQMD, on average, 29 percent leak annually. These leaking refrigeration systems lost, on average, 65 percent of their refrigerant charge annually.

In many cases, owners and operators of refrigeration systems can benefit financially from using the refrigerant best management practices required by the proposed rule as these practices will result in cost savings by reducing the need to purchase refrigerant to replenish the refrigerant that had leaked.

What Are The Expected Costs?

Total annualized gross costs for impacted facilities after full implementation in 2020 are estimated at $49 million. However, total annualized net costs for these facilities are estimated at a savings of $19 million, reflecting a cost savings resulting from reduced refrigerant consumption.

Annual costs for refrigerant distributors, wholesalers, and reclaimers are estimated at $0.2 million.

Cost estimates were made specific to emission reductions for Kyoto gases[5] only and for Kyoto gases and non-Kyoto gases combined. The estimated cost-effectiveness is a savings of $2 per metric tonne carbon dioxide equivalent ($MTCO_2E$) of GHG reduced (in 2008 dollars) based on estimated reductions in 2020 for Kyoto gases only. The result for Kyoto gases and non-Kyoto gases combined is approximately the same at $2 saved for each $MTCO_2E$ of GHG reduced.

ARB staff conducted an analysis to determine how sensitive the average cost-effectiveness of the proposed rule is to the discount rate used. A range of discount rates were used to determine their impact on the average cost-effectiveness of the proposed rule. This analysis resulted in a net savings or net cost depending on the discount rate used with all results within the range of cost-effectiveness for measures approved by the Board in 2009, which have ranged from over $100 in savings to a cost of $21 per $MTCO_2E$.

What Was The Public Process to Develop The Regulation?

The proposed Regulation was developed through an extensive public process involving multiple stakeholders, state agencies, the U.S. EPA, the California Air Pollution Control Officers Association (CAPCOA), and the public. A large number of industry stakeholders including various trade associations, facility owners and operators, refrigerant and appliance manufacturers, agricultural industry, technicians, contractors, refrigerant distributors and reclaimers, technician training institutions and individual businesses actively participated in the proposed rule development process.

ARB staff held technical workgroup meetings and public workshops including:

- A kick-off public workshop in Sacramento specific to the stationary source, high-GWP GHG sector.
- Five technical working group meetings.
- Two series of public workshops with each including a workshop in three cities representing the southern, northern, and Central Valley areas of California.
- A public workshop in Sacramento to outline current recommendations.

Each public workshop in Sacramento was webcast to ensure the greatest possible access.

Public meeting notices, the draft regulation, emission estimates, cost analyses documents and the revised versions were posted on the web page created to provide information and periodic updates to anyone interested in the development of the proposed Refrigerant Management Program. Three ARB

---

[5] Kyoto gases include all gases specially listed in the Kyoto Protocol including carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

email lists were used to distribute information to approximately 6,700 individuals who expressed interest in the proposed program and climate change.

The public process also included direct outreach to businesses and facilities including:

- o Surveys of facilities
- o Surveys of stationary heating, ventilation, and air conditioning (HVAC) service contractors and technicians
- o Development and distribution of a Frequently Asked Questions (FAQ) pamphlet
- o Development and distribution of refrigerant best management practices brochure
- o Pilot outreach efforts conducted in two California cities (City of Industry and Merced) selected based on their size and the distribution of business in industries relevant to the proposed Refrigerant Management Program.
- o Communications with several small business associations in California, including the California Small Business Association, Small Business California, and the Merced and City of Industry chambers of commerce, as well as small business advocates such as the Governor's Office of Planning and Research, Office of the Small Business Advocate.

A detailed discussion of the public process and outreach is provided in Appendix D.

How Will Facilities Submit Reports and Pay Fees?

The development of an efficient reporting and payment system will be integral to the success of the Regulation. A web-based, secure reporting and payment system will be developed to provide a user-friendly reporting and payment framework.

Important characteristics of the reporting and payment system include:

1. Web-based recordkeeping and submittal of reports and payments.
2. Web-based batch data entry from existing refrigerant management software programs used by facilities.
3. Web-accessible interface that provides selective and secure access.
4. User-friendly interface with pull-down screens and help-based tools to facilitate accurate and efficient data entry and transfer.
5. Recordkeeping templates to assist facilities with implementing effective refrigerant management practices to reduce refrigerant consumption.

How Will the Proposed Regulation be Enforced?

The proposed Refrigerant Management Program affects GHG sources statewide. However, local and regional air districts have extensive expertise in enforcement, and already have relationships with many of the facilities that will be regulated. It is ARB's goal to leverage the expertise of the air districts in the administration of the proposed Regulation. Air districts may elect to assume the lead in enforcing the Regulation in two ways:

1. Entering a collaborative agreement between air districts and ARB. The agreement between the ARB and air district will outline all roles and responsibilities, enforcement performance requirements, and the amount and methods of payments that ARB will remit to the air district.
2. Air district adoption and implementation of a regulation that is functionally equivalent to the statewide Regulation.

As a statewide regulation, ARB will have full responsibility and authority to enforce the Regulation. This will include the collection and administration of fees.

Recommendation

Staff recommends that the Board approve its proposal to adopt sections 95380 through 95398 of title 17, California Code of Regulations, known as the Refrigerant Management Program.

I. OVERVIEW AND STAFF RECOMMENDATION

The California Global Warming Solutions Act of 2006 (AB 32) created a comprehensive program to reduce greenhouse gas (GHG) emissions in California. AB 32 required ARB to develop a Scoping Plan and consider regulations, market mechanisms, incentives, and other approaches to ultimately reduce California's GHG emissions equivalent to the 1990 baseline year by 2020. Additionally, AB 32 requires that rules and regulations adopted achieve maximum technologically feasible and cost-effective GHG emission reductions.

As part of its analysis to identify feasible and cost-effective emission reductions, ARB staff identified stationary refrigeration and air-conditioning (R/AC) appliances and refrigerant cylinders as sources of GHG emissions. The analysis revealed significant emissions from R/AC appliances and informed options to achieve GHG emission reductions from these appliances on the order of millions of metric tons of carbon dioxide equivalents ($MMTCO_2E$). In this rulemaking, the ARB staff is proposing a Regulation to: 1) reduce emissions of high-GWP refrigerants from stationary, non-residential refrigeration equipment, 2) reduce emissions resulting from the installation and servicing of R/AC appliances using high global warming potential (GWP) refrigerants, and 3) verify GHG emission reductions. This will be accomplished through registration, leak detection and monitoring, leak repair, retrofit or retirement planning, required service practices, refrigerant distributor and wholesaler prohibitions, and reporting and recordkeeping. The proposed Regulation is designed in accordance with AB 32 and was outlined in both the Early Action Report and Scoping Plan approved by the Board in October 2007 and December 2008, respectively.

This report with its appendices represents the Initial Statement of Reasons (ISOR) for Proposed Rulemaking required by the California Administrative Procedures Act. In this report the ARB staff presents the proposed Regulation for high-GWP refrigerant management for stationary sources, how it was developed, and why the proposed options were selected.

ARB staff estimates that business-as-usual (BAU) emissions from stationary R/AC appliances in 2020 will be 17.2 $MMTCO_2E$; 15.8 $MMTCO_2E$ from refrigeration systems and 1.4 $MMTCO_2E$ from air-conditioning systems. A significant fraction of these emissions can be reduced through technologically feasible, cost-effective best management practices enabling the earlier detection and repairs of refrigerant leaks. Implementation of this Regulation is estimated to reduce emissions by 7.2 $MMTCO_2E$ of Kyoto gases (HFC refrigerants) and 0.9 $MMTCO_2E$ of non-Kyoto gases (ozone depleting substances, or ODS, refrigerants), as compared to the 2020 BAU, on an annual basis once fully implemented. The estimated cost-effectiveness of the proposed Regulation is an approximate savings of $2 per metric tonne of carbon dioxide equivalent ($MTCO_2E$) of reduced emissions.

In developing the proposed Regulation, staff worked with stakeholders including representatives of refrigerant manufacturers, appliance manufacturers, non-governmental organizations, and organizations representing the users of R/AC appliances such as grocers, property managers, and agricultural industries.

Staff recommends that the Board adopt the proposed Regulation for the following reasons:

1. The proposed Regulation will achieve an annual reduction of 7.2 $MMTCO_2E$ of Kyoto gases, as compared to the 2020 BAU, to make a significant contribution towards achieving the total statewide emission reduction goal of approximately 169 $MMTCO_2E$ by 2020.
2. The proposed Regulation addresses the fastest growing sector of GHG emissions – the high-GWP GHG sector.
3. The proposed Regulation is technologically feasible and provides a necessary transition from management of ODS refrigerants only to management of non-ODS, high-GWP refrigerants and ensures a consistent regulatory framework for ODS and non-ODS refrigerants that complements existing federal regulations specific to ODS refrigerants originally published in 1993, and last amended in 2004.
4. The proposed Regulation is cost-effective. It requires improved refrigerant management practices such as leak detection and monitoring and leak repair, which are technologically feasible and are also good economic policy that, in a majority of cases can create cost savings to facility owners.

II. REQUIREMENTS OF AB 32

AB 32 (California Health and Safety Code, section 1, division 25.5 (commencing with section 38500), The California Global Warming Solutions Act of 2006, creates a comprehensive, multi-year program to reduce GHG emissions in California. Specifically, Health and Safety Code section 38562 requires that ARB adopt regulations that "achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions" from the sources identified for early actions or strategies. Section 38562(d) requires that reductions must be real, permanent, quantifiable, verifiable, and enforceable. AB 32 criteria are summarized below, with staff's assessment as to why the proposed regulatory action meets these criteria. The proposed regulatory action will reduce GHG emissions attributable to stationary, non-residential refrigeration systems.

1. **The State Board shall adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reduction from sources or categories of sources.**

   This Regulation was developed through an extensive public process involving multiple stakeholders, state agencies, the United States Environmental Protection Agency (U.S. EPA), the California Air Pollution Control Officers Association (CAPCOA), and the public. A large number of stakeholders including various trade associations, facility owners and operators, refrigerant and appliance manufacturers, agricultural industry, technicians, contractors, refrigerant distributors and reclaimers, technician training institutions and individual businesses actively participated in the proposed rule development process.

   The staff held several technical workgroup meetings and public workshops including:

   - One kick-off public workshop specific to the stationary source high-GWP GHG sector.
     - Sacramento, February 2008
   - Five technical working group meetings in Sacramento.
     - April, May, and June 2008
     - January and July 2009
   - Public workshops in cities throughout southern, northern, and Central Valley areas of California.
     - Sacramento, Fresno, and El Monte - September 2008
     - Sacramento, Modesto, and Diamond Bar - February 2009
   - One public workshop to outline current recommendations.
     - Sacramento, August 2009

   Each public workshop in Sacramento was also webcast to ensure access by a broader audience.

   Public meeting notices, the draft regulation, emission estimates, cost analyses documents and the respective revised versions were posted on the web page created especially to provide information and periodic updates to anyone interested in the development of the proposed Refrigerant Management Program. Three ARB email list serves were used to distribute information to approximately 6,700 individuals who signed up and expressed interest in the proposed program and climate change.

The public process also included direct outreach to businesses and facilities including:

- Surveys of facilities
- Surveys of stationary heating, ventilation, and air conditioning (HVAC) service contractors and technicians
- Development and distribution of a Frequently Asked Questions (FAQ) pamphlet
- Development and distribution of refrigerant best management practices brochure
- Pilot outreach effort conducted in two CA cities (City of Industry and Merced) selected based on their size and the distribution of business in industries relevant to the proposed Refrigerant Management Program.
- Staff communicated with several small business associations in California, including the California Small Business Association, Small Business California, and the Merced and City of Industry chambers of commerce, as well as small business advocates such as the Governor's Office of Planning and Research, Office of the Small Business Advocate.

The estimated reduced emissions are technically feasible as they are based on known best management practices such as automatic leak detection and regularly scheduled leak inspections, and leak repair as soon as practicable after detection.

The proposed Regulation is cost-effective as due to reduced refrigerant consumption, costs are reduced for facilities with stationary refrigeration systems and, on average, result in a net savings.

2. **Design the regulations, including distribution of emissions allowances where appropriate, in a manner that is equitable, seeks to minimize costs and maximize the total benefits to California, and encourages early action to reduce greenhouse gas emissions.**

The proposed Regulation is designed to maximize emission reductions through improved refrigerant leak detection and monitoring and expedited refrigerant leak repair. Requirements have also been designed to be equitable and applicable to potential GHG emission risk as it is related to the refrigerant charge of a R/AC appliance. Costs have been minimized through reduced requirements for facilities with refrigeration systems that use less than 200 pounds of refrigerant. Due to reduced refrigerant consumption, costs are reduced and, on average, result in a net savings, which encourages early action prior to the adoption of the Regulation.

The leak detection and monitoring, leak repair, and retrofit or retirement components of the proposed Regulation all become effective in 2011 for facilities with refrigeration systems of all applicable refrigerant charge size categories to maximize the emission reductions, while providing for a multi-year phase-in for registration and implementation fee elements.

3. **Ensure that activities undertaken to comply with the regulations do not disproportionately impact low-income communities.**

   The proposed Regulation is applied consistently throughout the State and is not anticipated to disproportionately impact any community. The proposed Regulation is not expected to result in significant negative impacts in any community.

4. **Ensure that entities that have voluntarily reduced their greenhouse gas emissions prior to the implementation of this section receive appropriate credit for early voluntary reductions.**

   The proposed Regulation is based on best management practices. There are facilities in California that are already meeting the majority of the requirements of the proposed Regulation by voluntarily using best management practices. To a great degree, it is the example set by such facilities that has informed the proposed Regulation. In these cases, based on their current business decisions, these facilities may not incur any additional costs to meet the regulatory inspection and maintenance requirements.

   Additionally, proposed implementation fees will be waived for a facility that certifies to have maintained refrigeration systems in the prior calendar year using advanced technologies, strategies, and practices that reduce refrigerant charges and emissions of ozone-depleting substances and greenhouse gases.

5. **Ensure that activities undertaken pursuant to the regulations complement, and do not interfere with, efforts to achieve and maintain federal and state ambient air quality standards and to reduce toxic air contaminant emissions.**

   High-GWP GHG emissions are distinct from criteria pollutants and toxic air contaminants that have historically been regulated through federal and state air quality standards. The proposed Regulation does not interfere with and is complementary of existing federal, state, and local laws and regulations.

6. **Consider cost-effectiveness of these regulations.**

   The average cost-effectiveness of the proposed Regulation is a savings of about $2 per $MTCO_2E$ in reduced emissions, on average, for facilities with stationary refrigeration systems. Throughout the rulemaking process, staff have met with stakeholders to ensure a thorough understanding of cost impacts and refined the proposed Regulation to be as cost-effective as possible by considering alternatives to balance costs and potential emission reductions. See Appendix C for a more detailed discussion regarding economic impact estimates.

7. **Consider overall societal benefits, including reductions in other air pollutants, diversification of energy sources, and other benefits to the economy, environment, and public health.**

   The proposed Regulation is not expected to cause any overall adverse impacts to society or the environment. California will benefit from the reduction of GHG emissions, and thereby contributes towards the mitigation of potential adverse impacts of climate change. The proposed Regulation originally included specifications for new refrigeration systems. This component has been removed from the proposed Regulation to be integrated with work in collaboration with the California Energy Commission (CEC) as it will allow for a full assessment of the interrelationship between refrigerant management, energy efficiency, and lifecycle GHG emissions.

   The primary focus of the proposed Regulation is HFC refrigerants used in stationary refrigeration systems as a GHG explicitly included in AB 32. PFC refrigerants (also explicitly included in AB 32) used in stationary refrigeration systems are also included, but they are in limited use. But, ODS such as CFC typically have GWPs on the order of 2 to 10 times that of HFC, so preventing the emission of CFC result in significant additional societal benefits in terms of climate change.

8. **Minimize the administrative burden of implementing and complying with these regulations.**

   The proposed Regulation affects a large number of facilities, so it has been developed to phase in many requirements based on the refrigerant charge size category of refrigeration systems to reduce the administrative burden of implementation on ARB and stakeholders.

   Table I provides the refrigeration system categories based on the refrigerant charge size, including the estimated number of facilities statewide that the refrigeration system category will apply. The refrigeration system category for a facility is based on the refrigeration system at a facility with the largest refrigerant charge size.

Table I. Proposed Refrigerant Charge Size Categories		
Refrigeration System Category	Refrigerant Charge Size Category Description	Estimated Number of Facilities
Large Refrigeration System	Refrigeration Systems with a Refrigerant Charge 2,000 pounds or Greater	2,000
Medium Refrigeration System	Refrigeration Systems with a Refrigerant Charge 200 pounds or Greater, but Less than 2,000 pounds	8,500
Small Refrigeration System	Refrigeration Systems with a Refrigerant Charge Greater than 50 pounds, but Less than 200 pounds	15,500

As an example of phased-in requirements, the registration provision will require facilities in the Large Refrigeration System category to register in 2012, in the Medium Refrigeration System category in 2014, and in the Small Refrigeration System category in 2016. The phased in approach reduces the administrative burden of data management and allows time for online reporting systems to be developed.

A similar approach is proposed for the facility reporting provision. Reporting will begin based on the same dates as registration. The primary difference between the reporting and registration requirements is the removal of all reporting for facilities with refrigeration systems requiring between 50 and 200 pounds of a high-GWP refrigerant.

The proposed Regulation requires facilities and refrigerant distributors, wholesalers, and reclaimers to record and report data to facilitate identifying and mitigating emissions of refrigerant. ARB is currently working on an on-line reporting system to reduce the burden of compliance through the allowance of electronic reporting and batch uploading of data from existing refrigerant management software packages currently in use by some facilities.

9. Minimize leakage.

Leakage is not expected to occur as a result of the proposed Regulation. Leakage occurs when an emission limit or regulatory requirement set by the State causes business activities to be displaced outside of California. The focus of the proposed Regulation applies to facilities with refrigeration systems in California. The use of best management practices in a California facility will not create a competitive disadvantage for California facilities because the proposed Regulation provides, on average, a cost savings through reduced consumption of refrigerant.

10. Consider the significance of the contribution of each source or category of sources to statewide emissions of greenhouse gases.

The California GHG emissions inventory shows that high-GWP GHG are a very significant and fast growing sector of the California anthropogenic GHG inventory. Unless controls are enacted, emissions are expected to more than triple between 2004 and 2020 to reach over 46 $MMTCO_2E$. This increase would result in the high-GWP sector equaling 8 percent of the total estimated 2020 California GHG inventory.

The proposed Regulation will achieve emission reductions of about 7.2 $MMTCO_2E$ per year in Kyoto gases in 2020. See Appendix B for additional details. These emission reductions are an essential component of the statewide emission reduction goal of approximately 169 $MMTCO_2E$ by 2020.

11. The greenhouse gas emission reductions achieved are real, permanent, quantifiable, verifiable, and enforceable by the state board.

The emissions and emission reductions from stationary R/AC appliances were calculated based on data available from reports submitted by facilities in the jurisdiction of the South Coast Air Quality Management District (SCAQMD) pursuant to Rule 1415 (Reduction of Refrigerant Emissions from Stationary Refrigeration and Air-conditioning Systems); this data was extrapolated statewide. The carbon dioxide equivalent GHG emissions and reductions were calculated based on GWP values defined by the Intergovernmental Panel on Climate Change (IPCC).[6] As outlined in Appendix B, additional data was obtained, including data from the U.S. EPA Vintaging Model and California specific Commercial End-Use Survey, to validate and verify emissions data used.

The proposed Regulation requires facilities to record data specific to refrigeration system and refrigerant use. Facilities with large and medium refrigeration systems will be required to annually report this information to the ARB. The reported data will be the basis of emission reduction quantification. Additionally, refrigerant distributors and wholesalers will report high-GWP refrigerant received and sold annually. This information will be used to verify the emission reductions quantified from reports submitted by facilities. As stationary, non-residential refrigeration systems constitute a large single component of all high-GWP emissions, assuming all other refrigerant use trends are held equal or can be estimated based on California high-GWP specific policies, emission reductions will be verified by changes in projected BAU statewide consumption of high-GWP refrigerants.

The reported data will identify facilities with apparent refrigerant leaks that have not been addressed and be the basis for investigation and potential enforcement actions. In addition, the data will inform ARB staff of factors that help to direct inspection and enforcement resources at the greatest risk of GHG emissions and non-compliance.

As a result of detailed research conducted to quantify current emissions and potential emission reductions, as provided in Appendix B, and effective data

[6] Intergovernmental Panel on Climate Change (IPCC), Second Assessment Report (SAR), 1995; IPCC, Fourth Assessment A-3 Report (AR4), 2007.

collection on refrigerant consumption, estimated emission reductions associated with the Refrigerant Management Program will be real, permanent, quantifiable, verifiable, and enforceable.

12. **For regulations.... ....the reduction is in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur.**

Regulations relevant to refrigerant management currently are limited to an existing set of requirements specific to ODS refrigerants promulgated by the U.S. EPA under section 608 (Stratospheric Ozone Protection, Stationary Sources) of the Clean Air Act and Amendments (CAAA). In response to the CAAA the SCAQMD adopted Rule 1415. These regulations created the basis of the BAU scenario.

The proposed Regulation complements federal regulations by recognizing a growing regulatory need to address all high-GWP refrigerants (and specifically non-ODS refrigerants) as production of ODS refrigerants is phased out. The proposed Regulation provides a transition of regulations from ODS refrigerants to ODS substitute refrigerants (HFC) resulting in a consistent management framework throughout the phase out of ODS. The proposed Regulation is also broader than historical federal regulations in that it includes more rigorous leak detection and monitoring requirements, as well as leak repair for any refrigerant leak that is detected.

13. **If applicable, the greenhouse gas emission reduction occurs over the same time period and is equivalent in amount to any direct emission reduction required pursuant to this division.**

The Regulation achieves its emission reductions from direct emissions.

14. **The state board shall rely upon the best available economic and scientific information and its assessment of existing and projected technological capabilities when adopting the regulations required by the law.**

ARB staff used the best economic and scientific information available to develop the proposed Regulation. Appendix B describes in detail the scientific and technical information used for the development of estimated BAU emissions and emission reductions. Appendix C describes in detail the economic information used as the basis for determining economic impacts of the proposed Regulation.

This page is intentionally left blank

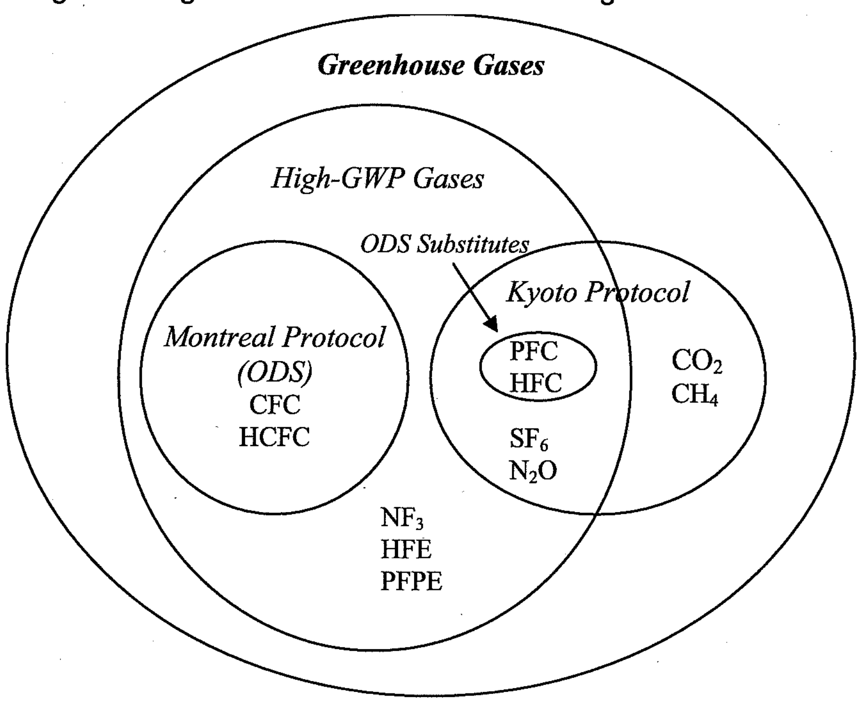
III. BACKGROUND

A. Stationary Source High-GWP GHG Sector

While not a discrete segment of the California economy, the stationary source high-GWP GHG sector consists of a broad range of sources that emit gases that on a pound for pound basis have hundreds to thousands of times the climate impact of carbon dioxide (CO_2). High-GWP refrigerants serve an important purpose as refrigerants in stationary HVAC, mobile vehicle air conditioning (MVAC), and refrigeration. High-GWP gases are also used as foam-blowing agents, in electrical transmission, as fire suppressants, in consumer products, and in the semiconductor industry.

As illustrated in Figure 1, high-GWP GHG used in stationary source R/AC appliances can generally be categorized as Kyoto Protocol gases, Montreal Protocol gases, and several miscellaneous gases not covered under either treaty.[7]

Figure I. High-GWP Greenhouse Gas Categories



An important category of high-GWP GHG is ODS, which include chlorofluorocarbons (CFC) and hydrochlorofluorocarbons (HCFC). ODS production is being phased out under the Montreal Protocol as a result of concerns about stratospheric ozone depletion, but legacy emissions from existing

[7] Figure 1. copied from: California Air Resources Board, Climate Change Scoping Plan Appendices, VOLUME I: SUPPORTING DOCUMENTS AND MEASURE DETAIL, December 2008.

sources are not controlled. Thus, ODS used as refrigerants were regulated as a result of concerns about stratospheric ozone depletion, but not due to concerns about climate change. The underlying assumption of the Montreal Protocol is that the gases produced will eventually be emitted due to equipment refrigerant leaks, servicing, or at end-of-life (EOL).

As a result of the Montreal Protocol's phaseout of ODS, ODS refrigerants used in stationary R/AC appliances have typically been replaced with hydrofluorocarbons (HFC) and perfluorocarbons (PFC), which are hence referred to as ODS substitutes. As an example, alternatives currently being used to replace HCFC-22 as a refrigerant are HFC blends with higher GWPs.[8] While ODS have negative impacts for both climate change and stratospheric ozone, ODS substitutes are not ozone-depleting but are typically potent GHG.

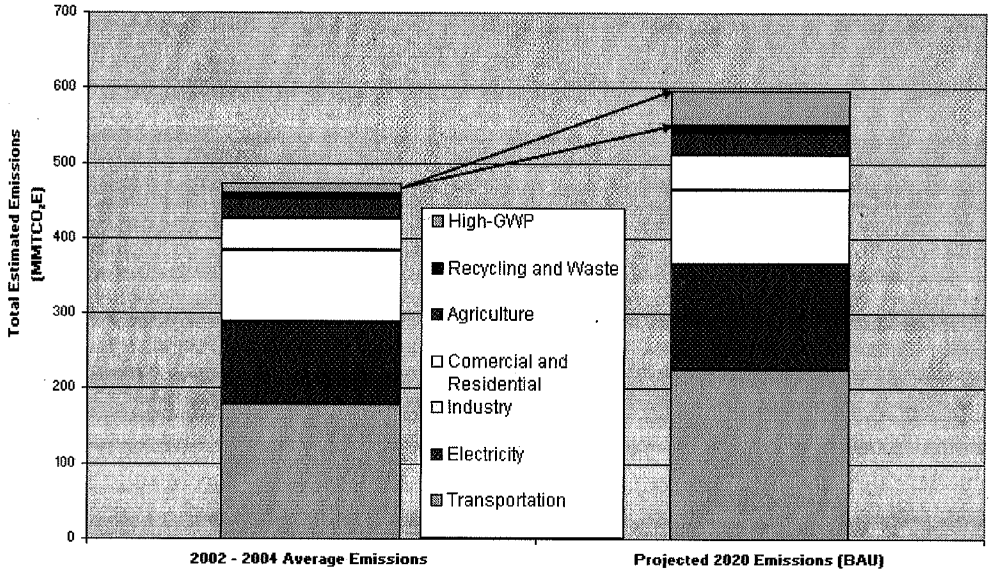
The majority of ODS substitutes are listed in the Kyoto protocol, and emissions of these gases are increasing as ODS refrigerants are replaced by ODS substitute refrigerants. Global HFC emissions in 2050 are estimated to be equivalent to 9 to 19 percent of the projected global BAU GHG emissions, on a CO_2 equivalent basis.[9] Specific to California, the 2002 – 2004 average GHG emissions explicitly identified in AB 32 for the high-GWP GHG sector was estimated to represent 3 percent of the California anthropogenic GHG inventory. However, the sector is growing rapidly due to the increased use of Kyoto gases as substitutes for ODS and is anticipated to reach 8 percent of the total estimated 2020 California BAU GHG inventory. As indicated in Figure II, by 2020 under the California-specific BAU scenario, high-GWP gases will become a much greater component of the California GHG inventory, which pursuant to AB 32 must be reduced to a baseline 1990 target by 2020.

Currently there is a significant gap created in emission control efforts for non-ODS, high-GWP refrigerants. The proposed measure is the first of its kind in the United States to explicitly address emissions of all high-GWP refrigerants.

Figure II provides a comparison of the estimated 2002-2004 average emissions and projected 2020 emissions, and illustrates the significant growth of the high-GWP GHG sector as compared to other sectors of the statewide GHG inventory.

[8] J.M. Velders, S.O. Andersen, J.S. Daniel, D.W. Fahey, and M. McFarland, The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences, USA, March 2007.
[9] J.M. Velders, D.W. Fahey, J.S. Daniel, M. McFarland, and S.O. Andersen, The large contribution of projected HFC emissions to future climate forcing, Proceedings of the National Academy of Sciences, USA, June 2009.

Figure II. Comparison of 2002-2004 Average Emissions and Projected 2020 Emissions (BAU) by Percent of Total California GHG Inventory



Based on most recent available data from Air Resources Board, Climate Change Scoping Plan, December 2008.

Stationary refrigeration is a source of high-GWP refrigerant emissions due to a lack of incentives to reduce emissions. There are many companies that maintain effective refrigerant management practices that reduce emissions and reduce maintenance costs. However, the low cost of many high-GWP refrigerants, as well as a lack of incentives for emission control, has resulted in a common practice of re-charging leaky, poorly designed, or poorly maintained R/AC appliances without attempting a repair. As a result, venting of refrigerant occurs during maintenance or EOL disposal. The Refrigerant Management Program's leak detection and monitoring, leak repair, and retrofit or retirement components are a suite of integrated strategies to address a well documented problem.

In the absence of effective controls, emissions from the high-GWP GHG sector are expected to more than triple over the next several years, resulting in over 46 $MMTCO_2E$ of high-GWP Kyoto gas emissions in 2020; 15.8 $MMTCO_2E$ from stationary, non-residential refrigeration. The proposed Regulation is expected to yield GHG emission reductions of 7.2 $MMTCO_2E$ of Kyoto gases by 2020. Additionally, the proposed Regulation is expected to yield an added benefit of GHG emission reductions of 0.9 $MMTCO_2E$ of non-Kyoto gases, or ODS, by 2020.

B. Stationary Refrigeration and Air-Conditioning Systems

Tens of millions of stationary commercial and industrial R/AC appliances exist in California, ranging from small, tightly sealed refrigerators and air-conditioning units to large parallel rack refrigeration systems (refrigeration systems commonly used in supermarkets) and centrifugal chillers (commonly used in process cooling and commercial building air-conditioning systems) containing thousands of pounds of refrigerant.

Emissions from stationary R/AC appliances are categorized as direct refrigerant emissions and indirect emissions (CO_2-equivalent emissions resulting from energy use to operate the system). The focus of the Regulation is to minimize direct emissions that occur during the equipment lifetime (i.e., from leaks, ruptures, maintenance, etc.), with an emphasis on large non-residential refrigeration systems. Thus, approximately 26,000 facilities throughout California with refrigeration systems with a refrigerant charge greater than 50 pounds of a high-GWP refrigerant would be affected by the proposed Regulation.

R/AC appliances serve many diverse purposes and, as a result, vary greatly in the type of refrigerant used and the total refrigerant charge. A primary determinant of the potential emissions from a R/AC appliance is the refrigerant charge. Common equipment types can be categorized by refrigerant charge sizes as provided in Table II, which provides refrigerant charge size categories as discussed in the proposed Regulation. Table II does not include R/AC appliances with a refrigerant charge of 50 pounds or less as the proposed Regulation does not establish requirements for these systems with respect to leak detection and repair as they are usually tightly sealed and result in limited refrigerant leaks.

Table II. Equipment Type and Refrigerant Charge Size Categories of R/AC Appliances

Equipment Type	Typical Application and Refrigerant Charge Size
Process cooling and cold storage equipment	Mostly refrigeration systems with refrigerant charge greater than 2,000 pounds A small percentage of refrigeration systems with refrigerant charge between 200 and 2,000 pounds
Centralized refrigeration equipment (i.e. parallel rack and remote condensing refrigeration systems)	Mostly parallel rack refrigeration systems with refrigerant charge between 200 and 2,000 pounds A small percentage of refrigeration systems with refrigerant charge greater than 2,000 pounds
Condensing unit refrigeration equipment (i.e., large walk in refrigeration units, condensing units supporting several refrigerated cabinets)	Nearly 100% of applicable refrigeration systems with refrigerant charge between 50 and 200 pounds
Air-conditioning chillers	Mostly packaged chiller air-conditioning systems with refrigerant charge between 200 and 2,000 pounds A small to moderate percentage of centrifugal chiller air-conditioning systems with refrigerant charge greater than 2,000 pounds
Air-conditioning rooftop units and unitary systems	Nearly 100% of systems with refrigerant charge greater than 50 pounds are between 50 and 200 pounds A small percentage of systems with refrigerant charge between 200 and 2,000 pounds

The facilities types that commonly use R/AC appliances, along with the typical refrigerant charge sizes of R/AC appliances used can be categorized as provided in Table III.

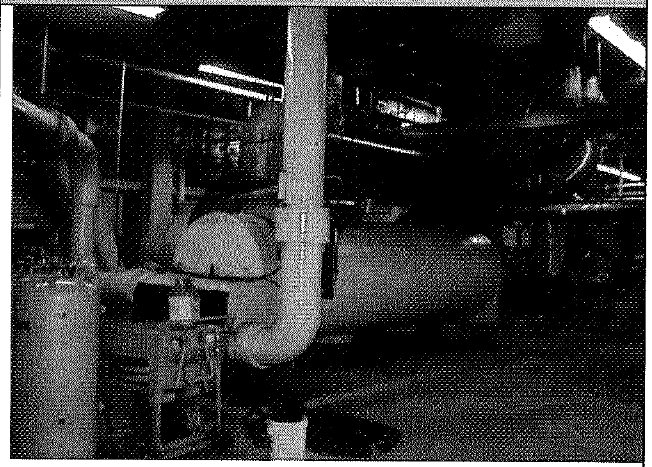
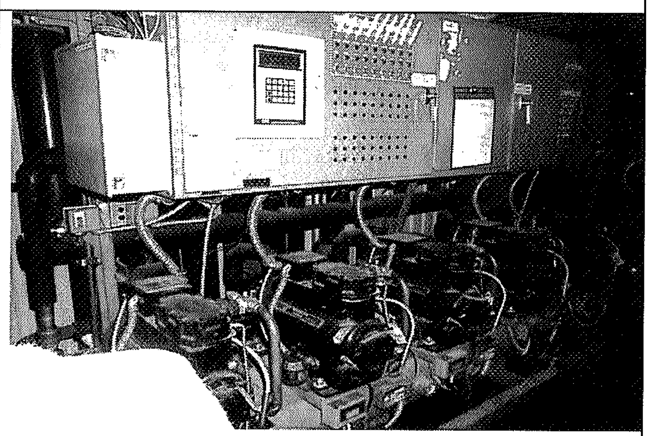
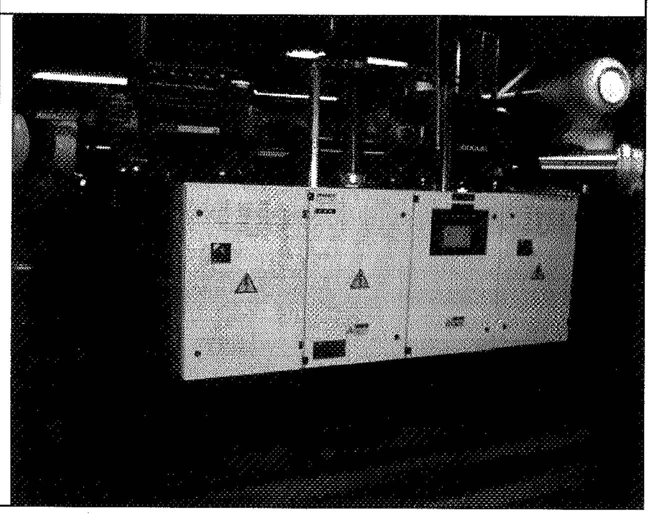
Table III. Facility Types and Typical Refrigeration and Air-conditioning Appliance Refrigerant Charge Sizes	
Facility type	**Typical Refrigerant Charge Size**
Food processing facilities	Greater than 2,000 pounds (Large)
Cold storage warehouses	Greater than 2,000 pounds (Large)
Petroleum industry	Greater than 2,000 pounds (Large)
Manufacturing facilities	Greater than 2,000 pounds (Large)
Grocery stores	Between 200 and 2,000 pounds (Medium)
Small retail food stores	Between 50 and 200 pounds (Small)
Office Buildings	Between 50 and 200 pounds (Small)

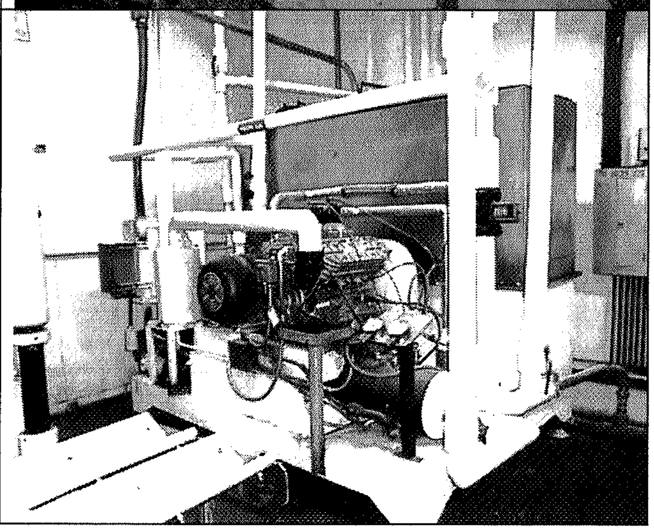
C. Typical Refrigeration and Air-conditioning Appliances In Operation

Appendix B provides detailed descriptions of the primary types of R/AC appliances in operation. Table IV provides a brief description and images of typical systems listed in Table II.

Table IV. Typical Refrigeration and Air-conditioning Appliances in Use[10]	
Refrigerant Charge Size Category	**Typical R/AC Appliance**
Large Centralized Cooling System Duty Types: Industrial Process, Comfort Cooling, or Other Refrigeration	

[10] Images provided courtesy of Environmental Support Solutions.

Refrigerant Charge Size Category	Typical R/AC Appliance
Large Centralized Centrifugal Chiller Duty Types: Industrial Process, Comfort Cooling, or Other Refrigeration	
Large or Medium Commercial Refrigeration Duty Types: Refrigeration for Supermarket or Cold Storage	
Medium Packaged Centrifugal Chiller Duty Types: Industrial Process, Comfort Cooling, or Other Refrigeration	

Refrigerant Charge Size Category	Typical R/AC Appliance
Medium or Small Unitary Chillers Duty Types: Industrial Process, Comfort Cooling, or Other Refrigeration	
Small Unitary Industrial Process Chiller Duty Type: Refrigeration	

D. Refrigerant Leaks

Facilities with R/AC appliances will always face the potential for refrigerant leaks, and the sources of leaks vary greatly. A refrigerant leak may occur in a R/AC appliance due to a weakened valve, rust in filter dryers or heat pump accumulator, tiny holes on capillary tubing due to friction, a damaged line set that carries refrigerant from the condenser to the evaporator coil, or a failure of the flare connection.[11] Additional common areas for refrigerant leaks include leaking joints, seals, gaskets and cracked pipes, as well as areas subject to significant vibration.[12] Refrigerant leaks may also include incidents where some aspect of

[11] Stouffer, D., "Refrigerant Leak Creates Environmental Problems for Businesses," February, 2009, http://air.environmental-expert.com/resultEachArticle.aspx?cid=32055&codi=45718&idproducttype=6, (accessed March 9, 2009).
[12] British Refrigeration Association, Code of Practice for Refrigerant Leak Tightness in compliance with the F-Gas Regulation, December 2007.

the refrigerant circuit is breached releasing refrigerant to the atmosphere; significant breaches are typically observed and quickly repaired.

Figure III. Refrigerant Leak Illustration

The image to the left illustrates a leaking expansion valve component in a small direct expansion system. The refrigerant leak is indicated by the stain on the ground.

E. Refrigerant Use, Sale, and Disposal

Refrigerants use, sale, and disposal are based on their varied purposes and their value chain impacts several industries. Stationary HVAC and refrigeration service industries are the primary end users of refrigerants related to refrigerant management.

Refrigerants are distributed and sold in a wide variety of cylinder sizes; common sizes for stationary HVAC and MVAC service are 30 to 50 pounds. Although refillable cylinders are available on the market, non-refillable cylinders are more often used. Without regard to the size of a cylinder or if a cylinder is refillable, residual refrigerant is always present in the cylinder when considered empty by a technician, but may not be useable due to a lack of sufficient pressure in the cylinder. This residual refrigerant, or heel, is a source of GHG emissions.

IV. OVERVIEW OF RELATED FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS

ARB staff reviewed existing international, federal and local laws and regulations governing high-GWP refrigerants to use as the foundation for this proposed statewide Regulation. In developing the proposed Regulation ARB staff worked with U.S. EPA staff and SCAQMD staff to ensure that the proposed Regulation is complementary to existing rules and can be easily harmonized into one consistent regulatory framework to reduce GHG emissions.

A. International Regulations

The primary international regulation reviewed was the Fluorinated Gas (F-Gas) Regulation (Regulation (European Council) No 842/2006). The objective of the F-Gas regulation is to contain, prevent and thereby reduce emissions of fluorinated greenhouse gases covered by the Kyoto Protocol. The F-gas Regulation became effective in June 2006.[13]

B. Federal Laws and Regulations

The proposed Regulation to a great extent is modeled from existing regulations promulgated under the CAAA section 608. California businesses currently using R/AC appliances requiring more than 50 pounds of an ODS refrigerant are subject to leak repair, required service practices, and recordkeeping requirements under existing U.S. EPA regulations outlined below. The proposed Regulation expands these existing federal regulations to include R/AC appliances using all high-GWP refrigerants.

Federal management of refrigerants is through regulations promulgated under the CAAA; section 608 of the CAAA includes requirements applicable to refrigerant use during stationary HVAC servicing, while Section 609 includes requirements specific to refrigerant use during MVAC servicing. These regulations originate from laws passed to mitigate stratospheric ozone depletion.

Section 608 of the CAAA includes required service practices that maximize the recycling of ODS during the service of stationary HVAC systems. Section 608 includes requirements specific to venting, approved equipment, technician training and certification, recordkeeping, certification requirements, and sales restrictions.

Section 609 of the CAAA is similar to Section 608, but it is specific to management of refrigerants while maintaining, servicing, repairing, or disposing of MVAC systems. Section 609 includes requirements specific to venting, evacuation, reclamation, equipment certification, refrigerant leaks, technician certification, sales restrictions, certification by owners of recycling and recovery equipment, reclaimer certification, safe disposal, and recordkeeping.

---

[13] Fluorocarbons and Sulphur Hexafluoride, http://www.fluorocarbons.org/en/debate/regulatory_developments/f_gas_regulation.html, (accessed September 24, 2009)

Final regulations promulgated under section 608 of the CAAA, published on May 14, 1993 (58 Federal Register (FR) 28660), established a recycling program for ODS refrigerants recovered during the servicing and maintenance of R/AC appliances. Together with the prohibition on venting during the maintenance, service, repair, and disposal of class I and class II ODS (January 22, 1991; 56 FR 2420), these regulations were intended to substantially reduce the production and emissions of ODS refrigerants. The final rule on venting and sales of refrigerant substitutes (March 12, 2004; 69 FR 11946) sustained the prohibition against venting HFC and PFC refrigerants.

Federal regulations specific to refrigerant cylinder management are based on the CAAA and U.S. Department of Transportation (DOT) cylinder specifications. The CAAA prohibits the sale of ODS refrigerants, except to a U.S. EPA certified technician or the employer of a certified technician. DOT regulations applicable to refrigerant management include: 1) Title 49: Transportation, Part 173, Shippers, General Requirements of Shipments and Packaging; and 2) Title 49, Transportation, Part 178, Specifications for Packagings, Subpart C, Specifications for Cylinders. These regulations outline requirements specific to cylinder type, size, service pressure, test pressure, size limitation, maximum water capacity, pressure of contents, material (steel or aluminum), and markings.

Federal Refrigeration Training and Certification Program

As required by the CAAA, the U.S. EPA has established refrigeration training and certification requirements for management of refrigerants. Section 609 training and certification is required for servicing of MVAC systems. Section 608 training and certification is required for servicing stationary HVAC systems, and includes four types of certification:

1. Type I - for servicing small appliances (e.g., residential refrigerators, household air-conditioning systems, etc.)
2. Type II - for servicing or disposing of high- or very high-pressure appliances (e.g., commercial retail food refrigeration systems), except small appliances and MVAC
3. Type III - for servicing or disposing of low-pressure appliances (e.g., R-123-based chillers)
4. Universal - for servicing all types of equipment

The U.S. EPA training programs focus on issues related to ODS and stratospheric ozone layer protection. The core of the training program includes the following topics:

1. Ozone Depletion
2. Clean Air Act and Montreal Protocol
3. Section 608 Regulations
4. Substitute Refrigerants and Oils

5. Refrigeration
6. Three R's – Recover, Recycle, and Reclaim
7. Recovery Techniques
8. Dehydration Evacuation
9. Safety
10. Shipping

In addition to the core program, the Type II training (High Pressure) includes training specific to high pressure systems in the core program topic categories, and also includes the following additional topics:

1. Leak Detection
2. Leak Repair Requirements
3. Recovery Techniques
4. Recovery Requirements

In addition to the core program, the Type III training (Low Pressure) includes training specific to low pressure systems in the core program topic categories, and also includes the following additional topics:

1. Leak Detection
2. Leak Repair Requirements
3. Recovery Techniques
4. Recharging Techniques
5. Recovery Requirements
6. Refrigeration
7. Safety[14]

In California there are 52 programs[15] that provide instruction in basic engineering principles and technical skills in support of engineers and other professionals engaged in developing and using refrigeration and stationary HVAC and MVAC systems. The instruction includes principles of heating and cooling technology, design and operational testing, inspection and maintenance procedures, installation and operation procedures, and report preparation. A primary purpose for this instruction is to prepare technicians to pass the test to become U.S. EPA certified technicians. A large component of these available training programs is through California's community college network, which provides a partnership

---

[14] U.S. EPA, "Overview of Issues on EPA Certification Test," U.S. EPA, http://www.epa.gov/Ozone/title6/608/technicians/certoutl.html, (accessed July 15, 2008).
[15] California Employment Development Department, "Training Program Summary," http://www.labormarketinfo.edd.ca.gov/cgi/dataBrowsing/traProgramSummary.asp?menuChoice=&cipcode=150501&geogArea=0601000000, (accessed July 15, 2008).

opportunity between the ARB and community colleges. Currently, ARB is working with community college instructors with a focus on training ARB and air district staff as an initial step in developing a partnership with a goal of evolving into technician training programs for refrigerant best management practices.

These training institutions will be important in the process of outreach and education of certified technicians specific to the requirements of the proposed Regulation and the use of best management practices to reduce high-GWP refrigerant emissions.

C. State Statute, Regulations, and Programs

There currently are few California statewide laws specific to emissions of high-GWP refrigerants from stationary R/AC appliances.

California laws and regulations specific to refrigerant cylinders are limited and generally applicable to cylinder labeling. Although the California Health and Safety Code includes statutes specific to refrigeration manufacturers (Section 19800) and certified appliance recyclers (Sections 25211-25214), there are no laws or regulations specific to the management of refrigerants in cylinders.

The California Code of Regulations (CCR) does include regulations specific to cylinder labeling. CCR, Business Regulations, title 4, Division of Measurement Standards Section 4051 requires that compressed gas cylinders be labeled with the tare weight, net contents, product identity, name and address of responsible company.

California Health and Safety Code Section 25212 provides that materials requiring special handling contained in major appliances (major appliances in this reference is specific to appliances such as household refrigerators) shall not be disposed of at a solid waste facility and shall be removed from major appliances prior to the appliance being processed in a manner that could release materials that require special handling.

Public Resources Code Section 42175 requires that materials requiring special handling be removed from major appliances prior to crushing for transport or transferring to a baler or shredder for recycling.

Public Resources Code Section 42167 provides definitions of "materials that require special handling" to include: PCBs, CFC, HCFC, other non-CFC replacement refrigerants, used oil in major appliances, and mercury found in switches and temperature control devices.

D. South Coast Air Quality Management District Rule 1415

Similar to the U.S. EPA's requirements under Section 608 of the CAAA, SCAQMD issued Rule 1415 in 1991 aimed at reducing emissions of ODS refrigerants from stationary R/AC appliances.

In addition to being modeled from existing federal regulations, the proposed Regulation has been developed to be consistent with SCAQMD Rule 1415. Businesses in the SCAQMD jurisdiction are subject to leak inspection, leak repair, registration and fee, reporting, and recordkeeping requirements under the SCAQMD's Rule 1415.

The rule requires any person within SCAQMD's jurisdiction, who owns or operates a refrigeration or air-conditioning system, to minimize refrigerant emissions. A refrigeration system is defined for the purposes of the rule, as any non-vehicular equipment used for cooling or freezing, which holds more than 50 pounds of, any combination of class I and/or class II refrigerant, including, but not limited to, refrigerators, freezers, or air-conditioning equipment or systems. Equipment that is found to be leaking any ODS refrigerant must be repaired within 14 days.

The SCAQMD requires biennial reporting from owners and operators of stationary R/AC appliances holding more than 50 pounds of an ODS refrigerant. Specific information collected includes: number of R/AC appliances in operation; type of refrigerant in each R/AC appliances; amount of refrigerant in each R/AC appliance; date of the last annual audit or maintenance performed for each R/AC appliance; and the amount of additional refrigerant charged to each R/AC appliance every year. For the purposes of the rule, additional refrigerant charge is defined as the quantity of refrigerant (in pounds) charged to a refrigeration system in order to bring the system to a full-capacity charge and replace refrigerant that has leaked.

This page is intentionally left blank

V. REFRIGERANT MANAGEMENT PROGRAM REGULATION DEVELOPMENT

A. Public Process in Rule Development

As part of ARB's regulatory development, staff made extensive personal contacts with industry representatives, state and local regulatory agencies, and other interested parties through site visits, meetings, telephone calls, and electronic mail. The regulatory development process spanned over 18 months and included several meetings of a technical workgroup and drafting of regulatory proposals with stakeholder review and comments.

The public process specific to the Refrigerant Management Program was initiated with a February 15, 2008 public workshop to present all measures being considered by the ARB in the stationary source high-GWP GHG sector. A primary action during this meeting was to solicit the attending public and industry representatives to join technical workgroups to assist and guide the ARB staff in the research and regulation development process.

Technical workgroup meetings specific to the proposed Regulation were held starting in April 2008, with the first Commercial Refrigeration Technical Workgroup meeting. In May 2008, the first Stationary Source High-GWP Refrigerant Tracking/Reporting/Repair Program technical workgroup meeting was conducted; the second was held in July 2008. The July 2008 technical workgroup meeting introduced the concept to integrate the Specification for New Commercial and Industrial Refrigeration Systems measure and High-GWP Refrigerant Tracking/Reporting/Repair Program for Stationary Sources measure resulting in the Refrigerant Management Program measure. Based on stakeholder input and to ensure the ARB and CEC do not have potentially confusing and duplicative regulations related to energy efficiency and the resulting GHG impacts, ARB and CEC will collaborate to incorporate direct GHG emission reductions and whole-building energy efficiency in the next phase of updates to the California Building Standards Code (Title 24). Thus, the focus of the proposed Regulation that is the subject of this report is existing refrigeration systems. A fourth technical work group meeting was held in January 2009 followed by a fifth technical work group meeting in July 2009.

Public workshops were conducted in September, 2008, in the cities of Sacramento, Fresno, and El Monte. Additional public workshops were conducted in February, 2009, in the cities of Sacramento, Modesto, and Diamond Bar. All Sacramento public workshops were also webcast to ensure access by a broader audience. A webcast public workshop to present current staff recommendations was held in Sacramento in August 2009.

In late 2008 ARB staff conducted refrigeration and air-conditioning contractor and technician surveys. In July and August 2009, ARB staff conducted a facility survey to research common characteristics of R/AC appliances used commercially and to outreach to the business communities that could be impacted by the proposed Regulation.

In summary, ARB staff visited several businesses as well as held private meetings with stakeholders, technical workgroup meetings, and public workshops throughout the state of California. In addition to these meetings and workshops ARB staff conducted extensive outreach efforts via phone and e-mail to approximately 67 trade organizations, 600 individual businesses, 20 state and local government agencies, and several e-mail list serves.

Outreach to potentially impacted facilities and persons were extensive and are described in detail in Appendix D.

B. Stationary Source High-GWP BAU Emissions Inventory and Potential Emissions Reductions

The estimate of total stationary source high-GWP emissions is a range established based on several data sources. The estimates include a "top-down" approach based on national estimates from the U.S. EPA Vintaging Model as well as a "bottom-up" approach using facility reporting from the SCAQMD. The Vintaging Model was developed as a tool for estimating the annual chemical emissions from industrial sectors that have historically used ODS in their products[16]. Both approaches were refined with additional data obtained from ARB staff research and research conducted through contract on behalf of the ARB.

Potential 2020 emissions based on a BAU scenario from stationary, non-residential R/AC appliances is 17.2 $MMTCO_2E$ – 15.8 $MMTCO_2E$ from refrigeration systems and 1.4 $MMTCO_2E$ from air-conditioning systems. The potential 2020 emission reductions estimate is 8.1 $MMTCO_2E$ from refrigeration systems - 7.2 $MMTCO_2E$ of Kyoto gases (HFC refrigerants) and 0.9 $MMTCO_2E$ of non-Kyoto gases.

As described in Appendix B, BAU emissions and potential emission reductions were determined based on emissions data reported by businesses to the SCAQMD pursuant to Rule 1415. BAU emission rates were based on average leak rates determined for specific categories of refrigeration systems. These emission rates were extrapolated statewide and emission estimates were based on the estimated number of facilities and refrigeration systems in each category.

ARB conducted a comprehensive study to determine the possible 2020 average achievable leak rates obtainable through the use of best management practices. The potential emission reductions are equal to the difference in the statewide emissions estimated using the average BAU leak rates and the statewide emissions estimated using the leak rates obtainable using best management practices.

The 2020 BAU emissions inventory and post-implementation GHG emission reductions estimates are outlined in Table V.

---

16 Godwin, D. (U.S. EPA), Martin Van Pelt, M. and Peterson, K. (ICF Consulting), Modeling Emissions of High Global Warming Potential Gases from Ozone Depleting Substance Substitutes, 2003. http://www.epa.gov/ttn/chief/conference/ei12/green/godwin.pdf, retrieved December 1, 2008.

Table V. Potential Emissions and Emission Reductions Associated with the Proposed Regulation in 2020.				
	Emissions			Emission Reductions
Refrigeration System Category	2010 BAU	2020 BAU	2020 Post-Rule	2020 Total GHG Reduction
Small Refrigeration System	1.2	1.4	0.5	0.9 (0.8 HFC, 0.1 ODS)
Medium Refrigeration System	5.7	7.9	4.6	3.3 (3.0 HFC, 0.3 ODS)
Large Refrigeration System	5.0	6.5	2.6	3.9 (3.3 HFC, 0.6 ODS)
Total Emissions and Potential Emission Reductions	11.9	15.8	7.7	8.1 (7.2 HFC, 0.9 ODS)

Notes:
All emissions and emission reductions are expressed in $MMTCO_2E$.
Totals may not sum due to rounding.
See Appendix B for detailed discussion of estimates.

The full description of the analyses conducted to determine the BAU emissions inventory and potential emission reduction estimates, including the uncertainty in the estimates, is provided in Appendix B.

Data reported to the SCAQMD pursuant to Rule 1415 served as the primary source of data to estimate BAU emissions and potential emission reductions. The statewide estimates were based on extrapolations of Rule 1415 data. As detailed in Appendix B, several other sources of data were used to assist in validating statewide estimates.

This page is intentionally left blank

VI. REFRIGERANT MANAGEMENT PROGRAM PROPOSED REGULATORY PROVISIONS

The proposed Regulation consists of several primary components outlining applicability and specific requirements. The purpose and the applicability of the proposed Regulation are outlined in sections 95380 and 95381. Definitions used in the proposed Regulation are outlined in section 95382.

The general requirements for facilities with stationary refrigeration systems are included in the following provisions:

- Registration Requirements for Facilities with Stationary Refrigeration Systems (section 95383)
- Implementation Fees for Facilities with Stationary Refrigeration Systems (section 95384)
- Leak Detection and Monitoring Requirements for Facilities with Stationary Refrigeration Systems (section 95385)
- Leak Repair Requirements for Facilities with Stationary Refrigeration Systems (section 95386)
- Requirements to Prepare Retrofit or Retirement Plans for Facilities with Leaking Stationary Refrigeration Systems (section 95387)
- Reporting Requirements for Facilities with Stationary Refrigeration Systems (section 95388)
- Recordkeeping Requirements for Facilities with Stationary Refrigeration Systems (section 95389)

The general requirements for persons installing or servicing R/AC appliances using high-GWP refrigerants are included in the Required Services Practices for High-GWP Appliances provision (section 95390).

The general requirements specific to refrigerant sales and refrigerant distributors, wholesalers, and reclaimers are included in the following provisions:

- Prohibitions (section 95391)
- Reporting Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers (section 95392)
- Recordkeeping Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers (section 95393)

Additional provisions describe implementation and enforcement issues:

- Confidentiality (section 95394)
- Enforcement (section 95395)
- Equivalent Local Rules (section 95396)
- Approval of Exemptions (95397)
- Severability (95398)

This section discusses the general requirements and rationale for each provision of the proposed Regulation.

95380. Purpose

Summary of Proposed Regulation

This section states the purpose of the Regulation. The purpose of this Regulation is to reduce emissions of high-GWP refrigerants from stationary, non-residential refrigeration equipment and from the installation and servicing of refrigeration and air-conditioning appliances using high-GWP refrigerants.

Rationale for Proposed Regulation

This section is necessary to ensure the regulated public understands that the proposed Regulation is an emission reduction measure to reduce emission of high-GWP refrigerants, which are GHG, pursuant to Health & Safety Code section 38562, in accordance with the approved Scoping Plan prepared pursuant to Health & Safety Code section 38561.

95381. Applicability

Summary of Proposed Regulation

This section outlines that the proposed rule requirements are applicable to 1) a person who owns or operates a stationary refrigeration system that uses more than 50 pounds of a high-GWP refrigerant; 2) a person who installs, repairs, maintains, services, replaces, recycles, or disposes of a R/AC appliance; and 3) a person who distributes or reclaims high-GWP refrigerants.

Rationale for Proposed Regulation

This section is necessary to identify the persons to which the Regulation would apply.

95382. Definitions

Summary of Proposed Regulation

This section defines the terms used in the Regulation.

Rationale for Proposed Regulation

It is necessary that ARB defines these terms as they apply to the Refrigerant Management Program. Many of the terms are used in other Articles and Titles in the California Code of Regulations, Government Code sections or statutes, and the Code of Federal Regulations, and it is necessary that ARB be consistent with existing definitions to the extent that they apply to this Regulation.

Description of Proposed Regulation

The proposed Regulation has many definitions to provide clarity. A primary factor in the development of proposed definitions and use of terms is consistency with 1) international conventions for reporting GHG emissions, 2) existing federal and local regulations, and 3) current understanding of terms by the regulated community based on existing federal regulation guidelines and industry standards.

The following terms warrant a detailed discussion to set out their meaning within the context of existing conventions, laws and regulations, and industry use of terms.

Global Warming Potential Value: The "global warming potential value" or "GWP value" definition is provided to ensure that estimated emission reductions resulting from the proposed Regulation are consistent with the international convention for reporting GHG emissions. With respect to the GWP of a high-GWP refrigerant, the Fourth Assessment Report (AR4) published by the Intergovernmental Panel on Climate Change (IPCC) represents the latest scientific thinking. However, to calculate emissions and potential emission reductions, the IPCC's Second Assessment Report (SAR) is still used by international convention for reporting GHG emissions. The U.S. EPA uses the SAR GWP values for reporting the United States' GHG emissions under the United Nations Framework Convention on Climate Change (UNFCC). The Climate Action Reserve (CAR) and the International Council for Local Environmental Initiatives (ICLEI) both reference use of the SAR GWPs as well.

This is a long-standing issue since the IPCC's third assessment report (TAR, 2001) - the decision was made to base the Kyoto Protocol on the GWP values published in the SAR. As a result, those GWPs were locked in. A decision to update to more scientifically correct GWPs has not yet been made. Thus, the annual U.S. reporting and ARB are being consistent in using SAR as the source of GWPs.

Additionally, and most significantly, the California GHG baseline inventory, and thus the 2020 GHG emission target, is based on GWP values published in the SAR. Analysis and reporting for regulatory measures must be based on the GWP values published in the SAR in order to ensure an apples-to-apples comparison with the California GHG baseline inventory and emission reduction target.

There are several definitions that are copied, in whole, or in part from, or are provided by reference to, existing federal regulations to ensure that the meanings of the definitions are consistent with the language of federal regulatory text, guidance provided by the U.S. EPA, and the common understanding of the regulated community based on over a decade of complying with existing federal regulations. Definitions that are copied or referenced from existing federal regulations include the following:

- Appliance
- Certified reclaimer
- Certified refrigerant recovery or recycling equipment
- Certified technician
- Commercial refrigeration
- Normal operating characteristics and conditions
- Reclaim
- Recover
- Recycle
- Retire

Follow-up verification test	Retrofit
Industrial process refrigeration	System mothballing

In the above list of definitions developed based on consistency with existing federal regulations there is one definition that warrants further discussion.

Follow-up Verification Test: The definition of a follow-up verification test is important as it reflects the varied applications of such a test for a refrigerant leak. This test is required for a variety of refrigeration systems but may be foregone under some conditions, as such it requires flexibility. As an example, the definition includes the term, "except in cases where sound professional judgment dictates." This language is consistent with existing federal regulations and provides a required flexibility understood by the regulated community. It is provided to ensure a test that provides limited benefit in some circumstances is not required, and does not add unnecessary costs. Conversely, if reasonable professional judgment would find that the test is appropriate under the specific circumstance and it provides a benefit of preventing refrigerant emissions, then it is required.

95383. Registration Requirements for Facilities with Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the facilities required to register based on their use of a refrigeration system with more than 50 pounds of a high-GWP refrigerant. Additionally, this section sets out the registration schedule and the information that must be provided during registration.

Rationale for Proposed Regulation

Registration is necessary to identify facilities that have potential GHG emissions from their stationary refrigeration systems, and to identify the characteristics of the refrigeration systems that can be indicators of potential GHG emissions that are targeted for reduction pursuant to Health & Safety Code section 38562.

The average lifetime of the commercial refrigeration equipment applicable under the facility registration provision, according to U.S. EPA Vintaging Model technical data sheet estimates, is between 15 and 25 years, with most equipment expected to last about 20 years before replacement. The expected annual turnover rate based on the equipment lifetime is estimated to be in the range of 4% - 7% based on the system type. Based on the long useful lifetime of refrigeration systems having registration of facilities with these systems in operation is necessary to assist in enforcement activities and to identify the characteristics of the refrigeration systems that can be indicators of potential GHG emissions.

The phased-in approach proposed for registration is necessary to ensure that requirements for each facility reflect the potential GHG emission risks from each facility based on the refrigeration system(s) used.

Description of Proposed Regulation

The potential high-GWP refrigerant emission risk from stationary, non-residential refrigeration systems is directly related to the refrigerant charge size of the refrigeration system. The phased-in approach for registration is based on refrigerant charge size categories according to the following titles:

A. Large Refrigeration Systems: refrigerant charge greater than or equal to 2,000 pounds

B. Medium Refrigeration Systems: refrigerant charge greater than or equal to 200 pounds, but less than 2,000 pounds

C. Small Refrigeration Systems: refrigerant charge greater than 50 pounds, but less than 200 pounds

The refrigerant charge size categories were developed to focus requirements on facilities with refrigeration systems with the greatest potential emissions, while also reducing the administrative burden of implementation. A principal rationale for the refrigerant charge size lower limit of greater than 50 pounds is consistency with requirements pursuant to existing U.S. EPA regulations, and the SCAQMD Rule 1415. Additionally, R/AC appliances with a refrigerant charge of 50 pounds and less are commonly tightly sealed to prevent the escape of air or any other gases and result in limited refrigerant emissions.

Owners and operators of facilities with stationary, non-residential refrigeration systems with a refrigerant charge size of more than 50 pounds of a high-GWP refrigerant will have to register with the ARB.

Registration is required based on schedule provided in Table VI.

Table VI. Registration Requirement Schedule

Refrigeration System Category	Initial Registration Due Date
Large Refrigeration Systems	March 1, 2012
Medium Refrigeration Systems	March 1, 2014
Small Refrigeration Systems	March 1, 2016

Registration will include the following information pertaining to the facility and to the refrigeration equipment.

Table VII. Registration Requirement Data Submitted

Facility Information	Equipment Information
Name of operator	System identification number
Operator federal tax ID number	Equipment type
Facility NAICS business type code	Equipment manufacturer
Facility SIC code	Equipment model or description
Name of facility, including a facility identifier such as store number	Equipment model year

Facility Information	Equipment Information
Facility mailing address	Equipment serial number. An equipment serial number is not required if a refrigeration system is assembled with multiple components with individual serial numbers, the serial number is inaccessible after assembly, or the appliance does not otherwise have an serial number
Facility physical location address	Physical location of the refrigeration system
Facility contact person	Refrigeration system temperature classification – low temperature system, medium temperature system, or other
	Full charge of the refrigeration system
Facility contact person phone number	Type of high-GWP refrigerant used
Facility contact person e-mail address	

In the registration process a facility will obtain a facility identification number. If they use the web-based registration process to be developed by the ARB, then the facility identification number will be auto-generated in the process of starting a new registration. Alternately, a facility can contact ARB staff and they will be provided a facility identification number. All other data will be specific to the facility registering.

The average lifetime of commercial refrigeration equipment that is applicable under the facility registration provision, according to U.S. EPA Vintaging Model technical data sheet estimates, is between 15 and 25 years, with most equipment expected to last about 20 years before replacement. The expected annual turnover rate based on the equipment lifetime is estimated to be in the range of 4% - 7% based on the system type. Based on the long useful lifetime of the refrigeration systems having registration of facilities with these systems in operation is necessary to assist in enforcement activities and to identify the characteristics of the refrigeration systems that can be indicators of potential GHG emissions.

95384. Implementation Fees for Facilities with Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the initial and annual implementation fee a facility with a refrigeration system that uses 200 pounds or more of a high-GWP refrigerant will be required to pay.

Rationale for Proposed Regulation

Implementation fees are necessary to fund the implementation and enforcement of this Regulation and cost-effectively achieve specified GHG reductions pursuant to Health & Safety Code section 38562.

The imposition of fees only on facilities with medium or large refrigeration systems reflects the greater environmental impact posed by a leak at such a facility. A leak from a small refrigeration system presents a much smaller environmental impact.

The average lifetime of commercial refrigeration equipment that is applicable under the facility registration provision, according to U.S. EPA Vintaging Model technical data sheet estimates, is between 15 and 25 years, with most equipment expected to last about 20 years before replacement. The expected annual turnover rate based on the equipment lifetime is estimated to be in the range of 4% - 7% based on the system type. Based on the long useful lifetime of the refrigeration systems, requiring registration of facilities with these systems in operation is necessary to assist in enforcement activities and to identify the characteristics of the refrigeration systems that can be indicators of potential GHG emissions.

The proposed implementation fee exemption provides an incentive for facilities to use refrigeration systems that utilize advanced strategies and practices reducing refrigerant charges and emissions of ozone-depleting substances and greenhouse gases.

Description of Proposed Regulation

Implementation fees are proposed annually for facilities with a large or medium refrigeration system to be paid with the initial registration and annually thereafter. No implementation fee is proposed for facilities with only a small refrigeration system(s).

The amounts of the proposed implementation fees are based on discussions with CAPCOA and the ARB Enforcement Division staff related to their time and materials that would be needed to conduct inspections. The time needed includes pre-inspection time for facility reports review; on-site equipment inspection; review of equipment service records and leak repair records; review of refrigerant purchase, use, and shipping records; travel planning; and report writing. It is anticipated that compliance can be maintained with periodic enforcement inspections prioritized on facilities' potential or demonstrated leak risk, i.e. those facilities with a refrigeration system with a larger refrigerant charge size (greater potential emissions in the case of a leak) and equipment type(s) that is more prone to leaks or with a higher leak rate demonstrated by their annual report.

Implementation fees will fund staff to conduct inspection and enforcement activities, implement the program, provide outreach, assist the regulated community, and establish and maintain an on-line payment and reporting system to streamline all reporting requirements.

The implementation fees specific to each refrigerant charge size category are based on the average staff costs for administration of the proposed Regulation. The staff costs are related to the potential GHG emissions per facility as the time required for enforcement activities is estimated based on the need to focus on the facilities with the greatest potential GHG emissions. The implementation fees proposed for a facility with a medium and large refrigeration system are justified by the greater environmental impact posed by systems with a larger charge size. Facilities with large refrigeration systems represent approximately 8 percent of all facilities, but 41 percent of projected 2020 BAU GHG emissions. Facilities with medium refrigeration systems represent approximately 33 percent of all facilities, but 50 percent of projected 2020 BAU GHG emissions. Conversely, facilities with small refrigeration systems represent approximately 60 percent of all facilities, but only 9 percent of projected 2020 BAU GHG emissions.

A facility with multiple refrigeration systems will be required to pay fees based only on the largest refrigeration system in operation at the facility. For example if a facility has one large refrigeration system and two medium refrigeration systems they will pay a single implementation fee of $370.

The implementation fee structure is provided in Table VIII.

Table VIII. Proposed Implementation Fee

Refrigeration System Category	Annual Implementation Fee
Large Refrigeration Systems	$370
Medium Refrigeration Systems	$170
Small Refrigeration Systems	$0

Additional detailed information on the development of the implementation fee amount is provided in Appendix C.

The proposed implementation fee exemption provides an exemption from paying either an initial or annual implementation fee to incentivize facilities to use, or install in newly constructed facilities, refrigeration systems that decrease the environmental impact posed by a refrigeration system through the use of advanced strategies and practices to reduce emissions of ozone-depleting substances and greenhouse gases.

95385. Leak Detection and Monitoring Requirements for Facilities with Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the leak detection and monitoring systems or practices that will be required for refrigeration systems that use over 50 pounds of a high-GWP refrigerant.

Rationale for Proposed Regulation

Leak detection and monitoring is necessary to ensure detection of high-GWP refrigerant emissions and allow expedited refrigerant leak repair. High-GWP refrigerant leaks can be on-going for long periods of time without detection or loss of apparent operational efficiency. The Regulation's leak monitoring and inspection requirements are the primary means of achieving the emission reductions required by Health & Safety Code section 38562.

The tiered requirements for leak detection and monitoring and the specific performance standards for automatic leak detection systems are necessary to ensure that requirements for each facility relate to the potential emission risks from each facility based on the refrigeration system(s) used.

Description of Proposed Regulation

Starting in January 2011, leak detection and monitoring for high-GWP refrigerant leaks will be required for any system that requires more than 50 pounds of a high-GWP refrigerant. The requirements and frequency will depend on the refrigerant charge size category of the individual refrigeration system(s) in operation as summarized in Table IX.

Table IX. Proposed Leak Detection and Monitoring Requirements

Refrigeration System Category	Monitoring Requirement
Large Refrigeration Systems	Automatic leak detection system with continuous monitoring
Medium Refrigeration Systems	Quarterly leak inspections
Small Refrigeration Systems	Annual leak inspections

Automatic leak detection is required only for facilities with a large refrigeration system. Due to the time required to obtain funding for new equipment the automatic leak detection system requirement will be effective beginning in 2012, with monthly refrigerant leak inspections required in 2011 if an automatic leak detection system is not in operation.

The automatic leak detection systems that will be required are based on existing technology as described in ANSI/ASHRAE Standard 15-2001 Safety Standard for Refrigeration Systems. The proposed Regulation is consistent with this industry standard in that the detector must be continuously operated and provides real-time information. The detector required is not specified, but rather the function of the detector is specified to allow the system designer to select the type of detector based on the application.[17]

Facilities that use large commercial and industrial refrigeration systems can vary greatly ranging from petroleum refineries to a neighborhood supermarket. Similar types of facilities may have very different refrigerant monitoring requirements. In one scenario, a 50,000 square foot supermarket may have a machine room with one chiller that houses the entirety of high-GWP refrigerant used at the facility; this may be effectively monitored with only one or two sensors. Alternatively, the same market may have a machine room with refrigerant distributed to several compressors and many display cases throughout the entire facility; this will likely require many more than two sensors to be effectively monitored.

[17] American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. User's Manual for ANSI/ASHRAE Standard 15-2001 Safety Standard for Refrigeration Systems, 2003

Other factors that must be included in the design of a refrigerant monitoring system include the vapor density of the specific refrigerant used and the airflow pattern of the facility in areas with potential refrigerant leaks. [18] Due to the many factors involved, application-specific design for refrigeration systems and the necessary refrigerant leak detection systems is required. This requires a flexible regulatory framework.

The proposed regulatory language seeks to balance the need for exacting clarity in requirements with the need for flexibility to accommodate the varied, application-specific designs of refrigeration systems and refrigerant monitoring systems. Imprecise terms such as "proximity to principal components" and "areas of high potential for a refrigerant leak" are necessary to achieve this practical balance. ARB staff considered being more specific and prescriptive, for example requiring a minimum of three sensors. But, in some cases this would be overly prescriptive and add costs without the benefit of more effective monitoring, and in other cases this would not provide effective monitoring.

Any facility that installs an automatic leak detection system with continuous monitoring that directly detect the presence of refrigerant in air must place sensors or intakes such that they will measure the refrigerant concentrations in air in proximity to principal components of the refrigeration system (e.g., compressor, evaporator, condenser).

Automatic leak detection systems that directly detect the presence of refrigerant in air will be required to meet performance standards including the following:

1. Ability to accurately detect the presence of 10 ppm of refrigerant in the atmosphere.
2. Generate an alarm signal when the level of refrigerant in the atmosphere exceeds 100 ppm.

Automatic leak detection systems that use an indirect system (i.e. interpreting measurements that indicate a refrigerant leak) must alert the operator when measurements indicate a loss of 10 percent of the refrigerant charge or 50 pounds, whichever is less.

Some large refrigeration systems are intended to operate less than 12 months per year, or outside an enclosed building or structure. For these systems an automatic leak detection system is not required, but a leak inspection is required within 30 days of each initial operation of the refrigeration system, and at least quarterly during continued operations.

Medium or small facilities that are not required to have an automatic detection system must respectively use a calibrated refrigerant leak detection device, bubble test, or observation of oil residue. Facilities with small refrigeration systems only must do so annually, facilities with medium refrigeration systems

[18] Ibid.

must do so quarterly. Any leaks initially detected by observation of oil residue must then be confirmed by a calibrated refrigerant leak detection device or bubble test. If a medium or small refrigeration system is monitored via an automatic leak detection system that meets the proposed standards, them the facility owner or operator will not be required to conduct quarterly or annual leak inspections.

As the loss of refrigerant in a refrigeration system is an indication of a refrigerant leak, a leak inspection is required for all refrigeration systems that require more than 50 pounds of a high-GWP refrigerant any time an additional refrigerant charge is required that is equal to or greater than 5 pounds, or one percent of the refrigeration system full charge, whichever amount is greater.

95386. Leak Repair Requirements for Facilities with Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the leak repair requirements for refrigeration systems that use over 50 pounds of a high-GWP refrigerant.

Rationale for Proposed Regulation

Leak repair is necessary to ensure emissions of high-GWP refrigerants are reduced pursuant to Health & Safety Code section 38562.

Description of Proposed Regulation

Leaks repair must be completed within either 14, 45, or 120 days of leak detection. The applicable time-limit depends upon the nature of the system, and the circumstances surrounding the leak.

ARB is proposing that any refrigerant leak from a stationary, non-residential refrigeration system requiring more than 50 pounds of a high-GWP refrigerant be repaired by a U.S. EPA certified technician within 14 days of initial leak detection. Based on communications with representatives of facilities using best management practices, refrigerant leaks are commonly corrected within several hours or days of leak detection depending on the severity of the leak. This repair time-frame is primarily due to the economic cost of a continued refrigerant leak in terms of refrigerant consumption. The proposed Regulation provides up to 14 days to complete a refrigerant leak repair, although under certain circumstances, such as the unavailability of a certified technician or a required part, or if a refrigerant leak repair requires an industrial process shutdown, addition time for repair may apply. A facility owner or operator has 45 days to repair a refrigerant leak any of the following conditions applies:

1. Additional time is required to order components or secure the services of a U.S. EPA certified technician.
2. The ARB has approved an exemption, or there is a pending exemption request.

3. The leak repair requires the shutdown of an industrial process.

A facility owner or operator has 120 days to repair a refrigerant leak if all of the following conditions apply:

1. The facility owner or operator is an entity subject to Mandatory Greenhouse Gas Emissions Reporting requirements pursuant to section 95101 of the Health and Safety code.
2. The refrigeration system is an industrial process refrigeration appliance.
3. The refrigerant leak repair requires an industrial process shutdown.
4. Written records are maintained to document that all the above conditions were met.

Following any leak repair of a system subject to the Regulation initial and follow-up verification tests will be required.

If the refrigerant leak cannot be repaired and verified within the applicable 14, 45, or 120 days then the system owner or operator must prepare and implement a retrofit or retirement plan within a specified time period.

The following points are relevant to the functional need for the lengthy 120 day repair period that will be applicable under certain circumstances. As noted above, to qualify for the 120 day repair period a facility must be subject to Mandatory Greenhouse Gas Emissions Reporting under section 95101 of the Health and Safety code. Such facilities include electricity generating facilities, electricity retail providers and power marketers, oil refineries, hydrogen plants, cement plants, cogeneration facilities, and industrial sources that emit over 25,000 $MTCO_2E$ per year from stationary source combustion. For example, a facility that may be subject to the 120-day provision would be a petroleum refinery as it is required to annually report their GHG emissions and would likely also have to comply with the proposed Regulation.

The 120-day provision for leak repair at such facilities is provided to mitigate the Regulation's potential to require the shutdown of an industrial process due to a refrigerant leak with the related significant energy-related economic impacts. Repair of a refrigerant leak must ultimately be accomplished, but this provision seeks a balance between the importance of mitigating refrigerant leaks and the potential economic impact of the shutdown of facilities producing petroleum or other resources for California's consumers industries.

The 120-day provision for leak repair allows time for the specific life-cycle emissions and economic impact of the refrigerant leak. The determination of the net benefit of repairing the refrigerant leak and the economic costs that may result would be required if a facility applies for a conditional exemption under the proposed Regulation.

95387. Requirements to Prepare Retrofit or Retirement Plans for Facilities with Leaking Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the refrigeration system retrofit or retirement plan for refrigeration systems that use over 50 pounds of a high-GWP refrigerant and are shown to have unrepairable refrigerant leaks.

Rationale for Proposed Regulation

Retrofit or retirement plans for refrigeration systems that continually leak high-GWP refrigerants are necessary to reduce GHG emissions, pursuant to Health & Safety Code section 38562.

Description of Proposed Regulation

If a refrigerant leak persists, the refrigeration system owner or operator will be required to prepare a retrofit or retirement plan that establishes a schedule to retrofit or retire the system within six months of the initial leak detection.

The retrofit or retirement plan will not be submitted to the ARB, but will be maintained in a facility's on-site records, and will be required to include the following information pertaining to the facility and to the retrofitted or newly installed refrigeration systems.

Equipment Information

1. System Identification Number.
2. Equipment type.
3. Equipment manufacturer.
4. Equipment model or description.
5. Intended physical location of the refrigeration system through schematic or floor plan with location clearly noted.
6. Refrigeration system temperature classification – low temperature system, medium temperature system, or other.
7. Full charge of the refrigeration system.
8. Type of high-GWP refrigerant used.
9. A plan for the old refrigeration system disposition.
10. A detailed timetable including: the anticipated dates to begin and complete the installation, construction, or retrofit.
11. Date and signature of responsible facility representative.

95388. Reporting Requirements for Facilities with Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the reporting requirements for facilities with refrigeration systems that use 200 pounds or more of a high-GWP refrigerant.

Rationale for Proposed Regulation

Facility reporting is necessary to quantify GHG emission reductions that result from the proposed Regulation as required pursuant Health & Safety Code section 38562.

The reporting requirements are proposed only for facilities with large and medium refrigeration systems to minimize the administrative burden upon ARB in implementing the proposed Regulation and upon stakeholders in complying with the proposed Regulation as required pursuant to Health & Safety Code section 38562.

Reporting is not necessary for facilities with small refrigeration systems as nearly 90 percent of total GHG emission reductions are expected to result from facilities with large and medium refrigeration systems. Total statewide emissions that result from the proposed Regulation can be quantified based on reports from facilities with large and medium refrigeration systems extrapolated to quantify GHG emission reductions from all refrigeration systems using more than 50 pounds of a high-GWP refrigerant.

Description of Proposed Regulation

ARB is proposing that owners or operators of stationary, non-residential refrigeration systems that use 200 pounds or more of a high-GWP refrigerant report to the ARB annually by March 1 after the end of each calendar year.

Reporting will be phased in based on the schedule provided in Table X.

Table X. Proposed Facility Reporting Schedule

Refrigeration System Category	Initial Annual Report
Large Refrigeration Systems	March 1, 2012
Medium Refrigeration Systems	March 1, 2014
Small Refrigeration Systems	No Reporting Required

The information required in an annual Facility Stationary Refrigeration report falls into the following broad categories: facility refrigeration system(s), refrigeration system service and leak repairs, and refrigerant purchases and use. Each of these categories must respectively include the information described below.

Refrigeration System Information

1. System identification number.
2. Equipment type.
3. Equipment manufacturer.
4. Equipment model or description.
5. Equipment model year.

6. Equipment serial number. The serial number(s) of the affected equipment or component must be recorded when present and accessible. When the affected equipment or component is part of an assembly without a serial number or does not have an individual serial number or is not accessible after assembly, the physical location of the affected equipment must be recorded in enough detail to permit positive identification.
7. Physical location of a refrigeration system through schematic or floor plan with equipment locations clearly noted.
8. Temperature classification – The refrigeration system must be identified as a low temperature system, a medium temperature system, or other.
9. Full charge of the refrigeration system.
10. Type of high-GWP refrigerant(s) used.
11. Date of initial installation.

Refrigeration System Service and Leak Repair Information

1. Date leak detected, if applicable.
2. Date service provided or leak repair completed.
3. Cause of refrigerant leak, if applicable.
4. Description service provided or leak repair completed.
5. Date(s) of initial verification test(s), if applicable.
6. Date(s) of follow-up verification test(s), if applicable.
7. Total additional refrigerant charge of each type of high-GWP refrigerant, if applicable.
8. Purpose for additional refrigerant charge (leak repair, topping off, initial refrigerant charge, or seasonal adjustment), if applicable.
9. Name of certified technician completing leak repair, if applicable.
10. The certified technician's identification number issued by an approved technician certification program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.161, if applicable.
11. The certified technician's certification type(s) issued by an approved technician certification program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.161, if applicable.

Refrigerant Purchase and Use

1. The total weight in pounds of each type of high-GWP refrigerant that was purchased.
2. The total weight in pounds of each type of high-GWP refrigerant that was charged into a refrigeration system.
3. The total weight in pounds of each type of high-GWP refrigerant that was recovered from a refrigeration system.
4. The total weight in pounds of each type of high-GWP refrigerant that was stored in inventory at the facility, or stored at a different location for use by the facility, on the last day of the calendar year.
5. The total weight in pounds of high-GWP refrigerant that was shipped by the owner or operator for reclamation and destruction.

95389. Recordkeeping Requirements for Facilities with Stationary Refrigeration Systems

Summary of Proposed Regulation

This section describes the recordkeeping requirements for facilities with refrigeration systems that use over 50 pounds of a high-GWP refrigerant.

Rationale for Proposed Regulation

Facility recordkeeping is necessary to verify reported data and to ensure the Regulation is enforceable, pursuant to Health & Safety Code section 38562, based on findings from the review of facility records.

Description of Proposed Regulation

Facilities will be required to keep records and to retain records for a minimum of five years; recordkeeping must include the following:

1. Registration required by section 95383.
2. Documentation of all leak detection systems, leak inspections, and automatic leak detection system annual audit and calibrations required by section 95385.
3. Records of all refrigeration system and refrigeration system service and refrigerant leak repairs, and documentation of any conditions allowing repair of a refrigerant leak to be conducted more than 14 days after leak detection, as required by section 95386. Refrigeration system and refrigeration system service and refrigerant leak repair records must include documentation of all items reported pursuant to section 95388.
4. Retrofit or retirement plans required by section 95387.
5. All reports required by section 95388.
6. Invoices of all refrigerant purchases.

7. Records on of all shipments of refrigerants for reclamation or destruction.
8. Records of all refrigeration systems component data, measurements, calculations, and assumptions used to determine the full charge.

95390. Required Service Practices for High-GWP Appliances

Summary of Proposed Regulation

This section describes the required service practices to reduce emissions resulting from the installation and servicing of R/AC appliances using high-GWP refrigerants.

Rationale for Proposed Regulation

The required service practices are necessary to ensure emissions of high-GWP refrigerants are reduced pursuant to Health & Safety Code section 38562. Additionally, the required service practices are modeled from Title 40, Part 82 of the Code of Federal regulations to ensure consistency with federal regulations specific to ODS refrigerants.

Description of Proposed Regulation

ARB is proposing the following set of requirements as part of the Regulation to reduce emissions resulting from the installation and servicing of R/AC appliances using high-GWP refrigerants.

Required service practices proposed are rooted in the foundation of the CAAA, although they will be expanded to include all high-GWP refrigerants. The required service practices include the following:

1. In preparing an appliance for recycling or disposal, the person must not intentionally disrupt the refrigerant circuit of the appliance resulting in a discharge of refrigerant into the atmosphere, unless an attempt to recover refrigerant is made using specified equipment.
2. A person must make a recovery attempt using specified equipment for the specific type of appliance prior to opening an appliance to atmospheric conditions.
3. A person must not add refrigerant to an appliance during manufacture or service, unless such refrigerant is an ODS refrigerant, or a refrigerant approved under the U.S. EPA's Significant New Alternatives Policy (SNAP) program or is otherwise approved by the Executive Officer for the specific end use.
4. A person must not add an additional refrigerant charge to any appliance known to have a refrigerant leak, except that it is permissible to add an additional refrigerant charge for seasonal adjustment or to maintain operations while complying with refrigerant leak repair requirements.
5. A person servicing an appliance must hold a current, valid, and applicable certificate issued in accordance with Title 40 of the Code of Federal Regulations, Part 82, section 82.161.

6. A person must employ procedures approved by the U.S. EPA or Executive Officer for the certified refrigerant recovery or recycling equipment used. .
7. A person must use certified refrigerant recovery or recycling equipment as specified by the equipment manufacturer, unless the manufacturer's specifications conflict with the procedures approved by the U.S. EPA or Executive Officer.
8. A person must evacuate refrigerant from a non-refillable cylinder to a vacuum of 15 inches of mercury, relative to standard atmospheric pressure of 29.9 inches of mercury, prior to recycling or disposal.
9. A person must satisfy job site evacuation of refrigerants during recycling, recovering, reclaiming, or disposing in accordance with Title 40 of the Code of Federal Regulations, Part 82, §82.156.

In general, required service practices are based on Title 40 of the CFR, Part 82. The primary impact of placing these service practices in the proposed Regulation is to expand the existing requirements for ODS refrigerants (CFC and HCFC refrigerants) to cover all high-GWP refrigerants (CFC, HCFC, HFC, and PFC refrigerants).

The required service practices provision is an another area of the Regulation where language is copied from existing federal regulations. The terms, "attempt to recover refrigerant", "reasonably be expected", "recovery attempt", and "reason to believe" are from existing federal regulations and proposed to match federal regulatory text (so as to be consistent with industry's common understanding of the terms based on the U.S. EPA past guidance).

Title 40 of the CFR, Part 82 does not specify an evacuation requirement for non-refillable refrigerant cylinders. In researching non-refillable refrigerant cylinder evacuation standards several options were reviewed. Evacuation levels of a vacuum of 4 inches of mercury below atmospheric pressure and 15 inches of mercury, relative to standard atmospheric pressure of 29.9 inches of mercury, were considered. The standard of 4 inches is consistent with the CFR Appendix D to Subpart B of Part 82—Standard for HFC-134a Recover-Only Equipment. This requirement is specific to the use of extraction equipment for MVAC systems that must be capable of ensuring removal of refrigerant from the system being serviced by reducing the system pressure to a minimum of 102 mm (4 in) of mercury below atmospheric pressure (i.e., vacuum).

The standard of 15 inches is consistent with the CFR, Subpart F of Part 82, section 82.156. This requirement is specific to required levels of evacuation for appliances and specifies that when using recovery or recycling equipment manufactured or imported on or after November 15, 1993 evacuation is required at the following levels: 1) high-pressure appliance, or isolated component of such appliance, normally containing 200 pounds or more of refrigerant (10 inches of mercury); 2) medium-pressure appliance, or isolated component of such appliance, normally containing less than 200 pounds of refrigerant (10 inches of mercury); and medium-pressure appliance, or isolated component of such appliance, normally containing 200 pounds or more of refrigerant (15 inches of mercury).

Based on these requirements, certified refrigerant recovery and recycling equipment has been developed to meet the specified evacuation requirements. The AHRI certified product directory lists a wide variety of certified refrigerant recovery and recycling equipment available. The equipment ratings in the product directory provide a "Shut Off Vacuum" rating. The vast majority of the certified equipment listed is designed and tested to obtain a vacuum of 15 inches or higher before reaching the shut off vacuum rating.[19] Thus, the proposed evacuation requirements are technologically feasible with current equipment manufactured and required for use by existing U.S. EPA regulations.

95391. Prohibitions

Summary of Proposed Regulation

This section describes specific prohibitions of refrigerant sale, use, and disposal practices.

Rationale for Proposed Regulation

The prohibitions are necessary to ensure emissions of high-GWP refrigerants are reduced, pursuant to Health & Safety Code section 38562, by ensuring proper use of high-GWP refrigerants by qualified persons. Additionally, the prohibitions are modeled from Title 40, Part 82 of the Code of Federal regulations to ensure consistency with federal regulations specific to ODS refrigerants.

Description of Proposed Regulation

The Prohibitions provision is focused on reducing emissions caused by the distribution or reclamation of high-GWP refrigerants. The regulatory concept would place restrictions on refrigerant cylinder use that are consistent with Required Service Practices (section 95390), and would only allow refrigerant sales to qualified technicians.

Federal requirements and prohibitions specific to the purchase of refrigerants, recycling and reuse of refrigerants, and/or sale of reclaimed refrigerants are currently specific only to ODS refrigerants; the proposed Regulation will extend the requirements to all high-GWP refrigerants thus requiring emissions control on ODS refrigerants as well as ODS substitute refrigerants. Additional prohibitions focus on the use of approved refrigerants and reduction of refrigerant emissions from refrigerant cylinders.

The prohibitions include the following:

1. A person, effective January 1, 2011, must not sell, distribute, offer for sale or distribution, or purchase any high-GWP refrigerant for use as a refrigerant in a container of two pounds or greater to a person unless: 1)

[19] Air-Conditioning, Heating and Refrigeration Institute, Certified Product Directory, January 2009, http://www.ahridirectory.org/ahridirectory/pages/rrr/RRRE%2015%20January%2009_Directory.pdf, (accessed April 7, 2009).

the buyer is a certified technician; 2) the buyer is an employer of a certified technician; 3) the refrigerant is sold only for eventual resale to certified technicians, to air-conditioning or refrigeration appliance manufacturers, or the refrigerant is being sent for reclamation; or 4) the refrigerant is contained in a R/AC appliance.

2. A person must not sell used refrigerant to a new owner for use as a refrigerant unless the used refrigerant has first been reclaimed by a U.S. EPA-certified refrigerant reclaimer.
3. A person must not sell or distribute or offer to sell or distribute any refrigerant for any R/AC appliance unless such refrigerant is an ODS refrigerant, or a refrigerant approved under the U.S. EPA's Significant New Alternatives Policy (SNAP) program or the Executive Officer for the specific end use.
4. A person must not recycle or dispose of a non-refillable cylinder before the non-refillable cylinder has been evacuated to a vacuum of 15 inches of mercury, relative to standard atmospheric pressure of 29.9 inches of mercury.
5. A person must not distribute or sell certified refrigerant recovery or recycling equipment unless such equipment meets the levels of evacuation to be achieved by recovery or recycling equipment as specified in Title 40 of the Code of Federal Regulations, Part 82.
6. A person must not refill a non-refillable cylinder or use it as a temporary receiver during service.
7. A person must not repair or modify a non-refillable cylinder in any way to allow the non-refillable cylinder to be refilled.

95392. Reporting Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers

Summary of Proposed Regulation

This section describes the reporting requirements for refrigerant distributors, wholesalers, and reclaimers.

Rationale for Proposed Regulation

Distributors, wholesalers, and reclaimers reporting is necessary to verify GHG emission reductions that result from the proposed Regulation as required pursuant to Health & Safety Code section 38562.

Description of Proposed Regulation

ARB is proposing that refrigerant distributors, wholesalers, and certified reclaimers report specified information to the ARB annually by March 1, beginning March 1, 2012.

The refrigerant distributor or wholesaler annual reports will include: the refrigerant distributor or wholesaler company name, address, and contact person information; a listing of all California facilities; and the following aggregated information (on a company-wide basis):

1. The total annual aggregated weight in pounds of each type of high-GWP refrigerant that was purchased or received for the purpose of subsequent resale or delivery, or for any purpose other than reclamation or destruction.
2. The total annual aggregated weight in pounds of each type of high-GWP Refrigerant that was sold or distributed:

The certified reclaimer annual reports will include: the certified reclaimer company name, address, and contact person information; a listing of all California facilities, and the following aggregated information (on a company-wide basis):

1. The total annual aggregated weight in pounds of high-GWP refrigerant that was received for reclamation or destruction.
2. The total annual aggregated weight in pounds of each type of high-GWP refrigerant that was reclaimed in California.
3. The total annual aggregated weight in pounds of high-GWP refrigerant that was shipped out of California for reclamation.
4. The total annual aggregated weight in pounds of high-GWP refrigerant that was destroyed or shipped out of California for destruction.

A primary requirement of AB 32 is that emission reductions s can be quantified and verified. The primary quantification of emission reductions is based on facility reporting. The direct GHG emissions reported by each facility statewide are summed to quantify the emissions from facilities with large and medium refrigeration systems. As only facilities with large and medium refrigeration system report, the total statewide emissions reported from facilities with large and medium refrigeration systems would be extrapolated to encompass the entire stationary, non-residential refrigeration sector statewide, including facilities with small refrigeration systems. Emission reductions are quantified as the difference between current emissions, as outlined in Appendix B, and the quantified statewide emissions based on annual facility reports.

Statewide emission reductions are verified using data obtained through refrigerant distributor and wholesaler reporting. For each $MTCO_2E$ emission reduced there is a corresponding reduction in pounds of refrigerant emitted, for example based on the GWP of 1,500 for each $MTCO_2E$ emission reduced of R-22 refrigerant approximately 1.5 pounds of refrigerant is not emitted. The 1.5 pounds of R-22 that is not emitted also does not need to be purchased and charged into a refrigeration system to bring the system to its full refrigerant charge. Thus, the emission reductions result in reduced refrigerant consumption statewide, as compared to BAU.

The statewide emission verification process is a broad comparison of refrigerant emissions based on facility reporting and the overall impact on high-GWP refrigerant consumption. On a statewide basis there are many factors impacting refrigerant sales, so a one-to-one mass balance of emissions as compared to refrigerant consumption is not possible. But, as stationary, non-residential refrigeration systems constitute approximately 20 percent of all high-GWP emissions, the relationship between refrigerant sales and emission reductions does enable a verification of total emission reductions through refrigerant consumption trends and should be detected given the significant reductions anticipated as a result of the proposed Regulation.

95393. Recordkeeping Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers

Summary of Proposed Regulation

This section describes the recordkeeping requirements for high-GWP refrigerant distributors, wholesalers, and reclaimers.

Rationale for Proposed Regulation

Distributors, wholesalers, and reclaimers recordkeeping is necessary to verify reported data and to ensure the Regulation is enforceable, pursuant to Health & Safety Code section 38562, based on findings from the review of distributors, wholesalers, and reclaimers records.

Description of Proposed Regulation

Refrigerant distributors, wholesalers, and reclaimers will be required to maintain on-site records and to retain records for a minimum of five years; recordkeeping must include the following:

1. Annual reports required by section 95392.
2. Invoices of all High-GWP refrigerant received through sale or transfer and all High-GWP refrigerant distributed through sale or transfer.

95394. Confidentiality.

Summary of Proposed Regulation

This section describes the confidentiality requirements for all reports and information provided by a facility or refrigerant distributor, wholesaler, or reclaimer to the ARB.

Rationale for Proposed Regulation

This section is necessary to ensure the regulated public understands how reports and information are managed to ensure compliance with title 17 of the California Code of Regulations, sections 91000 to 91022.

Description of Proposed Regulation

All information submitted to the Executive Officer in a Facility Refrigerant Purchase and Use report shall not be designated as confidential.

Except for data reported specifically designated as a public record, a person submitting information to the Executive Officer may designate the information as confidential because it is a trade secret or otherwise exempt from public disclosure. All such requests for confidentiality shall be handled in accordance with the procedures specified in title 17, California Code of Regulations, sections 91000 to 91022.

95395. Enforcement

Summary of Proposed Regulation

This section describes the legal basis of the enforcement of the proposed Regulation.

Rationale for Proposed Regulation

This section is necessary to ensure the Regulation is enforceable as required pursuant to Health & Safety Code section 38562.

Description of Proposed Regulation

If the Executive Officer finds that any facility owner or operator, certified technician, non-certified technician, certified reclaimer, refrigerant distributor, refrigerant wholesaler, or other person does not comply with the requirements of this subarticle, the Executive Officer may seek an injunction or otherwise assess penalties to the extent permissible under Chapter 1.5 of Part 5, Division 26 of the Health and Safety Code commencing with Section 42400.

95396. Equivalent Local Rules

Summary of Proposed Regulation

This section describes the mechanism for ensuring all regions of the state are subject to similar requirements, regardless of whether it is subject to a local air-district rule.

Rationale for Proposed Regulation

This section is necessary to ensure the regulated public understands how the Regulation will be implemented in a specific air district in which they operate a facility and to minimize the administrative burden of compliance, as required pursuant to Health & Safety Code section 38562, with the potential for a statewide regulation and a rule adopted by a local air district.

Description of Proposed Regulation

If the Executive Officer formally determines that an air district has adopted regulations that will achieve emission reductions from stationary, non-residential refrigeration systems that are equivalent or greater to those that would be achieved via sections 95383 through 95389 of this Regulation, and enforcement and resulting benefits are demonstrated, then the requirements specified in sections 95383 through 95389 will be considered as having been satisfied.

95397. Approval of Exemptions

Summary of Proposed Regulation

This section describes the conditions upon which a facility may be exempted from specific sections of the proposed Regulation.

Rationale for Proposed Regulation

This section is necessary to ensure there is a mechanism to consider broader societal benefits, as required pursuant to Health & Safety Code section 38562, including economic impacts such as energy related economic impacts as well as total life cycle emissions specific to an individual facility.

Description of Proposed Regulation

The primary purpose of this provision is to provide flexibility in implementation of the proposed Regulation to address significant hardship that may be created by the leak repair and retrofit or retirement requirements of the Regulation. The Executive Officer may provide an exemption to the leak repair and retrofit or retirement plan requirements described above based on: life cycle emissions of a refrigeration system, economic hardship, or emissions caused by a natural disaster. Such exemptions would only be granted following a facility owner or operator's written application.

95398. Severability

Summary of Proposed Regulation

This section describes the severability of each part of the proposed Regulation and that if any part is held invalid, the remainder will continue in full force and effect.

Rationale for Proposed Regulation

This section is necessary to ensure that if any part of the proposed regulation is held invalid emissions of high-GWP refrigerants are still reduced based on other parts remaining in effect.

VII. REFRIGERANT MANAGEMENT PROGRAM IMPLEMENTATION AND ENFORCEMENT

A. Implementation

The proposed Regulation will impact approximately 26,000 California facilities. The greatest focus in implementation will be outreach to impacted facilities and training for compliance assistance. The Refrigerant Management Program will require significant planning to ensure successful implementation.

B. Implementation Activities

The success of this regulatory effort depends upon a well executed outreach and implementation plan that includes an effective electronic reporting system, outreach to facilities, implementation assistance to air districts and impacted facilities, enforcement training for air district and other personnel, and best practices technician training.

Upon Board approval of the proposed Regulation, staff will initiate outreach and implementation efforts. Primary implementation planning components will include:

- Facility Outreach and Compliance Training and Assistance Plan
- Reporting and Payment System Development
- Air District Enforcement Agreement Development and Assistance
- Inspection and Enforcement Guidelines Development

The time frame for implementation activities is January 2010 (post adoption) through January 2011. However, even after this date it is anticipated that there will be an ongoing need to reach out to impacted businesses to assist with implementation and compliance.

As described in Appendix D, based on outreach efforts conducted during the rule development process, staff determined a primary outreach challenge will be to provide clear and easy to understand instructions to facility owners on how to determine the refrigerant charge size of refrigeration systems used in their business. This is especially important for facilities with smaller refrigeration systems that need to determine if their refrigeration system uses more than 50 pounds of refrigerant, making it subject to the registration, refrigerant leak detection and monitoring, leak repair, and facility recordkeeping provisions of the proposed Regulation. This will be a primary task in the early part of developing outreach material.

<u>Facility Outreach and Compliance Training and Assistance Plan</u>

ARB staff will develop a plan to first focus on ensuring that facilities subject to the requirements are aware of the Regulation and that they can easily determine the full refrigerant charge of their refrigeration systems to understand which provisions are applicable to their business. The plan for post-regulation adoption outreach is explained in detail in Appendix D.

Reporting and Payment System Development

In order to manage the data generated from facilities, and allow facilities to submit reports and pay implementation fees online, a reporting and payment system will be developed. The system will facilitate efficient recording and tracking of information related to this Regulation and will have the following features:

1. Full database management system for recordkeeping, data reporting, storage, and retrieval that allows affected businesses to efficiently record data, submit reports, and pay implementation fees.
2. Web-accessible interface that provides selective and secure access.
3. User-friendly interface with pull-down screens and help-based tools to facilitate accurate and efficient data entry and transfer.
4. Internal checks so that data is screened for reasonableness and applicability.
5. Report generation for compliance determination and inspection prioritization.
6. Standard reports to evaluate program performance and estimate emission reductions.
7. Capability to allow batch data entry from refrigerant management software programs used currently by facilities.
8. Provide recordkeeping templates to assist facilities and enforcement personnel allowing them to better ensure compliance with recordkeeping requirements and report the benefits of reduced refrigerant consumption.

The development of an effective and efficient reporting and payment system will be integral to the success of the Refrigerant Management Program. Data will be made available to ARB and air district staff based on specified security rules to ensure data remains secure and is available only to appropriate persons authorized to review the information.

The data required to be reported will also provide facilities information specific to refrigerant leak frequency and the total refrigerant used and help them in determining the cost-effectiveness of refrigerant management and any savings from reduced refrigerant consumption.

Air District Enforcement Agreement Development and Assistance

It is anticipated that air districts will provide the primary mechanism for enforcing the program and be supported by implementation fees. ARB staff conducted a survey to determine how local air districts are likely to participate in the Refrigerant Management Program. Based on survey responses, air districts representing 94 percent of the State's population are likely to enforce the proposed Regulations in their jurisdiction. This can be accomplished by establishing a Refrigerant Management Program Enforcement agreement with air districts and/or by the district adopting an equivalent program.

Upon Board approval of the proposed Regulation, staff will work with a committee including representatives of CAPCOA and local air districts to develop a model Refrigerant Management Program Enforcement agreement. The agreement between the ARB and air districts will outline all roles and responsibilities, enforcement performance requirements, and the amount and methods of payments that ARB will remit to the air districts.

Staff will also develop guidelines and materials to assist air districts in the implementation of the Refrigerant Management Program including guidelines and protocols to ensure proper revenue accounting and payment remitted to air districts.

Assistance to air districts will include development of training materials for air district staff (as well as ARB staff) to ensure that enforcement staff have a clear technical understanding of the Regulation and the inspection and enforcement guidelines developed. Because there are numerous facility and system types subject to the proposed Regulation requirements staff will require broad knowledge of these systems. Training materials will be developed that include guidelines and materials to direct enforcement staff to ensure inspections are effective. It will also include review and use of reports that facilities have filed or the on-site records that they are required to maintain.

Inspection and Enforcement Guidelines Development

A multi-division team of ARB staff will develop inspection and enforcement guidelines for the Regulation and develop training materials on how to implement the guidelines. The guidelines will provide a mechanism to develop consistent standards for use statewide whether inspections and enforcement are conducted by ARB staff or local air district staff.

Program Implementation

Upon Board approval of the proposed Regulation, staff will initiate outreach activities and implementing the Regulation.

As outlined in Appendix D, the focus of program implementation will be to provide clear and concise information on the applicability of the proposed Regulation and how to comply, as well as how to most effectively reduce refrigerant emissions. The primary implementation outreach topics anticipated include:

- How to determine the refrigeration system full charge
- How to comply with the Regulation provisions applicable to your facility
- How to benefit from use of refrigerant best management practices for all high-GWP appliances
- How to effectively conduct leak inspections

C. Enforcement

The proposed Refrigerant Management Program affects GHG sources statewide. However, local and regional air districts have extensive expertise in enforcement, and already have relationships with many of the facilities that will be regulated. It is ARB's goal to leverage the expertise of the air districts in the administration of the proposed Regulation. Air districts may elect to assume the lead in enforcing the Regulation two ways.

1. Entering a collaborative agreement between air districts and ARB. The agreement between the ARB and air district will outline all roles and responsibilities, enforcement performance requirements, and the amount and methods of payments that ARB will remit to the air district.
2. Adopting and implementation of a regulation that is functionally equivalent to the statewide Regulation.

ARB staff has conducted a survey to determine which air districts are likely to participate in the proposed Refrigerant Management Program. Air districts representing approximately 94 percent of the State's population have indicated that they are likely to enforce the Regulation in their jurisdiction.

Without regard to the enforcement options chosen by an air district, the ARB will have a statewide, on-line reporting and payment system that is anticipated to be used by ARB and air district staff to conduct analysis of reported data and determine potential areas of non-compliance. The goal is to ensure a consistent statewide reporting system to reduce the impact on businesses with facilities in multiple air districts and to provide ARB and air district staff a consistent perspective of reported data to identify facilities not in compliance with the Regulation and to inform enforcement staff of where the greatest risk of GHG emissions and non-compliance could be based on the data submitted.

VIII. AFFECTED INDUSTRIES

The scope of affected industries is framed by the type of refrigerant (all high-GWP refrigerants) used by industries including facilities and certified technicians that use applicable refrigerants, and refrigerant distributors, wholesalers, and reclaimers that buy, sell, distribute, or reclaim applicable refrigerants.

Industries regulated by this action include those who: 1) own or operate facilities with a stationary, non-residential refrigeration system using more than 50 pounds of a high-GWP refrigerant; 2) service any appliance using a high-GWP refrigerant; or 3) distribute or reclaim a high-GWP refrigerant. Such entities include, but are not limited to, owners or operators of facilities using commercial refrigeration systems such as refrigerated warehouses; retail food stores, including supermarkets, grocery stores, wholesale markets, supercenters, and convenience stores; beverage and food manufacturers, distributors, and packagers; ice rinks; and other industrial process refrigeration applications. Additionally, the proposed Regulation will apply to any individual who distributes or reclaims high-GWP refrigerants.

The scope of facilities regulated specific to facilities with stationary refrigeration systems is outlined in Table XI with the facilities' related North American Industry Classification System (NAICS) code.

Table XI. Scope of Facilities and NAICS Codes Applicable to Registration for Facilities with Stationary Refrigeration Systems Provision

Category	North American Industry Classification System (NAICS) Code	Examples of regulated entities
Industrial Process Refrigeration	311, 325, 3254, 31212, 31211, 312113, 324110	Owners or operators of refrigeration equipment used in the manufacture of pharmaceuticals, frozen food, dairy products, baked goods, food and beverage, petrochemicals, chemicals, ice manufacturing
Commercial Refrigeration	493120, 452910, 445110, 446110, 445120	Owners or operators of refrigerated warehousing and storage facilities supermarket, grocery, warehouse clubs, supercenters, convenience stores.
Other Refrigeration	622110, 812220, 611310	Owners or operators of large hospitals, mortuaries/crematories, universities

U.S. EPA Certified Technicians and Refrigerant Reclaimers, Wholesalers and Distributors

It is estimated that there are 60,000 HVAC and refrigeration technicians in California that are certified by the U.S. EPA. This estimate is based on the number of licensed air-conditioning and refrigeration contractors in California obtained from the Contractors State License Board. There are approximately 10,000 contractors with a valid and active California business license in the Warm-Air Heating, Ventilating & Air Conditioning category, an additional 600 with a license in the Refrigeration category, and 1,400 with a license in both categories. Based on the U.S. Census data for HVAC businesses it was determined that HVAC firms have on average 10 paid employees. It was assumed that 50 percent of paid employees would require certification. Not all technicians require certification as a contractor's employees have many roles. As an example, an installer that installs an appliance prior to being charged with refrigerant or an employee that specializes in electronic components does not require certification. Certification is required only for those employees that maintain or service an appliance in a way that has a reasonable potential to emit a high-GWP refrigerant – or those working on refrigerant circuit components of an appliance. Assuming each contractor has on average five employees that require certification then there would be approximately 60,000 technicians in California. The proposed Regulation will require that any refrigerant leak be repaired by technicians certified pursuant to the CFR, Title 40, Part 82, § 82.161.

The proposed Regulation also applies to U.S. EPA certified reclaimers, as well as refrigerant distributors and wholesalers. The U.S. EPA maintains a national list of certified reclaimers including 40 reclaimers that provide services in California. A complete list of U.S. EPA approved reclaimers is available at: http://www.epa.gov/Ozone/title6/608/reclamation/reclist.html. Based on information from Heating, Air Conditioning & Refrigeration Distributors International (HARDI), a trade organization representing refrigerant wholesalers, there are approximately 230 companies in California that distribute refrigerants.

IX. ENVIRONMENTAL IMPACTS OF THE PROPOSED REGULATION

The ARB staff has conducted an analysis of the potential environmental impacts of the proposed Regulation. Based on our analysis, we have determined that the proposed Regulation will have no significant adverse environmental impacts.

A. Air Quality Impacts of the Proposed Regulation

The proposed Regulation is expected to reduce direct emissions of high-GWP GHG with no associated increases in criteria pollutants or air toxics. Total estimated GHG emission reductions in 2020 is about 8 $MMTCO_2E$.

The full description of the analysis to determine the potential high-GWP GHG emission reductions estimates is provided in Appendix B.

B. Legal Requirements Applicable to the Environmental Impact Analysis

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential environmental impacts of proposed regulations. The Secretary of Resources, pursuant to Public Resources Code section 21080.5, has certified the ARB rulemaking process. Consequently, the CEQA environmental analysis requirements may be included in the ISOR for this rulemaking. The ISOR serves as a functionally equivalent document to an initial study, a Negative Declaration, and an Environmental Impact Report. In addition, staff will respond, in the Final Statement of Reasons for the Regulation, to all significant environmental issues raised by the public during the public review period or at the ARB public hearing. Public Resources Code section 21159 requires that the environmental impact analysis conducted by the ARB include the following:

1. An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
2. An analysis of reasonably foreseeable feasible mitigation measures.
3. An analysis of reasonably foreseeable alternative means of compliance with any amendments to the proposed Regulation.

Regarding mitigation measures, CEQA requires an agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

1. <u>Reasonably Foreseeable Environmental Impacts of the Methods of Compliance</u>

   The ARB staff has not identified any significant adverse environmental impacts from complying with the proposed Regulation.

2. <u>Reasonably Foreseeable Feasible Mitigation Measures</u>

   CEQA requires an agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis. ARB staff has concluded that no significant adverse environmental impact would occur from adoption of, and compliance with, the Regulation. Therefore, no mitigation measures would be necessary.

3. Reasonably Foreseeable Alternative Means of Compliance with the Amendments to the Refrigerant Management Program

   The ARB is required to do an analysis of reasonably foreseeable alternative means of compliance with the proposed amendments to the Regulation. The ARB staff concluded that the proposed Regulation provides the most effective measure that is cost-effective and results in verifiable, enforceable GHG emission reductions. Alternatives considered are outlined in detail in the "Alternatives Considered" discussion in the Economic Impacts of the Proposed Regulation section (Section X) of this Staff Report.

C. Environmental Justice

ARB is committed to evaluating community impacts of proposed regulations including environmental justice concerns. Given that some communities experience higher exposure to air pollutants, it is a priority of ARB to ensure that full protection is afforded to all Californians. The proposed Regulation is not expected to result in significant negative impacts in any community.

To ensure that everyone has had an opportunity to stay informed and participate fully in the development of this regulation, staff has held multiple workshops and workgroup meetings, provided opportunities to participate in meetings by internet webcasting and phone, widely distributed all materials, and maintained consistent contact with interested stakeholders.

X. ECONOMIC IMPACTS OF THE PROPOSED REGULATION

ARB staff has reviewed the costs of the proposed Regulation for calendar years 2011 through 2020.

Table XII provides the cost estimated for 2020, to reflect the average annual total cost of the proposed Regulation once fully implemented.

Table XII. Statewide Annual Cost of the Proposed Rule in 2020		
Proposed Rule Components	**Annual Cost (HFC plus ODS systems) ($ millions)**	**Annual Cost (HFC systems only) ($ millions)**
Net Costs: Sections 95383 through 95390	$19.1 savings	$12.8 savings
Net Costs: Sections 95391 through 95393	$0.2	$0.1
Entire Rule Net cost	$18.9 savings	$12.7 savings
Proposed Rule Emissions Reductions	8 $MMTCO_2E$	7 $MMTCO_2E$
Proposed Rule Cost-effectiveness	$\$2/MTCO_2E$ savings	$\$2/MTCO_2E$ savings

Note: all costs are estimated in constant 2008 dollars.

The majority of costs are related to the general requirements for facilities with stationary refrigeration systems including the following provisions: Registration Requirements for Facilities with Stationary Refrigeration Systems (section 95383), Implementation Fees for Facilities with Stationary Refrigeration Systems (section 95384), Leak Detection and Monitoring Requirements for Facilities with Stationary Refrigeration Systems (section 95385), Leak Repair Requirements for Facilities with Stationary Refrigeration Systems (section 95386), Requirements to Prepare Retrofit or Retirement Plans for Facilities with Leaking Stationary Refrigeration Systems (section 95387), Reporting Requirements for Facilities with Stationary Refrigeration Systems (section 95388), and Recordkeeping Requirements for Facilities with Stationary Refrigeration Systems (section 95389). The total costs of these provisions combined are a savings of approximately $19 million annually.

Additional costs are associated with provisions related to refrigerant distributors, wholesalers, and reclaimers including the following provisions: Prohibitions (section 95391), Refrigerant Distributor, Wholesaler and Reclaimer Reporting (section 95392), and Refrigerant Distributor, Wholesaler and Reclaimer Recordkeeping (section 95393). The total costs of these provisions combined are less than $200,000 annually.

The total cost-effectiveness of the proposed Regulation is a savings of $\$2/MTCO_2E$ for the emission reductions of Kyoto gases and Non-Kyoto gases combined, and Kyoto gases only. A detailed analysis of costs and economic impacts is provided in Appendix C.

The cost and economic impacts analysis was conducted by determining average costs for each component of the proposed Regulation, including:

- Implementation fees

- Average capital and operating cost for automatic leak detection system
- Average leak inspection costs
- Average leak repair costs
- Average recordkeeping cost
- Average reporting costs
- Average refrigerant costs

The costs for each component of the proposed Regulation was multiplied by the estimated number of facilities and refrigeration systems outlined in Appendix B to determine a total cost for the proposed Regulation. These estimates were done separately for the ODS and HFC refrigerants and the total combined refrigerants.

Leak repair costs attributed to the proposed Regulation are a percentage of the total actual repair costs. Average leak repair costs represent the difference between immediate repairs as required under the proposed Regulation and BAU repairs at an estimated time when a repair would likely be conducted in any case to maintain operations. The time for repairs to occur to maintain operations is estimated as the point at which the loss of refrigerant exceeds 35 percent of the refrigerant charge at the charge loss rate indicated by staff research for specific equipment categories based on refrigeration system type and refrigerant charge size.

Example equipment categories include cold storage requiring over 2,000 pounds of a high-GWP refrigerant or refrigerant condensing units requiring between 50 and 200 pounds of a high-GWP refrigerant. The interest cost (or lost opportunity cost) at 5 percent per year of the gross repair cost (parts, labor, and refrigerant recharge) is attributed to the proposed Regulation. As an example, the average annual leak for medium refrigeration systems is approximately 17 percent, so it would take slightly over 2 years to leak 35 percent (17 percent per year for slightly over 2 years equals approximately 35 percent) of the refrigerant charge. At 5 percent per year for two years, the leak repair cost attributed to the proposed Regulation would be approximately 10 percent of the total leak repair cost.

The annual discount rate of 5% used in this analysis is representative of the cost of money when high-risk technologies and activities are not involved and is consistent with cost assumption of the AB 32 Scoping Plan. The Scoping Plan's analysis of costs and savings used a uniform real discount rate of 5% to estimate the cost of money for all proposed measures and provided the first step towards annualizing the upfront or capital expenditures. ARB staff conducted a sensitivity analysis to determine how sensitive the average cost-effectiveness of the proposed rule is to the discount rate used. A range of discount rates were used to determine their impact on the average cost-effectiveness of the proposed rule. This analysis resulted in a net savings or net cost depending on the discount rate used with all results within the range of cost-effectiveness for measures approved by the Board in 2009, which have ranged from over $100 in savings to a cost of $21 per $MTCO_2E$.

A detailed analysis of costs and economic impacts attributed to the proposed Regulation is provided in Appendix C.

The proposed Regulation cost-effectiveness was calculated by dividing the total cost by the emissions reductions outlined in Appendix B.

A. Legal Requirements for Fiscal Analysis

In proposing to adopt or amend any administrative regulation Section 11346.3 of the Government Code requires that State agencies must assess the potential for adverse economic impacts on California business enterprises and individuals, including the ability of California businesses to compete with businesses in other states. The assessment must also include the potential impact of the regulation on California jobs; business expansion, elimination or creation; and the ability of California business to compete with businesses in other states.

Also, State agencies are required to estimate the cost or savings to any state or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any non-discretionary cost or savings to local agencies, and the cost or savings in federal funding to the State.

The economic impacts analysis of the proposed Regulation was conducted to meet current legal requirements under the Administrative Procedure Act (APA) and the results are detailed in the required Form 399.

B. Potential Impact on California Businesses

California businesses having facilities with refrigeration systems that require more than 50 pounds of a high-GWP refrigerant will be impacted by the proposed Refrigerant Management Program through registration and the imposition of implementation fees, and leak monitoring and detection, leak repair, retrofit or retirement plan, reporting, and recordkeeping requirements. It is important to note that currently the majority of applicable R/AC appliances in operation use ODS refrigerants. California businesses currently using refrigeration systems requiring more than 50 pounds of an ODS refrigerant are subject to leak repair, required service practices, and recordkeeping requirements under existing U.S. EPA regulations. The same California businesses in the SCAQMD jurisdiction are subject to leak inspection, leak repair, registration and implementation fee, reporting, and recordkeeping requirements under the SCAQMD's Rule 1415. Thus, the recordkeeping and leak repair provisions of the proposed Regulation are consistent with existing requirements for California businesses, though certain elements of the proposal such as the facility implementation fees and reporting are new for businesses outside of the SCAQMD's jurisdiction.

Refrigeration and air-conditioning service contractors will be impacted through required service practices. The majority of these businesses, approximately 12,000, are refrigeration and air-conditioning service contractors that will be only minimally impacted by the required service practices provision, which in most cases are common business practices already required for ODS refrigerants pursuant to existing U.S. EPA regulations.

C. Potential Impact on Small Businesses

To the extent that small businesses have refrigeration systems requiring more than 50 pounds of a high-GWP refrigerant they will be subject to the proposed Regulation. Approximately 64 percent of the estimated 26,000 facilities affected by the proposed Regulation are small businesses (i.e., businesses having fewer than 100 employees). Approximately 90 percent of the 12,000 refrigeration and air-conditioning contractors are small businesses. The number of small businesses was estimated using census data describing the distribution of business size (by number of employees) for the industries affected by the proposed Regulation. The estimate of small business impacted is based on a legal definition of 100 employees, as compared to what many may perceive as a small business, which would be as few as 10 employees.

In the regulation development process, ARB staff developed several provisions specifically to minimize the impact to small businesses while still delivering the vast majority of potential emission reductions, including the following:

1. Set refrigerant charge size threshold at more than 50 pounds – eliminates most bars and restaurants, gas stations, bakeries, and liquor stores.
2. Apply leak inspection, repair, reporting, and recordkeeping requirements only to refrigeration systems, as compared to all R/AC appliances – eliminates facilities with only air-conditioning appliances.
3. Develop reduced requirements for facilities with small refrigeration systems only
    a. Annual leak inspection, as compared to quarterly
    b. No reporting
    c. No implementation fee.
4. Ensure requirements are consistent with existing rules already applicable to small businesses
    a. Consistency with federal regulations specific to ODS refrigerants
    b. Consistency with SCAQMD Rule 1415 requirements.

One alternative reviewed by ARB staff was to include all refrigeration systems with a refrigerant charge equal to or greater than 30 pounds. One result of recommending the threshold to be set at more than 50 pounds of a high-GWP refrigerant is a significant reduction in the number of small businesses impacted. In several cases facilities that tend to be owned or operated by small businesses will not be impacted based on the 50-pound refrigerant charge size threshold. Research conducted for the ARB indicates that the refrigerant charge size for refrigeration systems (condensing units) for bars and restaurants, gas stations, bakeries, and liquor stores are all generally below 50 pounds.[20]

One alternative selected that resulted in a significant cost reduction to small businesses is the focus on refrigeration systems only as compared to all R/AC appliances. As discussed further in the "Alternatives Considered" discussion in the Economic Impacts of the Proposed Regulation section (Section X) of this report, this alternative resulted in substantially reduced costs, including reduced costs for small businesses.

The types of facilities impacted tend to be highly represented in market segments dominated by large companies. As an example, the facilities using small refrigeration systems are dominated by large companies as about 30 percent of the over 15,500 facilities using small refrigeration systems are pharmacies and 63 percent of pharmacies are represented by only three major chains (CVS, Rite-Aid, Walgreens).

The potential impact of the proposed Regulation on small businesses will depend on the specific refrigeration systems used at a facility and their current refrigerant management practices. Based on ARB staff research, use of the best management practices described in the proposed Regulation resulting in meeting a 10 percent annual leak rate, on average, will result in a net savings to these small businesses.

The refrigerant sale, use, and disposal provisions of the Regulation will primarily affect small businesses in the refrigerant distribution, wholesale, and reclamation business sectors. This will include an estimated 230 refrigerant distributors and wholesalers and 40 refrigerant reclaimers.

One sector of positively impacted small businesses will be service contractors that specialize in refrigeration systems; there are approximately 2,000 in California. The provisions of the proposed Regulation provide business opportunities for these contractors as they will be needed to perform leak repairs and will likely conduct additional leak inspections.

D. Potential Impact on Business Creation, Elimination, or Expansion

No negative change is expected for California businesses as a result of this Regulation. This is because the proposed Regulation will impose requirements on businesses serving California clients, and the proposed Regulation is not anticipated to impact the level of services required by these clients.

The proposed Regulation requires that all refrigerant leak repairs be conducted by a U.S. EPA certified technician to be consistent with existing U.S EPA regulations specific to ODS refrigerants. Industry stakeholders have stated that there is a limited pool of certified technicians, so the proposed Regulation may have a positive business impact by creating greater demand for U.S. EPA certified technicians. It is anticipated that growth may occur in business for

[20] ARMINES, Inventory of Direct and Indirect GHG Emissions from Stationary Air conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air conditioning, Final Report, March 2009.

current certified technicians as well as encourage current non-certified technicians to become certified to fill the increased demand.

The proposed Regulation will also result in potential business expansion including increased sales and service agreements for automatic leak detection systems.

E. Potential Impact on Business Competitiveness

The proposed Regulation will have little or no impact on the ability of California businesses to compete with businesses in other states. Many of the businesses affected by the Regulation are local businesses serving California clients, and may not be strongly subject to interstate competition. Additionally, as the proposed Regulation will uniformly impact any company providing services in California, there is no anticipated adverse impact resulting from out-of-state competition. Based on reduced refrigerant consumption, on average, the proposed Regulation is anticipated to result in a savings of \$2 per $MTCO_2E$ in emissions reduced, which may provide a benefit to many businesses.

F. Potential Impact on California Consumers

No noticeable change in consumer prices is expected from the proposed Regulation; although initially some potential increased refrigerant distributor business costs may be passed to the consumer through price changes for refrigeration and air-conditioning repair services.

As businesses begin to use greater refrigerant best management practices required by the proposed Regulation and obtain the resulting cost benefits of reduced refrigerant consumption, the net savings of the proposed Regulation may also be passed on to consumers, though any savings would be expected to be quite small.

G. Potential Impact on California Employment

ARB staff expects no significant change in employment due to the compliance costs.

The proposed Regulation requires that all refrigerant leak repairs be conducted by a U.S. EPA certified technician to be consistent with existing U.S EPA regulations specific to ODS refrigerants. Industry stakeholders have stated that there is a limited resource of certified technicians, so the proposed Regulation may have a positive employment impact on creating greater demand for businesses and employment requiring U.S. EPA certified technicians. It is anticipated that growth may occur in business for current certified technicians as well as encourage current non-certified technicians to become certified to fill the increased demand.

H. Potential Impacts to California State and Local Agencies

Potential impacts to California state and local agencies are specific to either state and local agency compliance costs or implementation costs.

State and Local Agency Compliance Costs

The fiscal impact on state government related to compliance with the proposed Regulation is due to the registration, leak detection and monitoring, leak repair, reporting and recordkeeping provisions for state owned and leased buildings (including state universities).

Data characterizing the number of refrigeration systems used by state colleges and universities was obtained from the SCAQMD Rule 1415 dataset. This refrigeration system inventory was extrapolated statewide based on the total number of community colleges, state colleges and state universities present in California.

The annual impact on colleges and universities is estimated to be a net savings, on average, of approximately $122,000 ($3,500 savings per facility). The estimates include the statewide inventory of refrigeration systems (not including air-conditioning systems) of state government buildings and state university buildings.

There is limited expected fiscal impact on state government buildings since most are not expected to have impacted facilities. The impact to state facilities was dramatically reduced based on the selected alternative to focus on refrigeration systems only, as compared to refrigeration and air-conditioning systems.

There are no reports of state owned or operated facilities in the SCAQMD that could be extrapolated statewide. But, based on reports of county facilities including correctional and medical facilities, it is assumed state correctional and medical facilities may be impacted by the proposed Regulation. Any impacts are anticipated to be minimal.

The local government and state agencies that could be subject to required service practices include some cities, counties, public utility districts, school districts, or other agencies that maintain and service facilities that include refrigeration and air-conditioning appliances. But, these requirements are substantially the same as currently required under existing federal regulations specific to ODS refrigerants.

There are a few county owned facilities with small and medium size refrigeration systems that will have impacts. This cost is estimated to be approximately $700 statewide annually; approximately, on average, $20 per facility. County facilities applicable to the proposed Regulation will include facilities such as correctional facilities, medical facilities, and morgues.

There are no expected fiscal impacts on cities and local schools (K-12) in relation to the registration, leak detection and monitoring, leak repair, reporting and recordkeeping provisions since they are not expected to have impacted facilities.

The inventory of refrigeration equipment used by local governments and local schools was estimated using data obtained from the SCAQMD Rule 1415 dataset and a survey of local governments conducted by ARB staff. Refrigeration inventories for representative cities and counties were extrapolated statewide based on the total number of cities and counties in California. Existing data available from the SCAQMD Rule 1415 dataset indicated that no local schools in California use refrigeration systems with more than 50 pounds of refrigerant.

State and Local Agency Implementation Costs

State and local agency costs incurred to administer and enforce the Refrigerant Management Program will be related to activities of the ARB or local air districts. An air district may decide to enforce the proposed Regulation, which will result in additional expenses. These expenses will be compensated based on agreements between the respective air district and the ARB. Funding for these expenses is anticipated from the collection of implementation fees collected under the proposed Regulation, which were planned to cover the costs of program administration and enforcement. No enforcement costs to the state, beyond those covered by fees, are expected. Where air districts do not enforce the Regulation, the ARB staff will be required to enforce the Regulation.

Based on a phased implementation approach, the proposed regulatory action potential cost impact for implementation of the program (including cost of agreements with local air districts) is estimated at $0.4 million starting in fiscal year 2010-11, an additional $0.7 million starting in fiscal year 2012-13, and an additional $1.2 million starting in fiscal year 2014-15 to reach a total of 2.3 million in fiscal year 2014-15 and each year thereafter. Implementation fees are set to cover the estimated costs of implementing and enforcing the Regulation.

The costs of the program are associated with required staff positions (estimated at $175,000 per position with approximately 2 positions required in fiscal year 2010-11, and each year thereafter, prior to any receipt of implementation fees. The cost per position used in the calculations ($175,000) is based on the average ARB fully loaded cost per position (typical positions used for inspections in Enforcement division of ARB are Air Pollution Specialists and/or Air Resources Engineers).The primary role of these positions will be program administration, reporting and payment system development and maintenance, training for air district staff and facility owners and operators, and outreach to impacted facilities. After fiscal year 2011-12, additional staff will be required. The primary role of these positions will be program enforcement and administration, although they will also be involved in training for air district staff and facility owners and operators, and outreach to impacted facilities. Starting in fiscal year 2012-13, additional costs will be due to the need for an additional 4 positions. Starting in fiscal year 2014-15, additional costs will be due to the need for an additional 7 positions for a total of 13 positions required for fiscal year 2014-15 and each year thereafter. Costs for positions starting in fiscal year 2012-13 and after will be funded through the receipt of implementation fees.

The ARB anticipates that cost will include ARB staffing costs as well as funds for fee-for-service agreements with local air districts for administration and enforcement activities. It is anticipated that the majority of these positions will be air district staff compensated through the Regulation implementation fees to assist with program implementation and enforcement. ARB will require two administrative positions and one enforcement position. All other positions are anticipated to be required throughout local air districts.

Anticipated staffing allocations are based on a preliminary survey of air districts to determine how each air district is likely to participate in the Refrigerant Management Program. Air districts representing approximately 94 percent of the State's population responded that they are likely to enforce the Regulation in their jurisdiction, although final determinations by air districts are likely to occur after adoption of the proposed Regulation.

I. Alternatives Considered

Government Code section 11346.2 requires ARB to consider and evaluate reasonable alternatives to the proposed Regulation and provide reasons for rejecting those alternatives.

The ARB staff considered alternatives for all components of the proposed Regulation to ensure that the proposed Regulation achieves the maximum technologically feasible and cost-effective GHG emission reductions from stationary R/AC appliances. The discussion that follows is organized by alternatives that were considered for key components of the program (e.g., applicable refrigerant charge size subject to the Regulation).

Refrigerant Charge Size Criteria

The owner or operator of a facility with a stationary refrigeration system with a full charge of more than 50 pounds of high-GWP refrigerant will be subject to the provisions of the proposed Regulation. ARB staff also considered a minimum refrigerant charge threshold of 30 pounds for all refrigeration systems to capture smaller roof top units, walk-in coolers, and other smaller equipment. One commenter in the technical working group argued that smaller equipment accounts for significant refrigerant emissions and therefore should not be excluded from regulatory control. Other working group members, however, commented that smaller R/AC equipment tends to be tightly sealed and would therefore not result in significant emissions on a per-unit basis. These commenters agreed with ARB staff that by lowering the threshold to less than 50 pounds, tens of thousands of additional California facilities would be impacted, which would increase the administrative burden of the proposed Regulation while not resulting in significant emission reductions.

Further, because existing U.S. EPA regulations as well as SCAQMD regulations are based on R/AC appliances with a refrigerant charge of more than 50 pounds of ODS as the regulatory threshold, a different threshold in California could create confusion.

ARB estimates that lowering the refrigerant charge threshold to 30 pounds for refrigeration systems would increase the total number of impacted facilities by a factor of 4 or more (from 26,000 facilities to 108,000 facilities). Further, the refrigeration systems that use less than 50 pounds of refrigerant tend to be small tightly sealed appliances with very low per unit refrigerant leak rates.

Using a minimum refrigerant charge of 30 pounds or greater is estimated to have a net total cumulative cost of $96 million for 10 years, an increase of $284 million (difference between a net savings of $188 million in the Regulation and a net cost of $96 million in this alternative) ($27 million increase in 2020) over the proposed Regulation, but would have limited additional emission reductions and unduly burden small businesses. The cost effectiveness of the proposed regulation would change from a savings of $2 per $MTCO_2E$ to savings of $1 per $MTCO_2E$. Additionally, due to the increased number of facilities, administrative cost for the program would likely be substantially increased.

ARB also considered using a threshold of 200 pounds of refrigerant. But, there was significant concern regarding the issue of consistency with existing federal and local regulations being based on a 50-pound refrigerant threshold. This proposal would also reduce possible emission reductions by approximately 0.9 $MMTCO_2E$.

ARB will monitor changes in technologies that would warrant a revised threshold.

Leak Detection and Monitoring

ARB is proposing that by January 1, 2012, owners or operators of a stationary refrigeration system with a full charge greater than or equal to 2,000 pounds of high-GWP refrigerant, and which operates, or is intended to be operated, year-round must have an automatic leak detection system with continuous monitoring.

ARB staff had considered requiring continuous monitoring for all systems with a full charge greater than 600 pounds of high-GWP refrigerant. This lower threshold was based primarily on consistency with the Fluorinated Gas, or F-gas, regulations recently adopted by the European Commission that requires continuous monitoring for comparably sized-systems (>300 kg [approximately 660 pounds] refrigerant charge).[21]

ARB staff concluded that 2,000 pounds is a more appropriate threshold. The greatest risk for large refrigerant leaks is from large systems used for cold storage and process cooling. These risks are derived from the large refrigerant charge sizes contained within these systems and, in some cases, high existing refrigerant leak rates. See Appendix B for a detailed review of existing refrigerant leak rates.

[21] Official Journal of the European Union, REGULATION (EC) No 842/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on certain fluorinated greenhouse gases, http://www.fluorocarbons.org/documents/library/Legislation/JO_L161_1_842_2006_Regulation.pdf, (accessed September 3, 2009).

Further, ARB believes that it is more appropriate to require continuous monitoring for systems that are operating year-round, and not for systems that operate on a seasonal or intermittent cycle. For these latter systems, leak inspections are required any time the system is re-activated and quarterly thereafter, rather than requiring an automatic leak detection system.

Requiring all refrigeration systems with more than 600 pounds of high-GWP refrigerant charge to be fitted with an automatic leak detection system would have a total net cumulative cost of $255 million for 10 years, an increase of $443 million (difference between a net savings of $188 million in the Regulation and a net cost of $255 million in this alternative) ($46 million increase in 2020) over the proposed Regulation. The cost effectiveness of the proposed regulation would change from a savings of $2 per $MTCO_2E$ to cost of $3 per $MTCO_2E$.

Include all Refrigeration and Air-conditioning Systems

Staff considered including all stationary, non-residential R/AC appliances containing more than 50 pounds of a high-GWP refrigerant. Staff received comments that the emissions profiles of refrigeration and air-conditioning systems as two distinct sectors were quite different and that it would result in very different impacts in regards to cost-effectiveness and emission reductions. Staff obtained additional data that addressed these concerns.

Table XIII clearly illustrates why staff concluded that refrigeration systems should be the focus of the proposed Regulation. A regulation focused on refrigeration will include an estimated 26,000 facilities to address 2020 BAU emissions of 15.8 $MMTCO_2E$ and reduce emissions by about 8.1 $MMTCO_2E$ of GHG, including Kyoto and non-Kyoto GHG. Including air-conditioning systems at a similar cost structure per facility would expand the scope of the program by including 23,000 more facilities to address 2020 BAU emissions of 1.4 $MMTCO_2E$ while only providing additional emission reductions of 0.5 $MMTCO_2E$.

Table XIII. Refrigeration and Air-Conditioning GHG Emission Profiles Summary

R/AC System Charge Size	Estimated Facilities	Estimated 2020 BAU Emissions (MMTCO2E)	Potential 2020 Emission Reductions (MMTCO2E)
		REFRIGERATION	
Small Refrigeration Systems	~ 15,500	1.4	0.9
Medium Refrigeration Systems	~ 8,500	7.9	3.3
Large Refrigeration Systems	~ 2,000	6.5	3.9
Total Facilities with Refrigeration Systems	~ 26,000	15.8	8.1

R/AC System Charge Size	Estimated Facilities	Estimated 2020 BAU Emissions (MMTCO2E)	Potential 2020 Emission Reductions (MMTCO2E)
	AIR CONDITIONING		
Small Air-Conditioning Systems	~ 14,000	0.7	0.4
Medium Air-Conditioning Systems	~ 6,300	0.3	0.1
Large Air-Conditioning Systems	~ 2,700	0.4	*0.0
Total Facilities with Air-Conditioning Systems	~ 23,000	1.4	0.5

Notes:
Totals may not sum due to rounding.
* See Appendix B for detailed discussion of estimates.

The difference in the emission profile between refrigeration and air-conditioning systems would have a significant impact on cost-effectiveness.

It was found that including these systems would result in an estimated net cumulative cost of the Regulation of $57 million in 10 years; an increase of $245 million (difference between a net savings of $188 million in the Regulation and a net cost of $57 million in this alternative) ($26 million increase in 2020) over the proposed Regulation.

The majority of these systems are either small tightly sealed systems or chiller systems which, as a group, have very low leak rates. Annual emissions reductions as a result of including air-conditioning systems were approximately 0.5 $MMTCO_2E$ greater than the current proposal. The cost effectiveness of the proposed regulation including all R/AC systems would change from a savings of $2 per $MTCO_2E$ to cost of $1 per $MTCO_2E$, but the cost-effectiveness in the year 2020 specific to the approximately 23,000 facilities with only air-conditioning appliances would be approximately $43 per additional $MTCO_2E$ reduced.

Leak Repair Limit

The proposed Regulation will require repair of any refrigerant leak in a stationary refrigeration system with a full charge of more than 50 pounds of high-GWP refrigerant. ARB staff also considered adoption of the current U.S. EPA requirement that repairs be made when the annual leak rate of ODS refrigerant exceeds 35 percent in commercial or industrial refrigeration appliances, or 15 percent for comfort cooling appliances.

ARB staff chose not to propose a leak rate trigger for a number of reasons. First, ARB staff believes that any detected refrigerant leak should be investigated and repaired. Although one indication of a refrigerant leak is the need to add refrigerant, adding refrigerant alone does not confirm a leak. If refrigerant is required, it should be assumed that the system is leaking, and a leak inspection should be conducted. Exceptions to this general rule are additions of refrigerant required for seasonal adjustment, or an additional refrigerant charge into a R/AC appliance evacuated for repair.

Second, ARB staff believes that calculating an annual leak rate creates an additional compliance and recordkeeping burden that could be avoided without compromising environmental protection. For example, to determine if a leak requires repair, under the federal regulation, a refrigeration appliance owner or operator would have to calculate the leak rate based on monitoring over 12-consecutive months before adding refrigerant to an appliance. This may not be possible if there is no recorded use of refrigerant in this 12-month period. Without determining a leak rate, they would have no means of determining if the appliance's leak rate was kept beneath 35 percent, and would not know if further action was warranted.

ARB staff did consider requiring the calculation of the leak rate (as defined in CFR, Title 40, Part 82, § 82.152) upon each addition of refrigerant to the system, unless the addition is made in order to recharge refrigerant immediately following a retrofit or the addition is made as a seasonal adjustment. ARB staff views these revisions to be reasonable alternatives, but unnecessary compared to the simpler approach that is proposed.

Additionally, if the proposed Regulation allowed a 35 percent leak rate for refrigeration systems prior to leak repair, and this target leak rate applied to all systems during the year, then the GHG emission reductions compared to BAU are substantially reduced from 7.2 $MMTCO_2E$ to less than 1 $MMTCO_2E$ for Kyoto gases.

Finally, the SCAQMD Rule 1415 requires all leaks to be repaired. A similar statewide requirement would better ensure clarity and consistency with this existing program.

Banning of Non-refillable Refrigerant Cylinders

Alternatives staff reviewed specific to refrigerant cylinder are similar to concepts proposed, but not enacted, in U.S. EPA regulations. U.S. EPA regulations do not prohibit the use of non-refillable refrigerant cylinders, although this regulatory concept has been reviewed in the context of the management of 30-pound non-refillable refrigerant cylinders. Options the U.S. EPA had considered included: 1) a complete ban of non-refillable containers, 2) evacuation of cylinders, using industry guidelines, prior to disposal, and 3) a ban on importation of Class 1 ODS refrigerants in non-refillable cylinders.[22]

The banning of non-refillable cylinders could result in a GHG emission reduction benefit from refrigerant cylinders, although criteria pollutant emissions including diesel particulates from transportation may increase. Additionally, there may be other business impacts such as additional personnel injuries resulting from the use of heavier cylinders.

[22] ARI's Policy and Public Affairs - Executive Branch, http://ariadman.tempdomainname.com/ga/executive-branch/index.html, retrieved on May 13, 2008.

The banning of non-refillable cylinders would require substantial changes in the refrigerant distribution industry, and additional costs.

Placing restrictions on the sale of non-refillable cylinders would require capital expenditures for the manufacture of refillable cylinders to replace currently used non-refillable cylinders.

Based on a literature review of the U.S. market for common refrigerants such as R-22 and R-134a the total number of non-refillable cylinders sold in California is estimated at 720,000 annually. This is based on national sales estimates of one million 30-pound cylinders in the MVAC market and five million in the stationary HVAC market scaled down to the California population – 12 percent of six million 30-pound cylinders.[23] If non-refillable cylinders are banned, then these non-refillable cylinders must be replaced with refillable cylinders, which will increase manufacturing costs. These one-time replacement manufacturing costs would be recovered over time as non-refillable cylinders are manufactured each year while refillable cylinders are not required to be manufactured each year.

The proposed option would also require infrastructure development for refilling refrigerant cylinders. There is no existing data available specific to the cost of infrastructure development for cylinder refilling.

In the alternative scenario of a non-refillable cylinder ban there are other cost issues that may be a barrier. The tare weight of a 30-pound refillable cylinder may be 300 percent or greater than the tare weight of a non-refillable cylinder. Based on manufacturer data a non-refillable cylinder's tare weight would be around 6 pounds, while a refillable cylinder's tare weight may be as high as 21 pounds.[24] As the servicing locations for R/AC appliances are often up stairs or on rooftops, increased weight may increase workers' injuries or create the need for a lighter refillable cylinder, which would increase the number of times a technician may need to carry a cylinder to a servicing location. These costs are not quantified due to a lack of data, but may be extensive.

The requirement for refrigerant cylinders to be returned to a refrigerant distributor for refilling may result in additional vehicle miles traveled (VMT). Currently most refilling is completed at refrigerant manufacturing plants in southeastern United States. Until a high-GWP refrigerant refilling infrastructure is established in California VMT for refrigerant cylinders could increase substantially, requiring travel back to plants in or around Baton Rouge, Louisiana. Additionally, as refillable cylinders are heavier, the total tons per mile for local service vehicles would increase, which would increase total transportation related cost and emissions.

[23] Batt, J. Attachment 1: Description of Emission Reduction Measure Form, http://www.arb.ca.gov/cc/scopingplan/submittals/other/carb_solicitation_for_ideas_use_of_refillable_refrigerant_cylinders.pdf, (accessed March 16, 2009.

[24] Based on cylinder specifications from Amtrol Inc., http://www.amtrol.com/pdf/refrigrec.pdf, (accessed September 1, 2009), and Worthington Cylinders, http://www.worthingtoncylinders.com/Specifications/Refrigerant.aspx, (accessed September).

Requiring a Deposit on Non-refillable Refrigerant Cylinders

ARB staff considered requiring a $35 deposit on all non-refillable cylinders to ensure they are returned to a distributor for final evacuation and disposal.

The ARB received stakeholder comments and concerns regarding the need to understand the entire life cycle emissions and related transportation emissions associated with requiring a $35 deposit on non-refillable cylinders. There were concerns related to potential increases in GHG emissions related to increased transportation while transporting empty cylinders back to a central site.

Additionally, the distribution network currently is not developed to collect and process these cylinders for recycling or disposal, so the concept may result in third party contracts with other companies to provide this service. This service would require additional transportation from a refrigerant distributor to a third party service contractor facility.

The proposed alternative regulatory option would require infrastructure development for refrigerant cylinder evacuation and final recycling or disposal.

Prior to recommending any final action specific to a requirement to use refillable cylinders or to place a deposit on non-refillable cylinders, the total lifecycle GHG emissions impact of refrigerant cylinders including direct heel emissions as well as indirect emissions related to increased VMT must be further reviewed. ARB staff will continue to conduct research in this area and work with industry to find additional regulatory or voluntary solutions that will have a net GHG emissions reductions impact.

Analysis to estimate the cost, emissions, and potential emission reductions related to refrigerant cylinder management is a component of a research contract approved by the ARB with ICF International to investigate the costs and benefits of recovering and destroying or recycling high-global warming potential greenhouse gases. The contract began in June 2008, and is titled "Lifecycle Analysis of High-Global Warming Potential Greenhouse Gas Destruction". A final report is expected in late 2010.

Requiring new commercial and industrial refrigeration systems to meet specified performance standards.

ARB staff considered including general requirements for specification for new commercial and industrial refrigeration to reduce leaks and to increase energy efficiency. The alternative considered would have required that: 1) a facility with a new commercial and industrial refrigeration system use best available refrigeration technology - defined as any available technology used in a commercial refrigeration system that has a maximum refrigerant charge equivalent to 1.75 pounds of high-GWP refrigerant per 1000 British Thermal Units (Btu) per hour, or 2) a facility be designed to have a "total carbon footprint" 25 percent less than a specified baseline facility carbon footprint.

Emissions from commercial and industrial refrigeration systems are categorized as direct refrigerant emissions and indirect emissions (CO_2-equivalent emissions resulting from energy use). Commercial and industrial refrigeration systems exist in California, ranging from small, tightly sealed refrigerators to large direct expansion (DX) refrigeration systems containing hundreds or thousands of pounds of refrigerant. This measure was proposed to apply to a portion of new commercial and industrial refrigeration systems, including large DX refrigeration systems used in supermarkets, cold storage warehouses, and industrial processes, including food processing.

Staff concluded that a more holistic look at both direct and indirect emissions is the most appropriate way to ensure the greatest impact on GHG emission reduction benefits. To accomplish this the ARB and California Energy Commission (CEC) are collaborating to incorporate the new commercial and industrial refrigeration systems specifications based on direct GHG emission reductions and whole-building energy efficiency in the next phase of updates to the California Building Standards Code (Title 24).

A significant focus of the California Building Standards Code approach is to allow flexibility as long as a specific performance standard is met in the form of an energy budget. Energy use has a significant impact on the Life Cycle Climate Performance (LCCP) of a refrigeration system and buildings. One concept that will be reviewed in this process is the integration of a building energy budget and direct refrigerant emission impacts – or a building's LCCP.

To better understand the balance of direct and indirect emissions in terms of LCCP the ARB entered into a contract to inventory the direct and indirect GHG emissions from stationary refrigeration sources. The Final Report titled "Inventory of Direct and Indirect GHG Emissions from Stationary Air Conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning" is available at: **http://www.arb.ca.gov/cc/commref/commref.htm**.

Additional research is under consideration by the ARB titled, "Greenhouse Gas Performance Analysis for Commercial Buildings with Large Refrigeration/Air Conditioning Systems" to initiate a review of possible performance specifications.

Requirements for Best Practices Certified Technician Program

During the rulemaking process for the Refrigerant Management Program staff received comments regarding the need for better technician training. This need was discussed in detail with trade associations representing heating and air-conditioning equipment distributors and refrigeration and air-conditioning service contractors.

In reviewing the potential for a Best Practices Certified Technician regulatory or voluntary component it is important to note that there is already some activity in this general work area, although it is specific to energy efficiency. As a result of work being conducted by the California Public Utilities Commission (CPUC) and CEC, an HVAC Technician subcommittee has been created to discuss technician training opportunities to increase energy efficiency. Any further activity to address a potential Best Practices Certified Technician program would need to be in collaboration with the HVAC Workgroup to avoid duplication.

The general concept of a potential Best Practices Certified Technician regulatory or voluntary component would be based on the following principles:

- o All certified technicians are to be certified to understand best practices to reduce refrigerant emissions as outlined in ANSI/ASHRAE standard 147, or similar standards or guidelines.
- o Certification is developed by the current network of HVAC & Refrigeration training programs in California; there are currently 52.
- o The ARB role is to certify/approve a training program training and certification plan for each institution.

J. Plans for the Future

Plans for the future include consulting with current technical workgroup members on the possibility of establishing regulatory and/or voluntary programs specific to two alternatives considered that would serve to complement the Refrigerant Management Program:

1. Requiring new commercial and industrial refrigeration systems to meet specified performance standards
2. Requirement for Best Practices Certified Technician Program

As discussed previously, the new commercial and industrial refrigeration systems performance standards will be coordinated with the CEC. The Potential Best Practices Certified Technician program option will be important to ensuring that the emission reductions anticipated from the proposed Refrigerant Management Program are realized.

These two components will be important in furtherance of achieving the total statewide emission reductions target, but they will be considered separately from the proposed Refrigerant Management Program.

Additional plans for the future include a proposed high-GWP mitigation fee. The Climate Change Scoping Plan recommends applying a mitigation fee to high-GWP compounds with high potency, such as high-GWP refrigerants. High-GWP gases are used in a broad range of applications, including significant usage in stationary HVAC, MVAC, and refrigeration. High-GWP gases are also used in a wide range of other applications, such as foam-blowing agents, electrical transmission, fire suppressants, consumer products, and the semiconductor industry. In concept, a mitigation fee would address all high-GWP gases in a consistent manner and serve to decrease GHG emissions in several ways. It could change behavior by increasing price (e.g. improve leakage reduction efforts), induce new lower GWP alternative products, or provide fees to mitigate GHG emissions elsewhere within or outside of a given sector. The mitigation fee approach would be used to address emissions that are difficult to address via traditional regulatory approaches due to 1) many small uses that would require complicated regulations, 2) new gases and new or evolving usages, and 3) uses with no current alternative and a lack of incentive to either develop an alternative or reduce leakage beyond regulatory standards. High-GWP specific fees are already in place in several other countries including Australia, Norway, and Denmark.

If a mitigation fee is applied to high-GWP gases in the future, it would be harmonized with this Regulation. This may include the deletion of the implementation fee if a potential high-GWP fee would fully fund required enforcement and administration costs to ensure the emission reductions anticipated from the Refrigerant Management program are maintained.

XI. CONCLUSIONS AND RECOMMENDATIONS

ARB staff proposes a new regulation to address GHG emissions attributable to stationary R/AC appliances, with a focus on stationary, non-residential refrigeration systems.

The proposed Regulation fulfills the requirements applicable to AB 32 direct emission reduction measures to "achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions" and helps meet the goals of reducing GHG emissions to 1990 levels by 2020.

No alternatives considered by the Board would be more effective in achieving the goals of this proposal, nor would they be less burdensome to facilities that use refrigeration systems.

Staff recommends that the Board approve its proposal to adopt Sections 95380 through 95398 of title 17, California Code of Regulations.

This page is intentionally left blank

XII. REFERENCES

Air-Conditioning, Heating and Refrigeration Institute, Certified Product Directory, January 2009, http://www.ahridirectory.org/ahridirectory/pages/rrr/RRRE%2015%20January%2009_Directory.pdf, retrieved April 7, 2009.

Air-conditioning and Refrigeration Institute, Policy and Public Affairs - Executive Branch, http://ariadman.tempdomainname.com/ga/executive-branch/index.html, retrieved on May 13, 2008.

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. User's Manual for ANSI/ASHRAE Standard 15-2001 Safety Standard for Refrigeration Systems, 2003.

Amtrol, Inc. Refrigerant Recovery Cylinders, http://www.amtrol.com/pdf/refrigrec.pdf, retrieved September 14, 2009.

ARMINES, Inventory of Direct and Indirect GHG Emissions from Stationary Air conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air conditioning, Final Report, March 2009.

Batt, J. Attachment 1: Description of Emission Reduction Measure Form, http://www.arb.ca.gov/cc/scopingplan/submittals/other/carb_solicitation_for_ideas_use_of_refillable_refrigerant_cylinders.pdf, retrieved March 16, 2009.

British Refrigeration Association, Code of Practice for Refrigerant Leak Tightness in compliance with the F-Gas Regulation, December 2007.

California Air Pollution Control Officers Association, Memo to Anthony Andreoni, November 4, 2008.

California Air Resources Board, Fact Sheet – The Greenhouse Effect and California. http://www.arb.ca.gov/cc/factsheets/ccbackground.pdf. Accessed September 14, 2009.

California Air Resources Board, Climate Change Scoping Plan, December 2008.

California Air Resources Board, Climate Change Scoping Plan Appendices, VOLUME I: SUPPORTING DOCUMENTS AND MEASURE DETAIL, December 2008.

California Air Resources Board, Refrigerant Management Best Practices, July 21, 2009, http://www.arb.ca.gov/cc/reftrack/best_management_practices_pamphlet_electronic_version.pdf

California Air Resources Board, Refrigerant Management Program Frequently Asked Questions, July 21, 2009, http://www.arb.ca.gov/cc/reftrack/refrigerant_management_program_faq.pdf

California Air Resources Board. Refrigerant Management Program. Technician survey results. December 2008.

California Air Resources Board, STAFF REPORT: INITIAL STATEMENT OF REASONS FOR RULEMAKING PROPOSED REGULATION FOR MANDATORY REPORTING OF GREENHOUSE GAS EMISSIONS PURSUANT TO THE CALIFORNIA GLOBAL WARMING SOLUTIONS ACT OF 2006 (ASSEMBLY BILL 32), October 2007.

California Climate Change Center, Projecting Future Sea Level, March 2006.

California Employment Development Department, "Training Program Summary," http://www.labormarketinfo.edd.ca.gov/cgi/dataBrowsing/traProgramSummary.asp?menuChoice=&cipcode=150501&geogArea=0601000000, retrieved July 15, 2008.

California Energy Commission, California Commercial End-Use Survey (CEUS), March 2006. http://www.energy.ca.gov/ceus/ (accessed August 27, 2009).

California Environmental Protection Agency and California Resources Agency, Environmental Protection Indicators for California, 2004 update.

Energy Information Administration, Commercial Buildings Energy Consumption Survey (CBECS), 2003, http://www.eia.doe.gov/emeu/cbecs/

Energy Information Administration. Commercial Buildings Energy Consumption Survey (CBECS). Heating Equipment, Number of Buildings for Non-Mall Buildings. 2003. http://www.eia.doe.gov/emeu/cbecs/

Enhanced Capital Allowances, ECA ENERGY TECHNOLOGY CRITERIA LIST 2008 – REFRIGERATION EQUIPMENT Automated Permanent Refrigerant Leak Detection Systems, July 29, 2008, http://www.eca.gov.uk/NR/rdonlyres/286051AC-63CC-4199-BF20-7A083E220070/0/08Refrigeration_AutomatedPermanentRefrigerantLeakDetectionSystems.pdf, retrieved February 24, 2009.

European Fluorocarbons Technical Committee, Fluorocarbons and Sulphur Hexafluoride, http://www.fluorocarbons.org/en/debate/regulatory_developments/f_gas_regulation.html, (accessed September 24, 2009)

Godwin, D. (U.S. EPA), Martin Van Pelt, M. and Peterson, K. (ICF Consulting), Modeling Emissions of High Global Warming Potential Gases from Ozone Depleting Substance Substitutes, 2003. http://www.epa.gov/ttn/chief/conference/ei12/green/godwin.pdf, retrieved December 1, 2008.

ICF International, Memo to ARB, October 21, 2008.

ICF International, Memo to ARB, November 10, 2008.

Intergovernmental Panel on Climate Change and Technology and Economic Assessment Panel, Special Report on Safeguarding the Ozone Layer and the Global Climate System, Issues related to Hydrofluorocarbons and Perfluorocarbons, 2005.

http://www.ipcc.ch/publications_and_data/publications_and_data_reports_safeguarding_the_ozone_layer.htm (accessed September 24, 2009)

Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Chapter 2, Changes in Atmospheric Constituents and in Radiative Forcing, IPCC Working Group 1 Fourth Assessment Report, 2007, http://www.ipcc.ch/ipccreports/ar4-wg1.htm

Intergovernmental Panel on Climate Change, Climate Change 2001: The Scientific Basis, Chapter 6, Radiative Forcing of Climate Change, IPCC Working Group 1 Third Assessment Report, 2001. http://www.grida.no/publications/other/ipcc_tar/ (accessed January 28, 2009).

Intergovernmental Panel on Climate Change, Climate Change 1995: IPCC Second Assessment, 1995, http://www1.ipcc.ch/ipccreports/assessments-reports.htm

Intergovernmental Panel on Climate Change 2006 Guidelines for National Greenhouse Gas Inventories, Volume 3 (Industrial Processes and Product Use). http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol3.html (accessed July 6, 2009).

Lewis, Kimberly, Guidelines for Refrigerant Leak Monitor Installation, RSES Journal, April, 2002.

Official Journal of the European Union, REGULATION (EC) No 842/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on certain fluorinated greenhouse gases.

South Coast Air Quality Management District (SCAQMD) Rule 1415 (Reduction of Refrigerant Emissions from Stationary Refrigeration and Air Conditioning Systems) dataset, 2000-2005.

Stouffer, D., Refrigerant Leak Creates Environmental Problems for Businesses, February, 2009, available at: http://air.environmental-expert.com/resultEachArticle.aspx?cid=32055&codi=45718&idproducttype=6, retrieved March 9, 2009.

Troy, Eugene F, Options for Reducing Refrigerant Emissions from Supermarket Systems, EPA-600/R-97-039, April 1997.

United Nations Environment Programme 1998 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, October 1998; Annex III-Refrigerant Data. http://ozone.unep.org/teap/Reports/RTOC/index.shtml (accessed September 30, 2009).

United Nations Environment Programme 2006 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, January 2007. http://ozone.unep.org/teap/Reports/RTOC/index.shtml (accessed September 30, 2009).

U.S. Census Bureau censtats (census statistics) database: http://censtats.census.gov/cbpnaic/cbpnaic.shtml (Accessed August 17, 2009).

U.S. Census Bureau North American Industrial Classification System (NAICS) code guide. http://www.census.gov/eos/www/naics/ (accessed August 17, 2009).

U.S. EPA Vintaging Model national greenhouse gas emission estimates, 2010-2030; November 2008

U.S. EPA Vintaging Model refrigerant distribution for refrigeration equipment, 2010 and 2020, November 2008.

U.S. EPA Vintaging Model Alternative Fluorocarbons Environmental Acceptability Study Comparison for Common Refrigerants, April 2007.

J.M. Velders, S.O. Andersen, J.S. Daniel, D.W. Fahey, and M. McFarland, The importance of the Montreal Protocol in protecting climate, Proc. Natl. Acad. Sci. USA, March 2007.

J.M. Velders, D.W. Fahey, J.S. Daniel, M. McFarland, and S.O. Andersen, The large contribution of projected HFC emissions to future climate forcing, Proc. Natl. Acad. Sci. USA, June 2009.

Worthington Industries, Refrigerant Cylinders, http://www.worthingtoncylinders.com/Specifications/Refrigerant.aspx, retrieved September 14, 2009.

Proposed Regulation Order

REGULATION FOR THE MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES

Adopt new Subarticle 6, sections 95380 to 95398 in Subchapter 10, Article 4, title 17, California Code of Regulations, to read as follows:

Subarticle 6: MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES

95380. Purpose

The purpose of this subarticle is to reduce emissions of high global warming potential refrigerants from stationary, non-residential refrigeration equipment and from the installation and servicing of refrigeration and air-conditioning appliances using high-GWP refrigerants.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95381. Applicability

This subarticle applies to any person who owns or operates a stationary refrigeration system, as defined in this subarticle. This subarticle also applies to any person who installs, repairs, maintains, services, replaces, recycles, or disposes of a refrigeration or air-conditioning appliance, and to any person who distributes or reclaims refrigerants with high global warming potential.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95382. Definitions

(a) For the purposes of this subarticle, the following definitions shall apply:

(1) "Additional refrigerant charge" means the quantity, in pounds, of refrigerant added to a refrigeration system or appliance in order to bring the system to a full charge. "Additional refrigerant charge" does not include an initial refrigerant charge.

(2) "AHRI" means the Air-Conditioning, Heating and Refrigeration Institute.

(3) "Air-conditioning" means any stationary, non-residential appliance, including a computer-room air conditioner, that provides cooling to a space to an intended temperature of not less than 68°F for the purpose of cooling objects or occupants.

(4) "Air district" means an air quality management district or air pollution control district created or continued in existence under Health and Safety Code sections 40000-41357.

(5) "Air Pollution Control Officer" or "APCO" means the appointed head of a local air quality management district or air pollution control district whose appointment and duties are set forth in Health and Safety Code sections 40750-40753.

(6) "Appliance" means any device which contains and uses a high-GWP refrigerant, including any air conditioner, refrigerator, chiller, freezer, or refrigeration system.

(7) "ASHRAE" means the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

(8) "Automatic leak detection system" means a calibrated device using continuous monitoring for detecting leakage of refrigerants that on detection, alerts the operator, and may be either:

(A) A direct system that automatically detects the presence in air of refrigerant leaked from a refrigeration system; or

(B) An indirect system that automatically interprets measurements (e.g. temperature or pressure) within a refrigeration system that indicate a refrigerant leak (e.g., in refrigerated cases and other locations in the system) and alerts the operator to the presence of a refrigerant leak.

(9) "Certified reclaimer" means a person who is a certified reclaimer in accordance with Title 40 of the Code of Federal Regulations, Part 82, §82.164.

(10) "Certified refrigerant recovery or recycling equipment" means any refrigerant recovery or recycling equipment that meets the standards specified in Title 40 of the Code of Federal Regulations, Part 82, §82.152.

(11) "Certified technician" means a person who holds a current, valid, and applicable certificate pursuant to Title 40 of the Code of Federal Regulations, Part 82, §82.40 or §82.161.

(12) "Change of ownership" means a transfer of the title of a facility subject to this subarticle.

(13) "Chlorofluorocarbon" or "CFC" means a class of compounds primarily used as refrigerants, consisting of only chlorine, fluorine, and carbon.

(14) "Commercial refrigeration" means a refrigeration appliance utilized in the retail food and cold storage warehouse sectors. "Retail food" includes the refrigeration equipment found in supermarkets, convenience stores, restaurants and other food service establishments. "Cold storage" includes the equipment used to store meat, produce, dairy products, and other perishable goods.

(15) "Component" means a part of a refrigeration system or appliance (including condensing units, compressors, condensers, evaporators, receivers) and all of its connections and subassemblies, without which the refrigeration system or appliance will not properly function or will be subject to failures.

(16) "Computer-room air conditioner" means a central air conditioner specifically designed for use in data processing areas, maintaining an ambient temperature of approximately 72°F and a relative humidity of approximately 52 percent.

(17) “Continuous monitoring” means measuring the ambient concentration of refrigerant using electronic or mechanical sensors or interpreting measurements (e.g. temperature or pressure) within a refrigeration system that indicate a refrigerant leak in real time.

(18) “Detected refrigerant leak” means a refrigerant leak that is known to the owner or operator, or should reasonably have been known to the owner or operator.

(19) “Direct emissions” means high-GWP refrigerant emissions from a facility that are emitted by refrigeration systems under the operational control of a facility owner or operator. Direct emissions are calculated as the total weight in pounds of each type of high-GWP refrigerant that was charged into a refrigeration system minus the total weight in pounds of each type of high-GWP refrigerant that was recovered from a refrigeration system, as reported in the annual Facility Stationary Refrigeration report pursuant to section 95388.

(20) “Enclosed building or structure" means a building or structure with a roof and walls that prevent wind from entering the facility.

(21) “Equipment type” means commercial refrigeration, industrial process refrigeration, or other refrigeration.

(22) “Executive Officer” means the Executive Officer of the California Air Resources Board, or his or her delegate.

(23) “Facility” means any property, plant, building, structure, stationary source, stationary equipment or grouping of stationary equipment or stationary sources located on one or more contiguous or adjacent properties, in actual physical contact or separated solely by a public roadway or other public right-of way, and

under common operational control, that includes one or more refrigeration systems or appliance subject to this subarticle. Operators of military installations may classify such installations as more than a single facility based on distinct and independent functional groupings within contiguous military properties.

(24) "Facility identification number" means a unique identification number provided by the Executive Officer for each facility with one or more refrigeration systems in operation, pursuant to section 95383.

(25) "Follow-up verification test" means those tests that involve checking the repairs within 30 days of the refrigeration system's returning to normal operating characteristics and conditions. "Follow-up verification tests" for a refrigeration system from which the refrigerant charge has been evacuated means a test conducted after the refrigeration system or portion of the refrigeration system has resumed operation at normal operating characteristics and conditions of temperature and pressure, except in cases where sound professional judgment dictates that these tests will be more meaningful if performed prior to the return to normal operating characteristics and conditions. "Follow-up verification test" for a refrigeration system from which the refrigerant charge has not been evacuated means a reverification test conducted after the initial verification test and usually within 30 days of returning to normal operating characteristics and conditions. Where a refrigeration system is not evacuated, it is only necessary to complete any required changes to return the refrigeration system to normal operating characteristics and conditions.

(26) "Full charge", "optimal charge", or "critical charge" means the amount of refrigerant required in the refrigerant circuit for normal operating characteristics and conditions of a refrigeration system or appliance, as determined by using one of the following three methods:

(A) Use of the equipment manufacturer's specifications of the full charge;

(B) Use of calculations based on component sizes, density of refrigerant, volume of piping, seasonal variances, and other relevant considerations; or

(C) The midpoint of an established range for full charge based on the best available data regarding the normal operating characteristics and conditions for the system.

(27) "Global warming potential" or "GWP" means the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time.

(28) "Global warming potential value" or "GWP value" means the 100-yr GWP value first published by the IPCC in its Second Assessment Report (SAR) (IPCC, 1995); or if a 100-yr GWP value was not specified in the IPCC SAR, it means the GWP value published by the IPCC in its Fourth Assessment A-3 Report (AR4) (IPCC, 2007); or if a 100-yr GWP value was not specified in the IPCC AR4, then the GWP value will be determined by the Executive Officer based on data, studies and/or good engineering or scientific judgment. Both the 1995 IPCC SAR values and the 2007 IPCC AR4 values are published in table 2.14 of the 2007 IPCC AR4. The SAR GWP values are found in column "SAR (100-yr)" of Table 2.14.; the AR4 GWP values are found in column "100 yr" of Table 2.14."

(29) "High-GWP refrigerant" means a compound used as a heat transfer fluid or gas that is: (A) a chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or (B) any compound or blend of compounds, with a GWP value equal to or greater than 150, or (C) any ozone depleting substance as defined in Title 40 of the Code of Federal Regulation, Part 82, §82.3.

(30) "Hydrochlorofluorocarbon" or "HCFC" means a class of compounds primarily used as refrigerants, consisting of only hydrogen, chlorine, fluorine, and carbon.

(31) "Hydrofluorocarbon" or "HFC" means a class of compounds primarily used as refrigerants, consisting of only hydrogen, fluorine, and carbon.

(32) "Indirect emissions" means any emissions that are a consequence of the activities of a facility but occur at sources owned or controlled by another person related to energy consumed for electricity, heat, steam, and cooling.

(33) "Industrial process refrigeration" means complex customized appliances used in the chemical, pharmaceutical, petrochemical and manufacturing industries that are directly linked to the industrial process. "Industrial process refrigeration" includes industrial ice machines, appliances used directly in the generation of electricity, and ice rinks. Where one appliance is used for both industrial process refrigeration and other applications, it will be considered industrial process refrigeration equipment if 50 percent or more of its operating capacity is used for industrial process refrigeration.

(34) "Industrial process shutdown" means that an industrial process or facility temporarily ceases to operate or manufacture whatever is being produced at that facility.

(35) "Initial refrigerant charge" means the quantity, in pounds, of high-GWP refrigerant added to a refrigeration system or appliance in order to bring the system to a full charge upon initial installation of a refrigeration system or appliance.

(36) "Initial verification test" means a leak test that is conducted as soon as practicable after the repair is completed. "Initial verification test" with regard to leak repairs that require the evacuation of the refrigeration system or portion of the refrigeration system, means a test conducted prior to the replacement of the full charge and before the refrigeration system or portion of the refrigeration system has reached operation at normal operating characteristics and conditions of temperature and pressure. "Initial verification test" with regard to repairs conducted without the evacuation of the full charge means a test conducted as soon as practicable after the conclusion of the repair work.

(37) "Intended to be operated year round" means a refrigeration system at a facility that is not a seasonal facility.

(38) "Leak inspection" means an inspection of a refrigeration system to detect a leak of a high-GWP refrigerant.

(39) "Low temperature refrigeration system" means a commercial or industrial refrigeration system used for frozen products.

(40) "Medium temperature refrigeration system" means a commercial or industrial refrigeration system used for chilled products.

(41) "Newly constructed" means a facility that is not yet operational, or that has been operational for less than 6 months.

(42) "Non-certified technician" means a person who installs, maintains, services, repairs, modifies, or disposes of refrigeration or air-conditioning appliances that does not hold a current, valid, and applicable certificate pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.161.

(43) "Non-refillable cylinder" means a cylinder with a refrigerant capacity of two pounds or greater that is designed not to be refilled and is used in the servicing, maintenance or filling of a refrigeration system, appliance, motor vehicle air-conditioning system, or heat pump equipment.

(44) "Normal operating characteristics and conditions" means a refrigeration system operating temperatures, pressures, fluid flows, speeds, and other characteristics, including full charge of the refrigeration system that would be expected for a given process load and ambient condition during operation. Normal operating characteristics and conditions are marked by the absence of atypical conditions affecting the operation of the refrigeration system.

(45) "Operating" means the use of a refrigeration system for cooling or freezing. A refrigeration system is considered to be operating or in operation for the entirety of

any calendar month where it is used for cooling or freezing in any manner for more than a total of 24 hours.

(46) "Operator" means the entity having operational control of a facility.

(47) "Other refrigeration" means any stationary, non-residential appliance that is used for an application other than industrial process refrigeration, commercial refrigeration, or air-conditioning, or is used for two or more applications including industrial process refrigeration, commercial refrigeration, or air-conditioning.

(48) "Owner" means the entity having title of the facility which is subject to this subarticle.

(49) "Perfluorocarbon" or "PFC" means a class of compounds consisting only of carbon and fluorine.

(50) "Person" means any person, firm, association, organization, partnership, business trust, corporation, limited liability company, company, federal, state, or local governmental agency or public district.

(51) "Reclaim" means to reprocess refrigerant to all of the specifications specified in Title 40, Code of Federal Regulations, Part 82, §82.152.

(52) "Recover" means to remove refrigerant in any condition from an appliance and to store it in an external container without necessarily testing or processing it in any way.

(53) "Recycle" means to extract refrigerant from an appliance and clean refrigerant for reuse without meeting all of the requirements for reclamation. In general, recycled refrigerant is refrigerant that is cleaned using oil separation and single or multiple passes through devices, such as replaceable core filter-driers, which reduce moisture, acidity, and particulate matter.

(54) "Refillable cylinder" means a cylinder with a refrigerant capacity of two pounds or greater that is designed to be refilled and is used in the servicing, maintenance

or filling of a refrigeration system, appliance, motor vehicle air-conditioning system, or heat pump equipment.

(55) "Refrigerant circuit" means the parts of a refrigeration system that are normally connected to each other (or are separated by isolation valves) and are designed to contain a high-GWP refrigerant. A single refrigerant circuit is defined by all piping and components that use refrigerant from a common reservoir of a high-GWP refrigerant.

(56) "Refrigerant distributor or wholesaler" means a person to whom a product is delivered or sold for purposes of export, subsequent resale, or delivery to a certified technician, employer of a certified technician, appliance manufacturer, or another refrigerant distributor or wholesaler. "Refrigerant distributor or wholesaler" includes any person who imports refrigerant from outside of this state to distribute or sell refrigerant to a certified technician, employer of a certified technician, appliance manufacturer, or another refrigerant distributor or wholesaler, or who acts as an agent or broker in buying refrigerant.

(57) "Refrigerant leak" means any discharge of refrigerant into the atmosphere from an appliance, certified refrigerant recovery or recycling equipment, refrigerant cylinder, or other container.

(58) "Refrigerant leak detection device" means a device that can be calibrated to accurately detect and measure the ambient concentration of refrigerant at a minimum concentration level of 10 parts per million of vapor of a specific refrigerant or selection of refrigerants.

(59) "Refrigeration system" means stationary, non-residential equipment that is an industrial process refrigeration, commercial refrigeration, or other refrigeration appliance with a single refrigerant circuit that requires more than 50 pounds of any combination of high-GWP refrigerant to maintain normal operating characteristics and conditions. "Refrigeration system" does not include an air-conditioning appliance. A single refrigeration system is defined by a single refrigerant circuit.

(60) “Residential” means a residential dwelling containing four or fewer dwelling units on one lot or parcel.

(61) “Retire” means the permanent removal from service of a refrigeration system, or component, rendering it unfit for use by the current or any future owner or operator.

(62) “Retrofit” means the replacement of the refrigerant used in a refrigeration system with a refrigerant approved under the Significant New Alternatives Policy (SNAP) program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.170, or a refrigerant approved by the Executive Officer, and related refrigeration system changes required to maintain the refrigeration system operation and reliability following refrigerant replacement.

(63) “Seasonal adjustment” means the need to add refrigerant to a refrigeration system due to a change in ambient conditions caused by a change in season, followed by the subsequent removal of refrigerant in the corresponding change in season, where both the addition and removal of refrigerant occurs within one consecutive 12-month period after the initial installation of a refrigeration system or a repair of a refrigeration system requiring evacuation or partial evacuation of the refrigerant circuit.

(64) “Seasonal facility” means a facility where the purpose of the refrigeration system(s) at a facility ceases to be required during certain seasons of the year.

(65) “Stationary” means meeting at least one of the following conditions:

(A) Is installed in a building, structure, or facility.

(B) Is attached to a foundation, or if not so attached, will reside at the same location for more than 12 consecutive months.

(C) Is located at the same single location on a permanent basis (at least two consecutive years) and that operates at that single location at three months each year.

(66) “System identification number” means a unique identification number for each refrigeration system at a facility. The system identification number is comprised of the facility identification number followed by a hyphen, followed by a three digit number starting at 001 sequentially assigned to each unique refrigeration system at a facility. For example, if a facility has a facility identification number of ARB000001, then the system identification number for the first refrigeration system would be ARB000001-001.

(67) “System mothballing” means the intentional shutting down of a refrigeration system for a period of time greater than 60 days by the owners or operators of that facility, where the refrigerant has been evacuated from the refrigeration system or the affected component of the refrigeration system, at least to atmospheric pressure.

(68) “Temperature classification” means low temperature refrigeration system, medium temperature refrigeration system, or other.

(69) “Topping off” means adding refrigerant to a refrigeration system or appliance in order to bring the system to a full charge.

(70) Total Evaporator Cooling Load” means the total cooling in British thermal units (Btus) per hour required to maintain a facility’s refrigeration systems at the temperature for which they are designed. The total cooling for the evaporator cooling load does not include the cooling load of a facility’s heating, ventilation, and air-conditioning systems, sub-cooling, heat of rejection, or pump heat.

(71) “U.S. EPA” means the United States Environmental Protection Agency.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95383. Registration Requirements for Facilities with Stationary Refrigeration Systems

(a) *Refrigeration Systems with a Full Charge Greater Than or Equal to 2,000 Pounds.* On or before March 1, 2012, the owner or operator of a facility with a refrigeration system that begins operation before January 1, 2012, with a full charge greater than or equal to 2,000 pounds of a high-GWP refrigerant, must register with the Executive Officer by providing the information specified in subsection (e). The owner or operator of a facility with a refrigeration system that begins operation on or after January 1, 2012, with a full charge greater than or equal to 2,000 pounds of a high-GWP refrigerant, must register with the Executive Officer by March 1 of the calendar year after the calendar year in which the refrigeration system begins operating at the facility.

(b) *Refrigeration Systems with a Full Charge Greater Than or Equal to 200 Pounds, but Less Than 2,000 Pounds.* On or before March 1, 2014, the owner or operator of a facility with a refrigeration system that begins operation before January 1, 2014, with a full charge greater than or equal to 200 pounds, but less than 2,000 pounds, of a high-GWP refrigerant must register with the Executive Officer by providing the information specified in subsection (e). The owner or operator of a facility with a refrigeration system that begins operation on or after January 1, 2014, with a full charge greater than or equal to 200 pounds, but less than 2,000 pounds, of a high-GWP refrigerant must register with the Executive Officer by March 1 of the calendar year after the calendar year in which the refrigeration system begins operating at the facility.

(c) *Refrigeration Systems with a Full Charge Greater Than 50 Pounds, but Less Than 200 Pounds.* On or before March 1, 2016, the owner or operator of a facility with a refrigeration system that begins operation before January 1, 2016, with a full charge greater than 50 pounds, but less than 200 pounds, of a high-GWP refrigerant, must register with the Executive Officer by providing the information specified in subsection (e). The owner or operator of a facility with a refrigeration system that begins operation on or after January 1, 2016, with a full charge greater than 50 pounds, but less than 200 pounds, of a high-GWP refrigerant must register with the Executive Officer by March 1 of the calendar year after the calendar year in which the refrigeration system begins operating at the facility.

(d) *New Owners of Facilities*. If there is a change of ownership of a facility that has been registered pursuant to this section, the new owner or operator, by March 1 of the calendar year after the change of ownership has occurred, must register with the Executive Officer by providing the information specified in subsection (e).

(e) *Registration Information Requirements*. To register, the owner or operator must provide the following information to the Executive Officer:

(1) Facility information:

(A) Name of operator.

(B) Operator Federal Tax Identification Number.

(C) Facility North American Industry Classification System (NAICS) Business Type Code based on the 2007 NAICS United States structure.

(D) Facility Standard Industrial Classification (SIC) code.

(E) Name of facility, including a facility identifier such as store number.

(F) Facility mailing address including a street address, city, state, and zip code.

(G) Facility physical location address including a street address, city, state, and zip code.

(H) Facility contact person.

(I) Facility contact person phone number.

(J) Facility contact person e-mail address.

(2) Refrigeration system information – provided for each refrigeration system:

(A) System identification number (assigned by the facility owner or operator).

(B) Equipment type.

(C) Equipment manufacturer.

(D) Equipment model or description.

(E) Equipment model year.

(F) Equipment serial number. The serial number(s) of the affected equipment or component must be recorded when present and accessible. When the affected equipment or component is part of an assembly without a serial number or does not have an individual serial number or is not accessible after assembly, the physical location of the affected equipment must be recorded in enough detail to permit positive identification.

(G) Physical location of a refrigeration system through schematic or floor plan with equipment locations clearly noted.

(H) Temperature classification – The refrigeration system must be identified as a low temperature system, a medium temperature system, or other.

(I) Full charge of the refrigeration system.

(J) Type of high-GWP refrigerant(s) used.

(f) *Change of Ownership Requirements*. Before any change of ownership, a person selling a refrigeration system must insure that it is free of refrigerant leaks through a leak inspection performed by a certified technician. In addition, a person selling a refrigeration system that has been registered pursuant to this section must inform the buyer of the registration requirements specified in this section and must submit a change of ownership notification to the Executive Officer. The change of ownership notification must include the following information:

(1) Seller information:

(A) Facility identification number.

(B) Name of owner or operator.

(C) Name of facility, including a facility identifier such as store number.

(2) Buyer information:

(A) Name of owner or operator.

(B) Name of facility, including a facility identifier such as store number.

(C) Facility mailing address including a street address, city, state, and zip code.

(D) Facility contact person.

(E) Facility contact person phone number.

(F) Facility contact person e-mail address.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95384. Implementation Fees for Facilities with Stationary Refrigeration Systems

(a) *Initial Implementation Fee Upon Registration.* An implementation fee must be paid by each owner or operator of a facility with a refrigeration system with a full charge greater than or equal to 200 pounds of a high-GWP refrigerant. The fee is due and payable to the Executive Officer on the same date that the owner or operator is required to register pursuant to section 95383. The amount of the fee is specified in subsection (c).

(b) *Annual Implementation Fee.* An annual implementation fee must be paid by each owner or operator of a facility with a refrigerator system with a full charge greater than 200 pounds of a high-GWP refrigerant. The annual fee is due and payable to the Executive Officer no later than March 1 of each calendar year after the calendar year in which registration is required under section 95383. The amount of the implementation fee is specified in subsection (c).

(c) *Amount of Implementation Fee*. The amount of the initial and annual implementation fee is based on the refrigeration system with the largest full charge that is operating at the facility, and is as follows:

(1) The initial and annual implementation fee for a facility with a refrigeration system with a full charge of 2,000 pounds or greater is $370.

(2) The initial and annual implementation fee for a facility with a refrigeration system with a full charge of 200 pounds or greater, but less than 2,000 pounds is, $170.

(d) Facilities Exempt from Paying Fees. Notwithstanding subsections (a), (b), (c), and (f) of this section, the owner or operator is not required to pay the initial or annual implementation fee for any calendar year if during the previous calendar year all of the refrigeration systems at the facility have been maintained using the following advanced strategies and practices to reduce refrigerant charges and emissions of ozone-depleting substances and greenhouse gases.

(1) If the facility is not a newly constructed facility, all of the following criteria must be met:

(A) The facility must use only refrigerants with zero ozone-depleting potential; and

(B) The facility must use only refrigerants found acceptable by the U.S EPA Significant New Alternatives Policy (SNAP) program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.170 for the specific end use; and

(C) The facility must achieve an average HFC full charge equal to or less than 1.25 lbs. of refrigerant per 1000 Btu per hour total evaporator cooling load; and

(D) The facility must achieve a facility-wide annual refrigerant leak rate, as defined in Title 40 of the Code of Federal Regulation, Part 82, §82.152, of 10% or less; and

(E) The owner or operator must swear under penalty of perjury that the criteria specified in subsection (d)(1) have been met.

(2) If the facility is a newly constructed facility, all of the following criteria must be met:

(A) The facility must use only refrigerants with zero ozone-depleting potential; and

(B) The facility must use only refrigerants found acceptable by the U.S EPA Significant New Alternatives Policy (SNAP) program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.170 for the specific end use; and

(C) The facility must achieve an average HFC full charge equal to or less than 1.25 lbs. of refrigerant per 1000 Btu per hour total evaporator cooling load; and

(D) The owner or operator must swear under penalty of perjury that the criteria specified in subsection (d)(2) have been met.

(e) Upon request by an authorized representative of the Executive Officer including a local Air Pollution Control Officer, the owner or operator claiming that the facility meets the criteria of subsection (d) must provide documentation to demonstrate that the criteria are met, and must provide a written statement as provided in subsection (d)(1)(E) or (d)(2)(D).

(f) Summary of Requirements to Pay Implementation Fees. The following table summarizes the requirements of section 95384 to pay implementation fees.

	Initial Implementation Fee Upon Registration	**Annual Implementation Fee**
Facilities with a refrigeration system that begin operation before January 1, 2012 with a full charge of 2,000 pounds or greater.	Amount: $370 Due Date: The owner or operator must register and pay the fee by March 1, 2012.	Amount: $370 Due Date: Fee is due by March 1, 2013, and each year thereafter.
Facilities with a refrigeration system that begin operation on or after January 1, 2012 with a full charge of 2,000 pounds or greater.	Amount: $370 Due Date: The owner or operator must register and pay the fee by March 1 of the calendar year after the refrigeration system begins operating.	Amount: $370 Due Date: By March 1 of the calendar year after the refrigeration system is required to be registered, and each year thereafter.
Facilities with a refrigeration system that begin operation before January 1, 2014 with a full charge of 200 pounds or greater, but less than 2,000 pounds.	Amount: $170 Due Date: The owner or operator must register and pay the fee by March 1, 2014.	Amount: $170 Due Date: Fee is due by March 1, 2015, and each year thereafter.
Facilities with a refrigeration system that begin operation on or after January 1, 2014 with a full charge of 200 pounds or greater, but less than 2,000 pounds.	Amount: $170 Due Date: The owner or operator must register and pay the fee by March 1 of the calendar year after the refrigeration system begins operating.	Amount: $170 Due Date: By March 1 of the calendar year after the refrigeration system is required to be registered, and each year thereafter.

(g) Fees collected pursuant to this section shall be deposited into the California Air Pollution Control Fund.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95385. Leak Detection and Monitoring Requirements for Facilities with Stationary Refrigeration Systems

(a) *Refrigeration Systems with a Full Charge Greater Than or Equal to 2,000 Pounds.* The owner or operator of a refrigeration system with a full charge greater than or equal to 2,000 pounds of a high-GWP refrigerant must do the following:

(1) After January 1, 2011, the owner or operator of a refrigeration system that operates year round, or is intended to be operated year round, must conduct a leak inspection of the refrigeration system monthly using a refrigerant leak detection device, a bubble test, observation of oil residue. If oil residue is observed, a leak inspection must be conducted using a calibrated refrigerant leak detection device or bubble test to confirm a refrigerant leak. A monthly leak inspection of the refrigeration system is not required if an automatic leak detection system meeting the specifications provided in subsections 95385(a)(5) or 95385(a)(6) is used to monitor the refrigeration system.

(2) By January 1, 2012, the owner or operator of a refrigeration system, that operates year round, or is intended to be operated year-round, must install an automatic leak detection system if:

(A) The refrigerant circuit is located entirely within an enclosed building or structure, or

(B) The compressor, evaporator, condenser, or any other component of the refrigeration system(s) with a high potential for a refrigerant leak is located inside an enclosed building or structure.

(3) After January 1, 2012, the owner or operator of a refrigeration system that does not operate with the refrigerant circuit located entirely within an enclosed building or structure must conduct a leak inspection every three months using a calibrated refrigerant leak detection device, a bubble test, or observation of oil residue of all refrigerant circuit components that are not located within an enclosed building or structure. If oil residue is observed, a

leak inspection must be conducted using a calibrated refrigerant leak detection device or bubble test to confirm a refrigerant leak.

(4) If a facility has installed an automatic leak detection system which directly detects the presence in air of a high-GWP refrigerant, sensors or intakes must be placed so that they will continuously monitor the refrigerant concentrations in air in proximity of the compressor, evaporator, condenser, and other areas with a high potential for a refrigerant leak.

(5) If a facility has installed an automatic leak detection system which detects the presence in air of a high-GWP refrigerant, the owner or operator must annually audit and calibrate the system using manufacturer recommended procedures, so that it:

(A) Accurately detects a concentration level of 10 parts per million of vapor of the specific refrigerant or refrigerants used in the refrigeration system(s), and

(B) Alerts the operator when a refrigerant concentration of 100 parts per million of vapor of the specific refrigerant or refrigerants used in the refrigeration system(s) is reached.

(6) If a facility has installed an automatic leak detection system that automatically interprets measurements to indicate a refrigerant leak, the owner or operator must annually audit and calibrate the system, so that it will automatically alert the operator when measurements indicate a loss of refrigerant of 50 pounds or 10 percent of the refrigeration system full charge, whichever is less.

(7) If an automatic leak detection system alerts the owner or operator pursuant to subsections 95385(a)(5) or 95385(a)(6), the owner or operator must ensure that a leak inspection is conducted within 24 hours after the system alert. The leak inspections must be conducted using a calibrated refrigerant leak detection device or a bubble test to confirm a refrigerant leak and determine the refrigerant leak location(s).

(8) The owner or operator of a refrigeration system that does not operate, or is not intended to operate, year-round must conduct a leak inspection within 30 days after starting each operation of the refrigeration system, and every three months thereafter until the refrigeration system is shut down. The leak inspection must be conducted using a calibrated refrigerant leak detection device, a bubble test, or observation of oil residue. If oil residue is observed, a leak inspection must be conducted using a calibrated refrigerant leak detection device or bubble test to confirm a refrigerant leak. A leak inspection is not required after starting operation if there has been a leak inspection of the refrigeration system conducted within the preceding 90 days.

(b) *Refrigeration Systems with a Full Charge Greater Than or Equal to 200 Pounds, but Less Than 2,000 Pounds.* After January 1, 2011, the owner or operator of a refrigeration system with a full charge greater than or equal to 200 pounds, but less than 2,000 pounds, of a high-GWP refrigerant, and that is intended to be operated year round, must conduct a leak inspection of the refrigeration system every three months. The leak inspection must be conducted using a calibrated refrigerant leak detection device, a bubble test, or observation of oil residue. If oil residue is observed, a leak inspection must be conducted using a calibrated refrigerant leak detection device or bubble test to confirm a refrigerant leak. A leak inspection of the refrigeration system is not required pursuant to this subsection (b) if an automatic leak detection system meeting the specifications provided in subsections 95385(a)(5) or 95385(a)(6) is used to monitor the refrigeration system.

(c) *Refrigeration Systems with a Full Charge Greater Than 50 Pounds, but Less Than 200 Pounds.* After January 1, 2011, the owner or operator of a refrigeration system with a full charge greater than 50, but less than 200 pounds, of a high-GWP refrigerant, and that is intended to be operated year round, must annually conduct a leak inspection of the refrigeration system. The leak inspection must be conducted using a calibrated refrigerant leak detection device, a bubble test, or observation of oil residue. If oil residue is observed, a leak inspection must be conducted using a calibrated refrigerant leak detection device or bubble test to confirm a refrigerant leak. A leak inspection of the refrigeration system is not required pursuant to this subsection (c) if an automatic leak detection system meeting the specifications provided in subsections 95385(a)(5) or 95385(a)(6) is used to monitor the refrigeration system.

(d) *Requirements That Apply When Additional Refrigerant is Added to All Refrigeration Systems Regulated by this Subarticle.* After January 1, 2011, the owner or operator of any refrigeration system with a full charge greater than 50 pounds of a high-GWP refrigerant must conduct a leak inspection each time an additional refrigerant charge equal to or greater than 5 pounds, or one percent of the refrigeration system full charge, whichever amount is greater, is added to a refrigeration system. The leak inspection must be conducted using a calibrated refrigerant leak detection device, a bubble test, or observation of oil residue. If oil residue is observed, a leak inspection must be conducted using a calibrated refrigerant leak detection device or bubble test to confirm a refrigerant leak.

(e) Alternative Test Methods. The leak inspections required by this section may be conducted using alternative test methods that are demonstrated to the written satisfaction of the Executive Officer to be equally or more accurate than using a calibrated refrigerant leak detection device or bubble test.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95386. Leak Repair Requirements for Facilities with Stationary Refrigeration Systems

(a) *Leak Repair Requirements.* After January 1, 2011, the owner or operator of a refrigeration system must ensure that all detected refrigerant leaks are repaired as provided in this section, and must maintain records pursuant to section 95389 of all refrigerant leak repairs.

(b) *Refrigerant Leak Repair 14-Day Requirement.* A refrigerant leak must be repaired by a certified technician within 14 days of its detection, except in situations when a longer time period is allowed under subsections (c), (d), or (i) of this section.

(c) *Refrigerant Leak Repair 45-Day Allowance.* The owner or operator of a refrigeration system has 45 days to repair a refrigerant leak or replace a leaking component(s) if one or more of the following conditions apply:

(1) A certified technician is not available to complete the repair or replace the component(s). A written record(s) must be kept pursuant to section 95389 to document that no certified technician was available within 14 days of the initial leak detection.

(2) The parts necessary to repair a refrigerant leak are unavailable, and the owner or operator obtains a written statement from the refrigeration system or component manufacturer or distributor stating that the parts are unavailable. A written record(s) must be kept pursuant to section 95389 to document that the necessary parts were not available within 14 days of the initial leak detection.

(3) The owner or operator has received an exemption from the Executive Officer pursuant to section 95397. A written record(s) must be kept pursuant to section 95389 to document that the owner or the operator has requested and received an exemption. If the owner or operator has submitted a request for an exemption, a refrigerant leak repair is not required until a final exemption determination is made by the Executive Officer.

(4) The refrigerant leak repair requires an industrial process shutdown.

(d) *Refrigerant Leak Repair 120-Day Allowance.* The owner or operator of a refrigeration system has 120 days to repair a refrigerant leak or replace a leaking component(s) if all of the following conditions apply:

(1) The facility owner or operator is an entity subject to Mandatory Greenhouse Gas Emissions Reporting requirements pursuant to section 95101 of the Health and Safety Code; and

(2) The refrigeration system is an industrial process refrigeration appliance; and

(3) The refrigerant leak repair requires an industrial process shutdown; and

(4) Written records are maintained as provided in section 95389 to document that all the conditions required under this subsection are met.

(e) Initial Verification Test. An initial verification test must be conducted upon completion of refrigerant leak repairs.

(f) Follow-up Verification Test. After the initial verification test has been conducted, a follow-up verification test must be conducted on the complete refrigeration system. If the refrigeration system was evacuated during the refrigerant leak repair, the follow-up verification test must be conducted when the system is operating at normal operating characteristics and conditions. If the refrigeration system was not evacuated during the refrigerant leak repair, the follow-up verification test requirement of this subsection is satisfied once required changes are made to return the refrigeration system to normal operating characteristics and conditions.

(g) *Refrigerant Leak Repair Requirements After An Unsuccessful Verification Test.*

(1) If either an initial verification test or follow-up verification test indicate that a refrigerant leak is still occurring within the refrigeration system, the owner or operator must ensure repair of the refrigerant leak through a subsequent repair attempt(s) of the refrigerant leak within the time required for refrigerant leak repair by subsections (b), (c), or (d), or prepare a retrofit or retirement plan pursuant to section 95387.

(2) If a follow-up verification test pursuant to subsection 95386(f) indicates that a refrigerant leak has not been successfully repaired within the 14 days

allowed for a refrigerant leak repair under subsection (b), and the owner or operator does not have an approved exemption pursuant to section 95397, then the owner or operator must either successfully repair the refrigerant leak within 45 days of the initial refrigerant leak detection or must prepare a retrofit or retirement plan pursuant to section 95387 within 60 days of the initial refrigerant leak detection.

(3) If a follow-up verification test pursuant to subsection 95386(f) indicates that a refrigerant leak has not been successfully repaired within the 45 days allowed for a refrigerant leak repair under subsection (c), and the owner or operator does not have an approved exemption pursuant to section 95397, the owner or operator must prepare a retrofit or retirement plan pursuant to section 95387 within 60 days of the initial refrigerant leak detection.

(4) If a follow-up verification test pursuant to subsection 95386(f) indicates that a refrigerant leak has not been successfully repaired within the 120 days allowed for a refrigerant leak repair under subsections (d), and the owner or operator does not have an approved exemption pursuant to section 95397, the owner or operator must prepare a retrofit or retirement plan pursuant to section 95387 within 135 days of the initial refrigerant leak detection.

(h) *Refrigerant Leak Repair Contractors License Requirement.*

(1) Except as provided below in subsection(h)(2), all refrigerant leaks must be repaired by a certified technician holding a current and active California contractors license in the C38 - Refrigeration Contractor licensing classification, or by an employee of a contractor with these qualifications. If the refrigeration system requiring service is also used in an air-conditioning application, it is acceptable for the refrigerant leak to be repaired by a certified technician holding a current and active California contractors license in the C20 - Warm-Air Heating, Ventilating and Air-Conditioning Contractor licensing classification, or by an employee of a contractor with these qualifications.

(2) A current and active California contractors license is not required if:

(A) the refrigeration system service or refrigerant leak repair is performed by the facility owner or operator or its employees with wages as sole compensation, or

(B) the refrigeration system service or refrigerant leak repair is performed by the facility owner or operator through one undertaking or by one or more contracts, and the aggregate contract price for labor, materials, and all other items is less than five hundred dollars ($500), or

(C) the refrigeration system service or refrigerant leak repair is performed pursuant to a contract entered into before January 1, 2011, by any political subdivision of the United States government or the State of California, or by any incorporated town, city, county, irrigation district, reclamation district, or other municipal or political corporation.

(i) *Refrigerant Leak Repair Requirements During System Mothballing.* The leak repair requirements of this section shall not apply during the time that a refrigeration system is undergoing or is in system mothballing. The leak repair requirements of this section shall resume on the day that the refrigeration system resumes operation at a facility.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95387. Requirements to Prepare Retrofit or Retirement Plans for Facilities with Leaking Stationary Refrigeration Systems

(a) *Retrofit or Retirement Plan Requirements. .*

(1) After January 1, 2011, the owner or operator of a refrigeration system with a refrigerant leak that has not been successfully repaired within the time required for refrigerant leak repair under subsection (b), (c), or (d) of

section 95386 must prepare and implement a dated retrofit or retirement plan as provided in section 95386(g). The plan must establish a schedule to retrofit or retire a leaking refrigeration system no later than six months after the initial detection of the refrigerant leak, and all work must be completed during this six-month period.

(2) The retrofit or retirement plan must be kept at the site of the refrigeration system with a refrigerant leak. If a refrigeration system is to be retired and replaced, the plan must include information required under this subsection specific to the new refrigeration system to be constructed or installed. If a refrigeration system is to be retrofitted, the plan must include information required under this subsection specific to the refrigeration system after the retrofit has been completed. A retrofit or retirement plan must include the following information:

(A) The system identification number of the refrigeration system being retired or retrofitted.

(B) Equipment type.

(C) Equipment manufacturer.

(D) Equipment model or description.

(E) Intended physical location of the refrigeration system through schematic or floor plan with locations clearly noted.

(F) Temperature classification – The refrigeration system must be identified as a low temperature system, a medium temperature system, or other.

(G) Full charge of the refrigeration system.

(H) Type of high-GWP refrigerant(s) used.

(I) If a refrigeration system is to be retired and replaced, a plan to dispose of the retired refrigeration system.

(J) A timetable which includes, at a minimum:

1. the date installation, construction, or retrofit of the refrigeration system is expected to begin, and

2. the expected completion date of the installation, construction, or retrofit of the refrigeration system.

(K) A signature by a representative of the facility, including the date signed.

(b) *Retrofit or Retirement Plan Requirements During System Mothballing.* The retrofit or retirement requirements of this section shall not apply during the time that a refrigeration system is undergoing or is in system mothballing. The retrofit or retirement requirements of this section shall apply on the day that the refrigeration system resumes operation at a facility.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95388. Reporting Requirements for Facilities with Stationary Refrigeration Systems

(a) Reporting Requirements for *Refrigeration Systems with a Full Charge Greater Than or Equal to 200 Pounds.* After January 1, 2011, the owner or operator of a facility with a refrigeration system in operation with a full charge greater than or equal to 200 pounds of a high-GWP refrigerant must annually submit to the Executive Officer a Facility Stationary Refrigeration Report (Annual Report) that contains the information specified below in subsections 95388(b)(1) and 95388(b)(2). Each Annual Report must provide this information for the previous calendar year and must be submitted by the following dates:

(1) By March 1, 2012, the owner or operator of a facility with a refrigeration system that begins operation before January 1, 2012, with a full charge greater than or equal to 2,000 pounds of a high-GWP refrigerant must submit an Annual Report for the 2011 calendar year. By March 1, 2013,

and each calendar year thereafter, the owner or operator must submit an Annual Report providing information for the previous calendar year.

(2) The owner or operator of a facility with a refrigeration system that begins operation on or after January 1, 2012, with a full charge greater than or equal to 2,000 pounds of a high-GWP refrigerant must submit the first Annual Report for the previous calendar year by March 1 of the calendar year after the refrigeration system begins operating at a facility. Subsequent Annual Reports for the previous calendar year must be submitted by March 1 of each year thereafter.

(3) By March 1, 2014, the owner or operator of a facility with a refrigeration system that begins operation before January 1, 2014, with a full charge greater than or equal to 200 pounds of a high-GWP refrigerant must submit an Annual Report for the 2013 calendar year. By March 1, 2015, and each calendar year thereafter, the owner or operator must submit an Annual Report providing information for the previous calendar year.

(4) The owner or operator of a facility with a refrigeration system that begins operation on or after January 1, 2014, with a full charge greater than or equal to 200 pounds of a high-GWP refrigerant must submit the first Annual Report for the previous calendar year by March 1 of the calendar year after the refrigeration system begins operating at a facility. Subsequent Annual Reports for the previous calendar year must be submitted by March 1 of each year thereafter.

(b) The Annual Report must include the following information.

(1) Refrigeration system information. The following information must be provided for each refrigeration system:

(A) System identification number.

(B) Equipment type.

(C) Equipment manufacturer.

(D) Equipment model or description.

(E) Equipment model year.

(F) Equipment serial number. The serial number(s) of the affected equipment or component must be recorded when present and accessible. When the affected equipment or component is part of an assembly without a serial number or does not have an individual serial number or is not accessible after assembly, the physical location of the affected equipment must be recorded in enough detail to permit positive identification.

(G) Physical location of a refrigeration system through schematic or floor plan with equipment locations clearly noted.

(H) Temperature classification – The refrigeration system must be identified as a low temperature system, a medium temperature system, or other.

(I) Full charge of the refrigeration system.

(J) Type of high-GWP refrigerant(s) used.

(K) Date of initial installation.

(2) Refrigeration system service and leak repair information. The following information for must be provided for each automatic leak detection system audit, leak inspection, and refrigeration system service or refrigerant leak repair that required an additional refrigerant charge of five pounds or more, or an additional refrigerant charge equal to or greater than one percent of the full charge, whichever amount is greater:

(A) Date leak detected, if applicable.

(B) Date of service provided or leak repair completed.

(C) Cause of refrigerant leak, if applicable.

(D) Description of service provided or leak repair completed

(E) Date(s) of initial verification test(s), if applicable.

(F) Date(s) of follow-up verification test(s), if applicable.

(G) Total additional refrigerant charge of each type of high-GWP refrigerant, if applicable.

(H) Purpose for additional refrigerant charge (leak repair, topping off, initial refrigerant charge, or seasonal adjustment), if applicable.

(I) Name of certified technician completing leak repair, if applicable.

(J) The certified technician's identification number issued by an approved technician certification program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.161, if applicable.

(K) The certified technician's certification type(s) issued by an approved technician certification program pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.161, if applicable.

(3) Refrigerant Purchases and Use Information. The following information must be provided on refrigerant purchase and use:

(A) The total weight in pounds of each type of high-GWP refrigerant that was purchased during the calendar year.

(B) The total weight in pounds of each type of high-GWP refrigerant that was charged into a refrigeration system during the calendar year.

(C) The total weight in pounds of each type of high-GWP refrigerant that was recovered from a refrigeration system during the calendar year.

(D) The total weight in pounds of each type of high-GWP refrigerant that was stored in inventory at the facility, or stored at a different location for use by the facility, on the last day of the calendar year.

(E) The total weight in pounds of high-GWP refrigerant that was shipped by the owner or operator for reclamation and destruction during the calendar year.

(d) Reporting Requirements for *Refrigeration Systems with a Full Charge Greater Than 50 Pounds, but Less Than 200 Pounds.* The owner or operator of a facility with a refrigeration system in operation with a full charge greater than 50 pounds, but less than 200 pounds, of a high-GWP refrigerant is not required to submit annual reports. However, owners and operators of these facilities must report to the Executive Officer the information specified in this section within 60 days of receipt of a request from the Executive Officer.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95389. Recordkeeping Requirements for Facilities with Stationary Refrigeration Systems

(a) After January 1, 2011, the owner or operator of a facility with a refrigeration system in operation with a full charge greater than 50 pounds of a high-GWP refrigerant must maintain the following records for a minimum of 5 years. The records must be kept at the facility where the refrigeration system(s) is in operation and must be made available to an authorized representative of the Executive Officer, including a local Air Pollution Control Officer, upon request:

(1) All registration information required by section 95383.

(2) Documentation of all leak detection systems, leak inspections, and automatic leak detection system annual audit and calibrations required by section 95385.

(3) Records of all refrigeration system service and refrigerant leak repairs, and documentation of any conditions allowing repair of a refrigerant leak to be conducted more than 14 days after leak detection, as required pursuant to section 95386. Refrigeration system and refrigeration system service and refrigerant leak repair records must include documentation of all items reported pursuant to section 95388.

(4) Any retrofit or retirement plans required by section 95387.

(5) All reports required by section 95388.

(6) Invoices of all refrigerant purchases.

(7) Records of all shipments of refrigerants for reclamation or destruction, which must include the following information:

(A) Name and address of the person the high-GWP refrigerant was shipped to.

(B) Weight in pounds of high-GWP refrigerant shipped.

(C) Type of high-GWP refrigerant shipped.

(D) Date of shipment.

(E) Purpose of shipment (e.g. reclamation, destruction, etc.).

(8) Records of all refrigeration systems component data, measurements, calculations and assumptions used to determine the full charge.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95390. Required Service Practices for High-GWP Appliances

(a) *Required Service Practices.* A person performing any installation, maintenance, service, repair, or disposal of an appliance that could reasonably be expected to release refrigerant from the appliance into the environment must satisfy all of the following requirements:

(1) In preparing an appliance for recycling or disposal, the person must not intentionally disrupt the refrigerant circuit of the appliance resulting in a discharge of refrigerant into the atmosphere, unless an attempt to recover the refrigerant is made using certified refrigerant recovery or recycling equipment; and

(2) The person must make a recovery attempt using certified refrigerant recovery or recycling equipment for that type of appliance before opening

the appliance to atmospheric conditions. Attempts to recover refrigerant must be made even if the person believes that all refrigerant has been removed or has previously leaked from the appliance. Refrigerant may be returned to the appliance from which it is recovered or to another appliance owned by the same person without being recycled or reclaimed; and

(3) The person must not add any additional refrigerant to a refrigeration or air-conditioning appliance during manufacture or service, unless such refrigerant: (A) consists wholly of a class I or class II substance, as identified by section 602 of the federal Clean Air Act; or (B) is an alternative that has been found acceptable, under the Significant New Alternatives Policy (SNAP) program pursuant to section 612 of the federal Clean Air Act, for the specific refrigeration or air-conditioning end-use in which it is being employed; or (C) has been approved by the Executive Officer for the specific refrigeration or air-conditioning end-use in which it is being employed; and

(4) The person must not add an additional refrigerant charge to any appliance known to have a refrigerant leak, except that it is permissible to add an additional refrigerant charge for seasonal adjustment or an additional refrigerant charge required to maintain operations while preparing or conducting a leak repair pursuant to and in compliance with section 95386; and

(5) The person must hold a current, valid, and applicable certificate issued in accordance with Title 40 of the Code of Federal Regulations, Part 82, §82.161; and

(6) The person must employ procedures for which the certified refrigerant recovery or recycling equipment was approved by the U.S. EPA or Executive Officer; and

(7) The person must use certified refrigerant recovery or recycling equipment as specified by the certified refrigerant recovery or recycling equipment manufacturer, unless the manufacturer's specifications conflict

with the procedures approved by the U.S. EPA or the Executive Officer for the certified refrigerant recovery or recycling equipment; and

(8) The person must evacuate refrigerant from a non-refillable cylinder to a vacuum of 15 inches of mercury, relative to standard atmospheric pressure of 29.9 inches of mercury, before to recycling or disposal; and

(9) The person must satisfy job site evacuation of refrigerants during recycling, recovering, reclaiming, or disposing in accordance with Title 40 of the Code of Federal Regulations, Part 82, §82.156.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95391. Prohibitions

(a) *Prohibitions.* On or after January 1, 2011, no person shall sell, supply, offer for sale, or distribute any high-GWP refrigerant for use as a refrigerant, unless for reclamation or destruction, in a container with a refrigerant capacity of two pounds or greater unless:

(1) The buyer is a certified technician pursuant to Title 40 of the Code of Federal Regulations, Part 82, §82.40 or §82.161; or

(2) The buyer is an authorized representative of a person employing at least one certified technician who is certified pursuant to Title 40 of the Code of Federal Regulations, Part 82, §82.40 or §82.161 and is in full compliance with Title 40 of the Code of Federal Regulations, Part 82, §82.166, and the buyer has provided evidence that at least one technician is properly certified; or

(3) The refrigerant is sold only for eventual resale to a certified technician, an employer of a certified technician, or a refrigeration or air-conditioning appliance manufacturer, or the refrigerant is being sent for reclamation; or

(4) The refrigerant is contained in a refrigeration or air-conditioning appliance.

(b) No person shall sell, supply, offer for sale, or distribute used refrigerant to any person for use as a refrigerant unless the used refrigerant has first been reclaimed by a certified reclaimer.

(c) No person shall sell, supply, offer for sale, or distribute any refrigerant unless such refrigerant: (1) consists wholly of a class I or class II substance, as identified by Section 602 of the U.S. Clean Air Act; or (2) is an alternative that has been found acceptable, under the Significant New Alternatives Policy (SNAP) program pursuant to Section 612 of the U.S. Clean Air Act, for the specific refrigeration or air-conditioning end-use in which it is being employed; or (3) has been approved by the Executive Officer for the specific refrigeration or air-conditioning end-use in which it is being employed.

(d) No person shall recycle or dispose of a non-refillable cylinder before the non-refillable cylinder has been evacuated to a vacuum of 15 inches of mercury, relative to standard atmospheric pressure of 29.9 inches of mercury.

(e) No person shall distribute or sell certified refrigerant recovery or recycling equipment unless such equipment meets the levels of evacuation to be achieved by recovery or recycling equipment as specified in Title 40 of the Code of Federal Regulations, Part 82, §82.158.

(f) No person shall refill a non-refillable cylinder or use it as a temporary receiver during service.

(g) No person shall repair or modify a non-refillable cylinder in any way that allows the non-refillable cylinder to be refilled.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95392. Reporting Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers

(a) *Reporting Requirements for Refrigerant Distributors and Wholesalers.* A refrigerant distributor or wholesaler that sells, supplies, or distributes any amount of a high-GWP refrigerant for any purpose other than sales to a refrigerant distributor or wholesaler for eventual resale, or to any person for reclamation or destruction must submit an annual report to the Executive Officer by March 1, 2012, for the 2011 calendar year. By March 1, 2013, and each calendar year thereafter, the refrigerant distributor or wholesaler must submit an annual report providing information for the previous calendar year. The annual report must cover all California facilities under the operational control of the refrigerant distributor or wholesaler, must provide statewide annual aggregated data for the previous calendar year, and must include the following information:

(1) Name of refrigerant distributor or wholesaler.

(2) Refrigerant distributor or wholesaler mailing address including an address, city, state, and zip code.

(3) Refrigerant distributor or wholesaler contact person.

(4) The phone number of the refrigerant distributor or wholesaler contact person.

(5) The e-mail address of the refrigerant distributor or wholesaler contact person.

(6) The total statewide annual aggregated weight in pounds of each type of high-GWP refrigerant that was purchased or received for the purpose of subsequent resale or delivery for any purpose other than reclamation or destruction.

(7) The total statewide annual aggregated weight in pounds of each type of high-GWP refrigerant that was sold or distributed, excluding all sales to a facility outside of California or to a refrigerant distributor or wholesaler for eventual resale.

(8) The total statewide annual aggregated weight in pounds of high-GWP refrigerant that was shipped to a certified reclaimer.

(9) Name of all refrigerant distributor or wholesaler facilities under the operational control of the refrigerant distributor or wholesaler.

(10) Address of each refrigerant distributor or wholesaler facility under the operational control of the refrigerant distributor or wholesaler.

(11) Contact person name, phone number, and e-mail address for each refrigerant distributor or wholesaler facility under the operational control of the refrigerant distributor or wholesaler.

(b) *Reporting Requirements for Certified Reclaimers.* A certified reclaimer reclaiming any high-GWP refrigerant in California must submit an annual report to the Executive Officer by March 1, 2012, for the 2011 calendar year. By March 1, 2013, and each calendar year thereafter, the certified reclaimer must submit an annual report providing information for the previous calendar year. The annual report must cover all California facilities under the operational control of the certified reclaimer, must provide statewide annual aggregated data for the previous calendar year, and must include the following information:

(1) Name of the certified reclaimer.

(2) Mailing address of the certified reclaimer including a street address, city, state, and zip code.

(3) Certified reclaimer contact person.

(4) The phone number of the certified reclaimer contact person.

(5) The e-mail address of the certified reclaimer contact person.

(6) The total statewide annual aggregated weight in pounds of high-GWP refrigerant that was received by the certified reclaimer for reclamation or destruction.

(7) The total statewide annual aggregated weight in pounds of each type of high-GWP refrigerant that was reclaimed in California.

(8) The total statewide annual aggregated weight in pounds of high-GWP refrigerant that was shipped out of California for reclamation.

(9) The total statewide annual aggregated weight in pounds of high-GWP refrigerant that was destroyed or shipped out of California for destruction.

(10) Name of all certified reclaimer facilities under the operational control of the certified reclaimer.

(11) Address of each certified reclaimer facility under the operational control of the certified reclaimer.

(12) Contact person name, phone number, and e-mail address for each certified reclaimer facility under the operational control of the certified reclaimer.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95393. Recordkeeping Requirements for Refrigerant Distributors, Wholesalers, and Reclaimers

(a) The following records must be kept by each refrigerant distributor or wholesaler and certified reclaimer for a minimum of five years. These records must be kept at the facility of each distributor or wholesaler, or certified reclaimer and must be made available to an authorized representative of the Executive Officer upon request:

(1) Annual reports submitted pursuant to section 95392.

(2) Invoices of all high-GWP refrigerant received through sale or transfer and all high-GWP refrigerant distributed through sale or transfer. These invoices must indicate the name of the purchaser, the date of sale, and the quantity and the type of High-GWP refrigerant purchased, sold, or transferred.

(b) A refrigerant distributor or wholesaler selling a high-GWP refrigerant to a purchaser that is an employer of a certified technician must obtain written documentation from the purchaser showing that the purchaser currently employs at least one certified technician. This documentation must be kept at the facility of the refrigerant distributor or wholesaler for a minimum of five years, and must be made available to an authorized representative of the Executive Officer upon request.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95394. Confidentiality

(a) All of the information identified in section 95388(b)(3) is a public record and may not be claimed as confidential.

(b) Except for the information identified in subsection (a) above, any person submitting information to the Executive Officer pursuant to this subarticle may claim such information as "confidential" by clearly identifying such information as "confidential". Any claim of confidentiality by a person submitting information must be based on the person's belief that the information marked as confidential is either trade secret or otherwise exempt from public disclosure under the California Public Records Act (Government Code, section 6250 et seq.). All such requests for confidentiality shall be handled in accordance with the procedures specified in California Code of Regulations, title 17, sections 91000 to 91022.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

§ 95395. Enforcement

(a) *Injunctions.* Any violation of this subarticle may be enjoined pursuant to the Health and Safety Code section 41513.

(b) Each day or portion thereof that any leak inspection or leak repair is not completed after the date the leak inspection or leak repair is required to be completed, or each day or portion thereof that any registration, report, or plan required by this subarticle remains unsubmitted, is submitted late, or contains incomplete or inaccurate information, shall constitute a single, separate violation of this subarticle.

(c) Failure to pay the full amount of any fee required by this subarticle shall constitute a single, separate violation of this subarticle for each day or portion thereof that the fee has not been paid after the date the fee is due.

(d) Enforcement of this article may be carried out by authorized representatives of the Executive Officer including a local Air Pollution Control Officer.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95396. Equivalent Local Rules

(a) The requirements specified in sections 95383, 95384, 95385, 95386, 95387, 95388, and 95389 of this subarticle shall not be enforced within the geographical boundaries of any air district that adopts and enforces requirements that will achieve emission reductions from stationary refrigeration systems that are equivalent to or greater than those achieved pursuant to sections 95383, 95384, 95385, 95386, 95387, 95388, and 95389.

(b) Subsection (a) shall not become effective unless the Executive officer issues an Executive Order containing written findings that the criteria of subsection (a) have been met. The Executive Order shall include such terms and conditions as are necessary to insure that these criteria continue to be met.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95397. Approval of Exemptions

(a) *Exemption Criteria.* The owner or operator of facility with a refrigeration system may request the Executive Officer for an exemption from the requirements of section 95386 and section 95387. To request an exemption, the applicant must follow the application procedure specified in subsection 95397(b), and must demonstrate that the criteria for one or more of the three exemptions allowed by this section have been satisfied. Information submitted pursuant to this section shall be handled in accordance with the provision of section 95394. The Executive Officer may approve the following exemptions:

(1) Emissions Lifecycle Exemption. The Executive Officer may allow the continuation of a refrigerant leak for a specified time period of no longer than three years if the Executive Officer determines that the applicant has provided clear and convincing documentation that the refrigerant leak cannot be repaired and that allowing the refrigerant leak to continue will result in less combined direct and indirect emissions than replacing the leaking refrigeration system. The documentation must include information quantifying the lifecycle direct emissions and indirect emissions, including energy use, and must include a calculation of these emissions based on the average lifetime of the refrigeration system or facility. The applicant must also provide a mitigation plan that includes a list of proposed actions to minimize emissions. The plan must include an analysis of options to minimize usage, reduce leaks or venting, and recycle or destroy high-GWP refrigerant. Any exemption granted pursuant to this paragraph may be extended for one or more additional periods of up to three years if the Executive Officer determines that the demonstration made pursuant to this paragraph remains valid.

(2) Economic Hardship Exemption. The Executive Officer may allow the continuation of a refrigerant leak for a specified time period of no longer than three years if the Executive Officer determines that the applicant has

provided clear and convincing documentation that all of the following criteria are met:

(A) Compliance would result in extraordinary economic hardship, such as closure of the entire facility or a large portion of the facility, or loss of a large portion of the revenue from the facility; and

(B) The extraordinary hardship to the applicant would be without a corresponding benefit in reducing combined direct and indirect emissions; and

(C) The applicant has prepared a compliance report that can be implemented and will achieve compliance as expeditiously as possible. The compliance report must reasonably detail when compliance will be achieved and the method by which compliance will be achieved.

(D) Any exemption granted pursuant to this paragraph may be extended for one or more additional periods of up to three years if the Executive Officer determines that the demonstration made pursuant to this paragraph remains valid.

(3) Natural Disaster Exemption. The Executive Officer may allow the continuation of a refrigerant leak for a specified time period of no longer than three years if the Executive Officer determines that the applicant has provided clear and convincing documentation that failure to satisfy the conditions set forth in this subarticle was due to a natural disaster such as an earthquake or flood, an act of war or an act by a public enemy, or a civil disorder or riot.

(b) Application for Exemptions.

(1) To apply for an exemption the applicant must submit a written application demonstrating that the criteria have been met for one or more of the three exemptions specified in subsection (a).

(2) Within 30 days of receipt of the exemption application the Executive Officer shall determine whether the application is complete, and shall notify the applicant of this determination.

(3) If the exemption application is determined to be incomplete, the Executive Officer shall notify the applicant and specify the specific information needed to make the application complete.

(4) Within 90 days after an application is determined to be complete, the Executive Officer shall determine whether and under what conditions an exemption will be permitted. The applicant and the Executive Officer may mutually agree to a longer time period for reaching a decision. During the review period, the Executive Officer may request, and the applicant shall provide, such additional information that is reasonably necessary to the decision. The applicant may also on his or her own initiative submit additional supporting documentation before a decision has been reached. The Executive Officer shall notify the applicant of the decision in writing and shall specify such terms and conditions as are necessary to insure that emissions will be minimized, and that the criteria specified in subsection (a) will continue to be met. Such conditions may include, but are not limited to, a requirement that best management practices be followed or that the applicant must implement the mitigation plan submitted by the applicant or mitigation measures identified by the Executive Officer.

(c) The exemption shall cease to be effective upon the failure of the person to whom the exemption was granted to comply with any term or condition of the exemption.

(d) *Revocation or Modification of An Exemption.* If the Executive Officer determines that an exemption no longer meets the criteria specified in subsection (a) of this section, the Executive Officer may revoke or modify the exemption as necessary to insure that the exemption continues to meet the criteria.

(e) *Effect of Denial or Revocation of an Exemption.* If an applicant for an exemption is denied, or an existing exemption is revoked, within 14 days of a notice of such revocation the refrigerant leak must be repaired in accordance with section 95386, or the owner or operator of the facility must prepare a retrofit or retirement plan in accordance with section 95387.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

95398. Severability

(a) Each part of this subarticle is deemed severable, and in the event that any part of this article is held to be invalid, the remainder of this subarticle shall continue in full force and effect.

NOTE: Authority cited: Health and Safety Code Sections 38501, 38510, 38560, 38562, 38563, 38580, 38597, 39600, 39601, and 41511. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 38562, 38563, 38597, 38580, 39600, 39601, and 41511.

Appendix B

California Facilities and Greenhouse Gas Emissions Inventory – High-Global Warming Potential Stationary Source Refrigerant Management Program

Research Division

Release Date

October 23, 2009

This page intentionally left blank

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Background

The proposed Refrigerant Management Program regulation for the management of refrigerants used in stationary refrigeration equipment was developed by the California Air Resources Board (ARB) staff to reduce the emissions of high global warming potential (GWP) greenhouse gases (GHG) used in commercial and industrial refrigeration equipment. This regulation was developed as an early action measure as part of implementing Assembly Bill 32, the Global Warming Solutions Act of 2006 (AB 32). This program aims to minimize emissions of high-GWP refrigerants from stationary refrigeration equipment through facility registration, leak detection and monitoring, leak repair, system retrofit and retirement, required service practices, and record-keeping and reporting.

This appendix outlines analysis conducted to determine statewide emissions estimates of high-GWP GHG from stationary refrigeration and air-conditioning (R/AC) equipment. This analysis was used in the development of the proposed Refrigerant Management Program regulation.

High-GWP refrigerants include chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), and hydrofluorocarbons (HFC). CFC and HCFC are also classes of ozone depleting substances (ODS). HFC are non-ozone depleting substitutes. Both ODS and HFC have very high global warming potentials, ranging between 500 and 10,000 times more potent than carbon dioxide (CO_2).

ODS production is controlled under the Montreal Protocol as a result of concerns about stratospheric ozone depletion, but emissions are not strictly controlled. The underlying assumption of the Montreal Protocol is that all the gases produced will eventually be emitted. However, for some end uses there can be a considerable time lag between gas production and emission.

High-GWP GHG can generally be categorized as Kyoto gases or Non-Kyoto gases. Kyoto gases are those that pertain to the Kyoto Protocol including CO_2, HFC, methane, nitrous oxide, perfluorocarbons, and sulfur hexafluoride. Non-Kyoto gases include the ODS Montreal Protocol gases, and several miscellaneous gases not covered under either treaty.

<u>Existing Regulations:</u> ODS emissions from R/AC equipment are regulated at the federal level through regulations promulgated under the Clean Air Act and Amendments (CAAA) Section 608, (Stratospheric Ozone Protection, Stationary Sources), which establish maximum allowable leak rates and mandatory leak repair requirements for R/AC equipment that contains 50 lbs or more ODS refrigerant. The same regulations establish requirements prohibiting venting of ODS and HFC refrigerants.

In California, the South Coast Air Quality Management District (SCAQMD) regulates R/AC equipment under Rule 1415 (Reduction of Refrigerant Emissions from Stationary Refrigeration and Air Conditioning Systems).

Rule 1415 is consistent with regulations related to Section 608 of the CAAA as it applies to the minimum refrigerant charge size of 50 lbs per system, and applies to ODS. Rule 1415 is more stringent in allowable leak rates than Section 608, because Rule 1415 requires that leaks be repaired within 14 days after they are discovered (or should have been discovered), while Section 608 regulations allow annual leak rates up to 35% for refrigeration systems, and up to 15% for air-conditioning (AC) systems before repair is required.

<u>Refrigeration and AC Equipment Identified as Potentially Significant Contributors to GHG Emissions:</u> Stationary R/AC equipment was selected as a source of GHG emissions that could potentially be reduced, because R/AC equipment contains high-GWP greenhouse gases, a known contributor to overall GHG emissions.

Based on the 2002-2004 average emissions in the California GHG inventory, high-GWP sector emissions represented about 3 percent all California GHG emissions (source: ARB Climate Change Scoping Plan, Dec 2008, page 13). However, high-GWP sector emissions are one of the fastest growing sources of GHG emissions, and future Kyoto gas emissions from stationary R/AC equipment are expected to at least double by 2020 (sources: Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004, California Energy Commission, December 2006; and Inventory of U.S Greenhouse Gas Emissions and Sinks: 1990 – 2006, U.S. EPA, April 15, 2008).

To get an initial rough estimate of GHG emissions from stationary R/AC equipment in California, ARB staff used the United States Environmental Protection Agency (U.S. EPA) Vintaging Model national estimates for years 2010 – 2030 provided to ARB in October 2008. The U.S. EPA Vintaging Model was developed to estimate nationwide patterns of GHG emissions of HFCs, perfluorocarbons (PFCs), CFCs, and HCFCs from all major emission sources, including refrigerant usage.

National estimates were scaled down to California's 12.5% proportion of the U.S. population. Year 2010 was used as a baseline year; with year 2020 used as the initial target goal date for AB 32 measures. When estimating emissions through 2020, it was assumed that California's proportion of the U.S population remains at a constant 12.5 percent.

The following Table 1 shows initial emissions estimates from stationary R/AC equipment in California for baseline year 2010, as scaled down from national estimates using the U.S. EPA Vintaging Model.

Table 1. Stationary R/AC Equipment Annual Emissions Baseline Year 2010					
Stationary Source	**Number of Facilities** [1]	**Annual Emissions ($MMTCO_2E$)**	**Annual Emissions (Million lbs)**	**Percent of Stationary Refrigerant Emissions**	**Emissions Rate in lbs/facility/ year**
Large Commercial Refrigeration ≥ 50 lbs	26,000	9.4	10.8	37%	415
Small Commercial Refrigeration < 50 lbs	70,000	1.1	1.4	4%	20
Large Commercial AC ≥ 50 lbs	23,000	2.3	1.8	9%	80
Small Commercial AC < 50 lbs	500,000	5.2	5.7	21%	11
Residential AC and Refrigeration	10 million	7.3	7.3	29%	< 1
Total	10.6 million	25.3	27.0	100%	3

Source: U.S. EPA Vintaging Model estimates and technical data sheets, provided to ARB October 2008, and adapted through additional ARB analysis to determine facility numbers and R/AC source categories, as described in this appendix.

The following is a description of the five basic R/AC sectors shown in Table 1:

- Large commercial refrigeration (equipment contains 50 lbs or more refrigerant charge) includes refrigerated equipment found in supermarkets, large grocery stores, and other retail food establishments. The refrigeration equipment generally consists of refrigerant condensing units that commonly contain 50 to 200 lbs of refrigerant, and large centralized refrigeration systems that commonly contain more than 200 lbs of refrigerant, with a central compressor rack and condensing unit system linked to multiple display cases through extensive piping. Large commercial refrigeration also includes industrial process refrigeration, which consists of complex, often custom-designed refrigeration equipment used in manufacturing and industrial applications including the chemical, petrochemical, pharmaceutical, oil and gas, and metallurgical industries. Industrial process refrigeration systems are generally quite large, with an average refrigerant charge size of greater than 2,000 lbs.
- Small commercial refrigeration (equipment contains less than 50 lbs refrigerant charge) includes stand-alone display cases, small walk-in cold rooms, and other small refrigeration equipment used primarily in convenience stores, small grocery stores, pharmacies, and restaurants.

[1] Initial facility number estimates for commercial refrigeration and large commercial AC ranged from 10,000 to 100,000 for each sector. Facility numbers shown in this table reflect best estimates after additional analysis as described in this appendix.

- Large commercial AC (equipment contains 50 lbs or more refrigerant charge) includes centrifugal chillers and positive displacement (packaged) chillers used for comfort cooling in non-residential commercial buildings. Centrifugal chillers have a large refrigerant charge size, usually greater than 1,000 lbs of refrigerant, and packaged chillers generally have a refrigerant charge size between 500 and 600 lbs, on average.
- Small commercial AC (equipment contains less than 50 lbs refrigerant charge) includes unitary AC systems used for commercial building comfort cooling. The AC systems generally contain 20 lbs or less refrigerant charge.
- Residential AC and refrigeration include packaged AC units and refrigerator-freezers used in households. Packaged AC units generally contain 10 lbs or less of refrigerant charge, and refrigerator-freezers generally contain less than 1 lb. of refrigerant charge.

The 2010 estimated GHG emissions are predominantly from ODS (75% of total emissions), with the remaining 25% from HFC. By 2020, total GHG emissions only increase slightly, from 25 to 28 $MMTCO_2E$, but the HFC portion of emissions increases three-fold, from 25% to 75% of the total.

<u>Minimum refrigerant charge size threshold for emissions analysis:</u>
To focus emission estimates on R/AC equipment that create the most emissions, a decision was made at the beginning of the process to set a minimum refrigerant charge size threshold for further detailed analysis. As shown in Table 1, all stationary R/AC equipment emissions were initially estimated, regardless of refrigerant charge size.

Generally, it is understood that the more refrigerant a R/AC system contains, the greater the potential refrigerant loss. However, a cursory look at the data also show that R/AC systems with small refrigerant charges account for significant emissions, as can be seen in Table 1, which shows that residential AC and refrigeration account for 29% of total stationary R/AC equipment emissions, despite almost all residential systems containing less than 10 lbs of refrigerant. Additionally, small AC systems used commercially on average contain less than 20 lbs of refrigerant, but contribute 21% of all stationary R/AC emissions.

Cumulative emissions from R/AC equipment with less than 50 lbs of refrigerant are significant, but their emissions on a per facility basis tend to be low (compared to facilities with R/AC equipment that contains more than 50 lbs of refrigerant). For example, the significant emissions from residential AC and refrigeration are due to millions of households each potentially emitting small amounts of refrigerant. Similarly, the significant emissions from small AC systems are due primarily to the large number of facilities (approximately 500,000) with small AC systems.

In analysis, ARB staff chose to ensure consistency with the existing regulatory framework used in the CAAA Section 608 regulations and SCAQMD Rule 1415 to directly address emissions from R/AC systems with a minimum threshold of 50 lbs refrigerant charge and to indirectly address emissions from other appliances through technician required services practices. Because SCAQMD and federal regulations are based on R/AC equipment with a refrigerant charge of 50 lbs or greater of ODS as the regulatory threshold, a different threshold set by ARB statewide would create confusion.

<u>California-Specific Data:</u> The U.S. EPA Vintaging Model data was used as a starting point to identify the largest sources of GHG emissions from stationary R/AC equipment. Although the U.S. EPA Vintaging Model is an excellent data source, ARB staff also sought additional data from sources that would enable California-specific emission estimates. The emission estimates shown in this appendix are based upon California-specific data sources, which are described in detail in section 3.B., "Data Sources".

<u>Outcome of Emissions Analysis:</u> As part of its assessment of the feasibility of potential regulations, the ARB must consider cost-effectiveness. Development of such an estimate requires a characterization of the baseline emissions as well as the potential emission reductions from the proposal. It also requires identification of compliance costs, and estimates of the number and types of businesses using applicable R/AC systems. This appendix describes the methodology used to determine:

- Types and numbers of businesses with R/AC equipment;
- Types and numbers of R/AC equipment;
- Baseline refrigerant GHG emissions from a current business-as-usual (BAU) scenario; and
- Emission reductions as a result of rule implementation.

The results of the analysis summarized in this appendix are used as the basis to calculate costs of the proposed rule, which are presented in Appendix C.

2. Summary of Results

The numbers of facilities with R/AC equipment were estimated, along with potential GHG emission reductions from these facilities.

<u>Number of Facilities with Refrigeration or AC Equipment</u>
Numbers of facilities with stationary R/AC equipment containing 50 lbs or more high-global warming potential refrigerant were estimated.

R/AC equipment sizes were broken into the following six groups to allow for more precise analysis of the number of facilities using applicable R/AC systems, emissions, and potential emission reductions:

Refrigeration Equipment Refrigerant Charge Size Categories:

- Small Commercial Refrigeration Systems: 50 lbs or greater, but less than 200 lbs (50-<200 lbs);
- Medium Commercial Refrigeration Systems: 200 lbs or greater, but less than 2,000 lbs (200-<2,000 lbs); and
- Large Commercial Refrigeration Systems: 2,000 lbs or greater (≥2,000 lbs).

AC Equipment Refrigerant Charge Size Categories:

- Small Commercial AC Systems: 50 lbs or greater, but less than 200 lbs (50-<200 lbs);
- Medium Commercial AC Systems: 200 lbs or greater, but less than 2,000 lbs (200-<2,000 lbs); and
- Large Commercial AC Systems: 2,000 lbs or greater (≥2,000 lbs).

The following Table 2 shows the number of facilities with R/AC equipment in each refrigerant charge size category described above.

Table 2. Number of Facilities with R/AC Equipment ≥ 50 lbs; Baseline Year 2010

Facility Category (number of facilities containing the following equipment types) [2]	Lower Range	Best Estimate	Upper Range
Small Commercial Refrigeration Systems	10,000	15,500	22,000
Medium Commercial Refrigeration Systems	1,000	8,500	19,000
Large Commercial Refrigeration Systems	2,000	2,000	13,000
Sub-total Facilities with Commercial Refrigeration Equip ≥ 50 lbs	13,000	26,000	54,000
Small Commercial AC Systems	14,000	14,300	52,000
Medium Commercial AC Systems	700	6,100	11,100
Large Commercial AC Systems	800	2,700	4,900
Sub-total Facilities with AC Equip ≥ 50 lbs	15,500	23,100	68,000
Totals	**28,500**	**49,100**	**122,000**

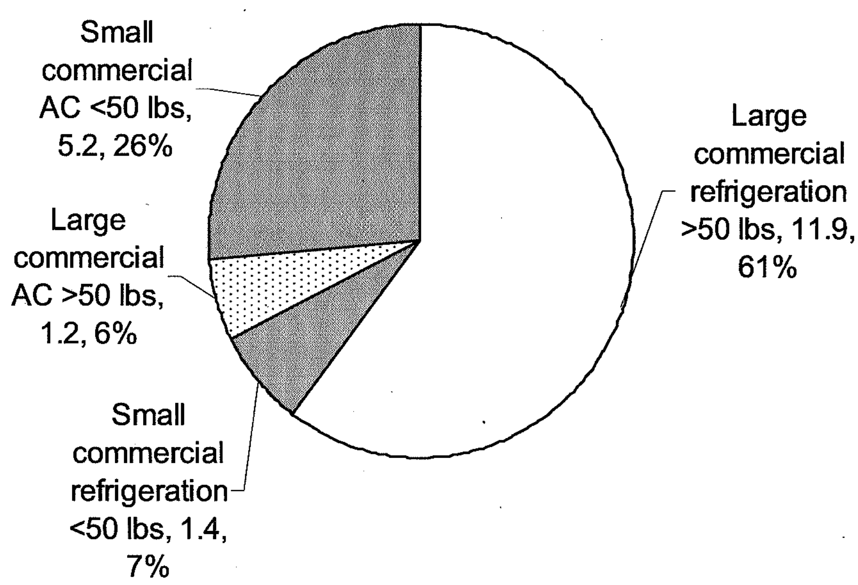
[2] The number of facilities shown in this table represents facilities containing one or more pieces of R/AC equipment within a given refrigerant charge size category. The best estimate is the most likely number of facilities ≥ 50 lbs. Note that the best estimate is not the average or mid-point between the lower range and upper range, but instead was determined using the most reliable data sources.

Emissions and Emission Reductions

The following Figure 1 shows finalized emissions estimates for baseline year 2010 to allow a quick visual comparison of the relative emissions from each commercial R/AC sector. (Refrigerant emissions from residential sources are not analyzed further in this emissions analysis.) These refined emissions estimates do not match exactly with the U.S. EPA Vintaging Model results shown in Table 1 due to the use of California-specific data which yielded slightly different state-wide emission factors, and therefore, slightly different results.

Because the California-specific data was based upon empirical data and a comprehensive bottom-up approach, it is believed to be more accurate than national estimates scaled down to California's population. The two primary changes resulting in using California-specific data was that the large commercial refrigeration sector initial emissions estimates increased from 9.4 to 11.9 $MMTCO_2E$, while the large commercial AC sector initial emissions estimates decreased from 2.3 to 1.2 $MMTCO_2E$. (Table 3 shows the emissions breakdown for each R/AC equipment refrigerant charge size category.)

Figure 1. GHG Emissions Estimates for Commercial Stationary R/AC Equipment (ARB-Refined Estimate) Year 2010 (20 MMTCO2E total) (Sector, Emissions in MMTCO2E and % total shown)



Data source: U.S. EPA Vintaging Model Estimates refined by ARB using California-specific data and emission factors, as described in this emissions methodology appendix.

Refrigeration Equipment:
Baseline 2010 emissions from stationary refrigeration equipment with refrigerant charges of 50 lbs or greater are about 7.4 $MMTCO_2E$ from HFC and 4.5 $MMTCO_2E$ from ODS (11.9 $MMTCO_2E$ total).

By 2020, BAU emissions from stationary refrigeration equipment with refrigerant charges of 50 lbs or greater are anticipated to increase 33% to 15.8 $MMTCO_2E$. HFC emissions are anticipated to almost double by 2020 to 14.3 $MMTCO_2E$ while ODS emissions are anticipated to decrease to 1.5 $MMTCO_2E$. (Montreal Protocol agreements limiting production of ODS including CFC and HCFC are responsible for a transition towards non-ODS replacements such as HFC.)

AC Equipment:
Baseline 2010 emissions from stationary AC equipment with refrigerant charges of 50 lbs or greater are about 0.2 $MMTCO_2E$ from HFC and 1.0 $MMTCO_2E$ from ODS (1.2 $MMTCO_2E$ total).

By 2020, BAU emissions from stationary AC equipment with refrigerant charges of 50 lbs or greater are anticipated to increase 17% to 1.4 $MMTCO_2E$. HFC emissions are anticipated to increase by 2020 to 1.0 $MMTCO_2E$ while ODS emissions will decrease to 0.4 $MMTCO_2E$.

Total Reductions:
Potential emission reductions from facilities with applicable R/AC equipment include HFC emission reductions of approximately 7.2 $MMTCO_2E$ by 2020, with another 0.9 $MMTCO_2E$ additional emission reductions from ODS (above the expected transitional decreases), for a total of 8.1 $MMTCO_2E$ GHG emission reductions. Additional potential emission reductions from AC equipment are 0.5 $MMTCO_2E$ (0.4 from HFC and 0.1 from ODS); for total projected emissions reductions of 8.6 $MMTCO_2E$.

The potential emission reductions are equal to the difference in the statewide emissions estimated using the average BAU leak rates (Table 3, 2020 BAU), and the statewide emissions estimated using the lower achievable leak rates obtainable using best management practices (Table 2, 2020 Post-Rule).

In aggregate, the proposed rule is expected to result in GHG emission reductions of approximately 50 percent, compared to BAU.

The following Table 3 shows emissions and potential reductions from commercial stationary R/AC equipment containing 50 lbs or more refrigerant charge. Emissions are broken out by basic type of equipment (refrigeration or AC), and refrigerant charge size (small, medium, or large).

Table 3. Potential emissions and emission reductions associated with the proposed regulation in 2010 and 2020. All emissions expressed in $MMTCO_2E$.				
	Emissions			Emission Reductions
R/AC Equipment Charge Size Category	**2010 BAU**	**2020 BAU**	**2020 Post-Rule**	**2020 Total GHG Reduction**
Small Commercial Refrigeration Systems	1.2	1.4	0.5	0.9 (0.8 HFC + 0.1 ODS)
Medium Commercial Refrigeration Systems	5.7	7.9	4.6	3.3 (3.0 HFC + 0.3 ODS)
Large Commercial Refrigeration Systems	5.0	6.5	2.6	3.9 (3.3 HFC + 0.6 ODS)
Refrigeration Subtotals	11.9	15.8	7.7	8.1 (7.2 HFC + 0.9 ODS)
Small Commercial AC Systems	0.6	0.7	0.3	0.4 (0.3 HFC + 0.1 ODS)
Medium Commercial AC Systems	0.3	0.3	0.2	0.1 (0.1 HFC + 0.0 ODS)
Large Commercial AC Systems	0.3	0.4	0.4	0 see footnote 3
AC Subtotals	**1.2**	**1.4**	**0.9**	**0.5 (0.4 HFC + 0.1 ODS)**
Total Emissions and Reductions	**13.1**	**17.2**	**8.6**	**8.6 [7.5 HFC + 1.1 ODS]**

Note: Sub-totals and totals may not sum exactly due to rounding.

The emissions and potential reductions estimates provide a single data mid-point within a range of plus or minus 22% that reflects the standard error of all refrigerant system leak rates, as determined through refrigerant usage and leak data reported by facilities to the South Coast AQMD under Rule 1415.

Reasonable ranges are as follows:

- 2010 BAU Emissions: 11.6 - 14.6 $MMTCO_2E$
- 2020 BAU Emissions: 15.2 - 19.4 $MMTCO_2E$
- 2020 Post-Rule Emissions: 8.5 - 8.7 $MMTCO_2E$
- Total Potential Emission Reductions: 6.7 - 10.5 $MMTCO_2E$

[3] Emission reductions for large commercial air-conditioning equipment (centrifugal chillers) are probable, but not well-defined using the methodology of comparing current business-as-usual leak rates to lower achievable leak rates, because the empirical data showed that for large centrifugal chillers, the lower achievable leak rate was already being met. Therefore, in this analysis, estimated reductions for large air-conditioning equipment are indicated as zero not because reductions cannot be achieved, but because they are not quantifiable given the constraints of current methodologies to identify further reductions from large chillers that, as reported, already achieve a low annual leak rate of 1%, which is less than the expected lower achievable leak rate of 2-4% per year.

3. Methods

This section describes the methodology used to estimate the number of facilities with R/AC equipment containing ≥ 50 lbs of refrigerant charge, current baseline emissions from those facilities, future emissions under a business-as-usual scenario, and potential emission reductions.

The Methods section is divided into the following sub-sections:

3.A. Emissions Calculation Formula and Emission Factors

3.B. Data Sources Used

3.C. Steps Taken to Determine Number of Facilities, Emissions, and Reductions

3.D. Detailed Description of Steps Used in Emissions Analysis

3.E. Potential Biases and Uncertainties in Data

3.A. Emissions Calculation Formula and Emission Factors

The calculation formula used to estimate GHG emissions is:

Emissions (MMTCO$_2$E) =
*Number of facilities * number of R/AC equipment units (systems) per facility * average refrigerant charge (lbs)/system * average percent of systems leaking during a given year * average percent of refrigerant charge lost from leaking systems * 4.54 x 10^{-10} MMT per lb * GWP of refrigerant*

Where:

- Number of facilities includes all facilities estimated to have R/AC equipment. In addition to the number of facilities, the types of businesses using applicable R/AC systems were also analyzed.
- The number of R/AC equipment units per facility factor is an average of the number of R/AC equipment units within a facility. The factor was developed by dividing the total number R/AC equipment units by the total number of facilities containing those systems.
- The average refrigerant charge per system is the average number of pounds of refrigerant for a given R/AC equipment category.
- The average percent of R/AC equipment units leaking during a given year is the total number of leaking R/AC equipment units divided by the number of all R/AC equipment units. This factor was calculated for each distinct combination of R/AC equipment type and refrigerant charge size (large centralized systems, medium centralized systems, large cold storage, medium cold storage, large process cooling, small refrigerant condensing

units, large centrifugal chiller, medium centrifugal chiller, medium packaged chiller, and small unitary AC).

- The average percent of refrigerant charge lost from leaking systems is the amount of refrigerant lost from leaking systems divided by the total refrigerant charge capacity of those systems that leak. (When the average percent of systems leaking during a given year is multiplied by the average percent of refrigerant charge lost from those leaking systems, the result is the annual average leak rate across all systems within the category. When this annual average leak rate is multiplied by the total quantity of refrigerant charge, the product is the annual amount of refrigerant lost in pounds, resulting from leaks.)
- Pounds of refrigerant loss (emissions) are converted to million metric tons (MMT) as a precursor to expressing emissions in the accepted "common denominator" of $MMTCO_2E$.

  4.54×10^{-10} MMT per lb is the conversion factor to convert pounds of refrigerant to million metric tons of refrigerant, which is derived from the following formula:

  *x lbs (input) * 0.454 kg/lb *.001 metric ton (MT)/kg * 0.000001 MMT/MT = MMT*

- The global warming potential of the refrigerant compared to CO_2 over a 100-year time horizon (GWP) is used to convert emissions in MMT to $MMTCO_2E$.

  For consistency with the method used to calculate California's GHG baseline emissions for AB 32, the Intergovernmental Panel on Climate Change (IPCC) Second Annual Report (IPCC SAR) was used as the source of GWP values. Where GWP values had not been published for specific refrigerants in the IPCC SAR, the values from the IPCC Third Annual Report (IPCC TAR) were used. Multiplying the quantity of refrigerant in MMT by the GWP yields emissions in terms of $MMTCO_2E$.

  In order to use the proper GWP for projected BAU emissions in 2010 and 2020, it was necessary to also use the U.S. EPA Vintaging Model's estimated ratio of R/AC equipment units that use HFC refrigerants compared to the systems that use ODS refrigerants (and the comparative share of all HFC and ODS refrigerant use by both pounds and $MMTCO_2E$). After individual GWPs were assigned to specific equipment, a weighted-average GWP was used for each category of R/AC equipment (centralized systems, cold storage systems, process cooling, chillers, refrigerant condensing units, and unitary AC units.)

The following example calculation shows how baseline 2010 GHG emissions were calculated from facilities within the small refrigeration equipment category, containing refrigerant condensing units that use 50 to 200 lbs of refrigerant. The source of data and rationale for the methodology used is further explained in subsequent sections after the example calculation.

Example Emissions Calculation:

Given:
15,500 facilities with refrigerant condensing units in 2010.
Each facility contains on average 5 condensing units.
15,500 facilities * 5 condensing units/facility = 77,500 units (systems).

Each system contains on average 122 lbs of refrigerant.

During an average given year, 22% of the systems leak.
Those systems that leak lose 65% of their refrigerant charge.
Therefore, the average annual leak rate across all systems is:
22% leaking systems * 65% of refrigerant charge leaked (from those leaking systems) = 14.5% of all refrigerant leaked each year, on average, from all systems.

The total refrigerant contained in the condensing units is:
122 lbs/system * 77,500 systems = 9,455,000 lbs.

At an annual leak rate of 14.5%, total pounds emitted are:
14.5% loss * 9,455,000 lbs = 1,370,975 lbs leaked per year.

To convert pounds to MMT, multiply by conversion factor 4.54×10^{-10} MMT per lb = 1,370,975 lbs * 4.54×10^{-10} MMT = 0.00062 MMT.

Converting MMT to $MMTCO_2E$, multiply by the GWP of the refrigerant in the equipment (average GWP of refrigerant in condensing units is 2,043):

0.00062 MMT * 2,043 = 1.27 $MMTCO_2E$ emissions per year.

The above calculation process was repeated for each of the distinct categories of R/AC equipment, which are described in methodology section 3.D., "Detailed Description of Steps Used in Emissions Analysis".

3.B. Data Sources Used

Multiple data sources were used in this analysis to determine facility numbers, emissions, and potential emission reduction estimates. The data sources are briefly described below. Additional details on how the data sources were used to develop emission factors are included in subsequent sections of this appendix.

For each data source, the emission factors it provided or helped to develop are included at the beginning of each data source section, followed by a description of the data source. Several data sources were used only to guide the analysis in the proper direction by informing staff on typical R/AC equipment uses, while other data sources were used as a secondary cross-check of more complete or precise data sources.

California Commercial End-Use Survey (CEUS): Emission factors derived from this data source include: number of facilities; number of R/AC equipment units (systems per facility); and average refrigerant charge per system (as a cross-reference).

Administered by the California Energy Commission, the CEUS survey collects a wide variety of data on the energy use of commercial buildings in California. The CEUS data included many data fields pertaining to commercial refrigeration and cooling systems. The following is a partial list of fields used to estimate statewide refrigerant emissions:

- Numbers of facilities in California by broad business-type categories.
- Number of facilities with specific types of R/AC equipment (single-zone direct expansion [DX] units, multiple-zone DX units, remote refrigerant condensing units, chillers, and HVAC systems [single-zone and multiple-zone]) and for specific retail food equipment (walk-in coolers/freezers, and multiple types of display cases).
- The total number of R/AC equipment units and the average number of units per type of business.
- Tons of cooling capacity by type of R/AC equipment (converted to pounds refrigerant charge for the emissions analysis).

CEUS data for year 2007 was a sampling of commercial buildings in California from 85 percent of the state's population and regions. The survey data was presented to ARB after it had been extrapolated to represent the entire survey region and population. ARB staff further extrapolated these estimates to 100 percent coverage of the state by multiplying all data results (building numbers, R/AC equipment units) by 1.18, (or 100%/85%) to scale up to a 100 percent representation of state data.

Note that the CEUS survey did not contain any information on the specific type of refrigerant used or annual refrigerant usage (losses). As a result, it was not used to establish specific emission factors such as average leak rates of systems. Instead the South Coast Air Quality Management District Rule 1415 data was used to establish most emission factors specific to refrigerant use.

South Coast Air Quality Management District (SCAQMD) Rule 1415 dataset: Emission factors derived from this data source include: number of facilities, number of R/AC equipment units (systems) per facility, average refrigerant charge per system, average percent of systems leaking during a given year, and average percent of refrigerant charge lost from leaking systems. Rule 1415 data was also used identify the types of businesses using the specific types of R/AC equipment, and to identify the refrigerants used in specific R/AC equipment groups.

As part of the SCAQMD Rule 1415 (Reduction of Refrigerant Emissions from Stationary Refrigeration and Air Conditioning Systems), all facilities using R/AC equipment with an ODS refrigerant charge 50 lbs or greater are required to submit a biennial report on the refrigerant charge of each piece of equipment and the amount of refrigerant used each year. The amount of refrigerant used each year is the amount added to existing systems, and is assumed to represent leaked refrigerant emissions. Only facilities with R/AC equipment utilizing ODS refrigerants are required to report under Rule 1415, although some systems using HFC refrigerant are included in reports.

In addition to refrigerant use patterns the biennial reports also include facility descriptions, standard industrial classification (SIC) codes, and types of R/AC equipment used.

The Rule 1415 biennial reports were selected as the primary source of data for emission factors because they were the most comprehensive collection of data available specific to actual refrigerant usage and losses, which gave it the distinction of being the best source of empirical data for refrigerant emissions in California. The Rule 1415 data were available for six years (reporting years 2000 through 2005) and consisted of approximately 16,000 records.

ARMINES - Inventory of Direct and Indirect GHG Emissions from Stationary Air conditioning and Refrigeration Sources, with Special Emphasis on Retail Food Refrigeration and Unitary Air Conditioning. Final Report, March 2009 (ARMINES 2009 report): ARMINES survey data was used as the primary source of information for numbers of facilities within the following business type categories: retail food, pharmacies, and hotels/motels. The ARMINES report was also used as a cross-reference for average refrigerant charge per system, average annual leak rates from R/AC equipment, and types of refrigerants used in food-related refrigeration.

The final report provided by ARMINES (principal investigator, Denis Clodic) as a part of a contract with ARB provides comprehensive inventories that are California-specific on the numbers and types of retail food facilities (supermarkets, grocery stores, convenience stores, mini-markets, restaurants, etc.), as well as the numbers and types of refrigeration equipment used by these facilities.

Data was obtained using surveys and facility visits in California. Additional reported data included inventories on numbers and types of commercial refrigeration systems used in cold storage, industrial process cooling, and air cooling in businesses. The ARMINES report was also used to establish or confirm various emission factors, including cooling capacities of refrigeration systems, types of refrigerants used in centralized systems, and typical refrigerant charge sizes.

The ARMINES report also made extensive use of the Building Services Research and Information Association (BSRIA) 2005 marketing study, which was used as a primary source of information to estimate the installed base of chillers in California.

U.S. EPA Vintaging Model. The U.S. EPA Vintaging Model emission estimates were used at the beginning of the analysis to determine current and future emissions from stationary R/AC equipment in California. Refrigerant distribution data was used to build a profile of typical refrigerants used for specific R/AC equipment groups. Technical summary sheets of R/AC equipment were used to cross-check several emission factors from other sources, including: number of R/AC systems per facility, average refrigerant charge per system, and annual refrigerant leak rates for distinct R/AC equipment groups.

The U.S. EPA Vintaging Model was developed to estimate nationwide patterns of GHG emissions of HFCs, perfluorocarbons (PFCs), CFCs, and HCFCs from all major emission sources, including refrigerant usage. Three U.S. EPA Vintaging Model data sources were used:

1) National GHG emission estimates projected for years 2010 through 2030 from the U.S. EPA's Vintaging Model for R/AC equipment were provided to ARB in October 2008. National estimates were scaled down to California based on population size.

2) Refrigerant distribution by R/AC equipment type, for baseline year 2010, and for year 2020. As part of the input variables added to the U.S. EPA Vintaging Model, refrigerant usage trends are estimated for each major R/AC equipment group. For each R/AC group, the specific refrigerants used and their share of the distribution are listed. For example, in 2010, it is estimated that for large and medium centralized systems, 42% of the systems will use R-22; 40% will use R-404A; and 18% will use R-507. Refrigerant distribution is shown in Table 5.

3) U.S. EPA Vintaging Model, EPA ODS Tracking System, and Alternative Fluorocarbons Environmental Acceptability Study (AFEAS) Comparison for Common Refrigerants (U.S. EPA 2007). Consists of U.S. EPA Vintaging Model technical summaries of R/AC system numbers, average annual leak rates of R/AC equipment, refrigerant emissions, average refrigerant charge size, types of refrigerant used, and trends in R/AC equipment and refrigerant uses. Used to supplement, refine, and act as a cross-check for Rule 1415 data. Summaries are provided for the following R/AC categories:

- ODS and ODS Substitutes in U.S. Commercial Refrigeration End Uses (includes centralized systems).
- ODS and ODS Substitutes in the U.S. Cold Storage End Uses.
- ODS and ODS Substitutes in the U.S. Industrial Process Refrigeration (IPR) End Uses.
- ODS and ODS Substitutes in the Centrifugal Chiller End Uses.
- ODS and ODS Substitutes in the Positive Displacement Chiller End Uses.
- ODS and ODS Substitutes in the Commercial Unitary AC End Uses.

US Census Bureau NAICS code website: Used as a secondary source to cross-check facility types and numbers.

The US Census Bureau published an online guide to mapping SIC codes to 2002 North America Industry Classification System (NAICS) codes on their website: http://www.census.gov/epcd/www/naics.html. This resource was used to help translate, or map the SIC codes provided in the Rule 1415 data to the currently used NAICS codes. NAICS codes are the "common denominator" used to describe facilities, and these had to be determined to extrapolate the number of facilities within the Rule 1415 dataset to a statewide number of facilities.

US Census Bureau censtats database: This resource was used to estimate the statewide number of facilities for individual NAICS codes. The US Census Bureau publishes statewide facility number estimates for individual NAICS codes in California on their website: http://censtats.census.gov/cbpnaic/cbpnaic.shtml.

Energy Information Administration 2003 Commercial Buildings Energy Consumption Survey (CBECS): The CBECS report provided characterizations of commercial heating, ventilation, and air-conditioning (HVAC) equipment use for broad facility categories, including office buildings and office complexes. CBECS data provided a cross-check for numbers and types of facilities with R/AC equipment ≥ 50 lbs.

The national Commercial Buildings Energy Consumption Survey was conducted to collect information on the number of commercial buildings nationwide and to characterize energy related building characteristics. As a part of this survey a data table is available that outlines the estimated number of buildings within several broad building activity types (e.g., office buildings and office complexes) that utilize comfort cooling equipment including packaged air-conditioning units, central chillers, and district chilled water. A "NAICS code crosswalk" including a list of three digit NAICS codes which are representative of the types of facilities characterized by each of the principal building activities is also provided. The NAICS codes provided a breakdown of office building categories by the types of HVAC equipment used, which allowed estimates of the proportion of office buildings within the refrigerant charge size categories of small, medium, and large.

Intergovernmental Panel on Climate Change Second Assessment Report (IPCC SAR), and Third Assessment Report (IPCC TAR): Used as the source for refrigerant global warming potential (GWP) used in emission estimates. Initially developed to address potential strategies to reduce or avoid climate change worldwide, the IPCC second and third assessment reports include estimates of the global warming potentials for common refrigerants.

2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories (IPCC GHG Guidelines): IPCC developed guidelines in 2006 for estimating national GHG inventories. Volume 3 (Industrial Processes and Product Use), Chapter 7 (Emissions of Fluorinated Substitutes for Ozone-Depleting Substances) includes a range of estimates of refrigerant charge (kilograms of refrigerant), lifetime of equipment (years), annualized refrigerant emissions, and recovery efficiency for several types of R/AC equipment.

Relevant types of R/AC equipment reported include: stand-alone commercial refrigeration, medium and large commercial refrigeration, industrial refrigeration (including food processing and cold storage), chillers, and commercial air conditioning. The IPCC guidelines contain information on the proper methodology to follow when estimating refrigerant GHG emissions. These methodologies helped inform and direct the ARB methodology used to estimate GHG emissions in California from stationary R/AC equipment.

IPCC/TEAP (Intergovernmental Panel on Climate Change [IPCC] and Technology and Economic Assessment Panel [TEAP]) Special Report on Safeguarding the Ozone Layer and the Global Climate Systems, 2005 (IPCC Special Report). Used as the primary source of information for estimated minimum achievable leak rates using best management practices for R/AC equipment.

The minimum feasible and achievable leak rates are used to estimate potential emission reductions. The Special Report provides the scientific context required for consideration of alternatives to ODS, potential methodologies for assessing options, and technical issues related to GHG emission reduction opportunities for several ODS emission sectors, including refrigeration and air conditioning.

The Special Report was used as a basic source of technical information on commercial refrigeration and air conditioning; providing an overview of relevant technologies, emission patterns and trends, ranges of annual leak rates for R/AC equipment, and consideration of improving containment, recovery, and recycling of refrigerants.

United Nations Environment Programme 1998 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, October 1998; Annex III-Refrigerant Data (UNEP 1998): The information contained within this report was used to compare international estimates of average refrigerant leak rates for R/AC equipment (as a "reasonable" baseline) with the average refrigerant leak rates reported under Rule 1415. A comprehensive report with detailed summaries on all major types of R/AC equipment used commercially, it describes GHG emissions from R/AC equipment, trends in refrigerant usage (transition of ODS to HFC and other refrigerants), and numbers and types of R/AC equipment.

United Nations Environment Programme 2006 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, January 2007 (UNEP 2007): This update to the 1998 report includes additional information on refrigerant leak rates under BAU scenarios and minimum achievable leak rates using best management practices for R/AC equipment. Used in conjunction with the IPCC Special Report to assign reasonable lower feasible and achievable leak rates for existing R/AC equipment.

3.C. Steps Taken to Determine Number of Facilities; Emissions and Potential Emission Reductions

The following steps were used determine the statewide number of facilities, emissions, and potential emission reductions from R/AC equipment with ≥ 50 lbs of high-GWP refrigerant (the steps will be described in further detail in the next section of this appendix):

1. R/AC equipment divided into basic three refrigerant charge size categories (small, medium, large)
2. Emission profiles made more specific by adding distinct R/AC equipment types to the existing refrigerant charge size categories of small, medium, and large. Identified distinct equipment groups, based on equipment type or function (including centralized system, cold storage, process cooling, refrigerant condensing units, chiller, and unitary AC).
3. Emission factors developed for each size and type of R/AC equipment
4. Number of facilities with R/AC equipment
5. Annual emissions estimated for baseline year 2010
6. Potential emissions estimated for year 2020 under business-as-usual scenario (no rule implementation)
7. Feasible lower average leak rates achievable after rule implementation is estimated
8. Emission reductions estimated for year 2020 (BAU emissions less post-rule emissions)

3.D. Detailed Description of Steps Used in Emissions Analysis

The following sub-section describes the methodology used in the steps taken to ultimately estimate number of facilities with R/AC equipment, emissions, and potential emission reductions.

Step 1. R/AC equipment divided into basic three refrigerant charge size categories (small, medium, large)

After the minimum refrigerant charge size threshold of 50 lbs per system was established, staff determined that a "one size fits all" approach to the rule would not result in the highest emission reductions for the lowest cost. The emission profiles of the R/AC equipment differ based on refrigerant charge size, and based on reported data, the different categories of R/AC equipment tend to be within defined refrigerant charge sizes. ARB staff analyzed more than 16,000 refrigerant leak data records reported under SCAQMD Rule 1415. Refrigerant loss (both in total pounds and by leak rate) was compared to refrigerant charge size. Natural break points recognized in the data showed three distinct groups of equipment, as determined by charge size, each with its own emissions profile. Based on the analysis, staff developed the following three basic refrigerant charge size groupings:

<u>Small Equipment ≥ 50 lbs, < 200 lbs</u>
As previously described, 50 lbs was the minimum refrigerant charge size threshold established. Small R/AC equipment using less than 200 lbs of refrigerant are characterized by relatively lower leak rates with less potential for large overall emissions compared to larger systems. An upper limit of 200 lbs was set based on its inclusion of all refrigerant condensing units and all unitary AC (with moderate leak rates), while excluding all centralized refrigeration systems, which tend to have higher leak rates. Small R/AC equipment comprises 60 percent of the number of facilities using applicable R/AC systems, and accounts for 15 percent of emissions from stationary commercial R/AC equipment.

<u>Medium Equipment (≥ 200 lbs, < 2,000 lbs)</u>
The 200-lb. threshold was primarily set to focus on emissions profiles representing moderate to extensive leak rates from a large number of systems. This category includes 90 percent of the centralized refrigeration equipment, 50 percent of cold storage equipment, 25 percent of centrifugal chillers, and all the packaged chillers. Medium R/AC equipment comprises 30 percent of the number of facilities using applicable R/AC systems, and accounts for 45 percent of emissions from stationary commercial R/AC equipment.

<u>Large Equipment (≥ 2,000 lbs)</u>
The 2,000-lb. lbs threshold was based upon emissions data from the Rule 1415

dataset, which shows that very large R/AC equipment using 2,000 lbs or more of refrigerant have relatively high leak rates. The combination of large refrigerant charge size and high leak rates combine to form the potential for the greatest emissions. The large category includes all process cooling equipment, 50 percent of cold storage equipment, 10 percent of the largest centralized refrigeration systems, and 75 percent of centrifugal chillers. Although large R/AC equipment only comprises 10 percent of the number of facilities using applicable R/AC systems, it accounts for 40 percent of emissions from stationary commercial R/AC equipment.

Step 2. Emission profiles made more specific by adding distinct R/AC equipment types to the existing refrigerant charge size categories

Initial emission estimates were made for three groups of R/AC equipment: small, medium, and large. The data generally indicated that as R/AC equipment become larger, they have higher leak rates. However, stakeholder comments led to additional analysis of all Rule 1415 data that clearly showed AC systems under the medium and large categories are chillers which leak significantly less than refrigeration equipment of the same refrigerant charge size.

To produce a meaningful analysis of equipment leak data to address stakeholder comments staff re-analyzed all equipment emissions by categorizing equipment into the following R/AC equipment types.

Refrigeration Systems
- Process Cooling (also called industrial cooling, industrial process cooling, and industrial refrigeration)
- Cold Storage
- Centralized Systems (also called DX [Direct Expansion] systems or parallel rack systems)
- Condensing Units (also called refrigerant condensing units or remote condensing units)

Air-conditioning (AC) Systems
- Centrifugal Chillers
- Packaged Chillers (also called positive displacement chillers, which include sub-types of chillers: reciprocating, screw, and scroll)
- Unitary AC (includes Split AC Systems [ducted and non-ducted]; Roof-top Units; and Packaged AC Systems)

The following summarizes typical uses of R/AC Systems:

- Process cooling, while technically a function and not a system, is the term commonly used to describe customized, built systems used in food and drink processing (brewing, distilling, dairy, and soft drink industries), and for industrial refrigeration in the chemical, petrochemical, and pharmaceutical industries. Process cooling systems fall into the large refrigerant charge size category based on very large refrigerant charges (3,500 lbs on average).

- Cold storage is also more technically a function, and not a system, but is the generally accepted term for custom built refrigeration systems used to cool large storage areas at temperatures between –20° and +50° F, primarily for food storage. Cold storage systems generally fall into the large and medium-size refrigerant charge size categories.
- Centralized systems are commonly used in supermarkets and grocery stores to cool food in display cases and walk-in-coolers. Centralized systems may contain multiple compressor racks in a central location, where the refrigerant circulates from the central location to the retail floor space. Centralized systems tend to be leaky because of the many feet of refrigerant piping and number of connections necessary for these systems. Centralized systems fall into the large and medium-size refrigerant charge size categories.
- Condensing units are similar to centralized refrigeration systems, but are smaller, consisting of only one compressor rack that may cool a single walk-in-cooler or one or two display cases. Generally used in retail food businesses such as convenience stores, and medium-sized to smaller-sized grocery stores. Condensing units are in the small refrigerant charge size category.
- Chillers, also known as water chillers, cool water or heat transfer fluids for air conditioning in retail and commercial buildings. The two primary types of chillers are centrifugal chillers and packaged chillers, which differ primarily by the mechanical system used. Packaged chillers tend to be smaller and more leak-tight than centrifugal chillers. Centrifugal chillers are in the large or medium-size refrigerant charge size categories. Packaged chillers are in the medium-size refrigerant charge size category only.
- Unitary AC systems are self-contained cooling units used for air conditioning in buildings. The typical unitary AC system contains less than 100 lbs of refrigerant. Unitary AC systems are in the small refrigerant charge size category.

Emission estimates were refined by categorizing systems by both refrigerant charge size and R/AC equipment type based on ten distinct combinations, or categories of R/AC equipment type and refrigerant charge size categories.

With three basic refrigerant charge size categories, and seven R/AC equipment types identified, theoretically, there could be 21 distinct combinations of refrigerant charge size and equipment type, but several combinations do not exist in reported data (such as large unitary AC systems, or small process cooling systems).

The ten R/AC equipment categories defined by the R/AC equipment types and refrigerant charge size combinations existing in the Rule 1415 dataset are:

- Centralized refrigeration system - large
- Centralized refrigeration system - medium
- Cold storage - large
- Cold storage - medium
- Process cooling - large
- Refrigerant condensing units - small
- Centrifugal chiller - large
- Centrifugal chiller - medium
- Chiller - packaged - medium
- Unitary AC - small

Each combination pairing of refrigerant charge size category and equipment type creates a distinct R/AC equipment category that defines the basis for all analysis. By estimating emissions from each distinct R/AC equipment type and refrigerant charge size combination, it allowed for a more precise analysis of emissions risks by R/AC equipment categories and total BAU emissions and potential reductions.

Step 3. Emission factors developed for each size and type of R/AC equipment

Emission factors were developed for each R/AC equipment category primarily from empirical data as reported under SCAQMD Rule 1415. As previously stated, GHG emissions in $MMTCO_2E$ were calculated using the following equation:

Emissions in $MMTCO_2E$ =

*Number of facilities * number of R/AC equipment units (systems) per facility * average refrigerant charge (lbs)/system * average percent of systems leaking during a given year * average percent of refrigerant charge lost from leaking systems * 4.54×10^{-10} MMT per lb * GWP of refrigerant*

The following Table 4 shows the emission factors for each distinct R/AC equipment category. The emission factors are also described in greater detail in this appendix sub-section.

(Table 4 shown on following page to preserve table continuity.)

Table 4. Emission Factors by R/AC Equipment Category						
R/AC Equipment Type and Charge Size Category	**Facility Number (2010)**	**Facility Number (2020)**	**Charge (lbs) / System[4]**	**% of Systems Leaking**	**% of Charge Leaked - leaking systems only**	**Avg. Annual Leak Rate - all systems[5]**
Small Refrigeration Systems (≥ 50 lbs, < 200 lbs)						
refrigerant condensing units	15,500	17,123	122	22%	65%	14%
Medium Refrigeration Systems (≥ 200 lbs, < 2,000 lbs)						
centralized refrigeration system	7,500	8,285	704	36%	43%	15%
cold storage	900	994	565	45%	80%	36%
Large Refrigeration Systems (≥ 2,000 lbs)						
centralized refrigeration system	900	994	2,486	77%	28%	21%
cold storage	800	884	7,546	77%	36%	27%
process cooling	340	376	3,640	22%	31%	7%
Small AC Systems (≥ 50 lbs, < 200 lbs)						
unitary AC systems	14,300	15,800	100	19%	60%	11%
Medium AC Systems (≥ 200 lbs, < 2,000 lbs)						
centrifugal chiller	800	900	1,007	6%	23%	1%
packaged chiller	5,300	5,900	526	18%	37%	7%
Large AC Systems (≥ 2,000 lbs)						
centrifugal chiller	2,700	3,000	3,978	15%	16%	2%

A. Number of Facilities:

Estimating the number of facilities with R/AC equipment ≥ 50 lbs of refrigerant charge required a detailed analysis that is covered in the next sub-section (Step 4) of this appendix.

---

[4] On average, there are approximately 2 refrigeration systems per facility with a large system, and 5 refrigeration systems per facility with medium or small systems. For AC equipment, there are approximately 1.8 chillers per facility with large or medium centrifugal or packaged chillers, and 5.5 unitary AC systems per facility with small AC systems.

[5] The average annual leak rate (all systems) is used to represent an average amount of refrigerant charge leaked per year across all systems, and is calculated by multiplying the percent of leaking systems by the percent of refrigerant charge leaked from those leaking systems. For example, if an equipment type had 40 percent of all systems leaking in a given year, and those systems on average leaked about 30 percent of their refrigerant charge, the resulting annual leak rate averaged across all systems would be 12 percent (40% * 30% = 12%).

B. Number and types of refrigeration or air conditioning equipment units (systems) per facility:

SCAQMD Rule 1415 empirical data was used as the basis to extrapolate numbers and types of R/AC equipment units per facility to statewide averages. For each reporting facility, the numbers and types of R/AC equipment (by equipment type and by refrigerant charge size) were summed for each category; and divided by the number of facilities containing the equipment category.

The following equation was used for each of the ten distinct R/AC equipment categories:

Average number of pieces of R/AC equipment per facility =
Number of R/AC systems/number of facilities containing that type of R/AC system

R/AC equipment units per facility were also independently calculated using CEUS survey data using the same method. CEUS data showed about 20 percent fewer systems per facility than the Rule 1415 data. Results between CEUS data and Rule 1415 were averaged to arrive at a mean number of R/AC equipment units per facility.

C. Average refrigerant charge size (pounds of refrigerant) per system:

Using methodology similar to that used to determine the average number of R/AC equipment units (systems) per facility, the Rule 1415 data reported refrigerant charge sizes for each piece of equipment were summed and divided by the total pieces of that equipment type:

Average refrigerant charge size per system =
Total pounds refrigerant charge (by R/AC equipment category)/total number of R/AC systems (by R/AC equipment category)

CEUS data was used to independently estimate average refrigerant charge size per system. The CEUS data level of precision for this factor is lower than the Rule 1415 average, because an additional conversion was necessary for CEUS data. Specifically, the CEUS data did not report the actual refrigerant charge size of systems in pounds, but was reported in terms of tons of cooling capacity for the system, which had to be converted to an equivalent refrigerant charge size in pounds. Conversion factors of 3.5 lbs refrigerant per ton of cooling capacity for AC systems and 5 lbs refrigerant per ton of cooling capacity for refrigeration systems were used.

Estimates of average refrigerant charge size from CEUS data were within ten percent of Rule 1415 estimates, but only Rule 1415 data was used because it was more precise. As an additional cross-check, average refrigerant charge sizes were compared to U.S. EPA Vintaging Model technical assessments, which indicated a wide range of average refrigerant charge sizes. Rule 1415 data fell well within U.S. EPA Vintaging Model refrigerant charge size parameters.

D. Types of refrigerants (and their global warming potentials) used:

Rule 1415 data was initially used to determine the types of refrigerants used for baseline emissions year 2010. However, an inherent bias was recognized within Rule 1415 data – only ODS-containing systems were required to report; therefore, HFC-containing systems would be virtually absent. Because Rule 1415 only requires ODS refrigerant reporting, use of this data set without adjustment would have under-estimated statewide emissions of HFCs.

The likely under-estimation of HFC emissions was corrected by using U.S. EPA Vintaging Model estimates of the current distribution of the number and types of R/AC equipment, including the type of refrigerant (ODS or HFC) used in the equipment. These current estimates formed the basis of the baseline 2010 refrigerant distribution assumptions.

For a given R/AC equipment category, the Vintaging Model refrigerant distribution was assigned to normalize Rule 1415 refrigerant data to actual refrigerant usage. For example, if 100% of the process cooling systems reported in Rule 1415 that an ODS refrigerant was used, but Vintaging Model data indicated that nationally, 40% of process cooling use HFC refrigerants, then 40% of the process cooling systems in Rule 1415 were randomly chosen and assigned HFC refrigerant to reflect the national distribution. Random assignment was used to prevent any systematic bias against associating high or low leakage systems with any particular type of refrigerant.

Note that in about five percent of the Rule 1415 reports, the refrigerant reported was indecipherable or inconclusive, such as "refrigerant R", or "Freon". Where the refrigerant used could not be ascertained, it was automatically selected for random assignment of normal refrigerant distribution for that type of system.

U.S. EPA Vintaging Model data was used to estimate refrigerant distribution according to R/AC equipment type in 2020. The U.S. EPA Vintaging Model projects that the proportion of R/AC equipment using ODS refrigerants will decline from 2010 to 2020 and use of HFC refrigerants will increase as ODS refrigerants are phased out. Projections are based on the number of R/AC equipment units currently in place, the average lifetime of equipment, ODS phase-out schedules, and the most probable non-ODS refrigerant replacements.

Aggregated industry data is used to estimate current R/AC equipment and their lifetimes. Projecting the likely non-ODS refrigerant substitutes is based upon current usage trends, assuming that refrigerant transitions occur linearly from the start date until the date of full usage. The U.S. EPA's Vintaging Model often uses several sets of assumptions to better approximate non-linear transitions, such as the transition of AC equipment from HCFC-22 to HFC blends.

The following Table 5 shows projected refrigerant distribution in 2010 and 2020, based on U.S. EPA Vintaging Model analysis.

Table 5. Refrigerant Distribution by R/AC Equipment Type, 2010 and 2020

R/AC Equipment type	Refrigerant	GWP	% Equipment 2010	% Equipment 2020	HFC or ODS
Centralized Systems	HCFC-22	1500	42.2%	3.0%	ODS
	R-404A	3260	39.7%	65.2%	HFC
	R-507	3300	18.1%	31.8%	HFC
Cold Storage	CFC-12	8100	2.0%	0.0%	ODS
	HCFC-22	1500	56.6%	28.1%	ODS
	R-404A	3260	26.2%	54.2%	HFC
	R-502	4500	6.6%	0.0%	ODS
	R-507	3300	8.6%	17.7%	HFC
Process Cooling	CFC-11	3800	1.0%	0.0%	ODS
	CFC-12	8100	15.6%	0.0%	ODS
	HCFC-22	1500	22.0%	11.0%	ODS
	HCFC-123	90	23.3%	29.4%	ODS
	HFC-134a	1300	33.3%	44.5%	HFC
	R-401A	970	0.4%	0.3%	HFC
	R-404A	3260	2.7%	8.8%	HFC
	R-410A	1725	0.9%	3.4%	HFC
	R-507	3300	0.8%	2.6%	HFC
Refrigerant Condensing Units	CFC-12	8100	2.2%	0.0%	ODS
	HCFC-22	1500	30.4%	7.3%	ODS
	HFC-134a	1300	40.4%	44.5%	HFC
	R-404A	3260	19.0%	33.3%	HFC
	R-507	3300	8.0%	14.9%	HFC
Chillers	CFC-11	3800	2.6%	0.0%	ODS
	CFC-12	8100	0.9%	0.0%	ODS
	HCFC-22	1500	73.8%	32.3%	ODS
	HCFC-123	90	6.8%	8.2%	ODS
	CFC-114	9300	0.1%	0.0%	ODS
	HFC-134a	1300	14.1%	32.3%	HFC
	HFC-236fa	6300	0.4%	0.1%	HFC
	R-407C	1526	1.0%	18.2%	HFC
	R-410A	1725	0.1%	8.9%	HFC
	R-500	6010	0.2%	0.0%	ODS
Unitary AC	HCFC-22	1500	78.4%	15.0%	ODS
	HFC-134a	1300	0.1%	0.7%	HFC
	R-407C	1526	0.3%	1.5%	HFC
	R-410A	1725	21.2%	82.8%	HFC

No break-out by equipment refrigerant charge size was available for HFC-ODS distribution ratios, but assessment of the U.S. EPA Vintaging Model data indicates that the distribution of refrigerants used by R/AC equipment is generally consistent across all refrigerant charge sizes for a given equipment type.

Global warming potentials (GWPs) were assigned according to the values for the 100-year time horizon as reported in the IPCC Second Annual Report (IPCC SAR). For some refrigerant GWP values not shown in the SAR, the IPCC Third Annual Report (IPCC TAR) values were used.

E. Average percent of systems leaking (during a given year):

Rule 1415 data was the best source of data for this factor, as other data tended to report annualized leak rates assuming that all equipment leaked a certain amount each year.

The factor is calculated from:

*Number of systems reporting a leak/total number of systems * 100%*

F. Average percent of refrigerant charge lost from leaking systems:

Rule 1415 data was used to calculate the average percent of refrigerant charge lost from leaking systems using the following equation:

Average percent of refrigerant charge lost from leaking systems =
*Pounds refrigerant lost (added) to equipment annually/total refrigerant charge (lbs) of leaking equipment * 100%*

The average percent of refrigerant charge lost from leaking systems can also be described as the annual leak rate for leaking systems. For example, if a system charge holds 100 lbs of refrigerant, and it leaked 20 lbs in a year, the annual leak rate for that system is 20%.

All refrigerant losses were summed for each specific R/AC equipment category and divided by the summed total of all refrigerant charge within the equipment category. Leak rates were also computed for individual systems, summed, and averaged to give a result for all systems. The results were consistent with the overall weighted average loss for all leaking systems.

Given the percent of systems leaking in a given year, and the average leak rate of refrigerant leaked from leaking systems, the average annual leak rate for all systems can be calculated:

Average annual leak rate (all systems) =

*Average percent systems leaking (during a given year) * average percent of refrigerant charge lost from leaking systems.*

Emissions projections under a BAU scenario for 2020 assume that current leak rates remain constant through 2020; although more leak-tight systems may be developed in the future. A discussion of improvements in equipment leak-tightness and how they would affect projected emissions and reductions is presented in more detail in section 3.E, "Potential Biases and Uncertainties in Data".

G. Final Result: Amount of refrigerant leaked from leaking systems (in pounds and in $MMTCO_2E$):

The emission factors are used to estimate the desired result of emissions from R/AC equipment containing 50 lbs or more refrigerant charge. Emissions are first calculated in pounds, and then converted to $MMTCO_2E$:

*Amount of refrigerant leaked (in pounds) from all leaking systems = Average percent of leaking systems * the average leak rate of those leaking systems * total pounds of refrigerant charge of all systems within the R/AC equipment category.*

To convert emissions from pounds to $MMTCO_2E$:

Leak amount in $MMTCO_2E$ =
*Pounds refrigerant leaked * conversion factor of 4.54×10^{-10} MMT per lb * GWP of refrigerant.*

Step 4. Number of Facilities with R/AC Equipment

ARB staff used several different sources of data to determine the number of facilities with R/AC equipment. Initially, SCAQMD Rule 1415 reported data was used to determine the types and numbers of facilities containing R/AC equipment with 50 lbs or more refrigerant.

For each R/AC equipment unit with 50 lbs or more ozone-depleting refrigerant, Rule 1415 reports require a description of the R/AC equipment, type of refrigerant used, and refrigerant charge size in pounds. Rule 1415 reports also include a business description and the SIC code for each reporting facility.

Reported SIC codes were mapped to NAICS codes and used, in conjunction with data provided by the US Census Bureau censtats database, to extrapolate the regional Rule 1415 data into a statewide estimate of the number of facilities in California in 2006. The data collected from Rule 1415 reports were treated as a valid sample of facilities statewide.

After initial facility estimates were made, ARB staff obtained additional data sources which resulted in a more precise estimate of the number of facilities with R/AC equipment. Specifically, staff realized that based on available data, better facility estimates could be made by looking at the number of facilities containing specific types of R/AC equipment rather than using the more general data available from Rule 1415 reports. Staff determined that no single data source was the best source of information for determining the number of facilities containing a given type of R/AC equipment. Therefore, each distinct type of R/AC equipment required a different data source or combination of sources.

To determine the total facilities inventory, it was necessary to break out the number of facilities containing one or more of the following types of R/AC equipment (with 50 lbs or more refrigerant):

- Centralized refrigeration systems
- Refrigerant condensing units
- Cold storage
- Process cooling
- Chillers (centrifugal and packaged)
- Unitary AC

The number of facilities was estimated for each distinct R/AC equipment category; as no single methodology was sufficient for all the different types of facilities and their R/AC equipment. To prevent double-counting, a facility was counted only once for its largest R/AC system. For example, if a facility contained a large centralized system and a small refrigerant condensing unit, it was counted once as a facility with a large refrigeration system.

<u>Refrigerant condensing units</u>
By definition in this emissions analysis, a refrigerant condensing unit contains less than 200 lbs of refrigerant, and is essentially a smaller version of a centralized system. Conversely, centralized systems are defined as direct expansion systems with 200 lbs or more refrigerant.

SCAQMD Rule 1415 data was used to determine the number of facilities with refrigerant condensing units. The SIC code for each reporting facility was mapped to a NAICS code. Based on an assessment of the facility type represented for each NAICS code (US Census Bureau website) it was determined whether systems used by facilities with each NAICS code represented refrigeration or AC systems. For example, the NAICS code 52210 represents facilities in the commercial banking sector. Based on this business description it was assumed that all R/AC equipment reported under this code were used for comfort cooling (AC systems) and not refrigeration. Similarly, the NAICS code 424420 represents facilities that are "packaged frozen food merchant wholesalers". Based on this business description it was assumed that

R/AC equipment reported under this code were used for refrigeration and were included in the inventory of facilities using refrigerant condensing units.

Reports from 2000 – 2005 served as the primary contributor to the Rule 1415 dataset (total 16,000 systems). However, after many of the analyses were conducted, more recent reports from 2006 – 2007 became available and were used to cross check and verify the analyses conducted with the older dataset. One important difference between the older reports and the newer reports is the inclusion of more precise descriptions of each R/AC system reported which classify the systems function as refrigeration, freezing, or air conditioning.

Reports from the 1415 dataset were not sufficiently specific to enable accurate mapping to a NAICS code for retail food facilities. Additionally, it was unclear whether pharmacies reporting to the SCAQMD used refrigeration or AC systems with more than 50 lbs refrigerant. The inventory of commercial refrigeration equipment in California provided in the ARMINES report was used to cross check the number of retail food and pharmacy facilities. The ARMINES report inventory indicated that, on average, the only retail food facilities with refrigerant condensing units with more than 50 lbs refrigerant were minimarkets, convenience stores, grocery stores, and supermarkets. Because supermarkets also used centralized systems with more than 200 lbs refrigerant they were counted in the inventory of facilities which use medium and large centralized systems.

<u>Centralized refrigeration systems</u>
The number of facilities with centralized refrigeration systems was derived from analyses of the SCAQMD Rule 1415 dataset and the ARMINES report in the same way that the number of facilities with refrigerant condensing units was derived. All facility types which reported using systems with between 200 - 2,000 lbs of refrigerant in the Rule 1415 dataset were considered.

As before, the SIC code for each reporting facility in the Rule 1415 dataset was mapped to a NAICS code. Of all the facility types which reported using R/AC equipment with 200 – 2,000 lbs of refrigerant, the facility types most likely to represent refrigeration systems (and not AC systems), were isolated in the same way as is described for refrigerant condensing units.

For those facilities representing medium and large refrigeration systems there were two possible system types that could be assigned, centralized systems or cold storage. All facility types that did not match the criteria for cold storage were assumed to represent centralized systems.

As with the refrigerant condensing units, these analyses of Rule 1415 data and equipment assignments were cross checked and verified by looking at the most recent Rule 1415 reports which include improved equipment descriptions and specific designations of the purpose of the systems reports (refrigeration, freezing, or AC).

Cold storage and Process cooling

SCAQMD Rule 1415 data was used to determine the number of facilities with cold storage or process cooling systems. As described previously for refrigerant condensing units and centralized systems the SIC code for each reporting facility was mapped to a NAICS code. Facility descriptions for individual NAICS codes are generally too specific to be useful for broad characterizations of affected business types in California. As a result, similar NAICS codes were grouped into aggregated business type categories.

The following Table 6 shows some of the NAICS codes associated with aggregated business types likely to use cold storage or process cooling refrigeration equipment.

Table 6. Facilities with Cold Storage or Process Cooling Equipment - List of mapped NAICS codes and Aggregated Facility Category

Aggregated Facility Category	Cold Storage	Process Cooling	Mapped NAICS codes		
Agricultural service	✓		115000		
Beer and ale	✓		312120	424810	
Dairy	✓		311510	311511	311513
Food processing			311000	311111	311812
Fresh fruit and vegetable wholesale	✓		424410	424480	424490
			493110		
Frozen food wholesale	✓		424420		
Fruit and vegetable processing			311400	311421	
Ice manufacturing	✓	✓	312113		
Manufacturing (non-food)		✓	325000	325120	325412
			325414	336400	325320
Meat processing	✓		311600	311611	311612
			311710		
Petroleum		✓	221110	324000	324110
Refrigerated warehousing/storage	✓		493120		

After NAICS codes were aggregated into similar facility categories, the number of facilities within each aggregated category was estimated using the U.S. Census Bureau censtats website.

The censtats website includes all facilities within a NAICS code. This inventory yields an artificially high estimate because facilities with systems containing less than 50 lbs of high GWP refrigerant are included. In order to include only those facilities with R/AC equipment using 50 lbs or greater of refrigerant it was necessary to use additional data sources.

Facility numbers were adjusted accordingly to remove those with very small R/AC equipment units (< 50 lbs) by using data in the CEUS dataset, U.S. EPA Vintaging Model technical data sheets, and the ARMINES report.

Additionally, ARB staff contacted stakeholders including equipment manufacturers, produce and vegetable growers, and other industry stakeholders to verify ARMINES research indicating that at least 80% of cold storage and food processing facilities in California use ammonia or CO_2 as their refrigerant, and thus would not be subject to the proposed rule. Stakeholders were able to verify this assumption, and based on this information, facility number estimates were reduced by 80% at all refrigerant charge sizes for cold storage and food processing categories (including agricultural service, beer and ale, dairy, food processing, fresh fruit and vegetable wholesale, fruit and vegetable processing, meat processing, and refrigerated warehousing/storage).

<u>Chillers (centrifugal and packaged)</u>

The number of facilities that have chillers in California was estimated primarily from CEUS inventory data, with ARMINES report data also used extensively as a cross-check. Because the refrigerant charge size of chillers was not always precise using CEUS data, the ARMINES report data was used to determine the number of chillers that fell into the medium and large categories, the distribution of refrigerant charge sizes, and technology type (centrifugal or packaged chiller).

Chiller data was compared to the inventory provided in the ARMINES Stationary Air Conditioning and Refrigeration Inventory Final Report, March 2009 (Table 1.11, U.S. Installed Base of Chillers from 1990 to 2004). The Building Services Research and Information Association (BSRIA) 2005 marketing study was used as the primary source of information, with national chiller sales and the installed base scaled to California's population

Additionally, chiller inventories from the CEUS and ARMINES reports were compared to estimates from the U.S. EPA Vintaging model technical datasheets scaled down to California based on population size.

<u>Unitary AC</u>

The number of facilities with unitary AC systems (between 50 and 200 lbs refrigerant) was estimated from CEUS data, and these estimates were cross-checked with data from the CBECS report, the U.S. EPA Vintaging Model technical data sheets, and the ARMINES report. Initial attempts to use Rule 1415 data to estimate facilities with unitary AC systems resulted in extremely high facility estimates that could not be confirmed using more precise data provided through CEUS, CBECS, and ARMINES.

The number of facilities with single and multi-zone HVAC systems was reported in CEUS, along with the tons of cooling capacity. Cooling capacity was converted to pounds refrigerant to exclude facilities using AC systems with less than 50 lbs of refrigerant.

Because CEUS data is specific to California commercial facilities, it is considered more accurate than scaled-down results from national estimates obtained from the CBECS, ARMINES, and U.S. EPA Vintaging Model technical data sheets.

The following conversion factors and assumptions were obtained from SCAQMD Rule 1415 data and the CEUS report:

- Rooftop AC systems in California contain, on average, 11 lbs of refrigerant, with very few (10%) containing more than 50 lbs refrigerant.
- Half of the rooftop AC systems in California are in commercial facilities, and the other half are residential.
- Each facility with unitary AC systems (50 lbs or greater) contain on average, 5.5 systems per facility.

The ARMINES data also included estimates for all AC systems in California. Analysis of data contained within the ARMINES report was in close agreement with CEUS estimates. Estimates obtained from analyses of the CBECS report resulted in facility numbers 30 percent higher than estimates based on CEUS. Although CBECS and ARMINES estimates varied, the CEUS data was used as the best facility number estimate; because the uncertainty level was much lower.

Using the methodology above, staff also estimated that approximately 500,000 facilities in California contain unitary AC equipment with less than 50 lbs of refrigerant.

Emissions and Reductions Summary for Steps 5 - 8:
The following Table 7 shows R/AC equipment emission estimates for baseline year 2010, projected emissions for 2020 under a business-as-usual scenario, and projected reduced emissions for 2020 after implementation of the proposed regulation.

Total GHG emission reductions in 2020 are the difference between 2020 emissions under business-as-usual, and after rule implementation. Methodology and results are further described in following sub-sections steps 5 through 8.

Table 7. Summary of Emissions by R/AC Equipment Charge Size. All emissions shown in MMTCO2E.				
	Emissions			Potential Emission Reductions
R/AC Equipment Type and Charge Category	**2010 BAU**	**2020 BAU**	**2020 Post-Rule**	**2020 Total GHG Reduction[6]**
Small Refrigeration Systems (≥ 50 lbs, < 200 lbs)				
refrigerant condensing units (one type of small refrigeration system, same as subtotal)	1.3	1.4	0.5	0.9 (0.8 HFC + 0.1 ODS)
Medium Refrigeration Systems (≥ 200 lbs, < 2,000 lbs)				
centralized refrigeration system	4.6	6.6	4.3	2.3 (2.2 HFC + 0.1 ODS)
cold storage	1.0	1.3	0.3	1.0 (0.8 HFC + 0.2 ODS)
Subtotal: Medium Refrigeration Systems	5.7	7.9	4.6	3.3 (3.0 HFC + 0.3 ODS)
Large Refrigeration Systems (≥ 2,000 lbs)				
centralized refrigeration system	1.1	1.5	0.7	0.8 (0.8 HFC + 0 ODS)
cold storage	3.7	4.8	1.7	3.1 (2.5 HFC + 0.6 ODS)
process cooling	0.2	0.2	0.2	0 see footnote 6
Subtotal: Large Refrigeration Systems	5.0	6.5	2.6	3.9 (3.3 HFC + 0.6 ODS)
Refrigeration System Subtotals	**11.9**	**15.8**	**7.7**	**8.1 (7.2 HFC + 0.9 ODS)**

[6] Note on Process Cooling and Centrifugal Chiller Emission Reductions: Data from the U.S. EPA Vintaging Model, IPCC Third Annual Report, and ARMINES indicate that large process cooling units tend to leak about 10% of their refrigerant each year. It is not known why the process cooling systems under Rule 1415 have a lower leak rate (7% annually) than other estimates. Similarly, centrifugal chiller leak rate data from Rule 1415 reports show very low leak rates (1% annually for medium centrifugal chillers, and 2% annually for large centrifugal chillers) that are lower than the commonly cited 2-4% annual leak rate.

Emission reductions for process cooling and centrifugal chillers are probable, but not well-defined using the methodology of comparing current business-as-usual leak rates to lower achievable leak rates, because the empirical data showed that for these R/AC equipment types, the lower achievable leak rate was already being met. Therefore, in this analysis, estimated reductions for process cooling and centrifugal chillers are indicated as zero not because reductions cannot be achieved, but because they are not quantifiable given the constraints of current methodologies to identify further reductions from equipment that, as reported, already achieve leak levels that are lower than expected achievable leak rates. CARB staff chose to under-estimate emission reductions by not assigning an arbitrarily lower achievable leak rate.

Table 7. Summary of Emissions by R/AC Equipment Charge Size. All emissions shown in MMTCO2E.				
	Emissions			Potential Emission Reductions
R/AC Equipment Type and Charge Category	**2010 BAU**	**2020 BAU**	**2020 Post-Rule**	**2020 Total GHG Reduction[6]**
Small AC Systems (≥ 50 lbs, < 200 lbs)				
unitary AC systems (one type of small AC system, same as subtotal)	0.6	0.7	0.3	0.4 (0.3 HFC + 0.1 ODS)
Medium AC Systems (≥ 200 lbs, < 2,000 lbs)				
centrifugal chiller	0.02	0.02	0.02	0 see footnote 6 (previous page)
packaged chiller	0.28	0.28	0.18	0.1 (0.1 HFC + 0.0 ODS)
Subtotal: Medium AC Systems	0.3	0.3	0.2	0.1 (0.1 HFC + 0.0 ODS)
Large AC Systems (≥ 2,000 lbs)				
centrifugal chiller (one type of large AC system, same as subtotal)	0.3	0.4	0.4	0 see footnote 6 (previous page)
AC System Subtotals	**1.2**	**1.4**	**0.9**	**0.5 (0.4 HFC + 0.1 ODS)**
Totals All R/AC Systems	**13.1**	**17.2**	**8.6**	**8.6 (7.5 HFC + 1.1 ODS)**

Step 5. Annual emissions estimated for baseline year 2010

Using the emission factors previously described, the baseline emissions in year 2010 were estimated for each size and type of system, as shown in Table 7.

Step 6. Potential emissions estimated for year 2020 under business-as-usual scenario (without rule implementation)

Year 2020 potential emissions were estimated under a business-as-usual scenario and are shown in Table 7. The following assumptions were included in the 2020 BAU emissions estimate:

- Number of facilities will grow by one percent per year.

- Refrigerant usage will gradually transition away from CFCs and HCFCs towards HFCs, as previously shown in Table 5 (Refrigerant Distribution by Equipment Type, 2010 and 2020).
- No other changes in emission factors will occur, i.e., the following remain unchanged:
  - Number of systems/facility
  - Average refrigerant charge (pounds) per system
  - Average percent of systems leaking during a given year
  - Average percent of refrigerant charge lost from leaking systems

Step 7. Feasible lower average leak rates achievable after rule implementation

It is not possible to prevent all refrigerant leaks in refrigeration and AC systems. Normal aging of equipment, such as weakened fittings and gaskets lead to leaks and are a part of R/AC equipment usage in the real world. However, it is possible to find and repair leaks more quickly when best practices in refrigerant management and system maintenance are utilized.

A primary assumption used to estimate emission reductions is that the proposed rule would not necessarily reduce the actual number, or percent of leaking R/AC systems during a given year. Rather, the rule defines inspection and maintenance best management practices and use of these practices would cause leaks to be detected and repaired more quickly and completely, thus reducing overall refrigerant emissions.

In order to calculate emission reductions from BAU to post-rule implementation, it was necessary to first estimate how much the annual leak rate could be reduced, then to quantify those emissions.

Two key sources were used as the basis of lower achievable leak rates:
1) the United Nations Environment Programme (UNEP) *2006 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee*; and 2) the Intergovernmental Panel on Climate Change [IPCC] and Technology and Economic Assessment Panel [TEAP] *Special Report on Safeguarding the Ozone Layer and the Global Climate Systems, 2005.* U.S. EPA Vintaging Model technical sheets on specific R/AC equipment types normal leak rates were also used as supplementary references.

The two key references indicate that using best management practices on old or new refrigeration equipment can reduce the average annual leak rates to 10 percent or less for large equipment, and 5 percent or less for small equipment.

Available references were often ambiguous on what was meant by "large" or "small" equipment. Initially, staff assumed large to be equipment with 2,000 lbs or more refrigerant, and small equipment contained less than 200 lbs refrigerant. However, additional analysis showed that the term "large" was frequently used to include any equipment with about 100 kilograms (220 lbs) or more refrigerant, and "small" equipment generally included all systems with less than less than 100 kilograms.

Therefore, the achievable lower annual leak rates for the purpose of estimating emission reductions was set to 10 percent for systems with 200 lbs or more refrigerant (medium and large equipment category), and 5 percent for systems with less than 200 lbs refrigerant (small equipment category).

Achievable lower leak rates for AC systems were also researched. AC systems are generally more leak tight than refrigeration systems of the same refrigerant charge size, especially chillers, which often operate under negative pressure, so that if a leak occurs, the system will take in air, instead of refrigerant leaking out.

The IPCC Special Report and U.S. EPA Vintaging Model estimate that centrifugal chillers should be able to leak as little as 2 to 4% annually, and medium-sized packaged chillers can achieve leak rates of 3.5% or less per year. Small unitary AC systems can achieve leak rates as low as 5% or less annually.

The following Table 8 shows average annual leak rates calculated from Rule 1415 data on actual usage (refrigerant losses) over six consecutive years (2000 through 2005) for the identified R/AC equipment categories. Table 8 also shows the lower achievable annual leak rates using best management practices, based on industry studies reported in the IPCC/TEAP Special Report and the UNEP Report as previously described.

Table 8. Refrigeration Equipment Leak Rates, BAU Compared to Post-rule

R/AC Equipment Type and Charge Category	Rule 1415 Data - Avg. Annual Leak Rate	Lower Achievable Avg. Annual Leak Rate w/ Best Mgmt. Practices	Reduction of Leak Emissions (relative %)
Refrigeration Systems			
centralized system (large)	21%	10%	53%
centralized system (medium)	15%	10%	33%
cold storage (large)	27%	10%	64%
cold storage (medium)	36%	10%	72%
process cooling (large)	7%	7%	0% see footnote 7

[7] Note on Process Cooling and Centrifugal Chiller Emission Reductions: Data from the U.S. EPA Vintaging Model, IPCC Third Annual Report, and ARMINES indicate that large process cooling units tend to leak about 10% of their refrigerant each year. It is not known why the process cooling systems under Rule 1415 have a lower leak rate (7% annually) than other estimates. Similarly, centrifugal chiller leak rate data from Rule 1415 reports show very low leak rates (1% annually for medium centrifugal chillers, and 2% annually for large centrifugal chillers) that are lower than the commonly cited 2-4% annual leak rate.

Table 8. Refrigeration Equipment Leak Rates, BAU Compared to Post-rule			
R/AC Equipment Type and Charge Category	**Rule 1415 Data - Avg. Annual Leak Rate**	**Lower Achievable Avg. Annual Leak Rate w/ Best Mgmt. Practices**	**Reduction of Leak Emissions (relative %)**
refrigerant condensing units (small)	14%	5%	65%
Sub-total refrigeration systems, (weighted average)	**19%**	**9%**	**51%**
AC Systems			
centrifugal chiller (large)	2%	2%	0% see footnote 7
centrifugal chiller (medium)	1%	1%	0% see footnote 7
packaged chiller (medium)	7%	3.5%	50%
unitary AC (small)	11%	5%	56%
Sub-total AC systems, (weighted average)	**5%**	**3%**	**40%**
Totals (weighted average)	**16%**	**8%**	**50%**

Step 8. Emission reductions estimated for year 2020 (BAU emissions less post-rule emissions):

Emission reductions for year 2020 are estimated by taking the difference between BAU emissions and achievable lower emissions as a result of rule implementation. Results are shown in Table 7.

3.E. Potential Biases and Uncertainties in Data

Potential biases inherent in the Rule 1415 baseline dataset and resulting emission factors include the assumptions made for current and future leak rates, which would decrease or increase estimates of emissions and potential reductions as a result of rule implementation.

1). Current Leak Rates:
The Rule 1415 reports were the most complete data set for leak rates of actual R/AC equipment used in California. However, SCAQMD estimated that less than twenty percent of regulated facilities submit required reports, which results in an under-reporting of data that could potentially bias data from a representative sample of all regulated facilities.

Footnote 7 (cont.) Emission reductions for process cooling and centrifugal chillers are probable, but not well-defined using the methodology of comparing current business-as-usual leak rates to lower achievable leak rates, because the empirical data showed that for these R/AC equipment types, the lower achievable leak rate was already being met. Therefore, in this analysis, estimated reductions for process cooling and centrifugal chillers are indicated as zero not because reductions cannot be achieved, but because they are not quantifiable given the constraints of current methodologies to identify further reductions from equipment that, as reported, already achieve leak levels that are lower than expected achievable leak rates. CARB staff chose to under-estimate emission reductions by not assigning an arbitrarily lower achievable leak rate.

Bias could be introduced in two ways: 1) lower leak rates than representative of the general R/AC equipment population because the facilities that report tend to be the ones that already have best management practices (and therefore low leak rates); or 2) higher leak rates than representative, because facilities that report do so because they have been identified by local environmental enforcement agencies for serious or minor violations of environmental regulations, and have been told to report for Rule 1415 and other environmental regulations. ARB staff believes it is likely that both scenarios exist, nullifying the positive and negative biases and rendering them neutral, leaving a valid non-biased sample from under-reporting of facilities.

2). Future Leak Rates:
Estimates of future fugitive emissions are difficult to predict or quantify, as they assume changes in R/AC equipment and refrigerant usage patterns that may not have occurred yet. Specifically, two alternate scenarios were considered in leak rate assumptions that change estimated BAU emissions and reductions in 2020 from those used in this analysis:

a) Achievable lower leak rate by 2020 for medium sized refrigeration equipment is decreased from 10% to 7.5% (increases estimated emission reductions). Although achievable lower leak rates for large and small sized refrigeration systems were described and supported by several studies, medium-sized equipment was not addressed directly.

ARB staff chose a 10% achievable lower leak rate for medium sized equipment, which is the same as for large equipment. Smaller equipment is assigned an achievable lower leak rate of 5%. Therefore, ARB staff considered assigning a 7.5% achievable lower leak rate for medium systems because it is the midpoint between achievable lower leak rates of 5% for small equipment and 10% for large equipment. However, such an assumption could not be fully justified because the studies available could be interpreted to show that what ARB considers medium equipment (200 – 2,000 lbs refrigerant), encompasses what the studies included as large equipment (220 lbs or more refrigerant). If we assume that medium-sized equipment could achieve a 7.5% leak rate, the projected emission reductions for 2020 are increased from 8.6 $MMTCO_2E$ to 9.8 $MMTCO_2E$ (15 percent greater emission reductions).

b) Newer equipment becomes increasingly leak-tight (decreases estimated emission reductions). Due to a combination of best management practices and better equipment design, average annual leak rates for R/AC equipment have decreased significantly since the late 1980s (due in part to the adoption of the Montreal Protocol in 1987, and the Section 608 requirements in the Clean Air Act Amendments of 1990).

ARB staff estimated 2020 BAU emissions with the assumption that current leak rates for BAU would be constant through 2020, with no reduced leak rates due to better equipment design. However, ICF International environmental consulting company has conducted research indicating that the past trends of more leak-tight equipment should continue through 2020 and beyond, with leak rates at least 10 percent less for new equipment compared to existing equipment.

The reduced leak rates would be expected to apply more towards factory-manufactured equipment, and less to "built" systems, which are custom-built on site, and have leak characteristics different for each system. ARB staff did not use this projection for estimated future emissions under BAU scenarios, because business-as-usual by definition implies that significant changes will not take place. However, ARB staff acknowledges that continued improvements in R/AC equipment design will most likely take place, thus helping to reduce refrigerant emissions, in conjunction with best management practices.

For comparison to BAU emissions in 2020 as calculated, ARB staff calculated 2020 emissions if new equipment installed between 2010 and 2020 leaked 10 percent less than existing equipment; the expected emissions in 2020 under the new BAU assumptions would decrease from 17.2 to 15.5 $MMTCO_2E$. Similarly, total expected emission reductions from the rule would decrease from 8.6 to 7.0 $MMTCO_2E$ (20 percent fewer reductions).

4. Summary and Conclusions

<u>Summary:</u>
Statewide estimates of the number of facilities using refrigeration or air-conditioning (R/AC) equipment containing 50 lbs or more of refrigerant were calculated and refined using several data sources. Emissions inventory estimates were calculated using R/AC equipment use patterns and annual leak rate data provided in the SCAQMD Rule 1415 dataset. Estimates of the distribution of R/AC equipment using specific HFC and ODS refrigerants were obtained from the U.S. EPA Vintaging Model estimates and applied to the Rule 1415 dataset. Refrigerant use distributions were adjusted to reduce a known bias in the rule 1415 data set generated by a requirement to report refrigerant use patterns for only R/AC equipment utilizing ODS refrigerants.

Finally, the reductions in emissions that could be associated with implementation of the proposed regulation and full compliance were estimated. Approximately 50 percent of CO_2E emissions could be reduced from stationary refrigeration or air-conditioning equipment (subject to the proposed rule) as a result of reduced leak rates from improved inspection and maintenance practices required by the regulation.

Conclusions:
Requiring the use of refrigerant best management practices outlined in the Refrigerant Management Program proposed regulation would result in significant GHG emission reductions. The primary emission reductions are a result of the leak detection and monitoring and leak repair components of the proposed rule. The reporting and record-keeping components ensure that the emission reductions are real, verifiable, and enforceable.

HFC emissions inventory estimates for the total annual CO_2 equivalent emissions from leaks associated with stationary refrigeration equipment (containing 50 lbs or more refrigerant) in California in 2010 are 7.4 $MMTCO_2E$, and are projected to increase to 14.3 $MMTCO_2E$ by 2020 under the BAU scenario. HFC emissions double between 2010 and 2020 as a result of the continued transition away from ozone-depleting refrigerants to HFC refrigerants. As a result of transitioning away from ODS refrigerants, emissions of ODS from refrigeration equipment are anticipated to decrease from 4.5 $MMTCO_2E$ in 2010 to 1.5 $MMTCO_2E$ in 2020. (Total GHG emissions of HFC and ODS combined increase about 33%, from 11.9 $MMTCO_2E$ in 2010 to 15.8 $MMTCO_2E$ in 2020.)

HFC emissions from AC equipment are projected to increase from 0.2 $MMTCO_2E$ in 2010 to 1.0 $MMTCO_2E$ in 2020. ODS emissions are anticipated to decrease from 1.0 $MMTCO_2E$ in 2010 to 0.4 $MMTCO_2E$ in 2020. The net increase in GHG emissions from AC equipment is 0.2 $MMTCO_2E$ (1.2 to 1.4 $MMTCO_2E$).

Analyses conducted by ARB staff estimate that approximately 50% of the CO_2E emissions from stationary R/AC equipment could be eliminated relative to BAU as a result of implementing inspection and maintenance best practices such as the leak detection and monitoring and leak repair practices.

Potential annual emission reductions of 7.2 $MMTCO_2E$ HFCs, with an additional 0.9 $MMTCO_2E$ ODS (8.1 $MMTCO_2E$ total) from refrigeration equipment by the year 2020 are projected as a result of the rule. Additional minor reductions from AC equipment are also anticipated as a result of required service practices, but are not quantified in this analysis.

Addendum A – Additional Methodology Details

Initial facility number estimates made by ARB for the proposed rule relied upon the SCAQMD Rule 1415 reported data for all facilities. As more precise data sources became available, the Rule 1415 data was used as the primary data source only to estimate the number of facilities with small refrigerant condensing units, cold storage systems, or process cooling systems (as previously described in this appendix). Although in most cases, the initial methodology was rejected in favor of better methodologies as more precise data became available, the initial methodology used is included below for completeness, because it was used to help identify types of businesses and refrigeration equipment likely to be subject to the rule. After the types of businesses and equipment were initially identified, further refinements could be made to more precisely estimate number of facilities, types and number of R/AC equipment, and emission factors of the equipment and facilities.

SCAQMD Rule 1415 reports include useful data on the types of businesses, R/AC equipment, refrigerant usage, and other data that were used by ARB to develop initial estimates on the magnitude of GHG emissions from stationary R/AC equipment.

All data obtained from SCAQMD Rule 1415 databases were initially scanned for errors and reasonable attempts to fill the data gaps were made, whenever possible.

Section 1. Initial Identification of Types of Businesses, Using SIC Codes.

Rule 1415 reports included a field for the business SIC code, which was used to map to a current NAICS code. NAICS codes were generally too specific and contained too few facilities for meaningful emissions analysis, so similar NAICS coded facilities were aggregated into similar business types.

Occasionally, the Rule 1415 report left the SIC code field blank. If a report did include a specific business description identical to descriptions provided by other facilities reporting an SIC code, then in these cases the facility with a missing SIC code was assigned the same SIC code as the other facilities with identical business descriptions.

Additionally, if a facility provided a business description that was sufficiently specific, a three digit SIC code was assigned to the respective facility based on NAICS code business descriptions. If a facility did not report an SIC code and the description provided was too vague to allow confident assignment of a three digit SIC code the data was not incorporated in further analyses.

The US Census Bureau NAICS code website was used to obtain a better understanding of the types of facilities included within each NAICS or SIC code throughout this process. In many cases the reported SIC code was mapped to a NAICS code based on the suggested mapping scheme provided by the US Census Bureau. In cases where two-digit SIC codes were reported, direct mapping to a NAICS code was not possible. In these cases the specific business description reported by each facility and the reported SIC code were used as guides to map a three- to four-digit NAICS code.

In general, the business description was relied upon more heavily than the reported SIC code because it was assumed that the employee reporting to the SCAQMD was better able to accurately describe their business than assign an appropriate SIC code from the list provided. Additionally, if SIC codes or business descriptions reported were vague, mapping to fewer NAICS digits was used to avoid over-specifying facility categories.

Assumptions/sources of bias: Several assumptions are implicit in the methods used to map SIC codes/business descriptions to NAICS codes described. It is necessary to assume that the employees completing and submitting the reporting forms to the SCAQMD accurately selected SIC codes to represent their primary business activity and that the business descriptions provided are also accurate. It is possible that the employee reporting included a business description that they felt reflected the goals of the SCAQMD instead of the actual business conducted there (for example: a real estate office building with a chiller, including a business description as "building cooling" instead of "real estate"). It is also necessary to assume that, during the SIC to NAICS code mapping process, accurate assessments of facility types included within each NAICS or SIC code were made based on information obtained from the US Census Bureau NAICS code website.

Finally, it is necessary to assume that data within the SCAQMD Rule 1415 dataset is accurate. Data was initially obtained as hard copies and converted to an electronic format using optical character recognition software. It is possible that errors were made during the process of converting data from hard copies to electronic format. However, any errors made during data transcription would have been compensated for by cross-checking the data for reasonableness and how well it reflected actual R/AC equipment numbers and refrigerant usage patterns, as compared to data from CBECS survey, CEUS survey, ARMINES research, and the U.S. EPA Vintaging Model.

Section 2. Initial Estimates of Facility Numbers and R/AC Equipment Numbers Using Rule 1415 Data

After NAICS code mapping was conducted and all NAICS codes were assigned, the numbers of facilities were determined. Facilities were designated further into categories by type of R/AC equipment and refrigerant charge size category.

<u>R/AC Equipment Size Ranges:</u> Datasets were first generated by sorting SCAQMD data by equipment refrigerant charge size. All R/AC equipment with at least 50 lbs of refrigerant was placed into one of the three basic refrigerant charge categories (large R/AC equipment 2,000 lbs or greater; medium R/AC equipment 200 lbs to 2,000 lbs; and small R/AC equipment 50 lbs to 200 lbs). R/AC equipment was also identified by its specific equipment type or function (centralized system, cold storage, chiller, etc.)

<u>Initial Statewide Extrapolation:</u> The next step to calculate numbers of facilities impacted by the proposed regulation was to determine the number of facilities statewide in each of the NAICS codes represented in the Rule 1415 dataset. Statewide facility number estimates for each NAICS code represented in each refrigerant charge size range were obtained from the US Census Bureau censtats database. The sum of these statewide facility number estimates provided the preliminary statewide estimates for the number of facilities potentially subject to the proposed rule.

To simplify data presentation, individual NAICS codes were assigned to aggregated categories representing broad facility types in California. After statewide facility number estimates for all represented NAICS codes were determined within each R/AC equipment size category, the estimates were summed to yield a cumulative facility number within each aggregated category.

The following Table 9 shows the NAICS codes that were assigned to aggregated categories of business types. Many aggregated categories consist of multiple NAICS codes because the codes are for very specific types of businesses, where the aggregated categories represent very broad business types, such as office buildings.

Table 9. Aggregated Facility Categories and Corresponding Mapped NAICS Codes

Aggregated category	Mapped NAICS codes				
Agricultural service	115000				
Airport	488110				
Amusement/recreation parks	713990	713950	713110	711211	711110
	711219				
Beer and ale	424810	312120			
Bottled gas dealers	454312				
Cemeteries/crematories	812220				
Dairy	311513	311511	311510		
Department stores	452111				
Education - Junior colleges	611210				
Education - tech and trade schools	611519				
Education - universities	611300				
Elementary and secondary schools	611110				
Food processing	311812	311111	311000		

Table 9. Aggregated Facility Categories and Corresponding Mapped NAICS Codes					
Aggregated category	**Mapped NAICS codes**				
Fresh fruit and vegetable wholesale	493110	424490	424480	424410	
Frozen food wholesale	424420				
Fruit and vegetable processing	311421	311400			
Hotels/motels	721110				
Ice manufacturing	312113				
Libraries	519120				
Manufacturing (non-food)	313000	322120	322200	322210	323110
	334516	334613	335313	335911	334513
	336300	336322	336400	336410	336411
	336414	336419	339000	339110	325000
	325120	325211	325300	325320	325411
	325412	325414	325510	325520	325991
	326113	326140	326160	326192	327213
	327310	331000	331111	331316	331512
	332811	332813	333319	334220	334410
	334413	334414			
	313000	322120	322200	322210	323110
Meat processing	311710	311612	311611	311600	
Medical care	623110	622310	622110	621512	
Misc warehousing/storage	493190				
Museums	712130	712110			
Office buildings	813990	813930	813910	425000	561439
	551112	551100	541860	541511	541330
	541110	541000	531312	531110	524298
	522390	522110	518210	518111	
Petroleum	324110	324000	221110		
Pharmacies	446110				
Publishing	511130	511120	511110	323117	
Refrigerated warehousing/storage	493120				
Religious organizations	813110	813000			
Research and development	541710				
Retail (food)	445299	445200	445110	445000	
Retail (non-food)	454390	453998	452000	448310	442110
	441110				
Service industry	811490	811198	561720		
Telecommunications	517110				
TV/movie production	515120	512191	512110		
Utilities	221320	221310	221210	221119	221000
	211111				
Wholesale - (non-food)	424690	424100	423410	423110	

Section 3. Assumptions Used to Assign R/AC Equipment Type

Rule 1415 reports were used as the primary source of data to identify the types and numbers of R/AC equipment with ≥ 50 lbs of refrigerant charge, and therefore, potentially subject to the proposed rule.

Where equipment type was not conclusive from Rule 1415 data (for example, "cooling unit"), an equipment type was assigned based on comparing the equipment's refrigerant type and refrigerant charge size to other R/AC equipment used in the same type of business, and assigning it to the most likely R/AC equipment category. The following Table 10 shows the likely equipment type assigned to unclear R/AC equipment descriptions.

Table 10. Equipment type designations assigned for unclear reported data

Aggregated Facility Category	**Equipment ≥ 50 lbs, < 200 lbs (small)**	**Equipment ≥ 200 lbs, < 2,000 lbs (medium)**	**Equipment ≥ 2,000 lbs (large)**
agricultural service	unitary AC or refrigerant condensing unit	cold storage	N/A
airport	unitary AC	chiller	N/A
amusement/recreation parks	unitary AC	chiller	centrifugal chiller
beer and ale	unitary AC or refrigerant condensing unit	cold storage	N/A
bottled gas dealers	unitary AC	chiller	N/A
cemeteries/crematories	unitary AC or refrigerant condensing unit	chiller	N/A
dairy	unitary AC or refrigerant condensing unit	cold storage	cold storage
department stores	unitary AC	chiller	centrifugal chiller
education - K - 12	unitary AC	chiller	centrifugal chiller
education - Junior college	unitary AC	chiller	N/A
education - tech and trade schools	unitary AC	N/A	N/A
education - universities	unitary AC or refrigerant condensing unit	chiller	centrifugal chiller
food processing	unitary AC or refrigerant condensing unit	cold storage	cold storage
fresh fruit and vegetable wholesale	unitary AC or refrigerant condensing unit	cold storage	cold storage
frozen food wholesale	unitary AC or refrigerant condensing unit	cold storage	cold storage

Table 10. Equipment type designations assigned for unclear reported data			
Aggregated Facility Category	**Equipment ≥ 50 lbs, < 200 lbs (small)**	**Equipment ≥ 200 lbs, < 2,000 lbs (medium)**	**Equipment ≥ 2,000 lbs (large)**
fruit and vegetable processing	unitary AC or refrigerant condensing unit	cold storage	N/A
hotels/motels	unitary AC or refrigerant condensing unit	chiller	centrifugal chiller
ice manufacturing	unitary AC or refrigerant condensing unit	N/A	N/A
libraries	unitary AC	chiller	N/A
manufacturing (non-food)	unitary AC or refrigerant condensing unit	chiller or cold storage	chiller, cold storage or process cooling
meat processing	unitary AC or refrigerant condensing unit	cold storage	cold storage
medical care	unitary AC or refrigerant condensing unit	chiller	centrifugal chiller
misc warehousing/storage	unitary AC or refrigerant condensing unit	chiller	centrifugal chiller
museums	unitary AC	chiller	N/A
office buildings	unitary AC	chiller	centrifugal chiller
petroleum	unitary AC or refrigerant condensing unit	chiller	centrifugal chiller
pharmacies	unitary AC or refrigerant condensing unit	chiller	N/A
publishing	unitary AC	chiller	centrifugal chiller
refrigerated warehousing/storage	unitary AC or refrigerant condensing unit	cold storage	cold storage
religious organizations	unitary AC	chiller	N/A
research and development	unitary AC or refrigerant condensing unit	chiller	N/A
retail (food)	unitary AC or refrigerant condensing unit	refrig: centralized system	refrig: centralized system
retail (non-food)	unitary AC	chiller	centrifugal chiller
semiconductor	unitary AC	chiller	process cooling
service industry	unitary AC	chiller	centrifugal chiller
telecommunications	unitary AC	chiller	N/A
television/movie production	unitary AC	chiller	centrifugal chiller

Table 10. Equipment type designations assigned for unclear reported data			
Aggregated Facility Category	**Equipment ≥ 50 lbs, < 200 lbs (small)**	**Equipment ≥ 200 lbs, < 2,000 lbs (medium)**	**Equipment ≥ 2,000 lbs (large)**
utilities	unitary AC or refrigerant condensing unit	chiller	centrifugal chiller
wholesale - (non-food)	unitary AC	chiller	centrifugal chiller

Appendix C

Economic Impact Estimates – High-Global Warming Potential Stationary Source Refrigerant Management Program

Research Division

Release Date

October 23, 2009

Table of Contents

List of Tables

1. Summary

The proposed Refrigeration Management Program regulation impacts facilities that utilize stationary refrigeration equipment with greater than or equal to 50 pounds of high global warming potential (GWP) refrigerant. Facilities are categorized into three size categories based on the amount of refrigerant required by individual systems used by a facility; greater than or equal to 50 lbs, but less than 200 lbs (small systems); greater than or equal to 200 lbs, but less than 2,000 lbs (medium systems); and 2,000 lbs and greater (large systems). The small systems are typified by small condensing unit refrigeration systems. The medium systems are mainly centralized refrigeration systems and cold storage systems. The large systems are mainly cold storage systems, process cooling systems, and some centralized refrigeration systems. Facilities are categorized by the largest system at the facility; i.e. a facility with both large and medium systems is categorized as a large facility. The resulting characterization of current refrigerant use patterns by facility types and statewide facility number estimates were used to estimate statewide carbon dioxide equivalent (CO_2E) emissions. For a full description of the affected facilities, see Appendix B (California Facilities and Greenhouse Gas Emissions Inventory).

This appendix presents estimates of the costs and cost savings of the proposed high-GWP stationary source refrigerant management program regulation. The economic benefits presented are limited to the cost savings from avoided refrigerant losses. Some energy savings are expected from more optimized operation due to maintaining the proper refrigerant charge and routine maintenance; however these benefits are not quantified. Energy savings would also likely reduce criteria pollutants in addition to emissions of CO_2 from power generation. The economic benefits from mitigated climate impacts from reduced use of high-GWP refrigerants are also not incorporated into these estimates. In these analyses all costs are estimated in constant 2008 dollars.

Costs of refrigerants are expected to rise as hydrochlorofluorocarbon (HCFC) and chlorofluorocarbon (CFC) refrigerants (also referred to as ozone depleting substances [ODS]) are phased out, and if production and import of hydrofluorocarbons (HFC) are restricted under future legislation. However, the rate of price increases from present to 2020 is unknown. The change in the uses of these refrigerants could only be broadly estimated based on linear interpolation of estimates from the United States Environmental Protection Agency (U.S. EPA) Vintaging Model for 2010 and 2020. As a result, this analysis provides an estimate of refrigerant prices that is likely less than what will occur because of the use of an average of current prices of the refrigerants available in 2008.

An important benefit of the proposed rule is that the mandated repairs, which result in the emissions benefits, often result in cost savings that exceed the compliance costs. However, the costs and benefits for any specific company of industry may vary widely from the overall average. The gross cost to regulated entities for 2020 is estimated to be $49 million per year. These estimated costs are more than offset by annual refrigerant savings estimated at $68 million based on current refrigerant prices for a net annual savings of $19 million. The average cost-effectiveness of the proposal is estimated to be a savings of $2 per metric ton CO_2 equivalent ($MTCO_2E$) in the year 2020 after the proposed regulation is fully implemented and for consistency with AB32 target dates. This estimate may understate the actual net savings since it does not account for rising refrigerant prices, energy savings due to optimized system operation, or benefits from mitigated climate impacts.

These costs and savings are based on averages; some businesses will experience higher costs associated with complying with the rule and some will experience lower costs.

2. Introduction

The proposed Refrigerant Management Program consists of two primary components: 1) facility reporting and refrigeration system maintenance and leak repair; and 2) reporting requirements and prohibitions for proper refrigerant sale, use, and disposal. Economic costs and benefits analyses were conducted separately for the individual components. This economic analysis estimates the total costs of the regulation to the regulated community and the fiscal impacts to the enforcement agencies. The economic benefits presented are limited to the cost savings from avoided refrigerant losses.

Costs to regulated facilities and businesses are estimated for the period of 2011 to 2020. The analyses are organized by facilities with large, medium, and small refrigeration systems and provide estimates of the costs and benefits by the size of the system and the type of refrigerant used: HFC-only, ODS-only, and both HFC and ODS.

The cost and economic benefit analyses rely on input from the Air Resources Board (ARB) emissions inventory and anticipated emission reductions outlined in Appendix B, cost and other data from technical literature, input from equipment manufacturers and other stakeholders, and industry surveys. All uncertainties outlined in Appendix B impact the uncertainty of the total cost estimates and economic benefits in this analysis. To evaluate and understand the impacts and uncertainties, additional data were collected and reviewed from as many sources as possible including stakeholders, manufacturers, and air agencies (U.S. EPA, California air pollution control districts, etc.)

For all labor estimates an hourly labor rate of $75 is used. This is a fully loaded (including overhead, benefits, etc.) average labor rate representing input from ICF International, stakeholders, the air quality control districts, and the ARB.

Businesses impacted by this regulation include facilities with refrigeration systems containing 50 lbs or more of high-GWP refrigerants. These include: supermarkets, meat packers, warehouses used for cold storage, food preparation and processing, hotels, medical facilities, institutions (universities, laboratories, etc.), process cooling facilities, etc. Additional details about these industries and the refrigeration systems they use are in Appendix B. The proposed regulation also impacts other service and sales businesses including: refrigeration and air-conditioning (R/AC) contractors, and technicians; and refrigerant reclaimers, distributors, and wholesalers.

No net change is expected in California's business competitiveness. It is possible some R/AC servicing businesses may be created or existing businesses expanded as a result of the possible increase in demand for U.S. EPA certified technicians and for manufacturing and installation of leak detection monitoring systems.

Estimated leak repair costs represent the difference between immediate repairs and repairs at the time the loss of refrigerant exceeds 35% of the charge (representing the current practices) at the refrigerant loss rate indicated by staff research for the refrigeration system type and size. This is similar to expanding on the U.S. EPA regulations promulgated under Section 608 of the Clean Air Act (Rule 608) whereby repairs of ODS-containing refrigeration systems are mandated when they have leaked 35% of the full refrigerant charge in the preceding year (12 month rolling average). The interest cost (or lost opportunity cost) at 5% per year of the gross repair cost (parts, labor, and refrigerant recharge) is attributed to the rule.

The post-rule implementation scenario leak repair costs reflect a portion of the total cost of leak repairs since the proposed rule does not create a need for leak repair but only requires that leak repairs be completed within 14 days of detection. Under the current practices scenario 100% of all leak repair costs are incurred at some point to maintain refrigeration system operations and preserve refrigerated product. These costs may be incurred immediately after detection of a leak based on best practices or, as often happens in the current practices, after months or years of deferred maintenance, often with top-offs of refrigerant rather than timely repairs. Based on repairs completed under the typical current practices time line, the total costs are incurred and the current emissions and current average leak rates result.

The annual discount rate of 5% used in this analysis is representative of the cost of money when high-risk technologies and activities are not involved and is consistent with cost assumption of the AB 32 Scoping Plan. The Scoping Plan's analysis of costs and savings used a uniform real discount rate of 5% to estimate the cost of money for all proposed measures and provided the first step towards annualizing the upfront or capital expenditures.

ARB staff conducted a sensitivity analysis to determine how sensitive the average cost-effectiveness is to the real discount rate used (Table 1). Real discount rates of 3% to 20% were used for the sensitivity analysis. Although considerably higher than reasonably expected, a real discount rate of 20% represents an extreme case used for the sole purpose of the sensitivity analysis. The resulting change in the cost-effectiveness of the proposed rule at the extreme case of 20% real discount rate was to increase to an average cost of \$2 per $MTCO_2E$ in reduced emissions from an average savings of \$2 per $MTCO_2E$ calculated with the 5% real discount rate. The cost effectiveness of the proposed Regulation at a savings or a cost of $2 per $MTCO_2E$ in reduced emissions is within the range of cost effectiveness for GHG-related items approved by the Board in 2009, which have ranged from over $100 in savings to a cost of $21 per $MTCO_2E$.

Table 1: Sensitivity of cost-effectiveness to real discount rate used (rounded to nearest whole dollar)

	3% Discount Rate	**5% Discount Rate**	**10% Discount Rate**	**20% Discount Rate**
Large facilities	-$5	-$5	-$4	-$3
Medium facilities	-$1	$0*	$2	$6
Small facilities	-$1	$0*	$3	$9
Average of all facilities	-$3	-$2	-$1	$2

* approximate break even – less than $1 cost or savings

The local air districts will be impacted by the need for additional inspection and enforcement resources. The costs to the ARB will include enforcement and inspection costs not assumed by the districts and costs to initiate and maintain a web-based reporting system and database as well as processing and maintaining the annual industry reports. These costs are expected to be recovered through the implementation fees imposed on the impacted facilities.

Positions required for administration of the Refrigerant Management Program may be ARB positions or positions throughout Air Districts that would be funded with ARB funds available through receipt of implementation fees.

3. Economic Cost and Cost Savings Estimates (Facility Reporting and Leak Repair Component)

This section presents the underlying data and calculations that were used to estimate the overall costs of the proposed regulation. It includes a discussion of the emissions input data as well as the costs of each key element of the program including the implementation fee, reporting and recordkeeping costs, automatic leak detection system annual audits, refrigeration system leak inspections, automatic leak detection system capital and operating costs, and leak repair costs.

Costs and savings due to the regulation are calculated using the emissions inventory data and projected emission reduction estimates provided in Appendix B and additional economic input variables discussed below. The resulting estimates are tiered by system size to reflect different workload demands (e.g. monitoring, inspection, etc.). Under the proposed rule the annual implementation fee and reporting requirements are phased in depending on the system size. The refrigerant leak detection and monitoring provisions become effective for all system sizes on January 1, 2011. The leak repair and recordkeeping provisions commence upon the effective date of the regulation for all applicable systems.

The cost related input factors used in the economic model, discussed below and listed in Table 2, are based on literature review, a survey of refrigeration and air-conditioning service contractors, certified technicians, and discussions with stakeholders.

Table 2: Economic estimates input cost factors

	Facilities with small systems	Facilities with medium systems	Facilities with large systems
Annual implementation fee (per facility)	0	$170	$370
Annual reporting and recordkeeping costs (per facility)	$115	$422	$488
Automatic leak detection annual audit, quarterly inspection, or annual inspection costs (per system)	$75 per system	$300 per system	$150 per system
Automatic leak detection capital costs (per system)	N/A	N/A	$917/year per system annualized over 12 years ($8,130 capital and installation cost financed at 5% real discount rate)
Automatic leak detection operational costs (per system)	N/A	N/A	$720
Cost of earlier leak repairs (base cost per leaking system) *	$62	$79	$328
Post-repair refrigerant recharge (per leaking system)	6 lbs ($67)	69 lbs ($758)	447 lbs ($4,910)

*Leak repairs costs provided as 5% real discount rate per year.

The refrigerant cost estimate ($11 per pound) is based on discussions with stakeholders and is derived from the average of a suite of refrigerants currently in common use. The cost of the individual refrigerants currently varies from $4.50 to $23.00 per pound. All costs and savings are stated in constant 2008 dollars.

The growth of the number of facilities and systems was estimated at 1% per year.

The cost calculation model used estimates the fiscal impact of the proposed regulation on facilities with average configurations (as outlined in Appendix B): small facilities with approximately 5 systems in the small refrigerant charge size category, medium facilities with approximately 5 systems in the medium refrigerant charge size category, and large facilities with approximately 2 systems in the large refrigerant charge size category. In practice facilities with more than one refrigeration system typically have a mixture of system sizes, i.e. many "large" facilities that have large sized systems will also often have medium and small size systems (and likewise, medium facilities will often have smaller systems). It is recognized that facilities with the average configuration modeled do not necessarily commonly exist in practice. The approach taken here provides a means of calculating the average impacts of the costs of the rule. The costs associated with several case studies of real-world, specific facility configurations were also calculated and are presented later in this document.

Recurring annual costs – Facilities will incur annual costs for implementation fees, reporting and recordkeeping, and leak inspections or annual leak detection monitoring system audits.

Equation 1: statewide recurring annual costs

$$C_a = N_f \times (F_a + R + L_c \times N_s)$$

C_a = statewide recurring annual costs
N_f = number of affected facilities
F_a = annual implementation fees per facility
R = reporting expenses per facility
L_c = annual and quarterly leak inspection or annual leak detection monitoring system audits and recordkeeping
N_s = number of systems per facility

The implementation fees and reporting costs are single costs per facility based on the largest system at the facility. The leak inspection or leak detection system audits and the costs of keeping their associated records are calculated as a cost per system at the facility (i.e. if a facility has 3 refrigeration systems it will incur a single annual implementation fee that covers the entire facility, based on the largest system at the facility, a single reporting cost also covers the entire facility, and 3 times the system leak inspection or leak detection system audit and recordkeeping costs listed in Table 2 [once for each system]).

Under the proposed rule the annual implementation fee and reporting requirements are phased in depending on the system size: facilities with large refrigeration systems submit their first report (covering calendar year 2011) and payment of the implementation fee in early 2012 (due by March 1, 2012) with subsequent reports and payments annually thereafter. Facilities with medium size refrigeration systems (but no large sized systems) would begin reporting for the year 2013 with the report and implementation fee payment due by March 1, 2014 with subsequent reports and payments annually thereafter. Facilities with only small refrigeration systems (i.e., they do not have medium or large systems) will not be subject to either the reporting or annual implementation fee requirements of the rule although they will be required to register beginning in 2016.

Beginning 2011, all facilities with refrigeration systems covered by this regulation will be required to conduct leak inspections of their refrigeration systems and to maintain records of their repairs and refrigerant transactions and have those records available for enforcement inspectors.

- Initial and Annual implementation fees – Each facility with a large or medium refrigeration system will pay an initial and annual implementation fee to the ARB which will be used by the enforcing agency (either the ARB or its authorized agent, a representative of a local air pollution control district) to recoup their implementation, inspection, and enforcement costs (staff training expenses, reporting system development, and inspection and recordkeeping time, etc.). The initial implementation fee would be collected at the time the facility registration is submitted and an annual implementation fee would be collected at the time the facility annual reports are submitted. Facilities with small refrigeration systems only (i.e., they do not have medium or large systems) will not be subject to the initial or annual implementation fee requirements of the rule, although they will be required to register by 2016 and maintain records of system inspections, refrigerant leaks, and repairs. The amounts of the initial and annual implementation fees are the same and were estimated to approximately balance the costs of administration and inspections (Table 3).

Table 3: Estimated average annual cost to inspect approximately 25% of large and medium facilities each year (2016) and small facilities on as-needed basis

System Inspection Costs	**Number or Cost**
Approximate number of Facilities	10,700
Inspections per year	2,900
Average hours per inspection	6.5
Average hours per inspection for program administration	1.2
*Estimated total cost per inspection	$760
Total cost of inspections	$2.2 Million
Average annual implementation costs per facility	$208
Total annual revenue from large and medium facilities	$2.2 Million
****Annual Personnel Years (PYs) Needed**	
Administrative PYs (ARB)	2
Inspection and Enforcement PYs (ARB and District)	11***
Total PYs cost (@$175,000 per position)	$2.2 million

*Cost per personnel hour (salary, benefits, office, supplies, travel) = $98
**Work hours per Personnel Year (PY) = 1780 hours
***For discussion purposes 10.7 PYs has been rounded to 11 (total of 13 PYs)

The proposed fee amounts ($170 for facilities with medium systems, $370 for facilities with large systems, $208 overall weighted average for all facilities with medium or large systems) are calculated based on estimates provided by California Air Pollution Control Officers Association (CAPCOA)[1] and the ARB Enforcement Division concerning the staff time and materials needed to conduct inspections.

CAPCOA's initial input on fee structure was received early in the rule development process. A primary difference in fee analyses conducted by the ARB and CAPCOA was CAPCOA's initial fee structure analysis included the estimated hours expected to be spent on the review of annual records and reports for each facility, physical onsite facility inspections, and the travel time. However, the estimate did not include additional hours needed to evaluate and cross reference onsite records with data included in the annual reports. The extensive review and cross references will be necessary to confirm compliance or indentify and verify any violations. The average annual implementation costs provided by CAPCOA are very close to the ARB estimates. Staff developed the final estimates of times and costs to conduct and report inspections after subsequent discussions with CAPCOA and

[1] Memo from CAPCOA to Anthony Andreoni, November 4, 2008

ARB's Enforcement Division. The average number of hours needed per facility inspection as shown in Table 3 include pre-inspection time for facility records review; on-site equipment inspection; review of equipment service records and leak repair records; review of refrigerant purchase, use, and shipping records; travel planning; cross referencing related records with the annual report submitted by the facility, and report writing.

The facility fees will be used to support implementation of the program which focuses on facility inspections. The total annual costs of the program ($2.2 million) as estimated in Table 3 are the product of the number of facilities inspected annually, the hours per inspection, and the hourly rate of the inspector. It is anticipated, that, on average, approximately 25% of the large and medium facilities will be inspected each year based on the relative risk of emissions and potential amount of emissions. This percentage is an expected average and does not imply the actual annual number of inspections.

Facilities with large and medium systems are the focus of inspections because they represent the vast majority of emissions (approximately 90% of annual emissions in terms of $MTCO_2E$ are estimated to occur from large and medium refrigeration systems). On average, facilities with only small refrigeration systems have the lowest emission potential on a per system and per facility basis. As such, facilities with small systems will only be inspected on an as-needed basis (<2% per year) based on specific concerns such as in response to complaints or other information which suggests a potential violation. It was assumed that compliance could be maintained with periodic enforcement inspections prioritized on the facilities' potential or demonstrated leak risk, i.e. those facilities with a larger charge size (greater potential emissions in the case of a leak), equipment type that is more prone to leaks, and with a higher leak rate demonstrated by their annual report. Facilities whose annual report indicates frequent leaks and substantial emissions may have a higher priority and be inspected more frequently.

ARB will need two administrative positions for program administration, reporting, and payment system development and maintenance, training for air district staff and facility owners and operators, and outreach to impacted facilities. These positions will also help to prioritize which facilities are inspected each year. In addition, 11 positions will be needed to conduct enforcement inspections. Since most of the districts have indicated they will either enforce the regulation under an agreement with the ARB or adopt a complementary rule, the enforcement positions are anticipated to be secured by districts and supported through implementation fees provided by ARB under the terms of their agreement with the ARB. All 13 proposed positions will be funded by revenue from the implementation fees. The cost per PY used in the calculations ($175,000) is based on the average ARB fully loaded cost per position (typical positions used for inspections in Enforcement division of ARB are Air Pollution Specialists and/or Air Resources Engineers).

- Reporting and recordkeeping costs – Although reporting and recordkeeping costs are not listed together in Equation 1, they are discussed together in this section since they are closely related.

  The proposed regulation will require each facility to maintain records of their leak inspections, repairs, refrigerant use and purchases, etc. The facilities with large and medium size systems will be required to report their leak inspections, service and maintenance, refrigerant leak repairs, and refrigerant consumption by device or system. Additionally, these facilities will be required to report an annual summary of refrigerant purchased, charged into systems, and recovered from systems. Facilities with only small systems will not be required to submit annual reports; however, they will be required to retain the records and have them available for ARB or local air district inspectors. The calculated costs assume that the ARB will initiate and maintain a web-based reporting system and database. The reporting and recordkeeping costs reflect time costs for the facility to maintain records and submit the annual report.

  Many facilities, especially those with large systems already have a process in place for tracking repairs, refrigerant use, and leak rates. The ARB is developing a system whereby the reports will be efficiently transferred to a centralized database for access by ARB and, where appropriate, the air districts. For large facilities it is estimated, based on discussions with stakeholders, to take 15 minutes per system leak to record leaks, 15 minutes per month per monitored system to maintain records of the automatic leak detection system, and 10 minutes once per year to electronically submit the report. For medium facilities it is estimated to take 15 minutes per system leak to record leaks, 15 minutes 4 times per year to maintain records of the leak inspections, and 10 minutes once per year to submit the report. For small facilities it is estimated to take 15 minutes per system leak to maintain repair records and 15 minutes once per year for each system to maintain the leak inspection records. The $75 labor rate was used in these calculations.

Table 4: Estimated reporting and recordkeeping costs per large facility

Large Systems	Minutes	Occurrences per Year	Systems / Units	Percent Leaking Systems	Hours
Recordkeeping - Recording Leaks	15	(variable by probability of leak)	2	67.5%	0.3
Recordkeeping - Automatic Leak Detection System Performance Records	15	12	2		6.0
Reporting	10	1			0.2
Total Hours					6.5
Total Costs (@ $75 / hour)					$488

The total reporting and recordkeeping costs per facility are listed in Table 2. Using large systems as an example, Table 4 illustrates how these costs are calculated.

- Facility leak inspections and leak detection system audits – Facilities with large refrigeration systems will be required to use an automated system to detect leaks (usually a continuous monitor, but other automatic leak detection systems or procedures will be allowed). Facilities with medium size systems will be required to conduct leak inspections quarterly. Facilities with small systems only will be required to conduct inspections annually. The automatic leak detection annual monitoring costs included in these analyses reflect the costs for an annual audit of the automatic leak detection monitoring system. It is estimated that an audit of a large system leak detection system will take two hours per system to complete.

  In reviewing the cost of leak inspections, the ARB staff compiled estimates based on two very different perspectives to inform cost estimates. One perspective was provided by ICF International and characterized the cost of inspection by in-house vs. external inspectors. The ICF International cost estimate was based on two to six hours of inspection time required per facility (on average, 2 to 5 systems inspected either annually or quarterly) and ranged from $93 to $561 per inspection. The low ICF International estimate represents a two-hour in-house inspection and the higher estimate represents a six-hour inspection by contracted inspectors and includes profits and fees by the contracting company.

  The other estimate was provided by CAPCOA and represented the cost of an enforcement inspection by the ARB or the air district (the local air quality management district or air pollution control district) inspectors. ARB and CAPCOA estimates were based on three to six hours per facility (on average, 2 to 5 systems inspected either annually or quarterly) and ranged from $195 to $682 per inspection.

  The costs used in these analyses were $75 to $300 per system per year reflecting one to four hours at a $75 per hour labor rate. The primary source of the uncertainty in this estimate is the assumption that salaries for inspection staff represent an in-house, hourly salary or the salary of a contracted certified technician. It was assumed that a leak inspection by facility personnel, a contracted inspection service, or enforcement agency personnel would take the same amount of time.

  An inspection of a medium system is estimated to take one hour per system each quarter, and an inspection of a small system is estimated to take one hour per system once per year. The $75/hour labor rate was used in these calculations. Medium and small facilities may substitute automatic leak detection for the quarterly or annual inspections.

Table 5 outlines how the total automatic leak detection annual audit and leak inspection costs are calculated. The total estimated costs are outlined in Table 2.

Table 5: Automatic leak detection system audit and leak inspection costs per system

Leak Inspection	Hours	Times per Year	Total Hours per System	Total Cost per System
Automatic Leak Detection Audit	2	1	2.0	$150
Medium Sized Leak Inspections	1	4	4.0	$300
Small Sized Leak Inspections	1	1	1.0	$75

<u>Automatic leak detection capital and operational costs</u> – Facilities with large refrigeration systems will be required to have a mechanism for automatic leak detection and monitoring of each large system. This will primarily be a continuous monitoring system measuring the presence of refrigerant in the air surrounding the components of the refrigeration system, but other continuous leak detection mechanisms and procedures will be allowed. In addition, facilities with medium or small systems may substitute automatic leak detection for the quarterly or annual system inspections. If a facility with medium or small systems is required to have a monitoring system to comply with health and safety rules this option may be beneficial. It may also be beneficial for facilities with large systems requiring automatic leak detection systems along with medium and/or small systems to include those systems in the automatic leak detection system.

The automatic leak detection system requirements of the proposed regulation can be met by installing a direct system that detects the presence of refrigerant in ambient air or an indirect system that indicates a refrigerant leak by interpreting parametric measurements of the refrigeration system. This analysis focuses on direct systems as the basis of the likely costs for an automatic leak detection system. In some cases the indirect (parametric monitoring) may be more feasible depending on the refrigeration system design (systems with outdoor components, etc).

Estimated costs related to automatic leak detection are based on a system that will meet all requirements of the rule and were confirmed through discussions with manufacturers. The ARB also contracted with ICF International for input into the analysis of the costs of automatic leak detection systems required by the proposed rule based on their experience in refrigerant management and participation in the development of the U.S. EPA Vintaging Model. The primary sources of uncertainty in the estimated costs of automatic leak detection are the type of equipment purchased and the installation of the monitoring system. To be conservative, this analysis assumes that each large refrigeration system would require a separate monitoring system. There is likely some unknown scalability factor in which multiple refrigeration systems can be monitored by a single monitoring system, this will depend on the capabilities of the monitoring system purchased and how it is installed.

The installation cost data reflects a best estimate of the capital cost to purchase an automatic leak detection system based on market studies conducted for this analysis[2]. The estimated capital costs of $8,130 for an eight sensor system are annualized over a twelve-year projected life of the monitoring system at a 5% real discount rate ($917/year). This cost represents an estimated average cost which takes into account: 1) the cost of a new monitoring system on each refrigeration system (estimated at between $10,000 to $11,000); 2) the cost of a somewhat larger system that is capable of monitoring more than one refrigeration system at the facility (estimated at $12,000 to $15,000 for up to 16 sensors; i.e. $6,000 to $7,500 per system to monitor two systems); and 3) the cost of enhancing an existing system installed to monitor the machine room for health and safety purposes (adding capacity and sensors to a monitoring system designed to alert the operator of concentrations of refrigerant potentially dangerous to worker health and safety [one or more sensors usually in the lowest area of the machine room where refrigerant gases would collect if present] to a monitoring systems with sensors placed to promptly detect leaks [estimated at $3,000 to upgrade control panel and new/additional sensors]).

Although one automatic leak detection system per refrigeration system was modeled, each facility will likely have a somewhat different configuration. In some applications a single monitoring system may be sufficient to monitor for leaks on several refrigeration systems, depending on refrigeration system and monitoring system configurations, sensor design and placement, and the design of the systems. Facilities may also choose to configure the monitoring systems to monitor zones of the facility; for example: one system may monitor all equipment in the equipment room while another monitoring system may monitor for leaks in the evaporators, etc.[3]

The typical monitoring system requires annual maintenance. The maintenance costs include the replacement of filters and/or calibration of the sensors, depending on the design of the system. These costs are typically approximately $90 per monitoring point per year ($720/year for the average 8 point monitoring system).[4]

Equation 2: annual automatic leak detection and monitoring costs

$$C_m = N_f \times (N_s \times (M + I))$$

C_m = automatic leak detection and monitoring costs
N_f = number of affected facilities
N_s = number of systems per facility requiring automatic leak detection systems
M = annual cost of maintaining the system
I = capital cost to install a system (annualized)

[2] ICF International memo to ARB, October 21, 2008
[3] Lewis, Kimberly, Guidelines for Refrigerant Leak Monitor Installation, RSES Journal, April 2002.
[4] ICF International memo to ARB October 21, 2008 and discussions with equipment manufacturers

Leak repair costs – Refrigeration system leaks may be categorized as smaller, operating leaks or catastrophic leaks. While the catastrophic leak may result in the sudden loss of much or all of the refrigerant charge, the operating leaks account for most of the leaks that occur and the majority of the refrigerant emissions.[5] Regular leak inspections or automatic leak detection systems are useful in finding operating leaks promptly, facilitating prompt repair and minimizing the amount of refrigerant lost. Under this rule both the operating leaks and catastrophic leaks would be repaired as quickly as possible (within 14 days) upon discovery.

All facilities and systems will be subject to the leak repair requirements of the regulation beginning with the effective date of the regulation. The repair costs are calculated as the base cost of making the repair and the refrigerant to recharge the system to replace the refrigerant lost in the leak. Since the leaking systems eventually need to be repaired to continue to operate without regard to this rule, the repair costs (both base costs and cost of the refrigerant to recharge the system after the repairs) attributable to the rule are based on the time cost of funds at 5% per year real discount rate and the length of time that the leak would be expected to continue under the current practices until the amount of refrigerant leaked would equal 35% as opposed to repair of the leak upon the first indication that the leak has occurred.

Leak repair costs are based on research conducted on behalf of the ARB by ICF International and discussions with stakeholders. The ARB conducted a survey of refrigeration and air-conditioning service contractors and technicians to validate prior research and discussions.

Annual leak repair costs presented in Table 2 are divided into three ranges based on refrigeration system size. It is assumed that repairs on a small system will be relatively simple while medium and large systems will require progressively more extensive repairs when a leak occurs. Leak repair costs include two components: the base cost of making the repair (parts, labor, and recovery of remaining refrigerant in the system) and the refrigerant needed to recharge the system to its nominal operating charge. Table 6 shows that the base annual repair costs (labor, parts, and refrigerant recovery) are $900, $1,550, and $2,450 for repair scenarios projected for the small, medium, and large systems. The base costs include 8, 12, and 16 hours of labor at $75/hour; $100, $300, and $600 in parts; and $200, $350, and $650 for refrigerant recovery for small, medium, and large systems, respectively. [6, 7]

The refrigerant needed to recharge the system following a repair is calculated from the modeled average target leak amount per system of that size and type and a refrigerant cost of $11 per pound. The target leak amount represents a realistic and achievable reduction in leaks projected as a result of the leak detection and

[5] Troy, Eugene, F., Options for Reducing Refrigerant Emissions from Supermarket Systems, Final Report, EPA-600/R-97-039, April 1997
[6] ICF International memo to ARB November 10, 2008
[7] ARB technician survey results

monitoring and best management practices provisions of this rule. Refrigerant savings are the difference between the current leakage and the target leak amount (Table 7). The recharge for large systems is, on average, about 447 pounds per system per year (see Appendix B for more details); down from 1090 pounds based on the current leak rate; a savings of 642 pounds ($7,060).

In the model for this rule the repairs would currently be initiated when the projected refrigerant loss reaches 35%. The time factor of the cost calculation is calculated as the number of years until the refrigerant leak reaches 35%. The interest cost (or lost opportunity cost) at 5% per year of the gross repair cost (parts, labor, and refrigerant recharge) is attributed to the rule. For example: a typical medium system containing 689 pounds of refrigerant which leaks an average of 17% of the charge per year under the current practices would lose 119 pounds per year. After approximately two years (2.1 years) the refrigerant loss would equal 35% of the charge; therefore a repair currently would be made at that time. Under the proposed regulation requirements the repair is made as quickly as possible upon the first indication of a leak (repairs are made within 14 days after discovery) rather than at a later date. This quicker repair time-frame to help reduce the cost of purchasing new replacement refrigerant lost due to leaks. Current repair practices typically top-off refrigerant systems without checking and repairing leaks – which may cost hundreds to thousands of dollars in refrigerant purchased each year to businesses (see refrigerant savings in Table 7). The cost attributable to the regulation would be the cost of borrowing (or lost opportunity cost) for 2.1 years at 5% per year; or approximately 10% of the gross cost of the repair. The cost of repairs attributable to the rule when the refrigerant loss equals or exceeds 35% in less than one year are calculated at 5% of the gross repair cost.

Table 8 illustrates the effective cost of funds of incurring the cost of the repairs immediately and is the portion of the repair costs that are attributed to the rule. Table 7 shows average values, specific values of the cost of funds were used in the calculations whenever possible.

Table 6: Base annual repair costs (figures rounded to the nearest whole value)

	Labor hours / cost (@ $75 per hour)	**Parts**	**Cost to recover the remaining refrigerant prior to repair**	**Total labor, parts, and recovery**
Small systems	8 hrs / $600	$100	$200	$900
Medium systems	12 hrs / $900	$300	$350	$1,550
Large systems	16 hrs / $1,200	$600	$650	$2,450

Table 7: Annual leak repair refrigerant costs and savings

	Current average annual refrigerant leak (lbs)	Target average annual refrigerant leak *	Annual refrigerant savings (lbs)	Annual refrigerant cost savings (@ $11 / lb)
Small systems	18	6	12	$127
Medium systems	119	69	50	$548
Large systems	1090	447	642	$7,060

* Expected amount needed to recharge following repair (lbs)

Table 8: Calculation of effective cost of funds for the average facility leak rate

	Annual average leak rate	Average charge (lbs)	Time frame	Effective cost of early repair
Small systems	14%	122	2.4 years	12%
Medium systems	17%	689	2.0 years	10%
Large systems	23%	4663	1.5 years	8%

Equation 3: annual leak repair costs

$C_r = (N_s \times L_s \times C_{rt}) \times (35\% / L_r) \times 5\%$

C_r = leak repair cost
N_s = number of systems
L_s = percent of systems leaking
C_{rt} = repair cost (parts, labor, and refrigerant to recharge system)
L_r = average annual leak rate

Statewide gross annual cost – The gross cost is the sum of all costs incurred in a given year.

Equation 4: statewide gross annual costs

$C_g = C_a + C_m + C_r$

C_g = statewide gross annual costs
C_a = statewide recurring annual costs
C_m = annual automatic leak detection and monitoring costs
C_r = annual leak repair cost

Refrigerant savings – Because the anticipated result of the proposed rule is the transition from the current average leak rate to the post rule implementation average leak rate, the costs and emissions that reflect each scenario are used to estimate cost effectiveness. The refrigerant savings arise as a result of earlier leak repairs following a transition to the post-rule implementation average leak rates. The change in leak rates results in estimated emission reductions due to the difference between the current emissions and the post rule implementation emissions.

Equation 5: refrigerant savings

$R_s = (L_{CUR} - L_{r1}) \times P_r$

R_s = annual refrigerant savings

L_{CUR} = annual refrigerant loss under the current practices

L_{r1} = reduced refrigerant needed per year

P_r = refrigerant price

Statewide net annual cost – The net annual cost is the gross annual cost minus the savings due to reduced refrigerant use because the leaks are repaired earlier as compared to the business as usual scenario.

Equation 6: statewide net annual costs

$C_n = C_g - R_s$

C_n = statewide net annual costs

C_g = statewide gross annual costs

R_s = annual refrigerant savings

Although some energy savings are expected from more optimized operation due to maintaining the proper charge and routine maintenance; these benefits are not quantified at this time and not included in Equation 6. The economic benefits associated with mitigated climate impacts are also not included.

Cost-effectiveness (C/E) – The cost-effectiveness is the ratio of the net costs to the emission reductions expected due to the enhanced leak detection and repair requirements of the rule, in dollars per metric ton of CO_2E (\$ / $MTCO_2E$).

Equation 7: cost-effectiveness (C/E)

$C_e = C_n / L_{r2}$

C_e = cost-effectiveness (\$ / $MTCO_2E$)

C_n = statewide net annual costs

L_{r2} = reduced leak per year in metric tons of CO_2E

In 2020 when the rule is in full effect the statewide net annual costs are expected to result in a savings of approximately \$19 million (\$20 million savings for large facilities, \$0.3 million cost for medium facilities, and \$0.2 million cost for small facilities) with reduced emissions of 8 MMTCO2E (4, 3, 1 MMTCO2E for large, medium, and small facilities, respectively) and a cost-effectiveness of approximately \$5/$MTCO_2E$ savings for large, approximately break even for medium and small facilities (\$0.08/MTCO2E cost for medium and \$0.26/$MTCO_2E$ cost for small) with an overall average of \$2/$MTCO_2E$ savings.

Total cost summary – The total costs of the rule are calculated for calendar years 2011 through 2020 (estimated costs in the year 2020 are summarized in Table 9). New facilities and systems are assumed to exist for the entire year they enter service and costs are calculated for a given whole year.

Table 9: Statewide average annual cost of Stationary Refrigeration System Registration and Leak Repair for all facilities in the year 2020

	Annual cost (HFC plus ODS systems) ($ millions)	Annual cost (HFC systems only) ($ millions)
Recurring Annual Costs		
Implementation	$2.4	$2.0
Reporting and recordkeeping	$7.0	$6.4
Leak inspection	$21.0	$19.7
Automatic leak detection and monitoring		
Capital and installation cost	$4.1	$3.2
Annual maintenance	$3.2	$2.5
Leak Repair* (labor, parts, and refrigerant recharge)	$11.3	$10.2
Gross cost	$49.0	$44.0
Refrigerant savings	$68.1	$56.8
Net cost	$19.1 savings	$12.8 savings
Emissions reductions	8 $MMTCO_2E$	7 $MMTCO_2E$
Cost-effectiveness (annual average)	$2/$MTCO_2E$ savings	$2/$MTCO_2E$ savings

*Leak repairs provided as 5% real discount rate cost of funds per year (see text for details)

The costs and cost-effectiveness for any given facility will be dependent on the size, design, number of refrigeration systems at the facility, and the quality of maintenance and repair. A facility that quickly locates and repairs leaks will reduce the amount of refrigerant leaked when a leak occurs and save more refrigerant and therefore, receive more of the cost benefits than a facility that is not as vigilant. It will also be more cost effective for a facility to construct their refrigeration system and make repairs using high quality parts so that leak occurrences are minimized.

Table 10 presents the costs to 'average' facilities. Implicit in Table 10 is the assumption that evacuation equipment, already required by federal rules for ODS system repairs, is already available and could be employed for recovery of all refrigerants. As a result, the proposed rule is not anticipated to result in additional costs for evacuation equipment. For all labor estimates an hourly labor rate of $75 is used. The average facility with small systems has approximately 5 systems, the average facility with medium systems has approximately 5 systems, and the average facility with large systems has approximately 2 systems (number of systems rounded for clarity, actual average number used in calculations). Repair costs included in the analyses represent 5% of the total cost of making the repair (parts, labor, and refrigerant recovery plus the refrigerant needed to recharge the system based on the modeled leak amount) per year to reflect the real discount rate cost of funds to do the repairs immediately upon the first indication of a leak rather than at a later date. Costs also include the percent of systems that leak in a given year as described in Appendix B (on average, approximately 68% of large systems, 37% of medium systems, and 22% of small systems will leak and require repairs each year). The impact on the average facility with small, medium, or large refrigeration systems is projected to be a net cost of $14, $30, and a savings of $8,720 respectively with an overall average impact of the program of a net savings of $667 per facility.

Table 10: Example average costs to average facilities (figures rounded to the nearest whole number)

	Facilities with small systems	Facilities with medium systems	Facilities with large systems
Annual implementation fee	$0	$170	$370
Annual reporting and recordkeeping costs	$115	$422	$488
Automatic leak detection annual audit, quarterly inspection, or annual inspection costs	$375	$1,500	$300
Automatic leak detection capital costs	N/A	N/A	$1,830/year ($16,260 annualized over 12 years)*
Automatic leak detection operational costs	N/A	N/A	$1,440
Leak repair costs	$161	$677	$984
Total gross cost	$651	$2,770	$5,410
Refrigerant savings	$637	$2,740	$14,130
Total net annual costs	$14	$30	$8,720 savings

*Multiple monitoring systems since the average large facility has multiple large systems

4. Example Case Studies

The analysis of potential emission reductions and costs is based on the average costs and leak rates for an entire population of refrigeration systems and the resulting annual emissions, in contrast to the emissions that would result from a single refrigerant leak incident. As an example, a refrigeration system with a refrigerant charge of 2,000 pounds that has a 10% annual refrigerant leak rate would leak 200 pounds of refrigerant over a one-year period if it were not repaired. If detected promptly and repaired within 14 days of detection the actual emissions from this specific leak would be reduced to less than eight pounds – less than ½ of one percent of the full charge. In this example refrigerant savings would amount to over $2,000.

Several scenarios have been calculated to illustrate how individual facilities may be impacted by the proposed regulation. Although the rule is expected to go into effect in 2011, there will be a phase-in period. The case studies are based on the year 2020 because it allows for comparison with the statewide emission reduction targets specified in AB 32 and because all aspects of the rule will be in effect at all facilities subject to the regulation. These scenarios are described in the bullets that follow and then summarized in Table 11. Since it is assumed that the leaking systems will have to eventually be repaired to continue to operate without regard to this rule, the repair costs in the model are based on the real discount rate cost of funds (estimated at an annual rate of 5% per year of the cost of the repair) to do the repairs immediately upon the first indication of a leak rather than at a later date when the leak gets to the point of affecting the operation of the system. Other key assumptions including the assumed leak rate as well as the leak rate following repair are discussed in Appendix B.

These case studies are based on actual facility configurations encountered during development of the rule and average leak rates, etc. from the emission inventory for the types and sizes of equipment at these facilities. The case studies were also calculated with the actual reported refrigerant leaks. The results for the actual data are consistent with the average results; however, they are highly variable from year to year based on the facility's annual performance. The average results are presented to be more widely representative of facility types and configurations. If a facility has no leaks in a given year the total gross costs and net annual costs would be reduced since the repair costs and refrigerant savings would be zero ($0). The reporting and recordkeeping costs would also be slightly reduced. The annual implementation fees and monitoring system costs are fixed costs whether a leak occurs or not.

Table 11: Case study example costs for the average the facility of specific types listed (2020)

	Annual reporting and recordkeeping costs and system inspections / audits costs	Annual implementation fees	Annual monitoring system capital and operating costs	Expected annual repair Costs attributed to early repair *	Total gross annual costs	Annual refrigerant savings due to early repair of leaks	Net annual costs	Cost-effectiveness ($/ $MTCO_2E$)
Supermarket with 1 large system (3,000 lbs total charge)	$400	$370	$1,640	$420	$2830	($3,780)	($948)	($2)
Supermarket with 4 medium systems (4,400 lbs total charge)	$1,540	$170	$0	$800	$2,520	($2,610)	($97)	($0)
Dairy distributor with 2 medium systems (2,000 lbs total charge)	$780	$170	$0	$380	$1,320	($1,190)	$140	$1
Pharmacy with 1 small refrigeration system (72 lbs total charge)	$100	$0	$0	$30	$130	($75)	$50	$8

* 5% per year real discount rate cost of total funds for making repairs immediately after identifying a leak rather than at a later date

- A supermarket with a single large system with a total refrigerant charge of 3,000 pounds that combines all refrigeration and air-conditioning loads of the store. (Although air-conditioning systems are not included in the proposed rule, systems that combine both refrigeration and air-conditioning functions would be included in the rule.)
- A supermarket with four medium systems totaling 4,400 pounds of refrigerant to handle all combined refrigeration and air-conditioning loads of the store.
- A dairy distributor with two medium systems (800 pounds and 1,200 pounds).
- A pharmacy with one small refrigeration system (72 pounds).

5. Economic Cost and Cost Savings Estimates (Refrigerant Sale, Use, and Disposal)

The cost and economic impacts specific to the reporting of the Refrigerant Use, Sale, and Disposal component (Table 12) are based on requirements and prohibitions specific to California refrigeration and motor vehicle air conditioning (MVAC) and stationary heating, ventilation and air-conditioning (HVAC) service providers and refrigerant reclaimers, distributors, and wholesalers.

The cost resulting from the refrigerant use, sale, and disposal component of the Refrigerant Management Program proposed rule are primarily borne by U.S. EPA certified technicians, refrigerant reclaimers, and refrigerant distributors or wholesalers.

Table 12: Statewide annual cost of Refrigerant Use, Sale, and Disposal for all HVAC distributors, wholesalers, and reclaimers for the year 2020

	Annual cost (HFC plus ODS systems) ($ millions)	Annual cost (HFC systems only) ($ millions)
Refrigerant Distributor or Wholesaler Prohibitions, Reporting and Recordkeeping Costs	$0.094	$0.070
Refrigerant Reclaimer Reporting and Recordkeeping Costs	$0.095	$0.071
Total Cost (Refrigerant Sale, Use, and Disposal)	$0.189	$0.141

California Service Contractors & Certified Technicians - As leak repairs are required to be completed by U.S. EPA certified technicians the certification cost to a technician related to a repair will be borne by a facility or the certified technician. Other than cost already identified for affected facilities, the primary requirements are related to evacuation of R/AC systems and recovery of refrigerant from empty cylinders, these costs are assumed to be borne by facilities for payments for refrigerant leak repair services. Equipment evacuation is already required by federal regulation for U.S. EPA certified technicians that provide refrigeration and air-conditioning service using ODS. As the alternative to cylinder evacuation is intentional venting of refrigerant and intentional venting is prohibited by federal law, the proposed rule does not create any additional costs for cylinder evacuation. Evacuation equipment, already required by federal rules for ODS system repairs, is already available and could be employed for recovery of all refrigerants. The proposed rule is not anticipated to result in additional costs for evacuation equipment.

California Refrigerant Distributors and Wholesalers - Based on federal regulations, Title 40 of the Code of Federal Regulation, Part 82, §82.166, refrigerant wholesalers who sell ODS refrigerants must retain invoices that indicate the name of the purchaser, the date of sale, and the quantity of refrigerant purchased. Although reporting is required under the proposed regulation, while it is not required by federal regulations, the reporting for distributors and wholesalers is a simple annual inventory report of the total refrigerant shipped to certified technicians and to reclaimers. The annual report would consist primarily of a summary of recordkeeping required in significant part by federal regulations. Based on similar reporting requirements, using the U.S. EPA reclaimer reporting estimate of five hours annually and approximately 250 distributors in California additional reporting costs for the proposed annual report requirement are anticipated to be minimal at approximately $94,000 per year, approximately $375 per distributor/wholesaler per year.

<u>California Refrigerant Reclaimers</u> - Pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.154 refrigerant sales for ODS are limited to 1) sales to certified technicians, or their employer, 2) sales for the purpose of resale to certified technicians or appliance manufacturers, or 3) sales of refrigerant in an appliance. The proposed rule maintains the same requirements and extends the requirement to all high-GWP gases. The U.S. EPA estimated the annual burden of these requirements to total 8,882 hours. Many of the records required for the federal regulations would be required for all high-GWP gases as the refrigerant sales would be to the same certified technicians and appliance manufacturers. But, to be conservative if the ARB assumes the same burden and reduces the amount to reflect only California (~12%), the estimated burden would be 1,066 hours or approximately $80,000 annually at $75 per hour for all refrigerant sales.

Based on federal regulations refrigerant reclaimers reclaiming ODS must maintain records of the names and addresses of persons sending them material for reclamation and the quantity of material sent to them for reclamation. This information must be maintained on a transactional basis. Pursuant to Title 40 of the Code of Federal Regulation, Part 82, §82.166, within 30 days of the end of the calendar year, reclaimers must report to the U.S. EPA the total quantity of material sent to them that year for reclamation, the mass of refrigerant reclaimed that year, and the mass of waste products generated that year. Reporting requirements in the proposed regulation in substantial part are already required by federal regulations for ODS. In the determination of costs for reclaimer reporting, the U.S. EPA estimated that reporting required a total of five hours annually. At five hours and approximately 40 reclaimers in California additional reporting costs as a result of this rule are anticipated to be minimal at approximately $15,000 per year, approximately $375 for reclaimer per year.

6. Conclusion

In summary (Table 13), the refrigerant management rule will significantly reduce the emissions of high-GWP GHG in California, is technologically feasible, and will achieve emissions reductions at an average cost-effectiveness of a savings of about $2/MTCO_2E$ and an average savings of approximately $700 per facility per year.

Table 13: Statewide annual cost of the entire proposed rule for the year 2020

	Annual cost (HFC plus ODS systems) ($ millions)	Annual cost (HFC systems only) ($ millions)
Net Costs: General Requirements for Stationary Refrigeration System Registration and Leak Repair (Table 9)	$19.1 savings	$12.8 savings
Net Costs: General Requirements for Refrigerant Use, Sale, and Disposal (Table 12)	$0.2	$0.1
Entire Rule Net Cost	$18.9 savings	$12.7 savings
Proposed Rule Emissions Reductions	8 $MMTCO_2E$	7 $MMTCO_2E$
Proposed Rule Cost-effectiveness (overall average)	$2/$MTCO_2E$ savings	$2/$MTCO_2E$ savings

Appendix D

Summary of the Public Process for Development and Implementation of the High-Global Warming Potential Stationary Source Refrigerant Management Program (RMP)

Research Division

Release Date

October 23, 2009

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

This page intentionally left blank.

1. Background

The proposed Refrigerant Management Program (RMP) is an AB 32 early action measure designed to reduce the emissions of high global warming potential (GWP) greenhouse gases in California by requiring some best practices in the management of refrigerants by system owners/operators, repair technicians, wholesale distributors, and reclaimers. High-GWP refrigerants, including chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), and hydrofluorocarbons (HFC), typically have thousands of times greater global warming potency than carbon dioxide (CO_2). High-GWP refrigerants are used in a broad array of sectors in California that use refrigeration and air conditioning systems. California Air Resources Board (ARB) staff estimate that approximately 26,000 businesses in California are applicable to the proposed RMP and use commercial refrigeration systems with more than 50 pounds high global warming potential (GWP) refrigerant. Because high-GWP refrigerants are used by many different business types ARB staff conducted extensive outreach efforts during the rule development process.

Throughout the rule development process ARB staff relied upon a diverse set of methods to distribute information about the proposed rule and solicit comments and feedback from potentially impacted industries. Pre-rule adoption outreach efforts included: technical work group meetings, statewide public workshop series, individual meetings with stakeholders, phone calls to trade associations, direct phone calls to individual businesses, e-mail list serves, and development of outreach materials. As an example of the extensive outreach efforts made during the rule development process ARB staff contacted 67 trade associations and 800 individual businesses. ARB staff has developed a comprehensive post-rule adoption outreach plan that utilizes the strength of the previous outreach efforts conducted and builds upon them to communicate with an even more extensive group of stakeholders.

2. Introduction

The RMP is a regulation proposed by the California ARB to reduce the emissions of high-GWP refrigerants used in stationary non-residential refrigeration systems. ARB staff estimate that greenhouse gas emissions in California could be reduced by approximately 8 million metric tons carbon dioxide equivalent annually through the facility registration, reporting, leak inspection, and maintenance requirements included in the RMP (see Appendix B for details). Appendix B provides a description of the methods used to estimate statewide emissions of high-GWP refrigerants from stationary non-residential refrigeration and air-conditioning systems.

As a part of the regulatory development process ARB staff established an inventory of the types and numbers of businesses in California that use stationary non-residential refrigeration systems with more than 50 pounds of a high-GWP refrigerant. In developing this inventory staff estimated that approximately 26,000 facilities in California use applicable non-residential refrigeration systems in many different industries including supermarkets, convenience stores, food processing and wholesale, refrigerated warehouses, pharmacies, hospitals, petroleum, utilities and some manufacturing (Appendix B). Approximately 64% of these are small businesses with fewer than 100 employees. Because of the large number of facilities potentially impacted by the RMP, extensive outreach efforts were conducted to educate business owners and solicit comments on the proposed regulation during the rule development process.

ARB staff goals in conducting outreach during the rule development process were: 1) inform affected industries about the RMP, 2) solicit feedback from affected industries to develop an effective rule and better understand their concerns, and 3) use industry input to develop an effective outreach plan. To reach the widest possible audience several methods of outreach were used focusing on working in collaboration with six groups of stakeholders. The outreach efforts implemented during the development of the RMP were individually tailored to facilitate effective communication and dissemination of information to each group of contacts. The six targeted stakeholder groups are:

- Technical workgroup composed of equipment and refrigerant manufacturers, environmental groups, government agencies, repair technicians, refrigerant distributors, and business owner/operators with broad knowledge of the commercial refrigeration industry in California.
- Trade associations representing businesses using large non-residential refrigeration and air-conditioning systems with high-GWP refrigerants.
- Individual businesses likely to use non-residential refrigeration systems with high-GWP refrigerants.
- Small businesses groups, chambers of commerce, and local government agencies throughout California.
- Subscribers to ARB climate change and high-GWP sector e-mail list serves.
- Government Agencies including United States Environmental Protection Agency (U.S. EPA), California Air Pollution Control Officers Association (CAPCOA), South Coast Air Quality Management District (SCAQMD), air quality management districts and air pollution control districts (Air Districts), and the California Energy Commission.

Table 1 includes a comprehensive list of all outreach efforts conducted during the development of the Refrigerant Management Program.

Table 1. Refrigerant Management Program Outreach Activities

Outreach Activities	Month - Year
Board Approves Early Action First Report (provided the concept for developing the RMP regulation)	April-07
Board Approves Early Action Final Report (provided the concept for developing the RMP regulation)	October-07
Refrigerant Management Program website and e-mail serves established	January-08
High-GWP Sector Statewide Public Workshop	February-08
Site Visit - UC Davis Lighting & Cooling Technology Center	March-08
Commercial Refrigeration Technical Work Group Meeting	April-08
Refrigerant Tracking/Reporting/Repair Work Group Meeting	May-08
Draft Scoping Plan Released (provided general description of the RMP)	June-08
First Draft Refrigerant Management Program Rule Released	July-08
Meeting with Hussman and Ingersoll Rand	July-08
Refrigerant Tracking/Reporting/Repair Work Group Meeting	July-08
Updated California Air Pollution Control Officers Association (CAPCOA) Climate Protection Committee	July-08 & Monthly After
Conducted Facility Surveys	July & August-08
Site Visit - Refrigeration Supplies Distributor	August-08
Site Visit - Office Building Property Management Maintenance Tour	August-08
Met with California Grocers Association (CGA) and California Retailers Association (CRA)	August-08
Site Visit - Supermarket Systems Tours	August-08
Met with Representatives of Agricultural Sector Trade Associations	September-08
Met with Hudson, Inc.	September-08
Second Draft Refrigerant Management Program Rule Released	September-08
Refrigerant Management Program Public Workshop – Fresno	September-08
Meeting with Heating, Air Conditioning, Refrigerant Distributors International	September-08
Refrigerant Management Program Public Workshop - El Monte	September-08
Refrigerant Management Program Public Workshop - Sacramento	September-08
Final Scoping Plan Released	October-08
Met with Verisae	November-08
Conducted Refrigeration and Air-conditioning Contractor and Technician Surveys	November & December-08
Met with Institute of Heating and Air Conditioning Industries, Inc. (IHACI)	November-08

Table 1. Refrigerant Management Program Outreach Activities	
Outreach Activities	**Month - Year**
Met with Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)	December-08
Refrigerant Management Program Work Group Meeting	January-09
Establish additional trade association contacts and update all previous contacts	January-09
Third Draft Refrigerant Management Program Rule Released	January-09
Refrigerant Management Program Public Workshop - Diamond Bar	February-09
Refrigerant Management Program Public Workshop - Modesto	February-09
Meeting with Heating, Air Conditioning, Refrigerant Distributors International (HARDI)	February-09
Refrigerant Management Program Public Workshop - Sacramento	February-09
Meeting with Western States Petroleum Association (WSPA)	February-09
Meeting with City of Los Angeles HVAC Technicians	February-09
Meeting with AB 32 Implementation Group	February-09
Field visit/inspection w/ U.S. EPA - Oakland Airport	February-09
Field visit/inspection w/ U.S. EPA - Richmond Wholesale Meats cold storage warehouse	February-09
Survey all local Air Districts regarding anticipated participation in the RMP after board adoption	February-09
Site Visit - Grand opening of Raley's in Petaluma	April-09
Site Visit - Tour of UC Davis chillers and refrigeration systems	April-09
Refrigerant Management Program Technical Workgroup Meeting	July-09
Update Trade Associations and Distribute Refrigerant Best Management Practices Brochure & Frequently Asked Questions (FAQ) Document	July -09
Released Refrigerant Management Best Practices Brochure & FAQ Document to Small Business Associations	July-09
Released Refrigerant Management Best Practices Brochure & FAQ Document to Small Business Development Centers	July-09
Teleconference meeting with Small Business Association with the help of the Governor's Office of the Small Business Advocate	July-09
Conducted direct business outreach pilot to contact all possible businesses in City of Industry and City of Merced to inform them of proposed rule and provide information.	July-August-09
Refrigerant Best Management Practices Brochure & FAQ Documents Distributed to Air Districts and Posted on Web Pages	August-09
Fourth Draft Refrigerant Management Program Rule Released	August-09
Public workshop in Sacramento (webcast)	August-09
Site Visit - Saticoy Lemon facility in Ventura, CA	August-09
Meeting with Western States Petroleum Association (WSPA)	August-09

3. Summary of Rule Development Outreach Process

In summary, ARB staff held 9 site visits to individual businesses, 13 meetings with individual stakeholders, 5 technical workgroup meetings, and 3 series of public workshops throughout the state of California. In addition to these meetings and workshops ARB staff conducted extensive outreach efforts via e-mail and phone to approximately 67 trade organizations, 800 individual businesses, 20 state and local government agencies, and 3 ARB e-mail list serves.

4. Components of Rule Development Outreach Plan

Throughout the process of developing the RMP ARB staff have used many different approaches in conducting outreach to industries likely to use large non-residential refrigeration and air-conditioning systems. Staff has used e-mail, direct phone calls, outreach documents, private meetings, public workshops, and technical working groups to distribute information throughout the rule development process and solicit feedback from stakeholders.

4.A Technical workgroup

Beginning in April 2008, a technical workgroup comprised of individual business, non-governmental organizations (NGO), and government representatives with expertise relevant to the stationary non-residential refrigeration and air-conditioning sector in California was assembled. Technical workgroup members included equipment and refrigerant manufacturers, environmental groups, government agencies, technicians, distributors, and individual business owners. The purpose of the technical working group was to provide a forum for ARB staff and experts in the non-residential refrigeration or air-conditioning field to discuss draft versions of the regulation. Comments received in technical work group meetings served to improve the quality of the regulation and its utility for affected businesses. Additionally, the technical workgroup meetings enabled industry groups potentially affected by the RMP to express their comments and concerns in a more detailed and targeted manner than a workshop may afford.

4.B Trade association outreach

Beginning in July 2008, trade associations with member businesses likely to use large non-residential refrigeration or air-conditioning systems with high-GWP refrigerant were contacted by phone. Trade association contacts were given updates by phone on the progress of the proposed rule in January and July 2009. In total 67 trade associations were contacted by phone throughout the process of developing the RMP (Attachment 1, provides a list of all trade associations contacted). To assist trade associations with distributing accurate and effective information to their member businesses they were provided with outreach documents in follow up e-mails after each update. Outreach documents distributed to trade associations included a press release document, a refrigerant Best Management Practices (BMP) brochure (Attachment 2), and Frequently Asked Questions (FAQ) document (Attachment 3).

4.C Direct business outreach

In addition to the substantial "top down" outreach to trade associations, manufacturers, and distributors ARB staff contacted many individual businesses throughout California directly. ARB staff contacted individual businesses in two ways: 1) e-mail updates of all public workshops were sent to a list of approximately 800 individual businesses in the South Coast Air Quality Management District (SCAQMD) and 2) phone calls to individual businesses in two California cities.

i. E-mail contacts

E-mail addresses for approximately 800 individual businesses in California which use large non-residential refrigeration or air-conditioning systems with high-GWP refrigerant were obtained from reports submitted to the SCAQMD as a part of compliance with their Rule 1415. Regular updates on all public workshops and regulatory documents were sent, via e-mail, to all individual businesses reporting to the SCAQMD with a valid e-mail address. Because the proposed RMP represents an extension of the SCAQMD Rule 1415 these e-mails were specifically targeted to a relevant and active audience of individual business owners and operators.

ii. Phone contacts

ARB staff implemented a novel direct outreach campaign to inform individual businesses during the process of developing the proposed RMP. Two representative cities in California were selected based on their size and the distribution of business in industries relevant to the proposed RMP. The City of Industry and Merced were selected because they are located in geographically distinct regions of the state and contain a representative sample of businesses in the industries most likely to use non-residential refrigeration systems subject to the requirement of the proposed rule.

The primary goals of this outreach project were to 1) demonstrate a form of direct outreach that could be used in combination with other programs after the RMP is adopted, 2) communicate with businesses that would not otherwise be made aware of the RMP during the rule development process, 3) solicit comments from small businesses on the proposed RMP, and 4) identify a few businesses already implementing the best management practices outlined in the RMP who are willing to come forward and be recognized for these positive efforts.

The direct outreach project resulted in 187 total phone calls. The responses of individual businesses to the phone calls varied substantially. Thirty calls successfully identified a business using applicable refrigeration systems and provided them with outreach materials. Another 56 calls identified businesses with refrigeration systems that were not applicable to the rule (or used no applicable refrigeration systems). Seventy-five calls resulted in at least two voice mail messages with no reply. A smaller subset of contacts (26 total) were not viable or ended the call abruptly.

In general, this direct outreach effort was successful in contacting businesses that would otherwise not have heard of the RMP through traditional avenues. Some important lessons learned during the development of this project included: 1) encouraging staff to modify the "phone script" to better match their own conversational style, 2) the need for at least one or two bilingual staff in any future direct outreach efforts (Spanish and Mandarin speakers would be most valuable), and 3) a focused outreach effort in a small geographic area many not be as beneficial in cases where the proposed rule is anticipated to affect only a small proportion of businesses in a given industry statewide. Most of the businesses contacted were not affiliated with a trade association and therefore represented contacts that would otherwise not have been made aware of the proposed RMP using traditional outreach methods. This result provided an important demonstration of the success of this project and highlights the necessity of using direct outreach as a complement to top down outreach through trade associations. Attachment 4 provides more details on the direct outreach efforts to these two representative cities.

4.D Small Business and local government organizations

ARB staff estimate that approximately 64% of the businesses in California that use large non-residential refrigeration systems are small businesses (fewer than 100 employees). As a result, staff made extensive efforts to outreach to the small business communities in California to distribute information regarding the proposed RMP and solicit comments during the rule development process. In addition to contacting many individual businesses directly (see previous section) staff communicated with several small business associations in California, including the California Small Business Association, Small Business California, and the Merced and City of Industry chambers of commerce, as well as small business advocates such as the Governor's Office of the Small Business Advocate. Small business groups were contacted by phone and sent follow up e-mails with the refrigerant BMP brochure (Attachment 2), the FAQ document (Attachment 3), links to the RMP webpage, contact information, and the August 2009 public workshop notice.

In collaboration with the Office of the Small Business Advocate a notice and invitation to a conference call to discuss the proposed RMP was sent to a network of up to 120,000 small businesses statewide. The invitation was sent from the Office of the Small Business Advocate to an e-mail distribution of approximately 700 small businesses and associations, which sent out the invitation to their e-mail network including 120,000 small business contacts. During the conference call individual businesses were provided a summary of the proposed RMP and encouraged to ask questions and voice concerns about the proposed rule.

ARB staff conducted a survey of city and county governments in collaboration with the California State Association of Counties and the Institute for Local Government to estimate the number of cities and counties using refrigeration or air-conditioning systems with more than 50 pounds of a high-GWP refrigerant. In addition to the survey, updates on the proposed RMP were distributed to all California counties and cities in February 2009 and August 2009. The refrigerant BMP brochure (Attachment 2) and FAQ document (Attachment 3) were distributed to cities and counties and posted on the League of California Cities website in August 2009.

4.E Local Air Districts

Throughout the rule development process ARB staff conducted regular outreach efforts to local Air Districts and solicited comments on the draft regulation and implementation plans. ARB staff provided monthly updates to the California Air Pollution Control Officers Association (CAPCOA) Climate Protection Committee on the status of the RMP throughout the rule development process.

In addition to regular updates to CAPCOA, ARB staff also conducted outreach to individual local Air Districts in California. ARB staff has worked closely with staff at the SCAQMD to obtain insights from the implementation of Rule 1415, obtain facility level data from all reports submitted as a part of Rule 1415, and received comments and suggestions on the proposed rule. ARB staff surveyed all local air districts to asses the feasibility of collaboration on the implementation and enforcement of the RMP and distributed outreach materials to the local air districts (Attachments 2 and 3).

4.F E-mail list serves

ARB staff distributed updates to the proposed RMP and public workshop announcements to a broad audience via three e-mail list serves. All updates were distributed to the Climate Change ("cc", 6,561 contacts), Commercial Refrigeration Specifications ("commref", 915 contacts), and High-GWP Refrigerant Tracking, Reporting and Recovery ("ref track", 853 contacts) e-mail list serves. Combined, these list serves represent approximately 6,700 unique contacts interested in tracking the progress of climate change and refrigerant related regulations in California.

4.G Outreach materials

To complement the substantial phone and e-mail outreach efforts made to trade associations, local government, and individual businesses ARB staff developed several outreach documents providing information about the proposed rule and refrigerant best management practices. During the process of rule development a succinct press release was developed and distributed to individual businesses and trade organizations for broader distribution to their members. Subsequently, a refrigerant BMP brochure (Attachment 2) and Frequently Asked Questions (FAQ) document (Attachment 3) were developed for distribution to local Air Districts, trade associations, and individual businesses.

5. Components of Post Rule Adoption Plan

ARB staff will develop an outreach plan to ensure that facilities subject to the requirements of the RMP are aware of the regulation and have access to information that streamlines their ability to comply (examples include an online refrigerant leak inspection video and online guide to use self-reporting database). Given the number of facilities subject to the proposed regulation, the effort will be a significant focus for several years followed by ongoing maintenance by staff. Throughout the extensive outreach efforts conducted during the development of the RMP ARB staff were able to test and refine several novel outreach projects. As a result of the wide array of outreach methods used staff developed an understanding of how to conduct the most effective outreach to communicate with the diverse set of industries affected by the RMP after rule adoption. Staff will continue to refine and improve upon these aspects of the rule development outreach project, in addition to adding new outreach and training projects after the RMP is adopted.

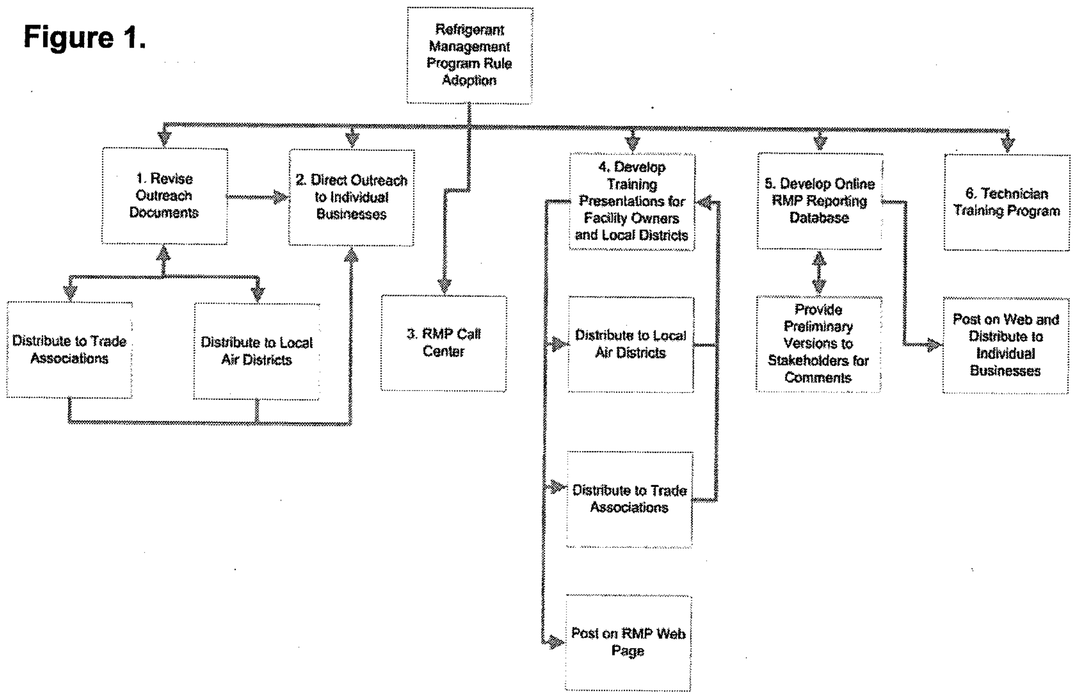
The focus of the outreach plan will be based on the final rule approved, but the goal will be to share clear and concise information on the applicability of the rule and how to comply, as well as how to most effectively reduce refrigerant emissions. The primary outreach topics anticipated include:

- How to determine the refrigeration system full charge
- How to comply with rule provisions applicable to your facility
- How to effectively conduct leak inspections
- How to benefit from use of refrigerant best management practices for all high-GWP appliances

A summary of key elements that are expected to be drawn on for the outreach during the implementation phase of the RMP follow.

Figure 1 depicts the planned outreach efforts to be conducted after the Refrigerant Management Program is adopted.

Figure 1.



5.A Facility Outreach Plan

i. Direct outreach to businesses

During the process of developing the RMP ARB staff conducted a novel direct outreach project which included calling all facilities in two sample cities likely to use large non-residential refrigeration systems. Because this direct outreach was successful in refining available data on the type of industries applicable to the RMP and in contacting businesses not affiliated with any trade associations ARB will obtain statewide address and contact information for businesses based on the Standard Industrial Code (SIC) or North American Industry Classification System (NAICS) code for business categories likely to be impacted by the RMP.

The contact information purchased will be used in two ways, 1) to conduct a limited set of direct calls to businesses likely to use large non-residential refrigerant systems and 2) to distribute direct mailings of outreach documents to all businesses on a statewide contact list. Staff will continue to make some calls to individual businesses likely to be affected by the RMP. Because it is not feasible to call all businesses in the affected industries statewide the remaining contacts will be made via direct mail from ARB or by including outreach documents in utility bills as a part of a collaborative effort with local utilities. In addition information will be distributed via HVAC technicians and contractors who visit these facilities to service the refrigeration and air-conditioning systems.

ii. Trade associations

During the rule development process ARB staff has established contacts with 67 state and national trade associations with member businesses likely to use large non-residential refrigeration systems. In general trade association contacts were engaged and willing to distribute information regarding the RMP to their member businesses. Staff will to continue to work with these contacts to distribute information about the RMP after it is adopted in two ways: 1) provide them with updated outreach documents for electronic distribution and 2) press releases to be included in monthly publications. Staff will also work with trade associations to give presentations, training sessions, or booths at trade conferences to provide training and assistance to member businesses.

iii. Reporting database

An online database will be developed by ARB staff to facilitate reporting and recordkeeping for businesses using non-residential refrigeration systems with more than 50 pounds of a high-GWP refrigerant. The online database will facilitate outreach to individual businesses by providing a place where they can easily and quickly submit required reports and learn about the requirements of the RMP that apply to their business based on the size of the refrigeration systems they use. The automated annual reporting will allow facilities to keep track of their refrigeration systems and refrigerant usage. This will enable them to make decisions to replace less efficient and leaky systems which will save money and the environment. Additionally, the database will enable rapid data collection and analysis by ARB and facilitate all training and enforcement efforts made by ARB and local Air Districts.

iv. RMP call center

Once the RMP comes into effect approximately one year after adoption ARB staff will establish a call center for facilities with questions about the requirements of the RMP and reporting using the online database. The call center hotline number and a general e-mail address (ex. RMP@arb.ca.gov) will be included on all outreach documents and provide a simple way for businesses to get basic information about the rule from trained staff. The call center will enable ARB to communicate directly with the large number and diversity of facilities expected to be impacted by the RMP, and effectively educate businesses about the regulation and requirements for compliance. Additionally, ARB staff participating in the call center will facilitate processing and entering any hard copy reports submitted by facilities outside the online reporting database provided.

v. Post-implementation outreach documents

Following board adoption of the RMP ARB staff will begin to assemble additional documents to be used in the subsequent outreach process. Staff will revise the refrigerant BMP brochure, develop a RMP fact sheet, and write a brief press release document in collaboration with the ARB Public Information Office (PIO). These documents will provide information about the rule in a simple format suitable for the general public and contact information for ARB staff, similar to the brochure and FAQ documents (Attachments 2 and 3) produced during the rule development process. Additionally, these revised outreach documents will be translated into other languages including Spanish to reach a broader audience. The revised outreach documents will be distributed to all previously established individual business and trade association contacts, local Air Districts, technicians, local chambers of commerce, and technician training centers.

5.B Facility Compliance Training and Assistance

i. Local Air Districts

After receiving the Board approval of the proposed RMP ARB staff will continue to work with representatives from local Air Districts and CAPCOA during the process of revising outreach documents and formulating the post rule adoption plan. Staff will work closely with representatives from local Air Districts when developing facility training presentations to ensure that the material reaches the broadest possible audience of facility owners using non-residential refrigeration systems, and is communicated in a simple and clear format. Because local Air Districts generally have enforcement personnel familiar with some of the facility types impacted by the proposed rule (e.g., supermarkets) their feedback during the process of planning the post rule adoption outreach plan will be helpful.

ii. Training presentations

In collaboration with staff in the enforcement division presentations which provide a clear and concise description of the requirements of the RMP and the types of systems and facilities that are applicable will be developed. ARB staff will collaborate with established contacts from trade associations, refrigeration system manufacturers, small business advocacy groups, and local chambers of commerce to give presentations at organized meetings and conferences. Additionally, staff could present information that streamlines the ability of businesses to comply with the rule including, for example an instructional video describing how to conduct a refrigerant leak inspection for facility owner/operators.

iii. Best Practices Certified Technician Outreach

Training for technicians has been identified as a key component for the effective implementation of the program. The quality of the work by these personnel will be the ultimate determinant of the quantity of emissions reduced by this program. Training needs have been discussed in detail with trade associations representing heating and air-conditioning equipment distributors and refrigeration and air-conditioning service contractors as well as several technician training institutions.

The general concept of a potential Best Practices Certified Technician Outreach plan specific to the Refrigerant Management Program would be based on developing a mechanism to ensure certified technicians are trained to understand best practices to reduce refrigerant emissions as outlined in ANSI/ASHRAE Guide 147 (Reducing Release of Halogenated Refrigerants from Refrigeration and Air-Conditioning Equipment and Systems), or similar standards or guidelines.

ARB staff will work with industry associations and training institutions to develop a full inventory of training opportunities and provide information during presentations to support the training opportunities currently available. ARB will also consider working with these organizations to develop specific training modules on methods to reduce emissions of refrigerants and comply with the Refrigerant Management Program. This training can be used to help reduce GHG emissions and potentially provide an advantage to those companies that have all employees completed the training.

The Best Practices Certified Technician Outreach Plan would be developed for implementation in harmony with any future plans to work towards regulatory and/or voluntary programs specific to requirements for a Best Practices Certified Technician Program as outlined in the Plans for the Future section of the staff report.

6. Summary

ARB staff conducted a comprehensive and extensive outreach campaign to a vast majority of industries likely to use and service non-residential refrigeration and air-conditioning systems during the process of developing the Refrigerant Management Program. The outreach efforts used by ARB staff involved 1) direct communication in workgroup and individual meetings, 2) top-down information distribution through an extensive network of trade association contacts and advocacy groups, and 3) direct phone call and e-mail outreach to many individual businesses throughout the state. In all cases ARB staff solicited comments on the proposed rule and technical appendices and sought to actively involve stakeholders in the process of rule development.

Immediately following rule adoption ARB staff will implement a comprehensive outreach plan similar to that used in the process of developing the RMP. Staff will use both direct contacts with businesses and top down outreach through trade associations, trade publications, chambers of commerce, and local Air Districts to distribute information and outreach documents. Additionally, ARB staff will develop training materials and presentations to educate affected business owners and technicians. Ongoing discussions with stakeholders throughout the rule development phase have played a significant role in the formation of the proposed RMP. ARB staff will continue to work closely with affected businesses and trade associations to, whenever necessary, adapt based on their input to ensure effective implementation.

Attachments

This Attachments section contains the following supporting documents:

1) List of trade association contacts
2) Refrigerant Best Management Practices brochure
3) Frequently Asked Questions outreach document
4) Direct Outreach Project Summary

Attachment 1. Trade associations contacted during development of the Refrigerant Management Program.

Industry type	Trade Association
Cold storage/ Food processing	Fresh Produce Association of America
	CA Grape and Tree Fruit League
	CA League of Food Processors
	Western Growers Association (WGA)
	Ventura County Agriculture Association
	California Beer and Beverage
	International Association of Refrigerated Warehouses
	International Dairy Foods Association
	California Cheese and Butter Association
	Western United Dairymen
	California Association of Meat Processors
	US Poultry and Egg Association
	Refrigerated Foods Association
	International Foodservice Distributors Association
	National Frozen and Refrigerated Foods Association
	CA Citrus
	Nisei Farmers League
	California Strawberry Commission
	World Food Logistics Organization
	Dairy Institute
Medical	Cemetery and Mortuary Association of California
	California Children's Hospital Association
	Alliance of Catholic Health Care
	California Association of Health Facilities (long term care)
	California Hospital Association
State and local government	California State Association of Counties
	League of California Cities
	Institute for Local Government
	California Department of General Services
	California Department of Corrections
	California Department of Education

Attachment 1. Trade associations contacted during development of the Refrigerant Management Program.	
Industry type	**Trade Association**
State and local government	Administrative Office of the Courts
	Office of Statewide Health Planning and Development (OSHPD)
Manufacturing	The Association of Electrical and Medical Imaging Equipment Manufacturers
	California Manufacturers and Technology Association
	National Association of Manufacturers
	Pharmaceutical Research and Manufacturers of America
Petroleum	Intermodal Association of North America
	California Independent Oil Marketers Association
	California Independent Petroleum Association
	Western States Petroleum Association
Retail groups	Grocery Manufacturers of America
	CA Independent Grocers
	California Grocers Association
	Dairy-Deli-Bakery Council of Southern California
	National community pharmacists association
	National association of chain drug stores
	National Association of Convenience Stores
	Retail Industry Leaders Association
Property Management/ Lodging	Apartment Association of California Southern Cities
	National Association of Industrial and Office Properties (NAIOP)
	California Business Properties Association
	California Hotel and Lodging Association
	California Lodging Industry Association
Education	Coalition for Adequate School Housing (CASH)
	Collaborative for High Performing Schools
	University of California - Office of the President
	California State Universities
Small business	California Small Business Association
	Small Business California
	Governor's Office of Small Business Advocate
Miscellaneous	National Association of Theater Owners
	Motion Picture Association of America
	Telecommunications Industry Association
	International Association of Amusement Parks and Attractions
	Los Angeles World Airports (LAWA)
	American Association of Airport Executives

What Types of Facilities Should Consider Implementing Refrigerant Best Management Practices?

Facilities with refrigeration and air-conditioning systems using Chlorofluorocarbon (CFC), Hydrofluorocarbon (HFC), or Hydrochlorofluorocarbon (HCFC) refrigerant including:

- Supermarkets
- Convenience stores
- Food processing and wholesale
- Refrigerated warehouses
- Pharmacies
- Hospitals
- Manufacturing
- Office buildings
- Institutions

Additional Information Sources for Commercial Refrigeration and Air-Conditioning Systems

U.S. EPA Regulations:
www.epa.gov/ozone/title6/608/index.html

South Coast Air Quality Management District Rule 1415:
www.arb.ca.gov/drdb/sc/cur.htm

Proposed Regulations

California Air Resources Board's Refrigerant Management Program:

The Refrigerant Management Program is a regulatory proposal to require specific refrigerant best management practices to reduce emissions of refrigerant from non-residential refrigeration systems.

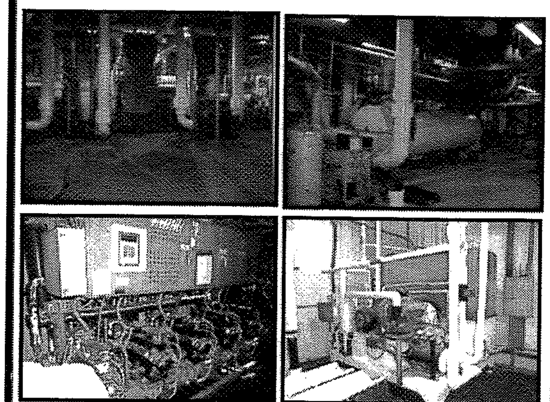
Program Information:
www.arb.ca.gov/cc/reftrack/reftrack.htm

Frequently Asked Questions:
www.arb.ca.gov/cc/facts/facts.htm

7/21/2009

California Environmental Protection Agency AIR RESOURCES BOARD

Refrigerant Best Management Practices



Commercial Refrigeration and Air-Conditioning Equipment

California Air Resources Board
1001 I Street, P.O. Box 2815
Sacramento, CA 95812

Contact: Chuck Seidler
cseidler@arb.ca.gov
(916) 327-8493

FACTS ABOUT Refrigerant Best Management Practices

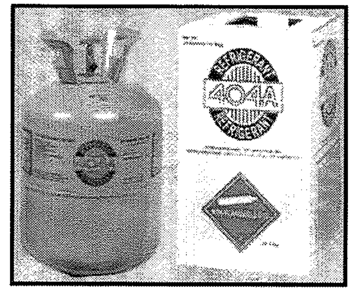
What are common Refrigerant Best Management Practices currently used?

- Designate one employee as a Refrigerant Manager
- Develop a Refrigerant Management Plan and Mission Statement
- Conduct an inventory of all systems that use refrigerant and their refrigerant charge
- Check for leaks regularly
  - Use automatic leak detection equipment
  - Conduct monthly manual leak inspections
- Repair refrigerant leaks promptly
- Do not "top off" refrigerant
- Use U.S. EPA certified technicians to conduct repairs
- Keep records of all refrigerant leaks, repairs, storage, and disposal

How do Best Management Practices help the environment?

CFC, HFC, and HCFC refrigerants are greenhouse gases typically thousands of times more potent than carbon dioxide (CO_2). Commercial refrigeration systems are the fastest growing source of greenhouse gas emissions in California.

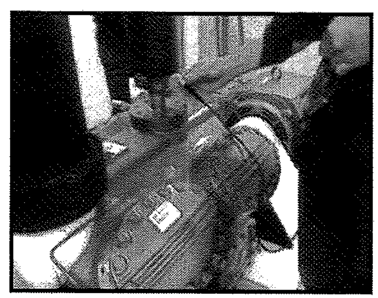
Reducing refrigerant leaks will reduce greenhouse gas emissions.



Is your facility a model of Refrigerant Best Management Practices?

The California Air Resources Board wants to highlight businesses that are already effectively conserving and properly managing refrigerants.

If you would like to have your business considered as an example to highlight refrigerant best management practices please contact ARB staff listed in this brochure.



How do Best Management Practices save money?

Facilities using commercial refrigeration and air-conditioning equipment that implement Refrigerant Best Management Practices reduce consumption of refrigerant.

Examples of savings from reaching a 10% annual leak rate with best management practices include:

1. A store with four refrigeration systems with a total charge of 1,000 pounds of refrigerant that leaked 30% per year could ***save*** $8,800 on refrigerant.

2. A food distribution facility with one refrigeration system with a total charge of 3,000 pounds of refrigerant that leaked 30% per year could ***save*** $6,600 on refrigerant.

What are the benefits of using Best Management Practices?

- Save $ annually on refrigerant
- Save energy
- Help comply with the law
  - Federal Clean Air Act, Section 608
  - South Coast Air Quality Management District Rule 1415
  - Proposed: Air Resources Board Refrigerant Management Program

388

FREQUENTLY ASKED QUESTIONS

Refrigerant Management Program

What is the Refrigerant Management Program?

The Refrigerant Management Program is a regulatory proposal to require specific best management practices to reduce emissions of refrigerant from non-residential refrigeration systems. The proposal includes provisions similar to current federal and local regulations in effect specific to ozone-depleting substances (ODS) refrigerants and extends requirements to ODS refrigerants substitutes.

Why is the Refrigerant Management Program proposed?

- It is a board approved AB 32 Early Action Measure developed to help meet the goals of reducing CA greenhouse gas emissions to 1990 levels by 2020.
- Addresses stationary source non-residential refrigeration, which is characterized by high leak rates and minimal oversight.
- Reduces emissions of Chlorofluorocarbon (CFC), Hydrofluorocarbon (HFC), and Hydrochlorofluorocarbon (HCFC) refrigerants, which are greenhouse gases typically thousands of times more potent than carbon dioxide (CO_2).

Who must comply with the proposed regulation?

The proposed regulation will affect any person who owns or operates a facility with a stationary, non-residential refrigeration system using more than 50 pounds of a high-global warming potential (GWP) refrigerant, services any appliance using a high-GWP refrigerant, or distributes or reclaims a high-GWP refrigerant.

What is a high-global warming potential refrigerant?

High-global warming potential, or high GWP, refrigerants include CFC, HCFC, and HFC refrigerants. Refrigerants that are not high-GWP include ammonia and carbon dioxide (CO_2).

What is a refrigeration system and what types of facilities use them?

A refrigeration system is any appliance that is, 1) used in the retail food and cold storage warehouse sectors, 2) used in manufacturing industries directly linked to an industrial process, or 3) used for any purpose other than comfort cooling that requires requires more than 50 pounds of a high-GWP refrigerant.

What are the estimated emission reductions of the proposed regulation?

The proposed regulation is estimated to reduce high-GWP refrigerant emissions by 8 million metric tonnes of carbon dioxide equivalent ($MMTCO_2E$). This reduction has an equivalent climate impact of removing 1.4 million cars and light trucks from the road each year.

What are the estimated costs?

On average the proposed regulation results in a cost savings of $2 per metric tonne of carbon dioxide equivalent ($MTCO_2E$) in emissions reduced. The cost savings is a direct result of reduced consumption of refrigerant through the use of best management practices.

What does the proposed regulation require?

The proposed regulation requires facility registration, leak detection and monitoring, leak repair, retrofit and retirement, reporting, and recordkeeping for any person who owns or operates a facility with a stationary, non-residential refrigeration system using more than 50 pounds of a high-GWP refrigerant. Required service practices for refrigerant management are applicable to any person who services an appliance using a high-GWP refrigerant. Reporting and recordkeeping requirements are also applicable to distributors, wholesalers, and reclaimers of high-GWP refrigerants.

When does the regulation take effect?

The proposed regulation has requirements that are phased in over time depending on the largest refrigeration system used at a facility.

Refrigeration systems are categorized as:

- **Large**: Refrigeration systems using 2,000 pounds or more of a high-GWP refrigerant
  - Systems typically used in cold storage warehouses, manufacturing, and some supermarkets
- **Medium**: Refrigeration systems using 200 pounds or more, but less than 2,000 pounds, of a high-GWP refrigerant
  - Systems typically used in smaller warehouses and many supermarkets
- **Small**: Refrigeration systems using more than 50 pounds, but less than 200 pounds, of a high-GWP refrigerant
  - Systems typically used in some pharmacies and small grocery stores

The following requirements for facilities using applicable refrigeration systems, refrigerant distributors and refrigerant reclaimers will apply on the effective date of the rule or January 1st, 2011:

- Required Service Practices applicable to the service of any high-GWP appliance
- Leak detection, monitoring, and recordkeeping
- Retrofit and retirement plans
- Refrigerant distributor, wholesaler, and reclaimer prohibitions

Refrigerant distributor, wholesaler, and reclaimer annual reporting requirements will become effective in 2012.

Requirements for facilities using applicable refrigeration systems that are phased in include:

- Annual Registration for Operation: Large in 2012, Medium in 2014, Small in 2016.
- Annual Implementation Fee: Paid upon initial Registration for Operation and annual renewals - Large ($370) and Medium ($170). There is no fee for Small.
- Annual Facility Reporting: Large in 2012 and Medium in 2014. No required reporting for Small.

How will the Refrigerant Management Program be enforced?

- Air Districts may adopt a rule of equivalent emission reduction benefit under local authority.
- Air Districts may enforce statewide rule under agreements with the ARB with funding provided through fees paid by facilities subject to the rule.

Will there be other regulations to reduce refrigerant emissions?

Yes. ARB is developing additional regulations or other measures to address emissions of refrigerants used for other stationary applications and motor vehicle air conditioning including: new commercial refrigeration specifications; residential refrigeration management; foam recovery and destruction; use of refrigerants with a lower global warming impact in new cars, buses, trucks, and equipment in California; recovery of refrigerant from decommissioned refrigerated shipping containers; enforcement of a federal ban on refrigerant release during servicing and dismantling; and emission reductions during professional servicing.

Where can I find out more information about the proposed regulation?

For the regulation and accompanying documents see: *www.arb.ca.gov/cc/reftrack/reftrack.htm.*
For further information contact: Mr. Chuck Seidler, cseidler@arb.ca.gov, (916) 327-8493

Refrigerant Management Program Direct Outreach Project Report July – August 2009

INTRODUCTION

The Refrigerant Management Program (RMP) is a regulation proposed by the California Air Resources Board (ARB) to reduce the emissions of high global warming potential (GWP) refrigerants from large stationary non-residential refrigeration systems and help meet the greenhouse gas reduction goals of California's Global Warming Solutions Act of 2006 (AB32). High GWP refrigerants include chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), and hydrofluorocarbons (HFC). ARB staff estimate that by 2020 greenhouse gas (GHG) emissions from stationary refrigeration systems in California could be reduced by approximately 8 million metric tons carbon dioxide equivalent (MMTCO2E) annually through the facility registration, reporting, leak inspection, and maintenance requirements included in the RMP.

In the process of developing the RMP, ARB staff developed an inventory of the types and numbers of businesses in California that use stationary commercial and industrial refrigeration systems with 50 pounds or more of a high GWP refrigerant. In developing this inventory staff estimated that approximately 26,000 facilities in California use applicable refrigeration systems. These facilities represent many different industries including supermarkets, convenience stores, food processing and wholesale, refrigerated warehouses, pharmacies, hospitals, petroleum, utilities, and some manufacturing. ARB staff estimate that almost 65% of these are small businesses with fewer than 100 employees. Because of the large number of small businesses potentially impacted by the RMP, an extensive and diverse outreach was conducted to educate business owners about refrigerant best management practices and solicit comments on the proposed regulation during the rule development process.

Throughout the rule development process, staff conducted several different outreach activities including: 1) contacting a total of 60 different trade associations representing businesses likely to use large commercial and industrial refrigeration systems, 2) distributing information to small business development centers, 3) distributing information to all 35 air quality districts, 4) hosting 5 technical workgroup meetings, 5) hosting 3 statewide public workshop series throughout California, and 6) e-mail list serves to ~6,700 contacts. All contacts were provided press releases, brochures, and FAQ documents for further distribution.

In addition to this substantial "top down" outreach ARB staff elected to conduct a novel direct outreach campaign to a comprehensive sample of businesses likely to use commercial and/or industrial refrigeration systems with high GWP refrigerants in two cites in California. The primary goals of this direct outreach project were:

1) To serve as a pilot study to determine the effectiveness of conducting a direct outreach to affected facilities/businesses.
2) Demonstrate a form of direct outreach that could be used in other programs or regulations that the ARB develops.
3) Communicate with small businesses that would not otherwise be made aware of the RMP during the rule development process.
4) Solicit comments from small businesses on the proposed RMP.
5) Identify businesses willing to be recognized for voluntarily using refrigerant best management practices outlined in the proposed RMP.
6) Gain information that informs the implementation phase of the RMP to ensure that small businesses are fully aware of its requirements as well as tools to assist with compliance.

DIRECT OUTREACH EFFORT - RESULTS

The direct outreach pilot project resulted in 187 total phone calls to individual businesses. The responses of individual businesses to the phone calls varied substantially. Thirty calls successfully identified a business using applicable refrigeration systems and provided them with outreach materials. Another 56 calls identified businesses with refrigeration systems that were not applicable to the rule (or used no commercial refrigeration). Seventy-five calls resulted in at least two voice mail messages with no reply. A smaller subset of contacts (26 total) were not viable or ended the call abruptly. Most of the businesses contacted were not affiliated with a trade association and therefore represented contacts that would otherwise not have been made aware of the proposed RMP using traditional outreach methods.

Table 1. Summary of calls by industry type.

Industry type	Successful contacts	Systems n/a	Voicemail only	Not viable contact	Total
Cold storage/ Food processing	13	13	33	11	**70**
Grocery store/ Supermarket	9	1	12	5	**27**
Convenience store	0	9	4	1	**14**
Pharmacy	3	5	3	1	**12**
Medical	2	12	4	3	**21**
Manufacturing/ Petroleum	3	16	19	5	**43**
	30	**56**	**75**	**26**	**187**

A secondary goal of this direct outreach project was to find individual businesses already following the refrigerant best management practices required in the RMP and interested in receiving public recognition for their efforts. Although several businesses were identified which claimed to employ very stringent refrigerant best management practices none volunteered to be publically recognized.

DIRECT OUTREACH EFFORT - DESCRIPTION OF INDIVIDUAL TASK COMPONENTS

a. Selection of cities to be used for the direct outreach project

The facility inventory developed for the Refrigerant Management Program estimated that approximately 26,000 facilities statewide use refrigeration systems with more than 50lbs of high GWP refrigerant (see Appendix B for more details). Because it would not be feasible to contact such a large number of facilities directly by phone two moderately sized cities in Northern and Southern California were selected to serve as samples of all affected industries statewide. Merced and City of Industry were selected based on several criteria including; geographic location, broad representation of all affected industry types, and less than 250 businesses contacts for both cities combined.

b. Development and distribution of contact list

Before planning a substantial phone based outreach effort to individual businesses in California the types and numbers of businesses likely to use large commercial/industrial refrigeration systems with high GWP refrigerants was estimated. The facility inventory developed for the proposed RMP identified specific industries and NAICS codes that were likely to apply to the proposed rule (see Appendix B for more information on methods and inventory). These NAICS codes were used, in conjunction with a subscription to a marketing firm Directories USA, to obtain contact information for approximately 26,000 individual facilities statewide that could be affected by the proposed RMP. The contact information provided by Directories USA included the following fields:

- Business description
    - Business name
    - NAICS code
    - NAICS code description

- Business data
    - Estimated number of employees
    - Estimated annual sales
    - Estimated square footage
    - Business status (single location or branch)

- Contact information

- Address
- Phone number
- Website URL (when available)

All individual business contacts (187 total) in the selected cities, Merced and the City of Industry, were assigned to participating ARB staff. Contacts were assigned so that each individual staff would be interacting with facilities in the same industry. By assigning contacts from only one or two industry types to each staff it would allow them to focus and specialize on the specific issues unique to each industry (ex. cold storage, food processing, manufacturing, medical facilities). For example calls to cold storage warehouses would initially focus on determining the type of refrigerant used in a facility because many facilities in California use low GWP refrigerants like ammonia. Additionally, calls to small grocery and convenience stores would initially focus on determining the size of the system used because many facilities are likely to have systems with less than 50lbs refrigerant.

c. Development of phone script, follow up form e-mail, and contact database

A standard phone script (Attachment 1) was drafted and used by staff to help ensure consistency in the information conveyed to stakeholders and responses provided to questions asked during phone calls. The script included several questions that were to be asked in all calls and subsequent questions to be asked during successful calls. Although it was assumed, when compiling the facility inventory, that only a small proportion of some industries use commercial refrigeration systems with more than 50lbs high GWP refrigerant (ex. manufacturing and cold storage) contact information for all businesses in each industry were obtained. As a result information regarding the presence and size of refrigeration systems used in a business was requested early in the phone call. Additionally, at the end of the script, ARB staff anticipated possible questions stakeholders could ask and provided sample answers.

After developing a first draft, the script was refined substantially based on comments and observations gleaned from a practice session where staff tested the script in a role playing scenario. After this practice session the script was changed to include more questions at the beginning of the call to engage the stakeholder promptly. As a result most of the description of the proposed rule was moved to the end of the call as a follow up to questions asked. After ARB staff completed several calls they adapted the script to better match their own individual speaking style and make the script sound more conversational.

Participating staff were provided with a contact database containing their assigned list of businesses contacts. The contact database also contained empty cells where staff could track the status of a contact (for example "follow-up required" or "not viable contact"), the name and e-mail of a contact person at each business, and answers to questions included in the call script (see

Attachment 2 for full list of fields included). After completing calls with a facility with applicable refrigeration systems, staff sent a form e-mail and several outreach documents (Frequently Asked Questions sheet and Refrigerant Best Management Practices brochure) to the business to provide additional information about refrigerant best management practices and the proposed RMP.

d. Observations and lessons learned

This project represents one of the first comprehensive effort to contact a substantial number of individual businesses by phone during the process of developing a broad regulation affecting many different facilities and industry types. Participating ARB staff made some valuable observations during this process that could provide useful guidance for any similar outreach projects.

Refrigeration systems not applicable to RMP: ARB staff noted that this type of outreach effort is less effective in industries where only a small proportion of the total facilities statewide are expected to be applicable to the rule. If less than 30% of the facilities in a given industry are likely to be applicable to the proposed rule then it is likely that, in a limited statewide sample, none of the calls made will result in successful contacts with applicable businesses.

Language barrier: In some cases the business owners/operators contacted did not speak English as their primary language. When conducting substantial phone based outreach efforts in the future making a few bilingual staff available could dramatically increase the effectiveness of the outreach to individual businesses.

Incorrect data: The data purchased from DirectoriesUSA, the marketing company used to obtain contact lists, was occasionally mis-categorized. In several cases business contacts listed under a specific NAICS code claimed that their primary business activities were very different from their reported NAICS code. This mis-categorization is possibly due to the fact that most businesses and marketing companies still use SIC codes for classification while the US Census bureau uses NAICS codes. Some accuracy in categorizing business types is lost when mapping from less specific SIC codes to more refined NAICS codes. Future outreach efforts of this kind might consider organizing businesses by SIC codes to reduce the number of calls made to mis-categorized businesses.

Phone call script modifications: Several important changes were made to the phone script by staff as they made more calls. Changes included asking to speak to the appropriate person in the company immediately after stating their name and affiliation (ARB). In many cases the person answering the phone knew nothing about the facility or refrigeration systems used there and staff found this expedited calls. Another change suggested by staff was to clearly state that the purpose for the call was not sales, but instead to solicit feedback on a government regulation being developed that may affect their business.

<u>Importance of direct calls in outreach process:</u> None of the businesses contacted with applicable refrigeration systems had heard of the proposed Refrigerant Management Program or were affiliated with a trade association. This highlights the importance of calling individual businesses in addition to the substantial "top down" outreach efforts used in the development of the RMP in contacting manufacturers, distributors, trade associations, and local chambers of commerce. The fact that all of the small businesses contacted were not aware of the proposed RMP and were not affiliated with trade organizations is an important result of this direct outreach project. This provides a strong indication that the most effective way to outreach to small businesses is by direct calls or mailings. Although some of the businesses contacted had more than 100 employees, most of them were small businesses.

Overall, staff agreed that assigning 30-40 calls per person over a 1 ½ week time span was not overly burdensome and that this form of outreach was effective in distributing information to individual businesses. After implementing this ambitious direct outreach project staff will work to incorporate a similar approach to subsets of the total facilities estimated to be affected by the rule (26,000 statewide). The experience obtained from conducting this outreach project will be vital in forming the development of a successful and comprehensive post-rule adoption outreach plan. Additionally, the information obtained from this direct outreach project will provide a useful comparison to the data used to establish the facility inventory.

ATTACHMENT 1: PHONE SCRIPT

Hi, my name is Jane Doe and I'm calling from the California Air Resources Board to talk to you about the refrigeration systems used in your business. I'm calling all local businesses in the area, including (convenience/grocery/warehouse/food processing/dairy/manufacturing) businesses like yours, that use large commercial refrigeration systems with high global warming potential refrigerants, for example Freon type refrigerants like R-22 or R404a. I'm not selling anything, I'd just like to talk to you about a regulation we developing called the Refrigerant Management Program which focuses on changes that can reduce leaks of refrigerant and save money.

Are you the right person to talk to?

When calling food warehouse or processing facilities may need to ask this question at the beginning: Do you know if your business uses ammonia or CO2 as a refrigerant in your cooling systems?

Have you heard about this program before?

If you don't mind I have a few quick questions and I'd like to give you a little more information about the proposed rule. It shouldn't take more than 5 minutes. The information that you and other businesses provide will help us make sure that the rule is effective, and has the least possible impact on your business.

1. Can you describe your business and the refrigeration/freezer systems you use?

2. Do you know if you have any refrigeration systems with more than 50 pounds of refrigerant?

    a. Alternate question for convenience stores or pharmacies: Do you plug all your refrigerated cases into a wall outlet or do they have a walk in area in the back where you stock the shelves?

3. Do you contract with a company to do all the maintenance and repairs, or do you use onsite staff?

4. How often do you usually inspect your refrigeration systems?

5. What trade associations are you affiliated with?

Thank you, this is very helpful.

The rule were developing is designed to reduce the emissions of refrigerant from large commercial refrigeration systems by requiring some Best Management Practices. Many businesses are already using these practices because they are also generally seen as good business.

Some examples of Best Management Practices include:

- Keeping records of all repairs made to refrigeration systems and all refrigerant added and lost from refrigeration systems
- Checking for refrigerant leaks regularly and repairing them as soon as they are found
- Using automatic leak detection equipment on very large systems (>2,000 lbs)

Based on many conversations I have had with business owners and technicians I've found that these practices can often help SAVE money on refrigerant each year.

* At this point – if the call is going well and you think they may be interested in working with us see the additional list of questions at the end.

Can I send you some additional information about our proposed rule by e-mail?

What is your e-mail address?

Please feel free to call me with any questions you have about the information I send you, or if you have comments or concerns about this proposed rule.

Thank you for taking time to talk to me today, I know you are very busy and I sincerely appreciate your attention.

If the call goes well:

I'm interested in finding some businesses that already use Best Management Practices and highlighting them as positive examples for other business owners because they not only save money but also help the environment.

Would you be willing to let myself and a few of my coworkers visit your business to learn more about your operation? We are interested in finding ways to highlight local businesses that already use Refrigerant Best Management Practices and would appreciate the chance to talk to you further.

Additional questions for "good" players:

1. Do you use an automatic leak detection system to monitor your refrigeration system?
2. What is the name of your service company?
3. How quickly are you able to fix a leak after it is detected?

Possible questions and suggested answers:

For example:

1. How do I know what the refrigerant charge in my equipment is?
   There are several ways to determine the full refrigerant charge in a system. These include:
   - The full charge may be listed on the equipment name plate which includes the make/model number, refrigerant type, and manufacturer information.
   - The full charge could also be included in documentation about the system provided by the manufacturer after installation.
   - The full charge could be determined by looking back at old service records from when a leak repair was conducted. By looking at the amount of refrigerant removed from the system before the repair and the amount added back after the repair was complete you can estimate the full charge.
   - If you have none of this information available you can contact the refrigeration system manufacturer.

2. Why is the RMP needed? Isn't there already enough regulation for refrigeration systems?

- Many refrigerants are very potent global warming chemicals. What this means is that, on average, a single pound of HFC, CFC, of HCFC refrigerant has the same global warming impact as 4,000lbs of carbon dioxide.
- Because they are so potent releases of even small amount of high global warming potential refrigerant can have contribute substantially to the greenhouse gas emissions in California.
- High global warming potential refrigerants represent the fastest growing source of greenhouse gas emissions in California.
- By using best management practices in dealing with refrigeration systems business owners can save money on refrigerant purchased every year and help reduce greenhouse gas emissions.

3. My business is barely managing to keep a float in these tough times. Why is ARB imposing yet another burdensome and costly regulation?
    - Our goal in developing the proposed refrigerant management program has been to reduce emission of greenhouse gases in a way that can also help businesses SAVE money every year.
    - Our research indicates that this proposed regulation will actually achieve emissions reductions at an average cost SAVINGS.
    - After many discussions with refrigeration system manufacturers and business owners we think that refrigerant best management practices will actually help typical businesses save money every year by spending less money on refrigerant
4. Will I be inspected by my local air district or by the Cal EPA? Is the local air district working with you on this rule?
    - We have been working closely with all local air districts in California including the **South Coast Air Quality Management District/San Joaquin Air Pollution Control District**.
    - After the rule is passed by our board we will work with local air districts to administer the program.
    - You will not have to send reports to multiple locations. We plan to have one statewide online database where you can submit your annual reports.

5. What will this rule cost me?
    - Our research indicates that many facilities which use Refrigerant Best Management Practices will save money every year on refrigerant.
    - The proposed refrigerant management program includes minimal annual fees for facilities that have at least one refrigeration systems with more than 200lbs refrigerant.
        - At least one system with 200-2,000lbs: $170 annual fee
        - At least one system with >2,000lbs: $370 annual fee
    - These fees will be used solely to pay for maintenance of the online reporting database and for enforcement.

- There would be cost for requirements such as regular leak inspections and keeping records of refrigerant leaks and repairs, but the money saved on refrigerant can be used to pay for these types of expenses.

Two examples of annual savings possible using refrigerant best management practices:

- A store with four refrigeration systems containing 1,000 pounds of refrigerant that leaked 30% per year could SAVE $8,800 every year on refrigerant.
- A food distribution warehouse with one refrigeration system containing 3,000lbs refrigerant that leaks 30% per year could SAVE $6,600 per year on refrigerant.

6. What are you doing with the information you asked me about my business and our refrigeration systems?
   - The information you gave me will help us learn more about the types of businesses in California that use large commercial refrigeration systems with high GWP refrigerants.
   - It will also help us get an idea of how commonly refrigerant best management practices are used in businesses and how aware most facilities are about these practices.

ATTACHMENT 2: LIST OF FIELDS INCLUDED IN OUTREACH DATABASE

A contact database was provided to all participating ARB staff and was intended to be filled in after each call made. The information recorded in the database was used to provide a summary of the effectiveness of the direct outreach project.

Fields included:

- Contact outcome (follow up required/successful contact/possible collaboration/not viable contact/refrigeration systems not applicable)
- City
- Business name (from DirectoriesUSA)
- Sales (from DirectoriesUSA)
- NAICS code description (from DirectoriesUSA)
- # employees (from DirectoriesUSA)
- Last name
- First name
- Title of contact person
- Phone number (from DirectoriesUSA)
- E-mail address
- Business type
- Date last contacted

- Contacted by phone? (yes/voicemail)
- Received outreach documents? (yes/follow-up)
- Received workshop notice? (yes/follow-up)
- Affiliated associations
- Notes

(Adopted June 7, 1991)(Amended October 14, 1994)

RULE 1415. REDUCTION OF REFRIGERANT EMISSIONS FROM STATIONARY REFRIGERATION AND AIR CONDITIONING SYSTEMS

(a) Purpose

The purpose of this rule is to reduce emissions of Class I and Class II refrigerants from stationary refrigeration and air conditioning systems by requiring persons subject to this rule to reclaim, recover, or recycle refrigerant and to minimize refrigerant leakage.

(b) Applicability

This rule is applicable to any person who owns or operates a refrigeration system, as defined in this rule. This rule is also applicable to any person who installs, replaces, services, disposes, audits, or relocates a refrigeration system, to any person who services or maintains recycling and recovery equipment, and to any person who recycles, recovers, reclaims, or sells refrigerant. All amendments to this rule adopted as of October 14, 1994 shall take effect as of October 14, 1994.

(c) For purposes of this rule, the following definitions shall apply:

(1) ADDITIONAL REFRIGERANT CHARGE is the quantity of refrigerant (in pounds) charged to a refrigeration system in order to bring the system to a full-capacity charge and replace refrigerant which has leaked.

(2) APPROVED RECOVERY EQUIPMENT is equipment for refrigerant recovery that is certified by the Environmental Protection Agency pursuant to the requirements of Part 82 of Title 40 of the Code of Federal Regulations.

(3) APPROVED RECYCLING EQUIPMENT is any refrigerant recycling equipment that is certified by Underwriters Laboratories, or another independent testing organization as approved by the Executive Officer's designee, and is certified by the Environmental Protection Agency pursuant to the requirements of Part 82 of Title 40 of the Code of Federal Regulations.

(4) AUDIT is an annual inspection of the refrigeration systems containing Class I refrigerants conducted to:

(A) identify leaks pursuant to a District-approved method (Section (2)(A)); and

(B) ensure proper operation pursuant to manufacturer's specification.

(5) CERTIFIED AUDITOR for the purpose of this Rule is a person that:

(A) has the following current, valid, and applicable U.S. Environmental Protection Agency certificate provided in accordance with Part 82 of Title 40 of the Code of Federal Regulations:

(i) a Type II Technician certificate for high or very high pressure refrigeration systems and a Type III Technician certificate for low pressure refrigeration systems; or

(ii) a Universal Technician certificate, or

(B) until June 30, 1995, has successfully completed a District-approved course in conducting inspections and generating records for compliance with this rule, and has a current, valid, written certification from the Executive Officer's designee.

(6) CERTIFIED RECLAIMER is a person who holds a current, valid, and applicable reclaimer certificate in accordance with Part 82 of Title 40 of the Code of Federal Regulations.

(7) CERTIFIED TECHNICIAN is a person who on and after November 14, 1994 has the following current valid, and applicable U.S. Environmental Protection Agency certificate provided in accordance with Part 82 of Title 40 of the Code of Federal Regulations:

(i) a Type II Technician certificate for high or very high pressure refrigeration systems; or

(ii) a Type III Technician certificate for low pressure refrigeration systems; or

(iii) a Universal Technician certificate.

(8) CLASS I REFRIGERANT is any compound or any combination of compounds designated by U.S. Environmental Protection Agency as a CLASS I refrigerant pursuant to 42 U.S.C. 7671(a).

(9) CLASS II REFRIGERANT is any compound or any combination of compounds designated by U.S. Environmental Protection Agency as a CLASS II refrigerant pursuant to 42 U.S.C. 7671(a).

(10) DISPOSE is to discard refrigerant in any manner, except destruction by incineration or by a treatment method specifically approved by the U.S. Environmental Protection Agency for handling such refrigerant without releasing it to the atmosphere.

(11) High pressure refrigeration system is a refrigeration system that uses a refrigerant with a boiling point between -50 and 10 degrees Centigrade at atmospheric pressure (29.9 inches of mercury).

(12) Low pressure refrigeration system is a refrigeration system that uses a refrigerant with a boiling point above 10 degrees Centigrade at atmospheric pressure (29.9 inches of mercury).

(13) MAINTENANCE is an annual service of the refrigeration system containing Class II refrigerants conducted to:

(A) ensure proper operation pursuant to manufacturer's specification; and

(B) assess the overall integrity of the refrigeration system to detect leaks.

(14) PERSON is any firm, business establishment, association, partnership, corporation, or individual, whether acting as principal, agent, employee, or in any other capacity, including any governmental entity or charitable organization.

(15) RECLAIM is to process refrigerant to a level equivalent to new product specifications in accordance with applicable requirements of the U.S. Environmental Protection Agency contained in Part 82 of Title 40 of the Code of Federal Regulations.

(16) RECOVER is to remove refrigerant, in any condition, from a system and to store it in an external container, without necessarily testing or processing it in any way.

(17) RECYCLE is to clean refrigerant for reuse by oil separation and single or multiple passes through moisture-absorption devices, such as replaceable core filter-driers which reduce moisture, acidity, and particulate matter.

(18) REFRIGERANT LEAK is any discharge of refrigerant from a refrigeration system, recovery equipment, or recycling equipment into the atmosphere.

(19) REFRIGERATION SYSTEM is any non-vehicular equipment used for cooling or freezing, which holds more than 50 pounds of, any combination of Class I and/or Class II refrigerant, including, but not limited to, refrigerators, freezers, or air conditioning equipment or systems.

(20) SELF-CONTAINED RECOVERY EQUIPMENT is any refrigerant recovery equipment that is capable of removing the refrigerant from a refrigeration system without the assistance of components contained in the refrigeration system.

(21) Very high pressure refrigeration system is a refrigeration system that uses a refrigerant with a boiling point below -50 degrees Centigrade at atmospheric pressure (29.9 inches of mercury).

(d) Requirements

(1) On and after January 1, 1992, no person shall install, service, modify, or dispose of any refrigeration system, or perform any related repairs or modifications that may cause release of Class I or Class II refrigerants unless that person meets all of the following requirements:

(A) Recovers, recycles, or reclaims the refrigerant, using approved recycling or recovery equipment for that type of refrigeration unit , and employs procedures for which the recycling or recovery equipment was approved by the U.S. Environmental Protection Agency. Recovery and recycling equipment shall be used as specified by the recovery or recycling equipment manufacturer unless manufacturer's specifications are in conflict with the equipment approved procedures. Refrigerant may be returned to the refrigeration system from which it is recovered from or to another refrigeration system owned by the same person without being recycled or reclaimed.

(B) Satisfies job site evacuation of Class I and Class II refrigerants during recycling, recovering, reclaiming, or disposing in accordance with applicable regulations of the U.S. Environmental Protection Agency as contained in Part 82, Subpart F, Section 82.156, of Title 40 of the Code of Federal Regulations then in effect including, but not limited to, "Required Levels of Evacuation for Air Conditioning and Refrigeration Equipment". De minimis refrigerant releases associated with a good faith attempt to recycle or recover refrigerants are allowed provided that required practices or requirements in accordance with regulations then in effect of the U.S. Environmental Protection Agency contained in Part 82, Subpart F, Section 82.156 and Section 82.158, and Part 82, Subpart B of Title 40 of the Code of Federal Regulation are followed.;

(C) Has at least one piece of approved, self-contained recovery equipment available at their place of business;

(D) On or after October 14, 1994, any person who owns or operates an approved recycling or recovery equipment:

(i) Shall not operate any approved recycling or recovering equipment except for the maintenance or repair of such equipment, unless the equipment has been tested for and been determined to have no leaks within the past six months as determined by a method approved by the Executive Officer's designee. Leaks in recycling, recovering, or charging equipment shall be repaired within 2 working days after the leak is first detected, unless the equipment does not leak if its use is discontinued;

(ii) Shall not alter the design of approved recovery and recycling equipment in a manner that would affect the equipment's ability to meet the certification standards set by the U.S. Environmental Protection Agency without resubmitting the altered design for approval testing. Until such altered equipment is tested by a U.S. Environmental Protection Agency approved testing facility and is shown to meet the certification standards set forth by the U.S. Environmental Protection Agency, equipment so altered shall not be considered approved; and,

(iii) Shall provide proof of certification for the recovery and recycling equipment from the U.S. Environmental Protection Agency to the Executive Officer's designee upon request.

(E) On and after November 14, 1994 has the following current, valid and applicable U.S. Environmental Protection Agency certificate provided in accordance with Part 82 of Title 40 of the Code of Federal Regulations:

(i) a Type II Technician certificate for high or very high pressure refrigeration systems; or

(ii) a Type III Technician certificate for low pressure refrigeration systems; or

(iii) a Universal Technician certificate.

(2) No person shall operate a refrigeration system unless all of the following applicable requirements are met:

(A) An annual audit has been conducted for refrigeration systems containing Class I refrigerant by a Certified Auditor to determine whether the system is operating pursuant to manufacturer's specifications and does not have refrigerant leaks. This audit shall commence no later than July 1, 1992, and every 12 months thereafter. At minimum, the annual audit shall require the following:

(i) A leak test shall be conducted for refrigeration systems operating above atmospheric pressure using one of the following methods:

(I) Electronic halogen detector used in accordance with manufacturer's specifications;

(II) Fluorescent tracer dyes injected into the system according to manufacturer's specifications, and scanned with an ultraviolet lamp; or

(III) An alternate method approved by the Executive Officer's designee.

(ii) A leak test shall be conducted for refrigeration systems operating below atmospheric pressure by using one of the following methods:

(I) Pressurizing the system by using an inert gas mixture with an indicator or by raising the temperature of the Evaporator; or

(II) An alternate method approved by the Executive Officer's designee.

(iii) Amount of refrigerant leak shall be determined, for each refrigeration system, by recording the total capacity of refrigerant charge in each refrigeration system, the quantity of any additional refrigerant charge to each refrigeration system, as defined in (c)(1), and the date of each charge. The quantity of additional refrigerant charge shall be determined by weighing the refrigerant charging container before and after each charge, using equipment that is accurate to the nearest pound.

(iv) An examination for deficiencies which may cause refrigerant leakage.

(B) An annual maintenance program for refrigeration systems containing Class II refrigerants has been established to ensure that the system is operating pursuant to the manufacturer's specification and that it does not have any refrigerant leaks. This program shall consist of all of the following:

(i) An inspection for leaks by a certified technician which includes an examination for deficiencies which may cause refrigerant leakage.

(ii) A written record of the quantity of any additional refrigerant charge to each refrigeration system. The quantity of additional refrigerant charge shall be determined by weighing the refrigerant charging container before and after each charge, using equipment that is accurate to the nearest pound.

(C) A Registration Plan for the entire facility has been submitted to the District by January 1, 1996 and every two years thereafter. This Registration Plan shall contain:

(i) number of refrigeration systems in operation;

(ii) type of refrigerants in each refrigeration system;

(iii) amount of refrigerant in each refrigeration system;

(iv) date of last annual audit or maintenance performed for each refrigeration system; and

(v) amount of refrigerant charged every year.

(3) On and after January 1, 1992, any person who owns or operates a refrigeration system that has a refrigerant leak as defined in paragraph (c)(18) shall ensure that the leak is repaired no later than 14 calendar days after the leak has been discovered or should have been discovered. The owner or operator shall maintain a log of repair activities beginning at the time the leak is discovered and ending at the time when the leak has been repaired. The refrigeration system shall be verified by a certified technician to be leak free before any refrigerant is added to the system.

(4) On or after November 14, 1994, no person shall sell, distribute, offer for sale or distribution, or purchase any Class I or Class II refrigerant for use as a refrigerant to any person unless:

(A) The buyer is certified pursuant to Part 82 of Title 40 of the Code of Federal Regulations;

(B) The refrigerant is sold only for eventual resale to certified technicians or to refrigeration system manufacturers;

(C) The refrigerant is contained in a refrigeration system; or

(D) The refrigerant is charged into a refrigeration system by a certified technician.

(5) Effective October 18, 1994 until May 15, 1995, no person shall sell or offer for sale any Class I or Class II refrigerant consisting wholly or in part of used refrigerant unless the refrigerant has been reclaimed by a certified reclaimer.

(6) No person reclaiming refrigerants shall release into the atmosphere more than 1.5 percent of the refrigerant received for reclamation.

(e) Recordkeeping

(1) On and after January 1, 1992, any person owning or operating any refrigeration system is required to maintain the following records for each refrigeration system:

(A) A report demonstrating compliance with paragraph (d)(2) and repairs required by paragraph (d)(3), which includes the following information:

(i) Date of annual audit and annual maintenance program;

(ii) All work completed for each refrigeration system to prevent or repair leaks, including results of leak testing and leak determinations;

(iii) Name(s) of the person who completed the inspection and repair, and name, address, and telephone number of the company the person is representing;

(iv) The permit number of the recycling or recovery equipment;

(v) The log of repair activities; and

(vi) Technician certificate type.

(B) A log of the quantity of each additional refrigerant charged to the refrigeration system and the date of each charge.

(C) A log of malfunctions of the refrigeration system, other than that determined in section (d)(2) and (d)(3), including the following:

(i) The cause of the malfunction; and

(ii) The type of repairs required and the date the repairs were completed.

(D) If refrigerant is recycled off-site, a transportation bill-of-lading (or other transportation document as approved by the Executive Officer's designee) indicating the name and location of the facility from which the refrigerant is shipped, the quantity of refrigerant transported, destination (company name, phone number, and location) and date of transportation.

(E) The quantity (in pounds) of Class I or Class II refrigerants purchased or used in the District in a calendar year and the name and address of the refrigerant supplier.

(2) On and after July 1, 1991, any person who receives refrigerant for recycling or reclaiming from off-site locations shall maintain copies of all transportation documents as required in section (e)(1)(D) for each shipment of refrigerant received.

(3) Records and reports required under sections (e)(1)(A), (e)(1)(B), and (e)(1)(C) shall be generated by a Certified Auditor or a certified technician. Annual audits and maintenance records shall be in a format approved in writing by the Executive Officer's designee.

(4) All persons who sell or distribute any Class I or Class II refrigerant shall retain invoices that indicate the name of the purchaser, the date of sale, and the quantity of refrigerant purchased.

(5) Purchasers of any Class I or Class II refrigerant who employ certified technicians shall provide evidence that at least one technician is properly certified to the wholesaler who sells them refrigerant. The wholesaler shall keep this information on file and may sell refrigerant to the purchaser or authorized representative even if such purchaser or authorized representative is not a properly certified technician. The purchaser must notify the wholesaler in the event that the purchaser no longer employs at least one properly certified technician.

(6) Reclaimers shall maintain records of the names and addresses of persons sending them material for reclamation and the quantity of the material (the

combined mass in pounds of refrigerant and contaminants) sent to them for reclamation.

(7) Reclaimers shall maintain records of the quantity of material sent to them for reclamation, the mass in pounds of refrigerant reclaimed, and the mass in pounds of waste product.

(8) On and after October 14, 1994, any person owning and operating an approved recycling or recovery equipment shall maintain the following records as required by paragraph (d)(1)(D), which includes the following information:

(A) Date of semi-annual inspection;

(B) All work completed for each recycling or recovery system to prevent or repair leaks, including results of leak testing and leak determinations;

(C) Name(s) of the person who completed the inspection and repair, and name, address, and telephone number of the company the person is representing; and

(D) The permit number of the recycling or recovery equipment.

(9) Records and reports as required under sections (e)(1), (e)(2), (e)(4), (e)(5), (e)(6), (e)(7), and (e)(8) shall be maintained for not less than 3 years after their creation and shall be made available to the Executive Officer's designee upon request.

Electronic Code of Federal Regulations e-CFR™

e-CFR Data is current as of March 6, 2009

Title 40: Protection of Environment

PART 82—PROTECTION OF STRATOSPHERIC OZONE

Browse Previous | Browse Next

Subpart F—Recycling and Emissions Reduction

Source: 58 FR 28712, May 14, 1993, unless otherwise noted.

§ 82.150 Purpose and scope.

(a) The purpose of this subpart is to reduce emissions of class I and class II refrigerants and their substitutes to the lowest achievable level by maximizing the recapture and recycling of such refrigerants during the service, maintenance, repair, and disposal of appliances and restricting the sale of refrigerants consisting in whole or in part of a class I and class II ODS in accordance with Title VI of the Clean Air Act.

(b) This subpart applies to any person servicing, maintaining, or repairing appliances. This subpart also applies to persons disposing of appliances, including small appliances and motor vehicle air conditioners. In addition, this subpart applies to refrigerant reclaimers, technician certifying programs, appliance owners and operators, manufacturers of appliances, manufacturers of recycling and recovery equipment, approved recycling and recovery equipment testing organizations, persons selling class I or class II refrigerants or offering class I or class II refrigerants for sale, and persons purchasing class I or class II refrigerants.

[69 FR 11978, Mar. 12, 2004]

§ 82.152 Definitions.

Appliance means any device which contains and uses a refrigerant and which is used for household or commercial purposes, including any air conditioner, refrigerator, chiller, or freezer.

Apprentice means any person who is currently registered as an apprentice in service, maintenance, repair, or disposal of appliances with the U.S. Department of Labor's Bureau of Apprenticeship and Training (or a State Apprenticeship Council recognized by the Bureau of Apprenticeship and Training). If more than two years have elapsed since the person first registered as an apprentice with the Bureau of Apprenticeship and Training (or a State Apprenticeship Council recognized by the Bureau of Apprenticeship and Training), the person shall not be considered an apprentice.

Approved equipment testing organization means any organization which has applied for and received approval from the Administrator pursuant to §82.160.

Certified refrigerant recovery or recycling equipment means equipment manufactured before November 15, 1993, that meets the standards in §82.158(c), (e), or (g); equipment certified by an approved equipment testing organization to meet the standards in §82.158(b), (d), or (f); or equipment certified pursuant to §82.36(a).

Commercial refrigeration means, for the purposes of §82.156(i), the refrigeration appliances utilized in the retail food and cold storage warehouse sectors. Retail food includes the refrigeration equipment found in supermarkets, convenience stores, restaurants and other food service establishments. Cold storage includes the equipment used to store meat, produce, dairy products, and other perishable goods. All of the equipment contains large refrigerant charges, typically over 75 pounds.

Critical component means, for the purposes of §82.156(i), a component without which industrial process refrigeration equipment will not function, will be unsafe in its intended environment, and/or will be subject to failures that would cause the industrial process served by the refrigeration appliance to be unsafe.

Custom-built means, for the purposes of §82.156(i), that the equipment or any of its critical components cannot be purchased and/or installed without being uniquely designed, fabricated and/or assembled to satisfy a specific set of industrial process conditions.

Disposal means the process leading to and including:

(1) The discharge, deposit, dumping or placing of any discarded appliance into or on any land or water;

(2) The disassembly of any appliance for discharge, deposit, dumping or placing of its discarded component parts into or on any land or water; or

(3) The disassembly of any appliance for reuse of its component parts.

Follow-up verification test means, for the purposes of §82.156(i), those tests that involve checking the repairs within 30 days of the appliance's returning to normal operating characteristics and conditions. Follow-up verification tests for appliances from which the refrigerant charge has been evacuated means a test conducted after the appliance or portion of the appliance has resumed operation at normal operating characteristics and conditions of temperature and pressure, except in cases where sound professional judgment dictates that these tests will be more meaningful if performed prior to the return to normal operating characteristics and conditions. A follow-up verification test with respect to repairs conducted without evacuation of the refrigerant charge means a reverification test conducted after the initial verification test and usually within 30 days of normal operating conditions. Where an appliance is not evacuated, it is only necessary to conclude any required changes in pressure, temperature or other conditions to return the appliance to normal operating characteristics and conditions.

Full charge means the amount of refrigerant required for normal operating characteristics and conditions of the appliance as determined by using one or a combination of the following four methods:

(1) Use the equipment manufacturer's determination of the correct full charge for the equipment;

(2) Determine the full charge by making appropriate calculations based on component sizes, density of refrigerant, volume of piping, and other relevant considerations;

(3) Use actual measurements of the amount of refrigerant added or evacuated from the appliance; and/or

(4) Use an established range based on the best available data regarding the normal operating characteristics and conditions for the appliance, where the midpoint of the range will serve as the full charge, and where records are maintained in accordance with §82.166(q).

High-pressure appliance means an appliance that uses a refrigerant with a liquid phase saturation pressure between 170 psia and 355 psia at 104 °F. This definition includes but is not limited to appliances using R–401A, R–409A, R–401B, R–411A, R–22, R–411B, R–502, R–402B, R–408A, and R–402A.

Industrial process refrigeration means, for the purposes of §82.156(i), complex customized appliances used in the chemical, pharmaceutical, petrochemical and manufacturing industries. These appliances are directly linked to the industrial process. This sector also includes industrial ice machines, appliances used directly in the generation of electricity, and ice rinks. Where one appliance is used for both industrial process refrigeration and other applications, it will be considered industrial process refrigeration equipment if 50 percent or more of its operating capacity is used for industrial process refrigeration.

Industrial process shutdown means, for the purposes of §82.156(i), that an industrial process or facility temporarily ceases to operate or manufacture whatever is being produced at that facility.

Initial verification test means, for the purposes of §82.156(i), those leak tests that are conducted as soon as practicable after the repair is completed. An initial verification test, with regard to the leak repairs that require the evacuation of the appliance or portion of the appliance, means a test conducted prior to the replacement of the full refrigerant charge and before the appliance or portion of the appliance has reached operation at normal operating characteristics and conditions of temperature and pressure. An initial verification test with regard to repairs conducted without the evacuation of the refrigerant charge means a test conducted as soon as practicable after the conclusion of the repair work.

Leak rate means the rate at which an appliance is losing refrigerant, measured between refrigerant charges. The leak rate is expressed in terms of the percentage of the appliance's full charge that would be lost over a 12-month period if the current rate of loss were to continue over that period. The rate is calculated using only one of the following methods for all appliances located at an operating facility.

(1) Method 1. (i) Step 1. Take the number of pounds of refrigerant added to the appliance to return it to a full charge and divide it by the number of pounds of refrigerant the appliance normally contains at full charge;

(ii) Step 2. Take the shorter of the number of days that have passed since the last day refrigerant was added or 365 days and divide that number by 365 days;

(iii) Step 3. Take the number calculated in Step 1. and divide it by the number calculated in Step 2.; and

(iv) Step 4. Multiply the number calculated in Step 3. by 100 to calculate a percentage. This method is summarized in the following formula:

$$\begin{array}{c}\text{Leak rate}\\ \text{(\% per year)}\end{array} = \frac{\text{pounds of refrigerant added}}{\begin{array}{c}\text{pounds of refrigerant}\\ \text{in full charge}\end{array}} \times \frac{365\ \textit{days/year}}{\begin{array}{c}\textit{shorter}\text{ of: \# days since}\\ \text{refrigerant last added or 365 days}\end{array}} \times 100\%$$

(2) Method 2. (i) Step 1. Take the sum of the quantity of refrigerant added to the appliance over the previous 365-day period (or over the period that has passed since leaks in the appliance were last repaired, if that period is less than one year),

(ii) Step 2. Divide the result of Step 1. by the quantity (*e.g.*, pounds) of refrigerant the appliance normally contains at full charge, and

(iii) Step 3. Multiply the result of Step 2. by 100 to obtain a percentage. This method is summarized in the following formula:

$$\underset{\text{(\% per year)}}{\text{Leak rate}} = \frac{\text{pounds of refrigerant added over past 365 days (or since leaks were last repaired, if that period is less than one year)}}{\text{pounds of refrigerant in full charge}} \times 100\%$$

Low-loss fitting means any device that is intended to establish a connection between hoses, appliances, or recovery or recycling machines and that is designed to close automatically or to be closed manually when disconnected, minimizing the release of refrigerant from hoses, appliances, and recovery or recycling machines.

Low-pressure appliance means an appliance that uses a refrigerant with a liquid phase saturation pressure below 45 psia at 104 °F. This definition includes but is not limited to appliances using R–11, R–123, and R–113.

Major maintenance, service, or repair means any maintenance, service, or repair that involves the removal of any or all of the following appliance components: compressor, condenser, evaporator, or auxiliary heat exchange coil; or any maintenance, service, or repair that involves uncovering an opening of more than four (4) square inches of "flow area" for more than 15 minutes.

Medium-pressure appliance means an appliance that uses a refrigerant with a liquid phase saturation pressure between 45 psia and 170 psia at 104 °F. This definition includes but is not limited to appliances using R–114, R–124, R–12, R–401C, R–406A, and R–500.

Motor vehicle air conditioner (MVAC) means any appliance that is a motor vehicle air conditioner as defined in 40 CFR part 82, subpart B.

MVAC-like appliance means mechanical vapor compression, open-drive compressor appliances with a normal charge of 20 pounds or less of refrigerant used to cool the driver's or passenger's compartment of an off-road motor vehicle. This includes the air-conditioning equipment found on agricultural or construction vehicles. This definition is not intended to cover appliances using R–22 refrigerant.

Normal operating characteristics or conditions means, for the purposes of §82.156(i), temperatures, pressures, fluid flows, speeds and other characteristics that would normally be expected for a given process load and ambient condition during operation. Normal operating characteristics and conditions are marked by the absence of atypical conditions affecting the operation of the refrigeration appliance.

Normally containing a quantity of refrigerant means containing the quantity of refrigerant within the appliance or appliance component when the appliance is operating with a full charge of refrigerant.

One-time expansion device means an appliance that relies on the one-time release of its refrigerant charge to the environment in order to provide a cooling effect.

Opening an appliance means any service, maintenance, repair, or disposal of an appliance that would release refrigerant from the appliance to the atmosphere unless the refrigerant was recovered previously from the appliance. Connecting and disconnecting hoses and gauges to and from the appliance to measure pressures within the appliance and to add refrigerant to or recover refrigerant from the appliance shall not be considered "opening."

Parent company means an individual, corporation, partnership, association, joint-stock company, or an unincorporated organization that can direct or cause the direction of management and policies of another entity, through the ownership of shares or otherwise.

Person means any individual or legal entity, including an individual, corporation, partnership, association, state, municipality, political subdivision of a state, Indian tribe, and any agency, department, or instrumentality of the United States, and any officer, agent, or employee thereof.

Process stub means a length of tubing that provides access to the refrigerant inside a small appliance or room air conditioner and that can be resealed at the conclusion of repair or service.

Reclaim refrigerant means to reprocess refrigerant to all of the specifications in appendix A to 40 CFR part 82, subpart F (based on ARI Standard 700–1995, Specification for Fluorocarbons and Other Refrigerants) that are applicable to that refrigerant and to verify that the refrigerant meets these specifications using the analytical methodology prescribed in section 5 of appendix A of 40 CFR part 82, subpart F.

Recover refrigerant means to remove refrigerant in any condition from an appliance and to store it in an external container without necessarily testing or processing it in any way.

Recovery efficiency means the percentage of refrigerant in an appliance that is recovered by a piece of recycling or recovery equipment.

Recycle refrigerant means to extract refrigerant from an appliance and clean refrigerant for reuse without meeting all of the requirements for reclamation. In general, recycled refrigerant is refrigerant that is cleaned using oil separation and single or multiple passes through devices, such as replaceable core filter-driers, which reduce moisture, acidity, and particulate matter. These procedures are usually implemented at the field job site.

Refrigerant means, for purposes of this subpart, any substance consisting in part or whole of a class I or class II ozone-depleting substance that is used for heat transfer purposes and provides a cooling effect.

Refrigerant circuit means the parts of an appliance that are normally connected to each other (or are separated only by internal valves) and are designed to contain refrigerant.

Self-contained recovery equipment means refrigerant recovery or recycling equipment that is capable of removing the refrigerant from an appliance without the assistance of components contained in the appliance.

Small appliance means any appliance that is fully manufactured, charged, and hermetically sealed in a factory with five (5) pounds or less of a class I or class II substance used as a refrigerant, including, but not limited to, refrigerators and freezers (designed for home, commercial, or consumer use), medical or industrial research refrigeration equipment, room air conditioners (including window air conditioners and packaged terminal air heat pumps), dehumidifiers, under-the-counter ice makers, vending machines, and drinking water coolers.

Substitute means any chemical or product, whether existing or new, that is used by any person as an EPA approved replacement for a class I or II ozone-depleting substance in a given refrigeration or air-conditioning end-use.

Suitable replacement refrigerant means, for the purposes of §82.156(i)(7)(i), a refrigerant that is acceptable under section 612(c) of the Clean Air Act Amendments of 1990 and all regulations promulgated under that section, compatible with other materials with which it may come into contact, and able to achieve the temperatures required for the affected industrial process in a technically feasible manner.

System-dependent recovery equipment means refrigerant recovery equipment that requires the assistance of components contained in an appliance to remove the refrigerant from the appliance.

System mothballing means the intentional shutting down of a refrigeration appliance undertaken for an extended period of time by the owners or operators of that facility, where the refrigerant has been evacuated from the appliance or the affected isolated section of the appliance, at least to atmospheric pressure.

Technician means any person who performs maintenance, service, or repair, that could be reasonably expected to release refrigerants from appliances, except for MVACs, into the atmosphere. Technician also means any person who performs disposal of appliances, except for small appliances, MVACs, and MVAC-like appliances, that could be reasonably expected to release refrigerants from the appliances into the atmosphere. Performing maintenance, service, repair, or disposal could be reasonably expected to release refrigerants only if the activity is reasonably expected to violate the integrity of the refrigerant circuit. Activities reasonably expected to violate the integrity of the refrigerant circuit include activities such as attaching and detaching hoses and gauges to and from the appliance to add or remove refrigerant or to measure pressure and adding refrigerant to and removing refrigerant from the appliance. Activities such as painting the appliance, rewiring an external electrical circuit, replacing insulation on a length of pipe, or tightening nuts and bolts on the appliance are not reasonably expected to violate the integrity of the refrigerant circuit. Performing maintenance, service, repair, or disposal of appliances that have been evacuated pursuant to §82.156 could not be reasonably expected to release refrigerants from the appliance unless the maintenance, service, or repair consists of adding refrigerant to the appliance. Technician includes but is not limited to installers, contractor employees, in-house service personnel, and in some cases owners and/or operators.

Very high-pressure appliance means an appliance that uses a refrigerant with a critical temperature below 104 °F or with a liquid phase saturation pressure above 355 psia at 104 °F. This definition includes but is not limited to appliances using R–13 or R–503.

Voluntary certification program means a technician testing program operated by a person before that person obtained approval of a technician certification program pursuant to §82.161(c).

[58 FR 28712, May 14, 1993, as amended at 59 FR 42956, Aug. 19, 1994; 59 FR 55925, Nov. 9, 1994; 60 FR 40439, Aug. 8, 1995; 68 FR 43806, July 24, 2003; 69 FR 11978, Mar. 12, 2004; 70 FR 1991, Jan. 11, 2005; 70 FR 19278, Apr. 13, 2005]

§ 82.154 Prohibitions.

(a)(1) Effective June 13, 2005, no person maintaining, servicing, repairing, or disposing of appliances may knowingly vent or otherwise release into the environment any refrigerant or substitute from such appliances, with the exception of the following substitutes in the following end-uses:

(i) Ammonia in commercial or industrial process refrigeration or in absorption units;

(ii) Hydrocarbons in industrial process refrigeration (processing of hydrocarbons);

(iii) Chlorine in industrial process refrigeration (processing of chlorine and chlorine compounds);

(iv) Carbon dioxide in any application;

(v) Nitrogen in any application; or

(vi) Water in any application.

(2) The knowing release of a refrigerant or non-exempt substitute subsequent to its recovery from an

appliance shall be considered a violation of this prohibition. De minimis releases associated with good faith attempts to recycle or recover refrigerants or non-exempt substitutes are not subject to this prohibition. Refrigerant releases shall be considered de minimis only if they occur when:

(i) The required practices set forth in §82.156 are observed, recovery or recycling machines that meet the requirements set forth in §82.158 are used, and the technician certification provisions set forth in §82.161 are observed; or

(ii) The requirements set forth in subpart B of this part are observed.

(b) No person may open appliances except MVACs and MVAC-like appliances for maintenance, service, or repair, and no person may dispose of appliances except for small appliances, MVACs, and MVAC-like appliances:

(1) Without observing the required practices set forth in §82.156; and

(2) Without using equipment that is certified for that type of appliance pursuant to §82.158.

(c) No person may manufacture or import recycling or recovery equipment for use during the maintenance, service, or repair of appliances except MVACs and MVAC-like appliances, and no person may manufacture or import recycling or recovery equipment for use during the disposal of appliances except small appliances, MVACs, and MVAC-like appliances, unless the equipment is certified pursuant to §82.158 (b) or (d), as applicable.

(d) Effective June 14, 1993, no person shall alter the design of certified refrigerant recycling or recovery equipment in a way that would affect the equipment's ability to meet the certification standards set forth in §82.158 without resubmitting the altered design for certification testing. Until it is tested and shown to meet the certification standards set forth in §82.158, equipment so altered will be considered uncertified for the purposes of §82.158.

(e) Effective August 12, 1993, no person may open appliances except MVACs for maintenance, service, or repair, and no person may dispose of appliances except for small appliances, MVACs, and MVAC-like appliances, unless such person has certified to the Administrator pursuant to §82.162 that such person has acquired certified recovery or recycling equipment and is complying with the applicable requirements of this subpart.

(f) Effective August 12, 1993, no person may recover refrigerant from small appliances, MVACs, and MVAC-like appliances for purposes of disposal of these appliances unless such person has certified to the Administrator pursuant to §82.162 that such person has acquired recovery equipment that meets the standards set forth in §82.158 (l) and/or (m), as applicable, and that such person is complying with the applicable requirements of this subpart.

(g) No person may sell, distribute, or offer for sale or distribution for use as a refrigerant any class I or class II substance consisting wholly or in part of used refrigerant unless:

(1) The class I or class II substance has been reclaimed as defined in §82.152 by a person who has been certified as a reclaimer pursuant to §82.164;

(2) The class I or class II substance was used only in an MVAC or MVAC-like appliance and is to be used only in an MVAC or MVAC-like appliance and recycled in accordance with §82.34(d);

(3) The class I or class II substance is contained in an appliance that is sold or offered for sale together with

the class I or class II substance;

(4) The class I or class II substance is being transferred between or among a parent company and one or more of its subsidiaries, or between or among subsidiaries having the same parent company; or

(5) The class I or class II substance is being transferred between or among a Federal agency or department and a facility or facilities owned by the same Federal agency or department.

(h) [Reserved]

(i) Effective August 12, 1993, no person reclaiming refrigerant may release more than 1.5% of the refrigerant received by them.

(j) Effective November 15, 1993, no person may sell or distribute, or offer for sale or distribution, any appliances, except small appliances, unless such equipment is equipped with a servicing aperture to facilitate the removal of refrigerant at servicing and disposal.

(k) Effective November 15, 1993, no person may sell or distribute, or offer for sale or distribution any small appliance unless such equipment is equipped with a process stub to facilitate the removal of refrigerant at servicing and disposal.

(l) No technician training or testing program may issue certificates pursuant to §82.161 unless the program complies with all of the standards of §82.161 and appendix D, and has been granted approval.

(m) No person may sell or distribute, or offer for sale or distribution, any substance that consists in whole or in part of a class I or class II substance for use as a refrigerant to any person unless:

(1) The buyer has been certified as a Type I, Type II, Type III, or Universal technician pursuant to §82.161;

(2) The buyer complies with §82.166(b) and employs at least one technician who is certified as a Type I, Type II, Type III, or Universal technician in accordance with §82.161;

(3) The buyer has been certified in accordance with 40 CFR part 82, subpart B and the refrigerant is either R–12 or an approved substitute consisting wholly or in part of a class I or class II substance for use in motor vehicle air conditioners in accordance with 40 CFR part 82, subpart G;

(4) The buyer complies with §82.166 (b) and employs at least one technician who is certified in accordance with 40 CFR part 82, subpart B, and the refrigerant is either R–12 or an approved substitute consisting wholly or in part of a class I or class II substance for use in motor vehicle air conditioners pursuant to 40 CFR part 82, subpart G. Nothing in this provision shall be construed to relieve persons of the requirements of §82.34(b) or §82.42 (b);

(5) The refrigerant is sold only for eventual resale to certified technicians or to appliance manufacturers (*e.g.,* sold by a manufacturer to a wholesaler, sold by a technician to a reclaimer);

(6) The refrigerant is sold to an appliance manufacturer;

(7) The refrigerant is contained in an appliance with a fully assembled refrigerant circuit; or

(8) The refrigerant is charged into an appliance by a certified technician or an apprentice during maintenance, service, or repair of the appliance.

(n) It is a violation of this subpart to accept a signed statement pursuant to §82.156(f)(2) if the person knew or had reason to know that such a signed statement is false.

(o) Rules stayed for consideration. Not withstanding any other provisions of this subpart, the effectiveness of 40 CFR 82.154(m), only as it applies to refrigerant contained in appliances without fully assembled refrigerant circuits, is stayed from April 27, 1995, until EPA takes final action on its reconsideration of these provisions. EPA will publish any such final action in theFederal Register.

(p) No person may manufacture or import one-time expansion devices that contain other than exempted refrigerants.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42956, Aug. 19, 1994; 59 FR 55926, Nov. 9, 1994; 60 FR 14610, Mar. 17, 1995; 60 FR 24680, May 9, 1995; 61 FR 7726, Feb. 29, 1996; 61 FR 68508, Dec. 27, 1996; 68 FR 43806, July 24, 2003; 69 FR 11979, Mar. 12, 2004; 70 FR 19278, Apr. 13, 2005]

§ 82.156 Required practices.

(a) All persons disposing of appliances, except for small appliances, MVACs, and MVAC-like appliances must evacuate the refrigerant, including all the liquid refrigerant, in the entire unit to a recovery or recycling machine certified pursuant to §82.158. All persons opening appliances except for MVACs and MVAC-like appliances for maintenance, service, or repair must evacuate the refrigerant, including all the liquid refrigerant (except as provided in paragraph (a)(2)(i)(B) of this section), in either the entire unit or the part to be serviced (if the latter can be isolated) to a system receiver (*e.g.,* the remaining portions of the appliance, or a specific vessel within the appliance) or a recovery or recycling machine certified pursuant to §82.158. A technician must verify that the applicable level of evacuation has been reached in the appliance or the part before it is opened.

(1) Persons opening appliances except for small appliances, MVACs, and MVAC-like appliances for maintenance, service, or repair must evacuate to the levels in table 1 before opening the appliance, unless

(i) Evacuation of the appliance to the atmosphere is not to be performed after completion of the maintenance, service, or repair, and the maintenance, service, or repair is not major as defined at §82.152; or

(ii) Due to leaks in the appliance, evacuation to the levels in table 1 is not attainable, or would substantially contaminate the refrigerant being recovered; or

(iii) The recycling or recovery equipment was certified pursuant to §82.158(b)(2). In any of these cases, the requirements of §82.156(a)(2) must be followed.

(2)(i) If evacuation of the appliance to the atmosphere is not to be performed after completion of the maintenance, service, or repair, and if the maintenance, service, or repair is not major as defined at §82.152, the appliance must:

(A) Be evacuated to a pressure no higher than 0 psig before it is opened if it is a high- or very high-pressure appliance;

(B) Be pressurized to a pressure no higher than 0 psig before it is opened if it is a low-pressure appliance. Persons must cover openings when isolation is not possible. Persons pressurizing low-pressure appliances that use refrigerants with boiling points at or below 85 degrees Fahrenheit at 29.9 inches of mercury (standard atmospheric pressure), (*e.g.* R–11 and R–123), must not use methods such as nitrogen, that require subsequent purging. Persons pressurizing low-pressure appliances that use refrigerants with boiling points above 85 degrees Fahrenheit at 29.9 inches of mercury, *e.g.*, R–113, must use heat to raise the internal pressure of the appliance as much as possible, but may use nitrogen to raise the internal pressure of the appliance from the level attainable through use of heat to atmospheric pressure; or

(C) For the purposes of oil changes, be evacuated or pressurized to a pressure no higher than 5 psig, before it is opened; or drain the oil into a system receiver to be evacuated or pressurized to a pressure no higher than 5 psig.

(ii) If, due to leaks in the appliance, evacuation to the levels in table 1 is not attainable, or would substantially contaminate the refrigerant being recovered, persons opening the appliance must:

(A) Isolate leaking from non-leaking components wherever possible;

(B) Evacuate non-leaking components to be opened to the levels specified in table 1; and

(C) Evacuate leaking components to be opened to the lowest level that can be attained without substantially contaminating the refrigerant. In no case shall this level exceed 0 psig.

(iii) If the recycling or recovery equipment was certified pursuant to §82.158(b)(2), technicians must follow the manufacturer's directions for achieving the required recovery efficiency.

(3) Persons disposing of appliances except for small appliances, MVACs, and MVAC-like appliances, must evacuate to the levels in table 1 unless, due to leaks in the appliance, evacuation to the levels in table 1 is not attainable, or would substantially contaminate the refrigerant being recovered. If, due to leaks in the appliance, evacuation to the levels in table 1 is not attainable, or would substantially contaminate the refrigerant being recovered, persons disposing of the appliance must:

(i) Isolate leaking from non-leaking components wherever possible;

(ii) Evacuate non-leaking components to the levels specified in table 1; and

(iii) Evacuate leaking components to the lowest level that can be attained without substantially contaminating the refrigerant. In no case shall this level exceed 0 psig.

Table 1—Required Levels of Evacuation for Appliances

[Except for small appliances, MVACs, and MVAC-like appliances]

	Inches of Hg vacuum (relative to standard atmospheric pressure of 29.9 inches Hg)	
Type of appliance	**Using recovery or recycling equipment manufactured or imported before November 15, 1993**	**Using recovery or recycling equipment manufactured or imported on or after November 15, 1993**
Very high-pressure appliance	0	0
High-pressure appliance, or isolated component of such appliance, normally containing less than 200 pounds of refrigerant	0	0

High-pressure appliance, or isolated component of such appliance, normally containing 200 pounds or more of refrigerant	4	10
Medium-pressure appliance, or isolated component of such appliance, normally containing less than 200 pounds of refrigerant	4	10
Medium-pressure appliance, or isolated component of such appliance, normally containing 200 pounds or more of refrigerant	4	15
Low-pressure appliance	25	25 mm Hg absolute

(4) Persons opening small appliances for maintenance, service, or repair must:

(i) When using recycling and recovery equipment manufactured before November 15, 1993, recover 80% of the refrigerant in the small appliance; or

(ii) When using recycling or recovery equipment manufactured on or after November 15, 1993, recover 90% of the refrigerant in the appliance when the compressor in the appliance is operating, or 80% of the refrigerant in the appliance when the compressor in the appliance is not operating; or

(iii) Evacuate the small appliance to four inches of mercury vacuum.

(5) Persons opening MVAC-like appliances for maintenance, service, or repair may do so only while properly using, as defined at §82.32(e), recycling or recovery equipment certified pursuant to §82.158 (f) or (g), as applicable.

(b) All persons opening appliances except for small appliances, MVACs, and MVAC-like appliances for maintenance, service, or repair and all persons disposing of appliances except small appliances, MVACs, and MVAC-like appliances must have at least one piece of certified, self-contained recovery or recycling equipment available at their place of business. Persons who maintain, service, repair, or dispose of only appliances that they own and that contain pump-out units are exempt from this requirement. This exemption does not relieve such persons from other applicable requirements of this section.

(c) System-dependent equipment shall not be used with appliances normally containing more than 15 pounds of refrigerant, unless the system-dependent equipment is permanently attached to the appliance as a pump-out unit.

(d) All recovery or recycling equipment shall be used in accordance with the manufacturer's directions unless such directions conflict with the requirements of this subpart.

(e) Refrigerant may be returned to the appliance from which it is recovered or to another appliance owned by the same person without being recycled or reclaimed, unless the appliance is an MVAC or MVAC-like appliance.

(f) Effective July 13, 1993, persons who take the final step in the disposal process (including but not limited to scrap recyclers and landfill operators) of a small appliance, room air conditioning, MVACs, or MVAC-like appliances must either:

(1) Recover any remaining refrigerant from the appliance in accordance with paragraph (g) or (h) of this section, as applicable; or

(2) Verify that the refrigerant has been evacuated from the appliance or shipment of appliances previously. Such verification must include a signed statement from the person from whom the appliance or shipment of appliances is obtained that all refrigerant that had not leaked previously has been recovered from the appliance or shipment of appliances in accordance with paragraph (g) or (h) of this section, as applicable. This statement must include the name and address of the person who recovered the refrigerant and the date the refrigerant was recovered or a contract that refrigerant will be removed prior to delivery.

(3) Persons complying with paragraph (f)(2) of this section must notify suppliers of appliances that refrigerant must be properly removed before delivery of the items to the facility. The form of this notification may be warning signs, letters to suppliers, or other equivalent means.

(g) All persons recovering refrigerant from MVACs and MVAC-like appliances for purposes of disposal of these appliances must reduce the system pressure to or below 102 mm of mercury vacuum, using equipment that meets the standards set forth in §82.158(l).

(h) All persons recovering the refrigerant from small appliances for purposes of disposal of these appliances must either:

(1) Recover 90% of the refrigerant in the appliance when the compressor in the appliance is operating, or 80% of the refrigerant in the appliance when the compressor in the appliance is not operating; or

(2) Evacuate the small appliance to four inches of mercury vacuum.

(i)(1) Owners or operators of commercial refrigeration equipment normally containing more than 50 pounds of refrigerant must have leaks repaired in accordance with paragraph (i)(9) of this section, if the appliance is leaking at a rate such that the loss of refrigerant will exceed 35 percent of the total charge during a 12-month period, except as described in paragraphs (i)(6), (i)(8), and (i)(10) of this section and paragraphs (i)(1)(i), (i)(1)(ii), and (i)(1)(iii) of this section. Repairs must bring the annual leak rate to below 35 percent.

(i) If the owners or operators of the federally-owned commercial refrigerant appliances determine that the leaks cannot be repaired in accordance with paragraph (i)(9) of this section and that an extension in accordance with the requirements discussed in this paragraph (i)(1)(i) of this section apply, they must document all repair efforts, and notify EPA of their inability to comply within the 30-day repair requirement, and the reason for the inability must be submitted to EPA in accordance with §82.166(n). Such notification must be made within 30 days of discovering the leaks. EPA will determine if the extension requested in accordance with the requirements discussed in paragraph (i)(1)(i) of this section is justified. If the extension is not justified, EPA will notify the owner/operator within 30 days of receipt of the notification.

(ii) Owners or operators of federally-owned commercial refrigeration equipment may have more than 30 days to repair leaks if the refrigeration appliance is located in an area subject to radiological contamination or where the shutting down of the appliance will directly lead to radiological contamination. Only the additional time needed to conduct and complete repairs in a safe working environment will be permitted.

(iii) Owners or operators of federally-owned commercial refrigeration equipment requesting or who are granted time extensions under this paragraph must comply with paragraphs (i)(3) and (i)(4) of this section.

(2) The owners or operators of industrial process refrigeration equipment normally containing more than 50 pounds of refrigerant must have leaks repaired if the appliance is leaking at a rate such that the loss of refrigerant will exceed 35 percent of the total charge during a 12-month period in accordance with paragraph (i)(9) of this section, except as described in paragraphs (i)(6), (i)(7) and (i)(10) of this section, and

paragraphs (i)(2)(i) and (i)(2)(ii) of this section. Repairs must bring annual leak rates to below 35 percent during a 12-month period. If the owners or operators of the industrial process refrigeration equipment determine that the leak rate cannot be brought to below 35 percent during a 12-month period within 30 days (or 120 days, where an industrial process shutdown in accordance with paragraph (i)(2)(ii) of this section is required,) and in accordance with paragraph (i)(9) of this section, and that an extension in accordance with the requirements discussed in this paragraph apply, the owners or operators of the appliance must document all repair efforts, and notify EPA of the reason for the inability in accordance with §82.166(n) within 30 days of making this determination. Owners or operators who obtain an extension pursuant to this section or elect to utilize the additional time provided in paragraph (i)(2)(i) of this section, must conduct all necessary leak repairs, if any, that do not require any additional time beyond the initial 30 or 120 days.

(i) The owners or operators of industrial process refrigeration equipment are permitted more than 30 days (or 120 days where an industrial process shutdown in accordance with paragraph (i)(2)(ii) of this section is required) to repair leaks, if the necessary parts are unavailable or if requirements of other applicable federal, state, or local regulations make a repair within 30 or 120 days impossible. Only the additional time needed to receive delivery of the necessary parts or to comply with the pertinent regulations will be permitted.

(ii) Owners or operators of industrial process refrigeration equipment will have a 120-day repair period, rather than a 30-day repair period, to repair leaks in instances where an industrial process shutdown is needed to repair a leak or leaks from industrial process refrigeration equipment.

(3) Owners or operators of industrial process refrigeration equipment and owners or operators of federally-owned commercial refrigeration equipment or of federally-owned comfort cooling appliances who are granted additional time under paragraphs (i)(1) or (i)(5) of this section, must have repairs performed in a manner that sound professional judgment indicates will bring the leak rate below the applicable allowable leak rate. When an industrial process shutdown has occurred or when repairs have been made while an appliance is mothballed, the owners or operators shall conduct an initial verification test at the conclusion of the repairs and a follow-up verification test. The follow-up verification test shall be conducted within 30 days of completing the repairs or within 30 days of bringing the appliance back on-line, if taken off-line, but no sooner than when the appliance has achieved normal operating characteristics and conditions. When repairs have been conducted without an industrial process shutdown or system mothballing, an initial verification test shall be conducted at the conclusion of the repairs, and a follow-up verification test shall be conducted within 30 days of the initial verification test. In all cases, the follow-up verification test shall be conducted at normal operating characteristics and conditions, unless sound professional judgment indicates that tests performed at normal operating characteristics and conditions will produce less reliable results, in which case the follow-up verification test shall be conducted at or near the normal operating pressure where practicable, and at or near the normal operating temperature where practicable.

(i) If the owners or operators of industrial process refrigeration equipment takes the appliance off-line, or if the owners or operators of federally-owned commercial refrigeration or of federally-owned comfort cooling appliances who are granted additional time under paragraphs (i)(1) or (i)(5) of this section take the appliance off-line, they cannot bring the appliance back on-line until an initial verification test indicates that the repairs undertaken in accordance with paragraphs (i)(1)(i), (ii), (iii), or (i)(2)(i) and (ii), or (5)(i), (ii), and (iii) of this section have been successfully completed, demonstrating the leak or leaks are repaired. The owners or operators of the industrial process refrigeration equipment, federally-owned commercial refrigeration appliances, or federally-owned comfort cooling appliances are exempted from this requirement only where the owners or operators will retrofit or retire the industrial process refrigeration equipment, federally-owned commercial refrigeration appliance, or federally-owned comfort cooling appliance in accordance with paragraph (i)(6) of this section. Under this exemption, the owner or operators may bring the industrial process refrigeration equipment, federally-owned commercial refrigeration appliance, or federally-owned comfort cooling appliance back on-line without successful completion of an initial verification test.

(ii) If the follow-up verification test indicates that the repairs to industrial process refrigeration equipment, federally-owned commercial refrigeration equipment, or federally-owned comfort cooling appliances have not been successful, the owner or operator must retrofit or retire the equipment in accordance with paragraph (i)(6) and any such longer time period as may apply under paragraphs (i)(7)(i), (ii) and (iii) or (i)(8)(i) and (ii) of this section. The owners and operators of the industrial process refrigeration equipment, federally-owned commercial refrigeration equipment, or federally-owned comfort cooling appliances are relieved of this requirement if the conditions of paragraphs (i)(3)(iv) and/or (i)(3)(v) of this section are met.

(iii) The owner or operator of industrial process refrigeration equipment that fails a follow-up verification test must notify EPA within 30 days of the failed follow-up verification test in accordance with §82.166(n).

(iv) The owner or operator is relieved of the obligation to retrofit or replace the industrial process refrigeration equipment as discussed in paragraph (i)(6) of this section if second repair efforts to fix the same leaks that were the subject of the first repair efforts are successfully completed within 30 days or 120 days where an industrial process shutdown is required, after the initial failed follow-up verification test. The second repair efforts are subject to the same verification requirements of paragraphs (i)(3), (i)(3) (i) and (ii) of this section. The owner or operator is required to notify EPA within 30 days of the successful follow-up verification test in accordance with §82.166(n) and the owner or operator is no longer subject to the obligation to retrofit or replace the appliance that arose as a consequence of the initial failure to verify that the leak repair efforts were successful.

(v) The owner or operator of industrial process refrigeration equipment is relieved of the obligation to retrofit or replace the equipment in accordance with paragraph (i)(6) of this section if within 180 days of the initial failed follow-up verification test, the owner or operator establishes that the appliance's annual leak rate does not exceed the applicable allowable annual leak rate, in accordance with paragraph (i)(4) of this section. If the appliance's owner or operator establishes that the appliance's annual leak rate does not exceed the applicable allowable annual leak rate, the owner or operator is required to notify EPA within 30 days of that determination in accordance with §82.166(n) and the owner or operator would no longer be subject to the obligation to retrofit or replace the equipment that arose as a consequence of the initial failure to verify that the leak repair efforts were successful.

(4) In the case of a failed follow-up verification test subject to paragraph (i)(3)(v) of this section, the determination of whether industrial process refrigeration equipment has an annual leak rate that exceeds the applicable allowable annual leak rate will be made in accordance with parameters identified by the owner or operator in its notice to EPA regarding the failure of the initial follow-up verification test, if those parameters are acceptable to EPA; otherwise by parameters selected by EPA. The determination must be based on the full charge for the affected industrial process refrigeration equipment. The leak rate determination parameters in the owner's or operator's notice will be considered acceptable unless EPA notifies the owners or operators within 30 days of receipt of the notice. Where EPA does not accept the parameters identified by the owner or operator in its notice, EPA will not provide additional time beyond the additional time permitted in paragraph (i)(3)(v) of this section unless specifically stated in the parameters selected by EPA.

(5) Owners or operators of comfort cooling appliances normally containing more than 50 pounds of refrigerant and not covered by paragraph (i)(1) or (i)(2) of this section must have leaks repaired in accordance with paragraph (i)(9) of this section if the appliance is leaking at a rate such that the loss of refrigerant will exceed 15 percent of the total charge during a 12-month period, except as described in paragraphs (i)(6), (i)(8) and (i)(10) of this section and paragraphs (i)(5)(i), (i)(5)(ii) and (i)(5)(iii) of this section. Repairs must bring the annual leak rate to below 15 percent.

(i) If the owners or operators of federally-owned comfort-cooling appliances determine that the leaks cannot be repaired in accordance with paragraph (i)(9) of this section and that an extension in accordance with the requirements discussed in paragraph (i)(5) of this section apply, they must document all repair efforts, and notify EPA of their inability to comply within the 30-day repair requirement, and the reason for the inability must be submitted to EPA in accordance with §82.166(n). Such notification must be made within 30 days of discovering that leak repair efforts cannot be completed within 30 days.

(ii) Owners or operators of federally-owned comfort-cooling appliances may have more than 30 days to repair leaks where the refrigeration appliance is located in an area subject to radiological contamination or where the shutting down of the appliance will directly lead to radiological contamination. Only the additional time needed to conduct and complete work in a safe environment will be permitted.

(iii) Owners or operators of federally-owned comfort-cooling appliances requesting, or who are granted, time extensions under this paragraph must comply with paragraphs (i)(3) and (i)(4) of this section.

(6) Owners or operators are not required to repair leaks as provided in paragraphs (i)(1), (i)(2), and (i)(5) of this section if, within 30 days of discovering a leak greater than the applicable allowable leak rate, or within 30 days of a failed follow-up verification test, or after making good faith efforts to repair the leaks as described in paragraph (i)(6)(i) of this section, they develop a one-year retrofit or retirement plan for the leaking appliance. Owners or operators who decide to retrofit the appliance must use a refrigerant or substitute with a lower or equivalent ozone-depleting potential than the previous refrigerant and must include such a change in the retrofit plan. Owners or operators who retire and replace the appliance must replace the appliance with an appliance that uses a refrigerant or substitute with a lower or equivalent ozone-depleting potential and must include such a change in the retirement plan. The retrofit or retirement plan (or a legible copy) must be kept at the site of the appliance. The original plan must be made available for EPA inspection upon request. The plan must be dated, and all work performed in accordance with the plan must be completed within one year of the plan's date, except as described in paragraphs (i)(6)(i), (i)(7), and (i)(8) of this section. Owners or operators are temporarily relieved of this obligation if the appliance has undergone system mothballing as defined in §82.152.

(i) If the owner or operator has made good faith efforts to repair leaks from the appliance in accordance with paragraphs (i)(1), (i)(2), or (i)(5) of this section and has decided prior to completing a follow-up verification test, to retrofit or retire the appliance in accordance with paragraph (i)(6) of this section, the owner or operator must develop a retrofit or retirement plan within 30 days of the decision to retrofit or retire the appliance. The owner or operator must complete the retrofit or retirement of the appliance within one year and 30 days of when the owner or operator discovered that the leak rate exceeded the applicable allowable leak rate, except as provided in paragraphs (i)(7) and (i)(8) of this section.

(ii) In all cases, subject to paragraph (i)(6)(i) of this section, the written plan shall be prepared no later than 30 days after the owner or operator has determined to proceed with retrofitting or retiring the appliance. All reports required under §82.166(o) shall be due at the time specified in the paragraph imposing the specific reporting requirement, or no later than 30 days after the decision to retrofit or retire the appliance, whichever is later.

(iii) In cases where the owner or operator of industrial process refrigeration equipment has made good faith efforts to retrofit or retire industrial process refrigeration equipment prior to August 8, 1995, and where these efforts are not complete, the owner or operator must develop a retrofit or retirement plan that will complete the retrofit or retirement of the affected appliance by August 8, 1996. This plan (or a legible copy) must be kept at the site of the appliance. The original must be made available for EPA inspection upon request. Where the conditions of paragraphs (i)(7) and (i)(8) of this section apply, and where the length of time necessary to complete the work is beyond August 8, 1996, all records must be submitted to EPA in accordance with §82.166(o), as well as maintained on-site.

(7) The owners or operators of industrial process refrigeration equipment will be allowed additional time to complete the retrofit or retirement of industrial process refrigeration equipment if the conditions described in paragraphs (i)(7)(i) or (i)(7)(ii) of this section are met. The owners or operators of industrial process refrigeration equipment will be allowed additional time beyond the additional time provided in paragraph (i)(7)(ii) of this section if the conditions described in paragraph (i)(7)(iii) of this section are met.

(i) Additional time, to the extent reasonably necessary will be allowed for retrofitting or retiring industrial process refrigeration equipment due to delays occasioned by the requirements of other applicable federal, state, or local laws or regulations, or due to the unavailability of a suitable replacement refrigerant with a lower ozone depletion potential. If these circumstances apply, the owner or operator of the facility must notify EPA within six months after the 30-day period following the discovery of an exceedance of the 35 percent leak rate. Records necessary to allow EPA to determine that these provisions apply and the length of time necessary to complete the work must be submitted to EPA in accordance with §82.166(o), as well as maintained on-site. EPA will notify the owner or operator of its determination within 60 days of receipt the submittal.

(ii) An additional one-year period beyond the initial one-year retrofit period is allowed for industrial process refrigeration equipment where the following criteria are met:

(A) The new or the retrofitted industrial process refrigerant equipment is custom-built;

(B) The supplier of the appliance or one or more of its critical components has quoted a delivery time of more than 30 weeks from when the order is placed;

(C) The owner or operator notifies EPA within six months of the expiration of the 30-day period following the discovery of an exceedance of the 35 percent leak rate to identify the owner or operator, describe the appliance involved, explain why more than one year is needed, and demonstrate that the first two criteria are met in accordance with §82.166(o); and

(D) The owner or operator maintains records that are adequate to allow a determination that the criteria are met.

(iii) The owners or operators of industrial process refrigeration equipment may request additional time to complete retrofitting or retiring industrial process refrigeration equipment beyond the additional one-year period if needed and where the initial additional one year was granted in accordance with paragraph (i)(7)(ii) of this section. The request shall be submitted to EPA before the end of the ninth month of the first additional year and shall include revisions of information required under §82.166(o). Unless EPA objects to this request submitted in accordance with §82.166(o) within 30 days of receipt, it shall be deemed approved.

(8) Owners or operators of federally-owned commercial or comfort-cooling appliances will be allowed an additional year to complete the retrofit or retirement of the appliances if the conditions described in paragraph (i)(8)(i) of this section are met, and will be allowed one year beyond the additional year if the conditions in paragraph (i)(8)(ii) of this section are met.

(i) Up to one additional one-year period beyond the initial one-year retrofit period is allowed for such equipment where the following criteria are met:

(A) Due to complications presented by the federal agency appropriations and/or procurement process, a delivery time of more than 30 weeks from the beginning of the official procurement process is quoted, or where the appliance is located in an area subject to radiological contamination and creating a safe working environment will require more than 30 weeks;

(B) The operator notifies EPA within six months of the expiration of the 30-day period following the discovery of an exceedance of the applicable allowable annual leak rate to identify the operator, describe the appliance involved, explain why more than one year is needed, and demonstrate that the first criterion is met in accordance with §82.166(o); and

(C) The operator maintains records adequate to allow a determination that the criteria are met.

(ii) The owners or operators of federally-owned commercial or comfort-cooling appliances may request additional time to complete retrofitting, replacement or retiring such appliances beyond the additional one-year period if needed and where the initial additional one year was granted in accordance with paragraph (i)(8)(i) of this section. The request shall be submitted to EPA before the end of the ninth month of the first additional year and shall include revisions of information earlier submitted as required under §82.166(o). Unless EPA objects to this request submitted in accordance with §82.166(o) within 30 days of receipt, it shall be deemed approved.

(9) Owners or operators must repair leaks pursuant to paragraphs (i)(1), (i)(2) and (i)(5) of this section within 30 days after discovery, or within 30 days after when the leaks should have been discovered if the owners intentionally shielded themselves from information which would have revealed a leak, unless granted additional time pursuant to §82.156(i).

(10) The amount of time for owners and operators to complete repairs, retrofit plans or retrofits/replacements/ retirements under paragraphs (i)(1), (i)(2), (i)(5), (i)(6), (i)(7), (i)(8), and (i)(9) of this section is temporarily suspended at the time an appliance is mothballed as defined in §82.152. The time for owners and operators to complete repairs, retrofit plans, or retrofits/replacements will resume on the day the appliance is brought back on-line and is no longer considered mothballed. All initial and follow-up verification tests must be performed in accordance with paragraphs (i)(3), (i)(3)(i), and (i)(3)(ii) of this section.

(11) In calculating annual leak rates, purged refrigerant that is destroyed at a verifiable destruction efficiency of 98 percent or greater will not be counted toward the leak rate. Owners or operators destroying purged refrigerants must maintain information as set forth in §82.166(p)(1) and submit to EPA, within 60 days after the first time such exclusion is used by that facility, information set forth in §82.166(p)(2).

[58 FR 28712, May 14, 1993, as amended at 59 FR 42956, 42962, Aug. 19, 1994; 59 FR 55926, Nov. 9, 1994; 60 FR 40440, Aug. 8, 1995; 68 FR 43807, July 24, 2003; 69 FR 11979, Mar. 12, 2004; 70 FR 1991, Jan. 11, 2005]

§ 82.158 Standards for recycling and recovery equipment.

(a) Effective September 22, 2003, all manufacturers and importers of recycling and recovery equipment intended for use during the maintenance, service, or repair of appliances except MVACs and MVAC-like appliances or during the disposal of appliances except small appliances, MVACs, and MVAC-like appliances, shall have had such equipment certified by an approved equipment testing organization to meet the applicable requirements in paragraph (b)(1), (b)(2), or (d) of this section. All manufacturers and importers of recycling and recovery equipment intended for use during the maintenance, service, or repair of MVAC-like appliances shall have had such equipment certified pursuant to §82.36(a).

(b) Equipment manufactured or imported on or after November 15, 1993 and before September 22, 2003, for use during the maintenance, service, or repair of appliances except small appliances, MVACs, and MVAC-like appliances or during the disposal of appliances except small appliances, MVACs, and MVAC-like appliances must be certified by an approved equipment testing organization to meet the requirements of paragraph (b)(1) of this section and the following requirements below. Equipment manufactured or imported on or after September 22, 2003, for use during the maintenance, service, or repair of appliances except small appliances, MVACs, and MVAC-like appliances or during the disposal of appliances except small appliances, MVACs, and MVAC-like appliances must be certified by an approved equipment testing organization to meet the requirements of paragraph (b)(2) of this section and the following requirements.

(1) In order to be certified, the equipment must be capable of achieving the level of evacuation specified in Table 2 of this section under the conditions of appendix B1 of this subpart (based upon the ARI Standard 740–1993, Performance of Refrigerant Recovery, Recycling and/or Reclaim Equipment):

Table 2—Levels of Evacuation Which Must Be Achieved by Recovery or Recycling Equipment Intended for Use With Appliances[1]

[Manufactured on or after November 15, 1993]

Type of appliance with which recovery or recycling machine is intended to be used	Inches of Hg vacuum
HCFC-22 appliances, or isolated component of such appliances, normally containing less than 200 pounds of refrigerant	0
HCFC-22 appliances, or isolated component of such appliances, normally containing 200 pounds or more of refrigerant	10
Very high-pressure appliances	0
Other high-pressure appliances, or isolated component of such appliances, normally containing less than 200 pounds of refrigerant	10
Other high-pressure appliances, or isolated component of such appliances, normally containing 200 pounds or more of refrigerant	15
Low-pressure appliances	[2]25

[1]Except for small appliances, MVACs, and MVAC-like appliances.

[2]mm Hg absolute.

The vacuums specified in inches of Hg vacuum must be achieved relative to an atmospheric pressure of 29.9 inches of Hg absolute.

(2) In order to be certified, the equipment must be capable of achieving the level of evacuation specified in Table 2 of paragraph (b)(1) of this section under the conditions of appendix B2 of this subpart (based upon the ARI Standard 740–1995, Performance of Refrigerant Recovery, Recycling and/or Reclaim Equipment).

(3) Recovery or recycling equipment whose recovery efficiency cannot be tested according to the procedures in appendix B1 or B2 of this subpart as applicable may be certified if an approved third-party testing organization adopts and performs a test that demonstrates, to the satisfaction of the Administrator, that the recovery efficiency of that equipment is equal to or better than that of equipment that:

(i) Is intended for use with the same type of appliance; and

(ii) Achieves the level of evacuation in Table 2. The manufacturer's instructions must specify how to achieve the required recovery efficiency, and the equipment must be tested when used according to these instructions.

(4) The equipment must meet the minimum requirements for certification under appendix B1 or B2 of this subpart as applicable.

(5) If the equipment is equipped with a noncondensables purge device, the equipment must not release more than three (3) percent of the quantity of refrigerant being recycled through noncondensables purging under the conditions of appendix B1 and B2 of this subpart as applicable.

(6) The equipment must be equipped with low-loss fittings on all hoses.

(7) The equipment must have its liquid recovery rate and its vapor recovery rate measured under the conditions of appendix B1 or B2 as applicable, unless the equipment has no inherent liquid or vapor recovery rate.

(c) Equipment manufactured or imported before November 15, 1993 for use during the maintenance, service, or repair of appliances except small appliances, MVACs, and MVAC-like appliances or during the disposal of appliances except small appliances, MVACs, and MVAC-like appliances will be considered certified if it is capable of achieving the level of evacuation specified in Table 3 of this section when tested using a properly calibrated pressure gauge:

Table 3—Levels of Evacuation Which Must Be Achieved by Recovery or Recycling Machines Intended for Use With Appliances[1]

[Manufactured before November 15, 1993]

Type of air-conditioning or refrigeration equipment with which recovery or recycling machine is intended to be used	Inches of vacuum (relative to standard atmospheric pressure of 29.9 inches Hg)
HCFC-22 equipment, or isolated component of such equipment, normally containing less than 200 pounds of refrigerant	0
HCFC-22 equipment, or isolated component of such equipment, normally containing 200 pounds or more of refrigerant	4
Very high-pressure equipment	0
Other high-pressure equipment, or isolated component of such equipment, normally containing less than 200 pounds of refrigerant	4
Other high-pressure equipment, or isolated component of such equipment, normally containing 200 pounds or more of refrigerant	4
Low-pressure equipment	25

[1]Except for small appliances, MVACs, and MVAC-like appliances.

(d) Equipment manufactured or imported on or after November 15, 1993 and before September 22, 2003, for use during the maintenance, service, or repair of small appliances must be certified by an approved equipment testing organization to be capable of achieving the requirements described in either paragraph (d)(1) or (d)(2) of this section. Equipment manufactured or imported on or after September 22, 2003, for use during the maintenance, service, or repair of small appliances must be certified by an approved equipment testing organization to be capable of either paragraph (d)(1) or (d)(3) of this section:

(1) Recovering 90% of the refrigerant in the test stand when the compressor of the test stand is operating and 80% of the refrigerant when the compressor of the test stand is not operating when used in accordance with the manufacturer's instructions under the conditions of appendix C, Method for Testing Recovery Devices for Use with Small Appliances; or

(2) Achieving a four-inch vacuum under the conditions of appendix B1 of this subpart, based upon ARI Standard 740–1993; or

(3) Achieving a four-inch vacuum under the conditions of appendix B2 of this subpart, based upon ARI Standard 740–1995.

(e) Equipment manufactured or imported before November 15, 1993 for use with small appliances will be considered certified if it is capable of either:

(1) Recovering 80% of the refrigerant in the system, whether or not the compressor of the test stand is operating, when used in accordance with the manufacturer's instructions under the conditions of appendix C, Method for Testing Recovery Devices for Use with Small Appliances; or

(2) Achieving a four-inch vacuum when tested using a properly calibrated pressure gauge.

(f) Equipment manufactured or imported on or after November 15, 1993 for use during the maintenance, service, or repair of MVAC-like appliances must be certified in accordance with §82.36(a).

(g) Equipment manufactured or imported before November 15, 1993 for use during the maintenance, service, or repair of MVAC-like appliances must be capable of reducing the system pressure to 102 mm of mercury vacuum under the conditions of the SAE Standard, SAE J1990 (appendix A to 40 CFR part 82, subpart B).

(h) Manufacturers and importers of equipment certified under paragraphs (b) and (d) of this section must place a label on each piece of equipment stating the following:

THIS EQUIPMENT HAS BEEN CERTIFIED BY [APPROVED EQUIPMENT TESTING ORGANIZATION] TO MEET EPA's MINIMUM REQUIREMENTS FOR RECYCLING OR RECOVERY EQUIPMENT INTENDED FOR USE WITH [APPROPRIATE CATEGORY OF APPLIANCE].

The label shall also show the date of manufacture and the serial number (if applicable) of the equipment. The label shall be affixed in a readily visible or accessible location, be made of a material expected to last the lifetime of the equipment, present required information in a manner so that it is likely to remain legible for the lifetime of the equipment, and be affixed in such a manner that it cannot be removed from the equipment without damage to the label.

(i) The Administrator will maintain a list of equipment certified pursuant to paragraphs (b), (d), and (f) of this section by manufacturer and model. Persons interested in obtaining a copy of the list should send written inquiries to the address in §82.160(a).

(j) Manufacturers or importers of recycling or recovery equipment intended for use during the maintenance, service, or repair of appliances except MVACs or MVAC-like appliances or during the disposal of appliances except small appliances, MVACs, and MVAC-like appliances must periodically have approved equipment testing organizations conduct either:

(1) Retests of certified recycling or recovery equipment in accordance with paragraph (a) of this section or

(2) Inspections of recycling or recovery equipment at manufacturing facilities to ensure that each equipment model line that has been certified under this section continues to meet the certification criteria.

Such retests or inspections must be conducted at least once every three years after the equipment is first certified.

(k) An equipment model line that has been certified under this section may have its certification revoked if it is subsequently determined to fail to meet the certification criteria. In such cases, the Administrator or her or his designated representative shall give notice to the manufacturer or importer setting forth the basis for her or his determination.

(l) Equipment used to evacuate refrigerant from MVACs and MVAC-like appliances before they are disposed of must be certified in accordance with §82.36(a).

(m) Equipment used to evacuate refrigerant from small appliances before they are disposed of must be capable of either:

(1) Removing 90% of the refrigerant when the compressor of the small appliance is operating and 80% of the refrigerant when the compressor of the small appliance is not operating, when used in accordance with the manufacturer's instructions under the conditions of appendix C, Method for Testing Recovery Devices for Use With Small Appliances; or

(2) Evacuating the small appliance to four inches of vacuum when tested using a properly calibrated pressure gauge.

(n) Effective October 22, 2003, equipment that is advertised or marketed as "recycling equipment" must be capable of recycling the standard contaminated refrigerant sample of appendix B2 of this subpart (based upon ARI Standard 740–1995), section 5, to the levels in the following table when tested under the conditions of appendix B2 of this subpart:

Maximum Levels of Contaminants Permissible in Refrigerant Processed Through Equipment Advertised as "Recycling" Equipment

Contaminants	Low-pressure (R–11, R–123, R–113) systems	R–12 systems	All other systems
Acid Content (by wt.)	1.0 PPM	1.0 PPM	1.0 PPM.
Moisture (by wt.)	20 PPM	10 PPM	20 PPM.
Noncondensable Gas (by vol.)	N/A	2.0%	2.0%.
High Boiling Residues (by vol.)	1.0%	0.02%	0.02%.
Chlorides by Silver Nitrate Test	No turbidity	No turbidity	No turbidity.
Particulates	Visually clean	Visually clean	Visually clean.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42957, Aug. 19, 1994; 68 FR 43807, July 24, 2003; 73 FR 34649, June 18, 2008]

§ 82.160 Approved equipment testing organizations.

(a) Any equipment testing organization may apply for approval by the Administrator to certify equipment pursuant to the standards in §82.158 and appendices B2 or C of this subpart. The application shall be mailed to: Section 608 Recycling Program Manager; Global Programs Division; Mail Code: 6205J; U.S. Environmental Protection Agency; 1200 Pennsylvania Avenue, NW.; Washington, DC 20460.

(b) Applications for approval must include written information verifying the following:

(1) The list of equipment present at the organization that will be used for equipment testing.

(2) Expertise in equipment testing and the technical experience of the organization's personnel.

(3) Thorough knowledge of the standards and recordkeeping and reporting requirements as they appear in §§82.158 and 82.166 and Appendices B2 and/or C (as applicable) of this subpart.

(4) The organization must describe its program for verifying the performance of certified recycling and recovery equipment manufactured over the long term, specifying whether retests of equipment or inspections of equipment at manufacturing facilities will be used.

(5) The organization must have no conflict of interest and receive no direct or indirect financial benefit from the outcome of certification testing.

(6) The organization must agree to allow the Administrator access to records and personnel to verify the information contained in the application.

(c) Organizations may not certify equipment prior to receiving approval from EPA. If approval is denied under this section, the Administrator or her or his designated representative shall give written notice to the organization setting forth the basis for her or his determination.

(d) If at any time an approved testing organization is found to be conducting certification tests for the purposes of this subpart in a manner not consistent with the representations made in its application for approval under this section, the Administrator reserves the right to revoke approval in accordance with §82.169. In such cases, the Administrator or her or his designated representative shall give notice to the organization setting forth the basis for her or his determination.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42962, Aug. 19, 1994; 68 FR 43808, July 24, 2003]

§ 82.161 Technician certification.

(a) Effective November 14, 1994, technicians, except technicians who successfully completed voluntary certification programs that apply for approval under §82.161(g) by December 9, 1994, must be certified by an approved technician certification program under the requirements of this paragraph (a). Effective May 15, 1995, all technicians must be certified by an approved technician certification program under the requirements of this paragraph (a).

(1) Technicians, as defined in §82.152, who maintain, service, or repair small appliances must be properly certified as Type I technicians.

(2) Technicians who maintain, service, or repair medium-, high-, or very high-pressure appliances, except

small appliances, MVACs, and MVAC-like appliances, or dispose of medium-, high-, or very high-pressure appliances, except small appliances, MVACs, and MVAC-like appliances, must be properly certified as Type II technicians.

(3) Technicians who maintain, service, or repair low-pressure appliances or dispose of low-pressure appliances must be properly certified as Type III technicians.

(4) Technicians who maintain, service, or repair low- and high-pressure equipment as described in §82.161(a) (1), (2) and (3) must be properly certified as Universal technicians.

(5) Technicians who maintain, service, or repair MVAC-like appliances must either be properly certified as Type II technicians or complete the training and certification test offered by a training and certification program approved under §82.40.

(6) Apprentices are exempt from this requirement provided the apprentice is closely and continually supervised by a certified technician while performing any maintenance, service, repair, or disposal that could reasonably be expected to release refrigerant from appliances into the environment. The supervising certified technician is responsible for ensuring that the apprentice complies with this subpart.

(b) *Test Subject Material.* The Administrator shall maintain a bank of test questions divided into four groups, including a core group and three technical groups. The Administrator shall release this bank of questions only to approved technician certification programs. Tests for each type of certification shall include a minimum of 25 questions drawn from the core group and a minimum of 25 questions drawn from each relevant technical group. These questions shall address the subject areas listed in appendix D.

(c) *Program Approval.* Persons may seek approval of any technician certification program (program), in accordance with the provisions of this paragraph, by submitting to the Administrator at the address in §82.160(a) verification that the program meets all of the standards listed in appendix D and the following standards:

(1) *Alternative Examinations.* Programs are encouraged to make provisions for non-English speaking technicians by providing tests in other languages or allowing the use of a translator when taking the test. If a translator is used, the certificate received must indicate that translator assistance was required. A test may be administered orally to any person who makes this request, in writing, to the program at least 30 days before the scheduled date for the examination. The letter must explain why the request is being made.

(2) *Recertification.* The Administrator reserves the right to specify the need for technician recertification at some future date, if necessary, by placing a notice in theFederal Register.

(3) *Proof of Certification.* Programs must issue individuals a wallet-sized card to be used as proof of certification, upon successful completion of the test. Programs must issue an identification card to technicians that receive a score of 70 percent or higher on the closed-book certification exam, within 30 days. Programs providing Type I certification using the mail-in format, must issue a permanent identification card to technicians that receive a score of 84 percent or higher on the certification exam, no later than 30 days after the program has received the exam and any additional required material. Each card must include, at minimum, the name of the certifying program, and the date the organization became a certifying program, the name of the person certified, the type of certification, a unique number for the certified person, and the following text:

[Name of person] has been certified as a [Type I, Type II, Type III, and/or Universal, as appropriate] technician as required by 40 CFR part 82, subpart F.

(4) The Administrator reserves the right to consider other factors deemed relevant to ensure the effectiveness of certification programs.

(d) If approval is denied under this section, the Administrator shall give written notice to the program setting forth the basis for her or his determination.

(e) If at any time an approved program violates any of the above requirements, the Administrator reserves the right to revoke approval in accordance with §82.169. In such cases, the Administrator or her or his designated representative shall give notice to the organization setting forth the basis for her or his determination.

(f) Authorized representatives of the Administrator may require technicians to demonstrate on the business entity's premises their ability to perform proper procedures for recovering and/or recycling refrigerant. Failure to demonstrate or failure to properly use the equipment may result in revocation of the certificate. Failure to abide by any of the provisions of this subpart may also result in revocation or suspension of the certificate. If a technician's certificate is revoked, the technician would need to recertify before maintaining, servicing, repairing or disposing of any appliances.

(g)(1) Any person seeking approval of a technician certification program may also seek approval to certify technicians who successfully completed a voluntary certification program operated previously by that person. Interested persons must submit to the Administrator at the address in §82.160(a) verification that the voluntary certification program substantially complied with most of the standards of §82.161(c) and appendix D of subpart F of this part. If the program did not test or train participants on some elements of the test subject material, the person must submit supplementary information on the omitted material to the Administrator for approval and verify that the approved information will be provided to technicians pursuant to section j of appendix D of subpart F of this part. In this case, the person may not issue a certification card to a technician until he or she has received a signed statement from the technician indicating that the technician has read the supplementary information. Approval may be granted for Type I, Type II, or Type III certification, or some combination of these, depending upon the coverage in the voluntary certification program of the information in each Type. In order to have their voluntary programs considered for approval, persons must submit applications both for approval as a technician certification program and for approval as a voluntary program by December 9, 1994.

(2)(i) Persons who are approved to certify technicians who successfully completed their voluntary programs pursuant to §82.161(g)(1) must:

(A) Notify technicians who successfully completed their voluntary programs of the Administrator's decision within 60 days of that decision;

(B) Send any supplementary materials required pursuant to §82.161(g)(1) to technicians who successfully completed their voluntary programs within 60 days of the Administrator's decision; and

(C) Send certification cards to technicians who successfully completed their voluntary programs within 60 days of receipt of signed statements from the technicians indicating that the technicians have read the supplementary information.

(ii) Persons who are disapproved to certify technicians who successfully completed their voluntary programs pursuant to §82.161(g)(1) must notify technicians who successfully completed their voluntary programs of the Administrator's decision within 30 days of that decision.

(iii) Persons who withdraw applications for voluntary program approval submitted pursuant to §82.161(g)(1) must inform technicians who successfully completed their voluntary programs of the withdrawal by the later of 30 days after the withdrawal or December 9, 1994.

(3) Technicians who successfully completed voluntary certification programs may receive certification in a given Type through that program only if:

(i) The voluntary certification program successfully completed by the technician is approved for that Type pursuant to §82.161(g)(1);

(ii) The technician successfully completed the portions of the voluntary certification program that correspond to that Type; and

(iii) The technician reads any supplementary materials required by the Administrator pursuant to §82.161(g)(1) and section j of appendix D of subpart F of this part, and returns the signed statement required by §82.161(g)(1).

[58 FR 28712, May 14, 1993, as amended at 59 FR 42957, 42962, Aug. 19, 1994; 68 FR 43808, July 24, 2003; 69 FR 11980, Mar. 12, 2004]

§ 82.162 Certification by owners of recovery and recycling equipment.

(a) No later than August 12, 1993, or within 20 days of commencing business for those persons not in business at the time of promulgation, persons maintaining, servicing, or repairing appliances except for MVACs, and persons disposing of appliances except for small appliances and MVACs, must certify to the Administrator that such person has acquired certified recovery or recycling equipment and is complying with the applicable requirements of this subpart. Such equipment may include system-dependent equipment but must include self-contained equipment, if the equipment is to be used in the maintenance, service, or repair of appliances except for small appliances. The owner or lessee of the recovery or recycling equipment may perform this certification for his or her employees. Certification shall take the form of a statement signed by the owner of the equipment or another responsible officer and setting forth:

(1) The name and address of the purchaser of the equipment, including the county name;

(2) The name and address of the establishment where each piece of equipment is or will be located;

(3) The number of service trucks (or other vehicles) used to transport technicians and equipment between the establishment and job sites and the field;

(4) The manufacturer name, the date of manufacture, and if applicable, the model and serial number of the equipment; and

(5) The certification must also include a statement that the equipment will be properly used in servicing or disposing of appliances and that the information given is true and correct. Owners or lessees of recycling or recovery equipment having their places of business in:

Connecticut

Maine

Massachusetts

New Hampshire

Rhode Island

Vermont

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region I; Mail Code SEA; JFK Federal Building; One Congress Street, Suite 1100; Boston, MA 02114–2023.

Owners or lessees of recycling or recovery equipment having their places of business in:

New York

New Jersey

Puerto Rico

Virgin Islands

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region II (2DECA-AC); 290 Broadway, 21st Floor; New York, NY 10007–1866.

Owners or lessees of recycling or recovery equipment having their places of business in:

Delaware

District of Columbia

Maryland

Pennsylvania

Virginia

West Virginia

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region III—Wheeling Operations Office; Mail Code 3AP12; 303 Methodist Building; 11th and Chapline Streets; Wheeling, WV 26003.

Owners or lessees of recycling or recovery equipment having their places of business in:

Alabama

Florida

Georgia

Kentucky

Mississippi

North Carolina

South Carolina

Tennessee

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region IV(APT-AE); Atlanta Federal Center; 61 Forsyth Street, SW.; Atlanta, GA

30303.

Owners or lessees of recycling or recovery equipment having their places of business in:

Illinois

Indiana

Michigan

Minnesota

Ohio

Wisconsin

must send their certifications to:

CAA section 608 Enforcement Contact, EPA Region V (AE17J); 77 West Jackson Blvd.; Chicago, IL 60604–3507.

Owners or lessees of recycling or recovery equipment having their places of business in:

Arkansas

Louisiana

New Mexico

Oklahoma

Texas

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region VI (6EN-AA); 1445 Ross Avenue, Suite 1200; Dallas, Texas 75202.

Owners or lessees of recycling or recovery equipment having their places of business in:

Iowa

Kansas

Missouri

Nebraska

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region VII; Mail Code APCO/ARTD; 901 North 5th Street; Kansas City, KS; 66101.

Owners or lessees of recycling or recovery equipment having their places of business in:

Colorado

Montana

North Dakota

South Dakota

Utah

Wyoming

must send their certifications to:

CAA section 608 Enforcement Contact, EPA Region VIII, Mail Code 8ENF-T, 999 18th Street, Suite 500, Denver, CO 80202–2466.

Owners or lessees of recycling or recovery equipment having their places of business in:

American Samoa

Arizona

California

Guam

Hawaii

Nevada

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region IX; Mail Code AIR–5; 75 Hawthorne Street; San Francisco, CA 94105.

Owners or lessees of recycling or recovery equipment having their places of business in:

Alaska

Idaho

Oregon

Washington

must send their certifications to:

CAA section 608 Enforcement Contact; EPA Region X (OAQ–107); 1200 Sixth Avenue; Seattle, WA 98101.

(b) Certificates under paragraph (a) of this section are not transferable. In the event of a change of ownership of an entity that maintains, services, or repairs appliances except MVACs, or that disposes of appliances except small appliances, MVACs, and MVAC-like appliances, the new owner of the entity shall certify within 30 days of the change of ownership pursuant to paragraph (a) of this section.

(c) No later than August 12, 1993, persons recovering refrigerant from small appliances, MVACs, and MVAC-like appliances for purposes of disposal of these appliances must certify to the Administrator that such person has acquired recovery equipment that meets the standards set forth in §82.158 (l) and/or (m), as applicable, and that such person is complying with the applicable requirements of this subpart. Such equipment may include system-dependent equipment but must include self-contained equipment, if the equipment is to be used in the disposal of appliances except for small appliances. The owner or lessee of the recovery or recycling equipment may perform this certification for his or her employees. Certification shall take the form of a statement signed by the owner of the equipment or another responsible officer and setting forth:

(1) The name and address of the purchaser of the equipment, including the county name;

(2) The name and address of the establishment where each piece of equipment is or will be located;

(3) The number of service trucks (or other vehicles) used to transport technicians and equipment between the establishment and job sites and the field;

(4) The manufacturer's name, the date of manufacture, and if applicable, the model and serial number of the equipment; and

(5) The certification must also include a statement that the equipment will be properly used in recovering refrigerant from appliances and that the information given is true and correct. The certification shall be sent to the appropriate address in paragraph (a).

(d) Failure to abide by any of the provisions of this subpart may result in revocation or suspension of certification under paragraph (a) or (c) of this section. In such cases, the Administrator or her or his designated representative shall give notice to the organization setting forth the basis for her or his determination.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42962, Aug. 19, 1994; 69 FR 11980, Mar. 12, 2004]

§ 82.164 Reclaimer certification.

Effective May 11, 2004, all persons reclaiming used refrigerant for sale to a new owner, except for persons who properly certified under this section prior to May 11, 2004, must certify to the Administrator that such person will:

(a) Reprocess refrigerant to all of the specifications in Appendix A of this subpart (based on ARI Standard 700–1995, *Specification for Fluorocarbons and Other Refrigerants*) that are applicable to that refrigerant;

(b) Verify that the refrigerant meets these specifications using the analytical methodology prescribed in Appendix A, which includes the primary methodologies included in the appendix to the ARI Standard 700–1995;

(c) Release no more than 1.5 percent of the refrigerant during the reclamation process; and

(d) Dispose of wastes from the reclamation process in accordance with all applicable laws and regulations.

(e) The data elements for certification are as follows:

(1) The name and address of the reclaimer;

(2) A list of equipment used to reprocess and analyze the refrigerant; and

(3) The owner or a responsible officer of the reclaimer must sign the certification stating that the refrigerant will be reprocessed to all of the specifications in Appendix A of this subpart (based on ARI Standard 700–1995, *Specification for Fluorocarbons and Other Refrigerants*) that are applicable to that refrigerant, that the refrigerant's conformance to these specifications will be verified using the analytical methodology prescribed in Appendix A (which includes the primary methodologies included in the appendix to the ARI Standard 700–1995), that no more than 1.5 percent of the refrigerant will be released during the reclamation process, that wastes from the reclamation process will be properly disposed of, that the owner or responsible officer of the reclaimer will maintain records and submit reports in accordance with §82.166(g) and (h), and that the information given is true and correct. The certification should be sent to the following address: U.S. Environmental Protection Agency; Global Programs Division (6205J); 1200 Pennsylvania Avenue, NW., Washington, DC 20460; Attn: Section 608 Recycling Program Manager—Reclaimer Certification.

(f) Certificates are not transferable. In the event of a change in ownership of an entity which reclaims refrigerant, the new owner of the entity shall certify within 30 days of the change of ownership pursuant to this section.

(g) Failure to abide by any of the provisions of this subpart may result in revocation or suspension of the certification of the reclaimer in accordance with §82.169. In such cases, the Administrator or her or his designated representative shall give notice to the organization setting forth the basis for her or his determination.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42957, 42962, Aug. 19, 1994; 59 FR 55927, Nov. 9, 1994; 68 FR 43809, July 24, 2003; 69 FR 11980, Mar. 12, 2004]

§ 82.166 Reporting and recordkeeping requirements.

(a) All persons who sell or distribute or offer to sell or distribute any refrigerant must retain invoices that indicate the name of the purchaser, the date of sale, and the quantity of refrigerant purchased.

(b) Purchasers of refrigerant who employ certified technicians may provide evidence that at least one technician is properly certified to the wholesaler who sells them refrigerant; the wholesaler must then keep this information on file and may sell refrigerant to the purchaser or his authorized representative even if such purchaser or authorized representative is not a properly certified technician. In such cases, the purchaser must notify the wholesaler in the event that the purchaser no longer employs at least one properly certified technician. The wholesaler is then prohibited from selling refrigerants to the purchaser until such time as the purchaser employs at least one properly certified technician. At that time, the purchaser must provide new evidence that at least one technician is properly certified.

(c) Approved equipment testing organizations must maintain records of equipment testing and performance and a list of equipment that meets EPA requirements. A list of all certified equipment shall be submitted to EPA within 30 days of the organization's approval by EPA and annually at the end of each calendar year thereafter.

(d) Approved equipment testing organizations shall submit to EPA within 30 days of the certification of a new model line of recycling or recovery equipment the name of the manufacturer and the name and/or serial number of the model line.

(e) Approved equipment testing organizations shall notify EPA if retests of equipment or inspections of manufacturing facilities conducted pursuant to §82.158(j) show that a previously certified model line fails to meet EPA requirements. Such notification must be received within thirty days of the retest or inspection.

(f) Programs certifying technicians must maintain records in accordance with section (g) of appendix D of this subpart.

(g) Reclaimers must maintain records of the names and addresses of persons sending them material for reclamation and the quantity of the material (the combined mass of refrigerant and contaminants) sent to them for reclamation. Such records shall be maintained on a transactional basis.

(h) Reclaimers must maintain records of the quantity of material sent to them for reclamation, the mass of refrigerant reclaimed, and the mass of waste products. Reclaimers must report this information to the Administrator annually within 30 days of the end of the calendar year.

(i) Persons disposing of small appliances, MVACs, and MVAC-like appliances must maintain copies of signed statements obtained pursuant to §82.156(f)(2).

(j) Persons servicing appliances normally containing 50 or more pounds of refrigerant must provide the owner/operator of such appliances with an invoice or other documentation, which indicates the amount of refrigerant added to the appliance.

(k) Owners/operators of appliances normally containing 50 or more pounds of refrigerant must keep servicing records documenting the date and type of service, as well as the quantity of refrigerant added. The owner/operator must keep records of refrigerant purchased and added to such appliances in cases where owners add their own refrigerant. Such records should indicate the date(s) when refrigerant is added.

(l) Technicians certified under §82.161 must keep a copy of their certificate at their place of business.

(m) All records required to be maintained pursuant to this section must be kept for a minimum of three years unless otherwise indicated. Entities that dispose of appliances must keep these records on-site.

(n) The owners or operators of appliances must maintain on-site and report to EPA Headquarters at the address listed in §82.160 the information specified in paragraphs (n)(1), (n)(2), and (n)(3) of this section, within the timelines specified under §82.156 (i)(1), (i)(2), (i)(3) and (i)(5) where such reporting or recordkeeping is required. This information must be relevant to the affected appliance.

(1) An initial report to EPA under §82.156(i)(1)(i), (i)(2), or (i)(5)(i) regarding why more than 30 days are needed to complete repairs must include: Identification of the facility; the leak rate; the method used to determine the leak rate and full charge; the date a leak rate above the applicable leak rate was discovered; the location of leak(s) to the extent determined to date; any repair work that has been completed thus far and the date that work was completed; the reasons why more than 30 days are needed to complete the work and an estimate of when the work will be completed. If changes from the original estimate of when work will be completed result in extending the completion date from the date submitted to EPA, the reasons for these changes must be documented and submitted to EPA within 30 days of discovering the need for such a change.

(2) If the owners or operators intend to establish that the appliance's leak rate does not exceed the applicable allowable leak rate in accordance with §82.156(i)(3)(v), the owner or operator must submit a plan to fix other outstanding leaks for which repairs are planned but not yet completed to achieve a rate below the applicable allowable leak rate. A plan to fix other outstanding leaks in accordance with §82.156(i)(3)(v) must include the following information: The identification of the facility; the leak rate; the method used to determine the leak rate and full charge; the date a leak rate above the applicable allowable leak rate was discovered; the location of leak(s) to the extent determined to date; and any repair work that has been completed thus far, including the date that work was completed. Upon completion of the repair efforts described in the plan, a second report must be submitted that includes the date the owner or operator submitted the initial report concerning the need for additional time beyond the 30 days and notification of the owner or operator's determination that the leak rate no longer exceeds the applicable allowable leak rate. This second report must be submitted within 30 days of determining that the leak rate no longer exceeds the applicable allowable leak rate.

(3) Owners or operators must maintain records of the dates, types, and results of all initial and follow-up verification tests performed under §82.156(i)(3). Owners or operators must submit this information to EPA within 30 days after conducting each test only where required under §82.156 (i)(1), (i)(2), (i)(3) and (i)(5). These reports must also include: Identification and physical address of the facility; the leak rate; the method

used to determine the leak rate and full charge; the date a leak rate above the applicable allowable leak rate was discovered; the location of leak(s) to the extent determined to date; and any repair work that has been completed thus far and the date that work was completed. Submitted reports must be dated and include the name of the owner or operator of the appliance, and must be signed by an authorized company official.

(o) The owners or operators of appliances must maintain on-site and report to EPA at the address specified in §82.160 the following information where such reporting and recordkeeping is required and in the timelines specified in §82.156 (i)(7) and (i)(8), in accordance with §82.156 (i)(7) and (i)(8). This information must be relevant to the affected appliance and must include:

(1) The identification of the industrial process facility;

(2) The leak rate;

(3) The method used to determine the leak rate and full charge;

(4) The date a leak rate above the applicable allowable rate was discovered.

(5) The location of leaks(s) to the extent determined to date;

(6) Any repair work that has been completed thus far and the date that work was completed;

(7) A plan to complete the retrofit or retirement of the system;

(8) The reasons why more than one year is necessary to retrofit or retire the system;

(9) The date of notification to EPA; and

(10) An estimate of when retrofit or retirement work will be completed. If the estimated date of completion changes from the original estimate and results in extending the date of completion, the owner or operator must submit to EPA the new estimated date of completion and documentation of the reason for the change within 30 days of discovering the need for the change, and must retain a dated copy of this submission.

(p)(1) Owners or operators who wish to exclude purged refrigerants that are destroyed from annual leak rate calculations must maintain records on-site to support the amount of refrigerant claimed as sent for destruction. Records shall be based on a monitoring strategy that provides reliable data to demonstrate that the amount of refrigerant claimed to have been destroyed is not greater than the amount of refrigerant actually purged and destroyed and that the 98 percent or greater destruction efficiency is met. Records shall include flow rate, quantity or concentration of the refrigerant in the vent stream, and periods of purge flow.

(2) Owners or operators who wish to exclude purged refrigerants that are destroyed from annual leak rate calculations must maintain on-site and make available to EPA upon request the following information after the first time the exclusion is utilized by the facility:

(i) The identification of the facility and a contact person, including the address and telephone number;

(ii) A general description of the refrigerant appliance, focusing on aspects of the appliance relevant to the purging of refrigerant and subsequent destruction;

(iii) A description of the methods used to determine the quantity of refrigerant sent for destruction and type of records that are being kept by the owners or operators where the appliance is located;

(iv) The frequency of monitoring and data-recording; and

(v) A description of the control device, and its destruction efficiency.

This information must also be included, where applicable, in any reporting requirements required for compliance with the leak repair and retrofit requirements for industrial process refrigeration equipment, as set forth in paragraphs (n) and (o) of this section.

(q) Owners or operators choosing to determine the full charge as defined in §82.152 of an affected appliance by using an established range or using that methodology in combination with other methods for determining the full charge as defined in §82.152 must maintain the following information:

(1) The identification of the owner or operator of the appliance;

(2) The location of the appliance;

(3) The original range for the full charge of the appliance, its midpoint, and how the range was determined;

(4) Any and all revisions of the full charge range and how they were determined; and

(5) The dates such revisions occurred.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42957, Aug. 19, 1994; 60 FR 40443, Aug. 8, 1995; 69 FR 11981, Mar. 12, 2004; 70 FR 1992, Jan. 11, 2005]

§ 82.169 Suspension and revocation procedures.

(a) Failure to abide by any of the provisions of this subpart may result in the revocation or suspension of the approval to certify technicians (under §82.161), approval to act as a recovery/recycling equipment testing organization (under §82.160), or reclaimer certification (under §82.164), hereafter referred to as the "organization." In such cases, the Administrator or her or his designated representative shall give notice of an impending suspension to the person or organization setting forth the facts or conduct that provide the basis for the revocation or suspension.

(b) Any organization that has received notice of an impending suspension or revocation may choose to request a hearing and must file that request in writing within 30 days of the date of the Agency's notice at the address listed in §82.160 and shall set forth their objections to the revocation or suspension and data to support the objections.

(c) If the Agency does not receive a written request for a hearing within 30 days of the date of the Agency's notice, the revocation will become effective upon the date specified in the notice of an impending suspension.

(d) If after review of the request and supporting data, the Administrator or her or his designated representative finds that the request raises a substantial factual issue, she or he shall provide the organization with a hearing.

(e) After granting a request for a hearing the Administrator or her or his designated representative shall designate a Presiding Officer for the hearing.

(f) The hearing shall be held as soon as practicable at a time and place determined by the Administrator, the designated representative, or the Presiding Officer.

(g) The Administrator or her or his designated representative may, at his or her discretion, direct that all argument and presentation of evidence be concluded within a specified period established by the Administrator or her or his designated representative. Said period may be no less than 30 days from the date that the first written offer of a hearing is made to the applicant. To expedite proceedings, the Administrator or her or his designated representative may direct that the decision of the Presiding Officer (who need not be the Administrator) shall be the final EPA decision.

(h) Upon appointment pursuant to paragraph (e) of this section, the Presiding Officer will establish a hearing file. The file shall consist of the following:

(1) The notice issued by the Administrator under §82.169(a);

(2) the request for a hearing and the supporting data submitted therewith;

(3) all documents relating to the request for certification and all documents submitted therewith; and

(4) correspondence and other data material to the hearing.

(i) The hearing file will be available for inspection by the petitioner at the office of the Presiding Officer.

(j) An applicant may appear in person or may be represented by counsel or by any other duly authorized representative.

(k) The Presiding Officer, upon the request of any party or at his or her discretion, may arrange for a pre-hearing conference at a time and place he or she specifies. Such pre-hearing conferences will consider the following:

(1) Simplification of the issues;

(2) Stipulations, admissions of fact, and the introduction of documents;

(3) Limitation of the number of expert witnesses;

(4) Possibility of agreement disposing of any or all of the issues in dispute; and

(5) Such other matters as may aid in the disposition of the hearing, including such additional tests as may be agreed upon by the parties.

(l) The results of the conference shall be reduced to writing by the Presiding Officer and made part of the record.

(m) Hearings shall be conducted by the Presiding Officer in an informal but orderly and expeditious manner. The parties may offer oral or written evidence, subject to the exclusion by the Presiding Officer of irrelevant, immaterial, and repetitious evidence.

(n) Witnesses will not be required to testify under oath. However, the Presiding Officer shall call to the attention of witnesses that their statements may be subject to the provisions of 18 U.S.C. 1001, which imposes penalties for knowingly making false statements or representations or using false documents in any matter within the jurisdiction of any department or agency of the United States.

(o) Any witness may be examined or cross-examined by the Presiding Officer, the parties, or their representatives.

(p) Hearings shall be reported verbatim. Copies of transcripts of proceedings may be purchased by the petitioner from the reporter.

(q) All written statements, charts, tabulations, and similar data offered in evidence at the hearings shall, upon a showing satisfactory to the Presiding Officer of their authenticity, relevancy, and materiality, be received in evidence and shall constitute a part of the record.

(r) Oral argument may be permitted at the discretion of the Presiding Officer and shall be reported as part of the record unless otherwise ordered by the Presiding Officer.

(s) The Presiding Officer shall make an initial decision that shall include written findings and conclusions and the reasons or basis regarding all the material issues of fact, law, or discretion presented on the record. The findings, conclusions, and written decision shall be provided to the parties and made a part of the record. The initial decision shall become the decision of the Administrator without further proceedings, unless there is an appeal to the Administrator or motion for review by the Administrator within 20 days of the date the initial decision was filed.

(t) On appeal from or review of the initial decision, the Administrator or her or his designated representative shall have all the powers which he or she would have in making the initial decision, including the discretion to require or allow briefs, oral argument, the taking of additional evidence, or a remand to the Presiding Officer for additional proceedings. The decision by the Administrator or her or his designated representative shall include written findings and conclusions and the reasons or basis therefore on all the material issues of fact, law, or discretion presented on the appeal or considered in the review.

[68 FR 43809, July 24, 2003]

Appendix A to Subpart F of Part 82—Specifications for Fluorocarbon and Other Refrigerants

This appendix is based on the Air-Conditioning and Refrigeration Institute Standard 700–1995.

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to evaluate and accept/reject refrigerants regardless of source (*i.e.,* new, reclaimed and/or repackaged) for use in new and existing refrigeration and air-conditioning products as required under 40 CFR part 82.

1.1.1 *Intent.* This standard is intended for the guidance of the industry including manufacturers, refrigerant reclaimers, repackagers, distributors, installers, servicemen, contractors and for consumers.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as the technology advances.

Section 2. Scope

2.1 *Scope.* This standard specifies acceptable levels of contaminants (purity requirements) for various fluorocarbon and other refrigerants regardless of source and lists acceptable test methods. These refrigerants are R–113; R–123; R–11; R–114; R–124; R–12; R–401C; R–406A; R–500; R–401A; R–409A; R–401B; R–411A; R–22; R–411B; R–502; R–402B; R–408A; R–402A; R–13; R–503 as referenced in the ANSI/ASHRAE Standard 34–1992. (American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., Standard 34–1992). Copies may be obtained from ASHRAE Publications Sales, 1791 Tullie Circle, NE, Atlanta, GA 30329. Copies may also be inspected at Environmental Protection Agency; Office of Air and Radiation Docket; 1301 Constitution Ave., NW., Room B108; Washington, DC 20460.

Section 3. Definitions

3.1 *"Shall," "Should," "Recommended,"* or *"It Is Recommended."* "Shall," "should," "recommended," or "it is recommended" shall be interpreted as follows:

3.1.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the appendix is claimed.

3.1.2 *Should, Recommended,* or *It is Recommended.* "Should", "recommended", or "it is recommended" is used to indicate provisions which are not mandatory but which are desirable as good practice.

Section 4. Characterization of Refrigerants and Contaminants

4.1 *Characterization.* Characterization of refrigerants and contaminants addressed are listed in the following general classifications:

4.1.1 *Characterization*

a. Gas Chromatography

b. Boiling point and boiling point range

4.1.2 *Contaminants*

a. Water

b. Chloride

c. Acidity

d. High boiling residue

e. Particulates/solids

f. Non-condensables

g. Impurities including other refrigerants

Section 5. Sampling, Summary of Test Methods and Maximum Permissible Contaminant Levels

5.1 *Referee Test.* The referee test methods for the various contaminants are summarized in the following paragraphs. Detailed test procedures are included in *Appendix C to ARI Standard 700–1995: Analytical Procedures for ARI Standard 700–1995,* 1995, Air-Conditioning and Refrigeration Institute. *Appendix C to ARI Standard 700–1995* is incorporated by reference. [This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from the Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Arlington, Virginia 22203. Copies may also be inspected at Public Docket No. A–92–01, Environmental Protection Agency, 1301 Constitution Ave., NW., Washington, DC, 20460 or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.] If alternative test methods are employed, the user must be able to demonstrate that they produce results equivalent to the specified referee method.

5.2 *Refrigerant Sampling*

5.2.1 *Sampling Precautions.* Special precautions should be taken to assure that representative samples are obtained for analysis. Sampling shall be done by trained laboratory personnel following accepted sampling and safety procedures.

5.2.2 *Gas Phase Sample.* A gas phase sample shall be obtained for determining the non-condensables. Since non-condensable gases, if present, will concentrate in the vapor phase of the refrigerant, care must be exercised to eliminate introduction of air during the sample transfer. Purging is not an acceptable procedure for a gas phase sample since it may introduce a foreign product. Since R–11, R–113, and R–123 have normal boiling points at or above room temperature, non-condensable determination is not required for these refrigerants.

5.2.2.1 *Connection.* The sample cylinder shall be connected to an evacuated gas sampling bulb by means of a manifold. The manifold should have a valve arrangement that facilitates evacuation of all connecting tubing leading to the sampling bulb.

5.2.2.2 *Equalizing Pressures.* After the manifold has been evacuated, close the valve to the pump and open the valve on the system. Allow the pressure to equilibrate and close valves.

5.2.3 *Liquid Phase Sample.* A liquid phase sample is required for all tests listed in this standard except the test for non-condensables.

5.2.3.1 *Preparation.* Place a clean, empty sample cylinder with the valve open in an oven at 110 °C (230 °F) for one hour. Remove it from the oven while hot, immediately connect to an evacuation system and evacuate to less than 1 mm mercury (1000 microns). Close the valve and allow it to cool. Weigh the empty cylinder.

5.2.3.2 *Manifolding.* The valve and lines from the unit to be sampled shall be clean and dry. The cylinder shall be connected to an evacuated gas sampling cylinder by means of a manifold. The manifold should have a valve arrangement that facilitates evacuation of all connecting tubing leading to the sampling cylinder.

5.2.3.3 *Liquid Sampling.* After the manifold has been evacuated, close the valve to the pump and open the valve on the system. Take the sample as a liquid by chilling the sample cylinder slightly. Accurate analysis requires that the sample container be filled to at least 60% by volume, however under no circumstances should the cylinder be filled to more than 80% by volume. This can be accomplished by weighing the empty cylinder and then the cylinder with refrigerant. When the desired amount of refrigerant has been collected, close the valve(s) and disconnect the sample cylinder immediately.

5.2.3.4 *Record Weight.* Check the sample cylinder for leaks and record the gross weight.

5.3 *Refrigerant Characterization.*

5.3.1 *Primary Method.* The primary method shall be gas chromatography (GC) as described in *Appendix C to ARI Standard 700–1995.* The chromatogram of the sample shall be compared to known standards.

5.3.2 *Alternative Method.* Determination of the boiling point and boiling point range is an acceptable alternative test method which can be used to characterize refrigerants. The test method shall be that described in the Federal Specification for "Fluorocarbon Refrigerants," BB–F–1421 B, dated March 5, 1982, section 4.4.3.

5.3.3 *Required Values.* The required values for boiling point and boiling point range are given in Table 1A, *Physical Properties of Single Component Refrigerants;* Table 1B, *Physical Properties of Zeotropic Blends (400 Series Refrigerants);* and Table 1C, *Physical Properties of Azeotropic Blends (500 Series Refrigerants).*

5.4 *Water Content.*

5.4.1 *Method.* The Coulometric Karl Fischer Titration shall be the primary test method for determining the water content of refrigerants. This method is described in *Appendix C to ARI Standard 700–1995.* This method can be used for refrigerants that are either a liquid or a gas at room temperature, including refrigerants 11, 113, and 123. For all refrigerants, the sample for water analysis shall be taken from the liquid phase of the container to be tested. Proper operation of the analytical method requires special equipment and an experienced operator. The precision of the results is excellent if proper sampling and handling procedures are followed. Refrigerants containing a colored dye can be successfully analyzed for water using this method.

5.4.2 *Limits.* The value for water content shall be expressed as parts per million (ppm) by weight and shall not exceed the maximum specified (*see* Tables 1A, 1B, and 1C).

5.5 *Chloride.*

The refrigerant shall be tested for chloride as an indication of the presence of hydrochloric acid and/or metal chlorides. The recommended procedure is intended for use with new or reclaimed refrigerants. Significant amounts of oil may interfere with the results by indicating a failure in the absence of chloride.

5.5.1 *Method.* The test method shall be that described in *Appendix C to ARI Standard 700–1995.* The test will show noticeable turbidity at chloride levels of about 3 ppm by weight or higher.

5.5.2 *Turbidity.* The results of the test shall not exhibit any sign of turbidity. Report the results as "pass" or "fail."

5.6 *Acidity.*

5.6.1 *Method.* The acidity test uses the titration principle to detect any compound that is highly soluble in water and ionizes as an acid. The test method shall be that described in *Appendix C to ARI Standard 700–1995.* This test may not be suitable for determination of high molecular weight organic acids; however these acids will be found in the high boiling residue test outlined in 5.7. The test requires a 100 to 120 gram sample and has a detection limit of 0.1 ppm by weight calculated as HCl.

5.6.2 *Limits.* The maximum permissible acidity is 1 ppm by weight as HCl.

5.7 *High Boiling Residue.*

5.7.1 *Method.* High boiling residue shall be determined by measuring the residue of a standard volume of refrigerant after evaporation. The refrigerant sample shall be evaporated at room temperature or at a temperature 45 °C (115 °F) for all refrigerants, except R–113 which shall be evaporated at 60 °C (140 °F), using a Goetz bulb as specified in *Appendix C to ARI Standard 700–1995.* Oils and/or organic acids will be captured by this method.

5.7.2 *Limits.* The value for high boiling residue shall be expressed as a percentage by volume and shall not exceed the maximum percent specified (*see* Tables 1A, 1B, and 1C). An alternative gravimetric method is described in *Appendix C to ARI Standard 700–1995.*

5.8 *Method of Tests for Particulates and Solids.*

5.8.1 *Method.* A measured amount of sample is evaporated from a Goetz bulb under controlled temperature conditions. The particulates/solids shall be determined by visual examination of the Goetz bulb prior to the evaporation of refrigerant. Presence of dirt, rust or other particulate contamination is reported as "fail." For details of this test method, refer to Part 3 of *Appendix C to ARI Standard 700–1995.*

5.9 *Non-Condensables.*

5.9.1 *Sample.* A vapor phase sample shall be used for determination of non-condensables. Non-condensable gases consist primarily of air accumulated in the vapor phase of refrigerants. The solubility of air in the refrigerants liquid phase is extremely low and air is not significant as a liquid phase contaminant. The presence of non-condensable gases may reflect poor quality control in transferring refrigerants to storage tanks and cylinders.

5.9.2 *Method.* The test method shall be gas chromatography with a thermal conductivity detector as described in *Appendix C to ARI Standard 700–1995.*

5.9.3 *Limit.* The maximum level of non-condensables in the vapor phase of a refrigerant in a container shall not exceed 1.5% by volume (*see* Tables 1A, 1B, and 1C).

5.10 *Impurities, including Other Refrigerants.*

5.10.1 *Method.* The amount of other impurities including other refrigerants in the subject refrigerant shall be determined by gas chromatography as described in *Appendix C to ARI Standard 700–1995.*

5.10.2 *Limit.* The subject refrigerant shall not contain more than 0.5% by weight of impurities including other refrigerants (*see* Tables 1A, 1B, and 1C).

Section 6. Reporting Procedure

6.1 *Reporting Procedure.* The source (manufacturer, reclaimer or repackager) of the packaged refrigerant shall be identified. The refrigerant shall be identified by its accepted refrigerant number and/or its chemical name. Maximum permissible levels of contaminants are shown in Tables 1A, 1B, and 1C. Test results shall be tabulated in a like manner.

Table 1A. Physical Properties of Single Component Refrigerants

	REPORTING UNITS	REFERENCE (SUBCLAUSE)	R-11	R-12	R-13	R-22	R-113	R-114	R-123	R-124
CHARACTERISTICS:										
BOILING POINT[1]	°F - 1.00 ATM	—	74.9	-21.6	-114.6	-41.4	117.6	38.8	82.6	12.2
	°C - 1.00 ATM	—	23.8	-29.8	-81.4	-40.8	47.6	3.8	27.9	-11.0
BOILING POINT RANGE[1]	K	—	0.3	0.3	0.5	0.3	0.3	0.3	0.3	0.3
TYPICAL ISOMER CONTENT	BY WEIGHT	—					0-1% R-113A	0-30% R-114A	0-8% R-123A	0-5% R-124A
VAPOR PHASE CONTAMINANTS:										
AIR AND OTHER NON-CONDENSABLES	% BY VOLUME - 25°C	5.9	N/A[2]	1.5	1.5	1.5	N/A[2]	1.5	N/A[2]	1.5
LIQUID PHASE CONTAMINANTS:										
WATER	PPM BY WEIGHT	5.4	20	10	10	10	20	10	20	10
ALL OTHER IMPURITIES INCLUDING REFRIGERANTS	% BY WEIGHT	5.1	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
HIGH BOILING RESIDUE	% BY VOLUME	5.7	0.01	0.01	0.05	0.01	0.03	0.01	0.01	0.01
PARTICULATES/SOLIDS	VISUALLY CLEAN TO PASS	5.8	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
ACIDITY	PPM BY WEIGHT	5.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CHLORIDES[3]	NO VISIBLE TURBIDITY	5.5	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

View or download PDF

Table 1B. Physical Properties of Zeotropic Blends (400 Series Refrigerants)

	REPORTING UNITS	REFERENCE (SUBCLAUSE)	R-401A	R-401B	R-402A	R-402B	R-406A [3]
CHARACTERISTICS:							
REFRIGERANT COMPONENTS			R-22/152A/124	R-22/152A/124	R-125/290/22.	R-125/290/22	R-22/600A/142B
NOMINAL COMP, WEIGHT%			53/13/34	61/11/28	60/2/38	38/2/60	55/4/41
ALLOWABLE COMP, WEIGHT%			51-54/11.5-13.5/33-35	59-63/9.5-11.5/27-29	58-62/1-3/36-40	36-40/1-3/58-62	53-57/3-5/40-42
BOILING POINT [1]	°F @ 1.00 ATM	—	-27.7 TO -18.1	-30.4 TO -21.2	-54.8 TO -53.9	-53.3 TO -49.0	-32.7 TO -15.0
	°C @ 1.00 ATM	—	-33.2 TO -27.8	-34.7 TO -29.6	-48.2 TO -47.7	-47.4 TO -45.0	-36.0 TO -26.1
BOILING POINT RANGE [1]	K	—	5.4	5.1	0.5	2.4	9.9
VAPOR PHASE CONTAMINANTS:							
AIR AND OTHER NON-CONDENSABLES	% BY VOLUME 25°C	5.9	1.5	1.5	1.5	1.5	1.5
LIQUID PHASE CONTAMINANTS							
WATER	PPM BY WEIGHT	5.4	10	10	10	10	10
ALL OTHER IMPURITIES INCLUDING REFRIGERANTS	% BY WEIGHT	5.1	0.50	0.50	0.50	0.50	0.50
HIGH BOILING RESIDUE	% BY VOLUME	5.7	0.01	0.01	0.01	0.01	0.01
PARTICULATES/SOLIDS	VISUALLY CLEAN TO PASS	5.8	PASS	PASS	PASS	PASS	PASS
ACIDITY	PPM BY WEIGHT	5.6	1.0	1.0	1.0	1.0	1.0

View or download PDF

Table 1B (continued). Physical Properties of Zeotropic Blends (400 Series Refrigerants)

	REPORTING UNITS	REFERENCE (SUBCLAUSE)	R-407C	R-408A	R-409A	R-410A	R-410B	R-411A [3]	R-411B [3]
CHARACTERISTICS									
REFRIGERANT COMPONENTS			R-32/125/134A	R125/143A/22	R22/124/142B	R32/125	R32/125	R1270/22/152A	R1270/22/152A
NOMINAL COMP, WEIGHT%			23/25/52	7/46/47	60/25/15	50/50	45/55	1.5/87.5/11.0	3/94/3
ALLOWABLE COMP, WEIGHT%			22-24/23-27/50-54	5-9/45-47/45-49	58-62/23-27/14-16	48.5-50.5/49.4-51.5	44-46/54-56	0.5-1.5/87.5-89.5/10-11	2-3/94-96/2-3
BOILING POINT [1]	°F - 1.00 ATM	---	46.4 TO -33.0	-48.8 TO -47.9	-32.4 TO -18.2	-60.1 TO -60.0	-60.3 TO 60.2		
	°C - 1.00 ATM	---	-43.6 TO -36.6	-44.9 TO -44.4	-35.8 TO -27.9	-51.2 TO -51.1	-51.3 TO 51.2		
BOILING POINT RANGE [1]	K	---	7.0	0.5	7.9	0.1	0.1		
VAPOR PHASE CONTAMINANTS: AIR AND OTHER NON-CONDENSABLES	% BY VOLUME - 25°C	5.9	1.3	1.5	1.5	1.5	1.5	1.3	1.3
LIQUID PHASE CONTAMINANTS:									
WATER	PPM BY WEIGHT	5.4	10	10	10	10	10	10	10
ALL OTHER IMPURITIES INCLUDING REFRIGERANTS	% BY WEIGHT	5.1	0.50	0.50	0.50	0.50	0.50	0.50	0.50
HIGH BOILING RESIDUE	% BY VOLUME	5.7	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PARTICULATES/SOLIDS	VISUALLY CLEAN TO PASS	5.8	PASS	PASS	PASS	PASS	PASS	PASS	PASS
ACIDITY	PPM BY WEIGHT	5.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0

View or download PDF

Table 1C. Physical Properties of Azeotropic Blends (500 Series Refrigerants)

	REPORTING UNITS	REFERENCE (SUBCLAUSE)	R500	R502	R503	R507	R508 [3]
CHARACTERISTICS:							
REFRIGERANT COMPONENTS			R12/152A	R22/115	R23/13	R125/143A	R23/116
NOMINAL COMP. WEIGHTS%			73.8/26.2	48.8/51.2	40.1/59.9	50/50	39/61
ALLOWABLE COMP. WEIGHTS%			72.8-74.8/ 25.2-27.2	44.8-52.8/ 47.2-55.2	39-41/ 59-61	49-51/ 49-51	37-41/ 59-63
BOILING POINT [1]	°F @ 1.00 ATM	---	-28.1	-49.7	-127.7	-52.1	-123.5
	°C @ 1.00 ATM	---	-33.4	-45.4	-88.7	-46.7	-86.4
BOILING POINT RANGE [1]	K	---	0.5	0.5	0.5	0.5	0.5
VAPOR PHASE CONTAMINANTS:							
AIR AND OTHER NON-CONDENSABLES	% BY VOLUME 25°C	5.9	1.5	1.5	1.5	1.5	1.5
LIQUID PHASE CONTAMINANTS:							
WATER	PPM BY WEIGHT	5.4	10	10	10	10	10
ALL OTHER IMPURITIES INCLUDING REFRIGERANTS	% BY WEIGHT	5.1	0.50	0.50	0.50	0.50	0.50
HIGH BOILING RESIDUE	% BY VOLUME	5.7	0.05	0.01	0.01	0.01	0.01
PARTICULATES/SOLIDS	VISUALLY CLEAN TO PASS	5.8	PASS	PASS	PASS	PASS	PASS
ACIDITY	PPM BY WEIGHT	5.6	1.0	1.0	1.0	1.0	1.0
CHLORIDES [2]	NO VISIBLE TURBIDITY	5.5	PASS	PASS	PASS	PASS	PASS

[1] BOILING POINTS AND BOILING POINT RANGES, ALTHOUGH NOT REQUIRED, ARE PROVIDED FOR INFORMATIONAL PURPOSES.

[2] RECOGNIZED CHLORIDE LEVEL FOR PASS/FAIL IS 3PPM.

[3] SHADED COLUMNS DENOTE REFRIGERANTS FOR WHICH ANALYTICAL DATA IS NOT AVAILABLE.

View or download PDF

Appendix A. References—Normative

Listed here are all standards, handbooks, and other publications essential to the formation and implementation of the standard. All references in this appendix are considered as part of this standard.

ASHRAE Terminology of Heating, Ventilating, Air Conditioning and Refrigeration, American Society of Heating Refrigeration and Air-Conditioning Engineers, 1992, 1791 Tullie Circle NE., Atlanta, GA 30329–2305; U.S.A.

ASHRAE Standard 34–1992, *Number Designation and Safety Classification of Refrigerants,* American Society of Heating Refrigeration and Air-Conditioning Engineers, 1992, 1791 Tullie Circle NE., Atlanta, GA 30329–2305; U.S.A.

Appendix C to ARI Standard 700–1995: Analytical Procedures to ARI Standard 700–1995, Specifications for Fluorocarbon and Other Refrigerants, Air-Conditioning and Refrigeration Institute, 1995, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203; U.S.A.

Federal Specification for *Fluorocarbon Refrigerants, BB–F–1421–B,* dated March 5, 1992, Office of the Federal Register, National Archives and Records Administration, 1992, 800 North Capitol Street, NW., Washington, D.C. 20402; U.S.A.

[69 FR 11981, Mar. 12, 2004]

Appendix A1 to Subpart F of Part 82—Generic Maximum Contaminant Levels

Contaminant	Reporting units
Air and Other Non-condensables	1.5% by volume @ 25 °C (N/A for refrigerants used in low-pressure appliances[1]).
Water	10 ppm by weight 20 ppm by weight (for refrigerants used in low-pressure appliances[1]).
Other Impurities Including Refrigerant	0.50% by weight.
High boiling residue	0.01% by volume.
Particulates/solids	visually clean to pass.
Acidity	1.0 ppm by weight.
Chlorides (chloride level for pass/fail is 3ppm)	No visible turbidity.

[1]Low-pressure appliances means an appliance that uses a refrigerant with a liquid phase saturation pressure below 45 psia at 104 °F.

Blend Compositions (Where Applicable)

Nominal composition (by weight%)	Allowable composition (by weight%)
Component constitutes 25% or more	±2.0
Component constitutes less than 25% but greater than 10%	±1.0
Component constitutes less than or equal to 10%	±0.5

[69 FR 11988, Mar. 12, 2004]

Appendix B1 to Subpart F of Part 82—Performance of Refrigerant Recovery, Recycling and/or Reclaim Equipment

This appendix is based on the Air-Conditioning and Refrigeration Institute Standard 740–1993.

Refrigerant Recovery/Recycling Equipment

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish methods of testing for rating and evaluating the performance of refrigerant recovery, and/or recycling equipment, and general equipment requirements (herein referred to as “equipment”) for containment or purity levels, capacity, speed, and purge loss to minimize emission into the atmosphere of designated refrigerants.

1.1.1 This standard is intended for the guidance of the industry, including manufacturers, refrigerant reclaimers, repackers, distributors, installers, servicemen, contractors and for consumers.

1.1.2 This standard is not intended to be used as a guide in defining maximum levels of contaminants in recycled or reclaimed refrigerants used in various applications.

1.2 *Review and Amendment.* This standard is subject to review and amendment as the technology advances.

Section 2. Scope

2.1 *Scope.* This standard defines general equipment requirements and the test apparatus, test mixtures, sampling and analysis techniques that will be used to determine the performance of recovery and/or recycling equipment for various refrigerants including R11, R12, R13, R22, R113, R114, R123, R134a, R500, R502, and R503, as referenced in the ANSI/ASHRAE Standard 34–1992, "Number Designation of Refrigerants" (American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.).

Section 3. Definitions

3.1 *Recovered refrigerant.* Refrigerant that has been removed from a system for the purpose of storage, recycling, reclamation or transportation.

3.2 Recover. Reference 40 CFR 82.152.

3.3 Recycle. Reference 40 CFR 82.152.

3.4 Reclaim. Reference 40 CFR 82.152.

3.5 *Standard Contaminated Refrigerant Sample.* A mixture of new and/or reclaimed refrigerant and specified quantities of identified contaminants which are representative of field obtained, used refrigerant samples and which constitute the mixture to be processed by the equipment under test.

3.6 *Push/Pull Method.* The push/pull refrigerant recovery method is defined as the process of transferring liquid refrigerant from a refrigeration system to a receiving vessel by lowering the pressure in the vessel and raising the pressure in the system, and by connecting a separate line between the system liquid port and the receiving vessel.

3.7 *Recycle Rate.* The amount of refrigerant processed (in pounds) divided by the time elapsed in the recycling mode in pounds per minute. For equipment which uses a separate recycling sequence, the recycle rate does not include the recovery rate (or elapsed time). For equipment which does not use a separate recycling sequence, the recycle rate is a maximum rate based solely on the higher of the liquid or vapor recovery rate, by which the rated contaminant levels can be achieved.

3.8 *Equipment Classification.*

3.8.1 *Self Contained Equipment.* A refrigerant recovery or recycling system which is capable of refrigerant extraction without the assistance of components contained within an air conditioning or refrigeration system.

3.8.2 *System Dependent Equipment.* Refrigerant recovery equipment which requires for its operation the assistance of components contained in an air conditioning or refrigeration system.

3.9 *"Shall", "Should", "Recommended"* or *"It is Recommended",* "Shall" "Should", "recommended", or "it is recommended" shall be interpreted as follows:

3.9.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.9.2 *Should, Recommended,* or *It is Recommended,* "Should", "recommended", is used to indicate provisions which are not mandatory but which are desirable as good practice.

Section 4. General Equipment Requirements

4.1 The equipment manufacturer shall provide operating instructions, necessary maintenance procedures, and source information for replacement parts and repair.

4.2 The equipment shall indicate when any filter/drier(s) needs replacement. This requirement can be met by use of a moisture transducer and indicator light, by use of a sight glass/moisture indicator, or by some measurement of the amount of refrigerant processed such as a flow meter or hour meter. Written instructions such as "to change the filter every 400 pounds, or every 30 days" shall not be acceptable except for equipment in large systems where the Liquid Recovery Rate is greater than 25 lbs/min [11.3 Kg/min] where the filter/drier(s) would be changed for every job.

4.3 The equipment shall either automatically purge non-condensables if the rated level is exceeded or alert the operator that the non-condensable level has been exceeded. While air purge processes are subject to the requirements of this section, there is no specific requirement to include an air purge process for "recycle" equipment.

4.4 The equipment's refrigerant loss due to non-condensable purging shall not be exceeded 5% by weight of total recovered refrigerant. (See Section 9.4)

4.5 Internal hose assemblies shall not exceed a permeation rate of 12 pounds mass per square foot [5.8 g/cm^2] of internal surface per year at a temperature of 120 F [48.8 °C] for any designated refrigerant.

4.6 The equipment shall be evaluated at 75 F [24 °C] per 7.1. Normal operating conditions range from 50 °F to 104 F [10 °C to 40 °C].

4.7 *Exemptions:*

4.7.1 Equipment intended for recovery only shall be exempt from sections 4.2 and 4.3.

Table 1—Standard Contaminated Refrigerant Samples

	R11	R12	R13	R22	R113	R114	R123	R134a	R500	R502	R503
Moisture content:											
PPM by weight of pure refrigerant	100	80	30	200	100	85	100	200	200	200	30
Particulate content:											
PPM by weight of pure refrigerant characterized by[1]	80	80	80	80	80	80	80	80	80	80	80
Acid content:											
PPM by weight of pure refrigerant—(mg KOH per kg refrig.) characterized by[2]	500	100	NA	500	400	200	500	100	100	100	NA

Mineral oil content:											
% by weight of pure refrigerant	20	5	NA	5	20	20	20	5	5	5	NA
Viscosity (SUS)	300	150		300	300	300	300	150	150	150	
Non condensable gases air content % volume[3]>	NA	3	3	3	NA	3	3	3	3	3	3

[1]Particulate content shall consist of inert materials and shall comply with particulate requirements in *ASHRAE* Standard 63.2, "Method of Testing of Filtration Capacity of Refrigerant Liquid Line Filters and Filter Driers."

[2]Acid consists of 60% oleic acid and 40% hydrochloric acid on a total number basis.

[3]Synthetic ester based oil.

Section 5. Contaminated Refrigerants

5.1 The standard contaminated refrigerant sample shall have the characteristics specified in Table 1, except as provided in 5.2

5.2 Recovery equipment not rated for any specific contaminant can be tested with new or reclaimed refrigerant.

Section 6. Test Apparatus

6.1 Self Contained Equipment Test Apparatus. The apparatus as shown in Figure 1 consists of a 3 cubic foot [0.085 m^3] mixing chamber with a conical-shaped bottom, although a larger mixing chamber is permissible. The size of the mixing chamber depends upon the size of the equipment. The outlet at the bottom of the cone and all restrictions and valves for liquid and vapor refrigerant lines in the test apparatus shall be a minimum of 0.375 in. [9.5 mm] inside diameter or equivalent. The minimum inside diameter for large equipment for use on chillers shall be 1.5 in. [38 mm.]. The mixing chamber shall contain various ports for receiving liquid refrigerant, oil, and contaminants. A recirculating line connected from the bottom outlet through a recirculating pump and then to a top vapor port shall be provided for stirring of the mixture. Isolation valves may be required for the pump. Alternative stirring means may be used if demonstrated to be equally effective.

6.1.1 For liquid refrigerant feed, the liquid valve is opened. For vapor refrigerant feed, the vapor valve is opened and refrigerant passes through an evaporator coil. Flow is controlled by a thermostatic expansion valve to create 5 F [3 °C] superheat at an evaporator temperature of 70 F ±3 F[21 °C±2°]. The evaporator coil or equivalent evaporator means shall be either sized large enough for the largest system or be sized for each system.

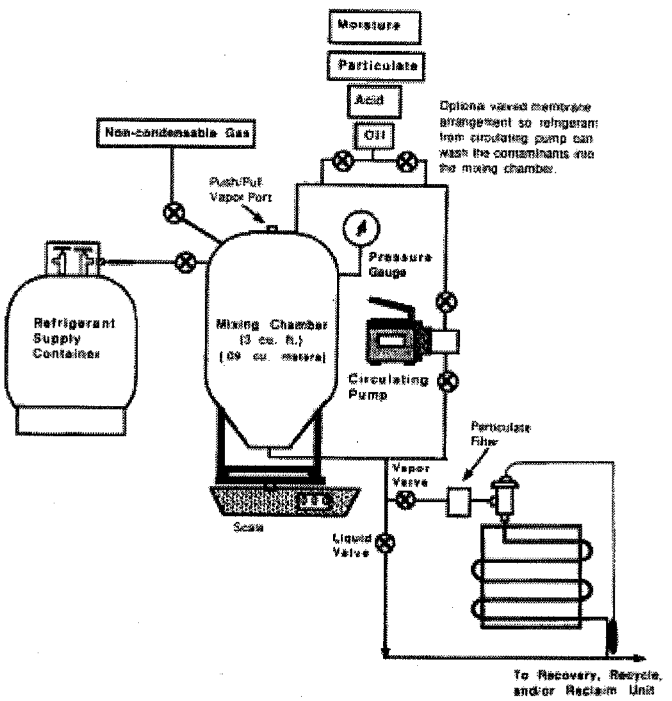
6.1.2 An alternative method for vapor refrigerant feed is to pass through a boiler and then an automatic pressure regulating valve set at refrigerant saturation pressure at 75 F ±3 F [24 °C ±2 °C].

6.2 System Dependent Equipment Test Apparatus. This test apparatus is to be used for final recovery vacuum rating of all system dependent equipment.

6.2.1 The test apparatus shown in Figure 2 consists of a complete refrigeration system. The manufacturer shall identify the refrigerants to be tested. The test apparatus can be modified to facilitate operation or testing of the system dependent equipment if the modifications to the apparatus are specifically described within the manufacturer's literature. (*See Figure 2* .) A1/4inch [6.3 mm] balance line shall be connected across the test apparatus between the high and low pressure sides, with an isolation valve located at the connection to the compressor high side. A1/4inch [6.3 mm] access port with a valve core shall be located in the balance line for the purpose of measuring final recovery vacuum at the conclusion of the test.

FIGURE 1

Test Apparatus for Self-Contained Equipment

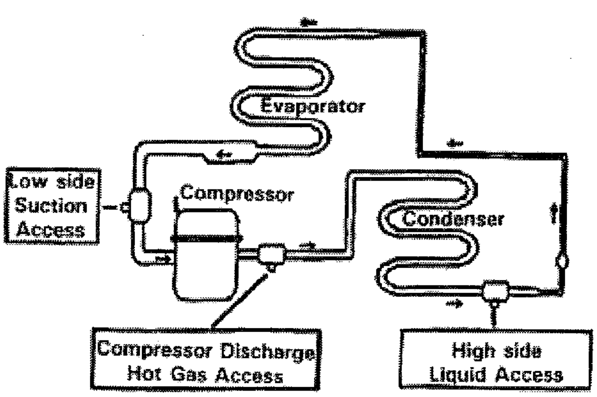


View or download PDF

FIGURE 2

System-Dependent Equipment Test Apparatus

Configuration of a standard air conditioning or refrigeration system for use as a test apparatus



View or download PDF

Section 7. Performance Testing

7.1 Contaminant removal and performance testing shall be conducted at 75 F ±2 F [23.9 °C ±1.1 °C].

7.1.1 The equipment shall be prepared for operation per the instruction manual.

7.1.2 The contaminated sample batch shall consist of not less than the sum of the amounts required to complete steps 7.1.2.2 and 7.1.2.3 below.

7.1.2.1 A liquid sample shall be drawn from the mixing chamber prior to starting the test to assure quality control of the mixing process.

7.1.2.2 Vapor refrigerant feed testing, if elected, shall normally be processed first. After the equipment reaches stabilized conditions of condensing temperature and/or storage tank pressure, the vapor feed recovery rate shall be measured. One method is to start measuring the vapor refrigerant recovery rate when 85% of refrigerant remains in the mixing chamber and continue for a period of time sufficient to achieve the accuracy in 9.2. If liquid feed is not elected, complete Step 7.1.2.4.

7.1.2.3 Liquid refrigerant feed testing, if elected, shall be processed next. After the equipment reaches stabilized conditions, the liquid feed recovery rate shall be measured. One method is to wait 2 minutes after starting liquid feed and then measure the liquid refrigerant recovery rate for a period of time sufficient to achieve the accuracy in 9.1. Continue liquid recovery operation as called for in 7.1.2.4.

7.1.2.4 Continue recovery operation until all liquid is removed from the mixing chamber and vapor is removed to the point where the equipment shuts down per automatic means or is manually stopped per the operating instructions.

7.1.2.5 After collecting the first contaminated refrigerant sample batch, the liquid and vapor value of the apparatus shall be closed and the mixing chamber pressure recorded after 1 minute as required in 9.5. After preparing a second contaminated refrigerant sample batch, continue recovery until the storage container reaches 80% liquid fill level. After recycling and measuring the recycle rate per section 7.1.3, set this container aside for the vapor sample in 8.2.2.

7.1.2.6 Interruptions in equipment operations as called for in instruction manual are allowable.

7.1.3 Recycle as called for in equipment operating instructions. Determine recycle rate by appropriate means as required in 9.3.

7.1.4 Repeat steps 7.1.2, 7.1.2.4, and 7.1.3 with contaminated refrigerant sample until equipment indicator(s) show need to change filter(s). It will not be necessary to repeat the recycle rate determination in 7.1.3.

7.1.4.1 For equipment with a multiple pass recirculating filter system, analyze the contents of the previous storage container.

7.1.4.2 For equipment with a single pass filter system, analyze the contents of the current storage container.

7.1.5 Refrigerant loss due to the equipment's non-condensable gas purge shall be determined by appropriate means. (See Section 9.4.)

7.2 System Dependent Equipment. This procedure shall be used for vacuum rating of all system dependent equipment. Liquid refrigerant recovery rate, vapor refrigerant recovery rate, and recycle rate are not tested on system dependent systems.

7.2.1 The apparatus operation and testing shall be conducted at 75 F ±2 F. [23.9 °C. ±/1.1. °C.].

7.2.2 The apparatus shall be charged with refrigerant per its system design specifications.

7.2.3 For measurement of final recovery vacuum as required in 9.5, first shut the balance line isolation valve and wait 1 minute for pressure to balance. Then connect and operate the recovery system per manufacturers recommendations. When the evacuation is completed, open the balance line isolation valve and measure the pressure in the balance line.

Section 8. Sampling and Chemical Analysis Methods

8.1 The referee test methods for the various contaminants are summarized in the following paragraphs. Detailed test procedures are included in Appendix A "Test Procedures for ARI STD 700." If alternate test methods are employed, the user must be able to demonstrate that they produce results equivalent to the specified referee method.

8.2 *Refrigerant Sampling.*

8.2.1 *Sampling Precautions.* Special precautions should be taken to assure that representative samples are obtained for analysis. Sampling shall be done by trained laboratory personnel following accepted sampling and safety procedures.

8.2.2 *Gas Phase Sample.* A gas phase sample shall be obtained for determining the non-condensables. Since non-condensable gases, if present, will concentrate in the vapor phase of the refrigerant, care must be exercised to eliminate introduction of air during the sample transfer. Purging is not and acceptable procedure for a gas phase sample since it may introduce a foreign product. Since R11, R113 and R123 have normal boiling points at or above room temperature, noncondensable determination is not required for these refrigerants.

8.2.2.1 The sample cylinder shall be connected to an evacuated gas sampling bulb by means of a manifold. The manifold should have a valve arrangement that facilitates evacuation of all connecting tubing leading to the sampling bulb.

8.2.2.2 After the manifold has been evacuated, close the valve to the pump and open the valve on the system. Allow the pressure to equilibrate and close valves.

8.2.3 *Liquid Phase Sample.* A liquid phase sample is required for all tests listed in this standard, except the test for non-condensables.

8.2.3.1 Place an empty sample cylinder with the valve open in an oven at 230 F [110 °C] for one hour. Remove it from the oven while hot, immediately connect to an evacuation system and evacuate to less than 1mm. mercury (1000 microns). Close the valve and allow it to cool.

8.2.3.2 The valve and lines from the unit to be sampled shall be clean and dry. Connect the line to the sample cylinder loosely. Purge through the loose connection. Make the connection tight at the end of the purge period. Take the sample as a liquid by chilling the sample cylinder slightly. Accurate analysis requires that the sample container be filled to at least 60% by volume; however under no circumstances should the cylinder be filled to more than 80% by volume. This can be accomplished by weighing the empty cylinder and then the cylinder with refrigerant. When the desired amount of refrigerant has been collected, close the valve(s) and disconnect the sample cylinder immediately.

8.2.3.3 Check the sample cylinder for leaks and record the gross weight.

8.3 *Water Content.*

8.3.1. The Coulometric Karl Fischer Titration shall be the primary test method for determining the water content of refrigerants. This method is described in Appendix A. This method can be used for refrigerants that are either a liquid or a gas at room temperature, including Refrigerants 11 and 13. For all refrigerants, the sample for water analysis shall be taken from the liquid phase of the container to be tested. Proper operation of the analytical method requires special equipment and an experienced operator. The precision of the results is excellent if proper sampling and handling procedures are followed. Refrigerants containing a colored dye can be successfully analyzed for water using this method.

8.3.2 The Karl Fischer Test Method is an acceptable alternative test method for determining the water content of refrigerants. This method is described in ASTM Standard for "Water in gases Using Karl Fisher Reagent" E700–79, reapproved 1984 (American Society for Testing and Materials, Philadelphia, PA).

8.3.3 Report the moisture level in parts per million by weight if a sample is required.

8.4 *Chloride.* The refrigerant shall be tested for chlorides as an indication of the presence of hydrochloric or similar acids. The recommended procedure is intended for use with new or reclaimed refrigerants. Significant amounts of oil may interfere with the results by indicating a failure in the absence of chlorides.

8.4.1 The test method shall be that described in Appendix A "Test Procedures for ARI–700." The test will show noticeable turbidity at equivalent chloride levels of about 3 ppm by weight or higher.

8.4.2 The results of the test shall not exhibit any sign of turbity. Report results as "pass" or "fail."

8.5 *Acidity.*

8.5.1 The acidity test uses the titration principle to detect any compound that is highly soluble in water and ionizes as an acid. The test method shall be that described in Appendix A. "Test Procedures for ARI–700." The test may not be suitable for determination of high molecular weight organic acids; however these acids will be found in the high boiling residue test outlined in Section 5.7. The test requires about a 100 to 120 gram sample and has a low detection limit of 0.1 ppm by weight as HC1.

8.6 High Boiling Residue.

8.6.1 High boiling residue will be determined by measuring the residue of a standard volume of refrigerant after evaporation. The refrigerant sample shall be evaporated at room temperature or a temperature 50 F [10°.0C], above the boiling point of the sample using a Goetz tube as specified in Appendix A "Test Procedures for ARI–700." Oils and or organic acids will be captured by this method.

8.6.2 The value for high boiling residue shall be expressed as a percentage by volume.

8.7 Particulates/Solids.

8.7.1 A measured amount of sample is evaporated from a Goetz bulb under controlled temperature conditions. The particulates/solids shall be determined by visual examination of the empty Goetz bulb after the sample has evaporated completely. Presence of dirt, rust or other particulate contamination is reported a "fail." For details of this test method, refer to Appendix B "Test Procedures for ARI–700."

8.8 Non-Condensables

8.8.1 A vapor phase sample shall be used for determination of non-condensables. Non-condensable gases consist primarily of air accumulated in the vapor phase of refrigerant containing tanks. The solubility of air in the refrigerants liquid phase is extremely low and air is not significant as a liquid phase contaminant. The presence of non-condensable gases may reflect poor quality control in transferring refrigerants to storage tanks and cylinders.

8.8.2 The test method shall be gas chromatography with a thermal conductivity detector as described in Appendix A "Test Procedures for ARI–700."

8.8.2.1 The Federal Specification for "Fluorocarbon Refrigerants," BB–F–1421B, dated March 5, 1992, section 4.4.2 (perchloroethylene method) is an acceptable alternate test method.

8.8.3 Report the level of non-condensable as percent by volume.

Section 9. Performance Calculation and Rating

9.1 The liquid refrigerant recovery rate shall be expressed in pounds per minute [kg/min] and measured by weight change at the mixing chamber (See Figure 1) divided by elapsed time to an accuracy within .02 lbs/min. [.009 kg/min]. Ratings using the Push/Pull method shall be identified "Push/Pull". Equipment may be rated by both methods.

9.2 The vapor refrigerant recovery rate shall be expressed in pounds per minute [kg/min] and measured by weight change at the mixing chamber (See Figure 1) divided by elapsed time to an accuracy within .02 lbs/min. [.0.009 kg/min].

9.3 The recycle rate is defined in 3.7 and expressed in pounds per minute [kg/min] of flow and shall be per ASHRAE 41.7–84 "Procedure For Fluid Measurement Of Gases" or ASHRAE 41.8–89 "Standard Method of Flow of Fluids—Liquids."

9.3.1 For equipment using multipass recycling or a separate sequence, the recycle rate shall be determined by dividing the net weight W of the refrigerant to be recycled by the actual time T required to recycle the refrigerant. Any set-up or operator interruptions shall not be included in the time T. The accuracy of the recycle rate shall be within .02 lbs/min. [.009 kg/min].

9.3.2 If no separate recycling sequence is used, the recycle rate shall be the higher of the vapor refrigerant recovery rate or the liquid refrigerant recovery rate. The recycle rate shall match a process which leads to contaminant levels in 9.6. Specifically, a recovery rate determined from bypassing a contaminant removal device cannot be used as a recycle rate when the contaminant levels in 9.6 are determined by passing the refrigerant through the containment removal device.

9.4 Refrigerant loss due to non-condensable purging shall be less than 5%. This rating shall be expressed as "passed" if less than 5%.

This calculation will be based upon net loss of non-condensables and refrigerant due to the purge divided by the initial net content. The net loss shall be determined by weighing before and after the purge, by collecting purged gases, or an equivalent method.

9.5 The final recovery vacuum shall be the mixing chamber pressure called for in 7.1.2.5 expressed in inches of mercury vacuum, [mm Hg or kP]. The accuracy of the measurement shall be within ±.1 inch

[±2.5mm] of Hg and rounding down to the nearest whole number.

9.6 The contaminant levels remaining after testing shall be published as follows:

Moisture content, PPM by weight

Chloride ions, Pass/Fail

Acidity, PPM by weight

High boiling residue, percentage by volume

Particulate/solid, Pass/Fail

Non-condensables, % by volume

9.7 Product Literature: Except as provided under product labelling in Section 11. performance ratings per 9.1, 9.2, 9.3, and 9.5 must be grouped together and shown for all listed refrigerants (11.2) subject to limitations of 9.8. Wherever any contaminant levels per 9.6 are rated, all ratings in 9.6 must be shown for all listed refrigerants subject to limitations of 9.8. The type of equipment in 11.1 must be included with either grouping. Optional ratings in 9.8 need not be shown.

9.8 Ratings shall include all of the parameters for each designed refrigerant in 11.2 as shown in Tables 2 and 3.

Table 2—Performance

Parameter/type of equipment	Recovery	Recovery/ recycle	Recycle	System dependent equipment
Liquid refrigerant recovery rate	([2])	([2])	N/A	N/A
Vapor refrigerant recovery rate	([2])	([2])	N/A	N/A
Final recovery vacuum	([1])	([1])	N/A	([1])
Recycle rate	N/A	([1])	([1])	N/A
Refrigerant loss due to non-condensable purging	([3])	([1])	([1])	N/A

[1]Mandatory rating.

[2]For a recovery or recovery/recycle unit, one must rate for either liquid feed only or vapor feed only or can rate for both. If rating only the one, the other shall be indicated by "N/A."

[3]For Recovery Equipment, these parameters are optional. If not rated, use N/A.

Table 3—Contaminants

Contaminant/type of equipment	Recovery	Recovery/recycle	Recycle	System dependent equipment
Moisture content	(*)	x	x	NA.
Chloride ions	(*)	x	x	NA.

Acidity	(*)	x	x	NA.
High boiling residue	(*)	x	x	NA.
Particulates	(*)	x	x	NA.
Non-condensables	(*)	x	x	NA.

*For Recovery Equipment, these parameters are optional. If not rated, use N/A.

xMandatory rating.

Section 10. Tolerances

10.1 Any equipment tested shall produce contaminant levels not higher than the published ratings. The liquid refrigerant recovery rate, vapor refrigerant recovery rate, final recovery vacuum and recycle rate shall not be less than the published ratings.

Section 11. Product Labelling

11.1 *Type of equipment.* The type of equipment shall be as listed:

11.1.1 Recovery only

11.1.2 System Dependent Recovery

11.1.3 Recovery/Recycle

11.1.4 Recycle only

11.2 Designated refrigerants and the following as applicable for each:

11.2.1 Liquid Recovery Rate

11.2.2 Vapor Recovery Rate

11.2.3 Final Recovery Vacuum

11.2.4 Recycle Rate

11.3 The nameplate shall also conform to the labeling requirements established for certified recycling and recovery equipment established at 40 CFR 82.158(h).

Attachment to Appendix B1

Particulate Used in Standard Contaminated Refrigerant Sample.

1. Particulate Specification

1.1 The particulate material pm will be a blend of 50% coarse air cleaner dust as received, and 50% retained on a 200-mesh screen. The coarse air cleaner dust is available from: AC Spark Plug Division, General Motors Corporation, Flint, Michigan.

1.2 Preparation of Particulate Materials

To prepare the blend of contaminant, first wet screen a quantity of coarse air cleaner dust on a 200-mesh screen (particle retention 74 pm). This is done by placing a portion of the dust on a 200-mesh screen and running water through the screen while stirring the dust with the fingers. The fine contaminant particles passing through the screen are discarded. The +200 mesh particles collected on the screen are removed and dried for one hour at 230 F [110 °C]. The blend of standard contaminant is prepared by mixing 50% by weight of coarse air cleaner dust as received after drying for one hour at 230 F [110 °C] with 50% by weight of the +200 mesh screened dust.

1.3 The coarse air cleaner dust as received and the blend used as the standard contaminant have the following approximate particle size analysis: Wt. % in various size ranges, pm.

Size range	As received	Blend
0–5	12	6
5–10	12	6
10–20	14	7
20–40	23	11
40–80	30	32
80–200	9	38

[58 FR 28712, May 14, 1993, as amended at 59 FR 42960, Aug. 19, 1994. Redesignated and amended at 68 FR 43815, July 24, 2003]

Appendix B2 to Subpart F of Part 82—Performance of Refrigerant Recovery, Recycling, and/or Reclaim Equipment

This appendix is based on the Air-Conditioning and Refrigeration Institute Standard 740–1995.

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish methods of testing for rating and evaluating the performance of refrigerant recovery, and/or recycling equipment and general equipment requirements (herein referred to as "equipment") for contaminant or purity levels, capacity, speed and purge loss to minimize emission into the atmosphere of designated refrigerants.

Section 2. Scope

2.1 *Scope.* This standard applies to equipment for recovering and/or recycling single refrigerants, azeotropics, zeotropic blends, and their normal contaminants from refrigerant systems. This standard defines the test apparatus, test gas mixtures, sampling procedures and analytical techniques that will be used to determine the performance of refrigerant recovery and/or recycling equipment (hereinafter, "equipment").

Section 3. Definitions

3.1 *Definitions.* All terms in this appendix will follow the definitions in §82.152 unless otherwise defined in this appendix.

3.2 *Clearing Refrigerant.* Procedures used to remove trapped refrigerant from equipment before switching from one refrigerant to another.

3.3 *High Temperature Vapor Recovery Rate.* For equipment having at least one designated refrigerant (see

11.2) with a boiling point in the range of −50 to +10 °C, the rate will be measured for R–22, or the lowest boiling point refrigerant if R–22 is not a designated refrigerant.

3.4 *Published Ratings.* A statement of the assigned values of those performance characteristics, under stated rating conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. As used herein, the term "published rating" includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated rating conditions.

3.5 *Push/Pull Method.* The push/pull refrigerant recovery method is defined as the process of transferring liquid refrigerant from a refrigeration system to a receiving vessel by lowering the pressure in the vessel and raising the pressure in the system, and by connecting a separate line between the system liquid port and the receiving vessel.

3.6 *Recycle Flow Rate.* The amount of refrigerant processed divided by the time elapsed in the recycling mode. For equipment which uses a separate recycling sequence, the recycle rate does not include the recovery rate (or elapsed time). For equipment which does not use a separate recycling sequence, the recycle rate is a rate based solely on the higher of the liquid or vapor recovery rate, by which the contaminant levels were measured.

3.7 *Residual Trapped Refrigerant.* Refrigerant remaining in equipment after clearing.

3.8 *Shall, Should, Recommended* or *It Is Recommended* shall be interpreted as follows:

3.8.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with this appendix is claimed.

3.8.2 *Should, Recommended* or *It Is Recommended* is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.9 Standard Contaminated Refrigerant Sample. A mixture of new or reclaimed refrigerant and specified quantities of identified contaminants which constitute the mixture to be processed by the equipment under test. These contaminant levels are expected only from severe service conditions.

3.10 *Trapped Refrigerant.* The amount of refrigerant remaining in the equipment after the recovery or recovery/recycling operation but before clearing.

3.11 *Vapor Recovery Rate.* The average rate that refrigerant is withdrawn from the mixing chamber between two pressures as vapor recovery rate is changing pressure and temperature starting at saturated conditions either 24 °C or at the boiling point 100 kPa (abs), whichever is higher. The final pressure condition is 10% of the initial pressure, but not lower than the equipment final recovery vacuum and not higher than 100 kPa (abs).

Section 4. General Equipment Requirements

4.1 *Equipment Information.* The equipment manufacturer shall provide operating instructions, necessary maintenance procedures and source information for replacement parts and repair.

4.2 *Filter Replacement.* The equipment shall indicate when any filter/drier(s) needs replacement. This requirement can be met by use of a moisture transducer and indicator light, by use of a sight glass/moisture indicator or by some measurement of the amount of refrigerant processed such as a flow meter or hour meter. Written instructions such as "to change the filter every 181 kg, or every 30 days" shall not be acceptable except for equipment in large systems where the liquid recovery rate is greater than 11.3 kg/min where the filter/drier(s) would be changed for every job.

4.3 *Purge of Non-Condensable.* If non-condensables are purged, the equipment shall either automatically purge non-condensables or provide indicating means to guide the purge process.

4.4 *Purge Loss.* The total refrigerant loss due to purging non-condensables, draining oil and clearing refrigerant (*see* 9.5) shall be less than 3% (by weight) of total processed refrigerant.

4.5 *Permeation Rate.* High pressure hose assemblies5/8in. [16 mm] nominal and smaller shall not exceed a permeation rate of 3.9 g/cm^2 /yr (internal surface) at a temperature of 48.8 °C. Hose assemblies that UL recognized as having passed ANSI/UL 1963 requirements shall be accepted without testing. See 7.1.4.

4.6 *Clearing Trapped Refrigerant.* For equipment rated for more than one refrigerant, the manufacturer shall provide a method and instructions which will accomplish connections and clearing within 15 minutes. Special equipment, other than a vacuum pump or manifold gauge set shall be furnished. The clearing procedure shall not rely upon the storage cylinder below saturated pressure conditions at ambient temperature.

4.7 *Temperature.* The equipment shall be evaluated at 24 °C with additional limited evaluation at 40 °C. Normal operating conditions range from 10 °C to 40 °C.

4.8 *Exemptions.* Equipment intended for recovery only shall be exempt from 4.2 and 4.3.

Section 5. Contaminated Refrigerants

5.1 *Sample Characteristics.* The standard contaminated refrigerant sample shall have the characteristics specified in Table 1, except as provided in 5.2.

5.2 *Recovery-Only Testing.* Recovery equipment not rated for any specific contaminant shall be tested with new or reclaimed refrigerant.

Section 6. Test Apparatus

6.1 *General Recommendations.* The recommended test apparatus is described in the following paragraphs. If alternate test apparatus are employed, the user shall be able to demonstrate that they produce results equivalent to the specified referee apparatus.

6.2 *Self-Contained Equipment Test Apparatus.* The apparatus, shown in Figure 1, shall consist of:

6.2.1 *Mixing Chamber.* A mixing chamber consisting of a tank with a conical-shaped bottom, a bottom port and piping for delivering refrigerant to the equipment, various ports and valves for adding refrigerant to the chamber and stirring means for mixing.

6.2.2 *Filling Storage Cylinder.* The storage cylinder to be filled by the refrigerant transferred shall be cleaned and at the pressure of the recovered refrigerant at the beginning of the test. It will not be filled over 80%, by volume.

6.2.3 *Vapor Feed.* Vapor refrigerant feed consisting of evaporator, control valves and piping to create a 3.0 °C superheat condition at an evaporating temperature of 21 °C ±2K.

6.2.4 *Alternative Vapor Feed.* An alternative method for vapor feed shall be to pass the refrigerant through a boiler and then through an automatic pressure regulating valve set at different saturation pressures, moving from saturated pressure at 24 °C to final pressure of recovery.

6.2.5 *Liquid Feed.* Liquid refrigerant feed consisting of control valves, sampling port and piping.

6.2.6 *Instrumentation.* Instrumentation capable of measuring weight, temperature, pressure and refrigerant loss, as required.

Table 1—Standard Contaminated Refrigerant Samples

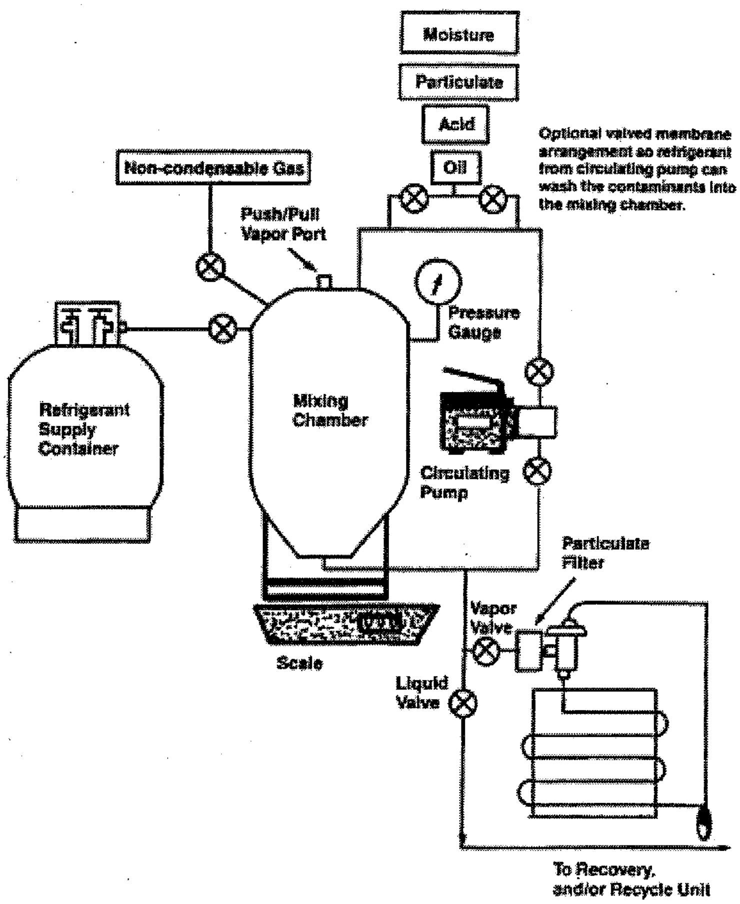
	R11	R12	R13	R22	R113	R114	R123	R134a	R500	R502	R503
Moisture Content: ppm by Weight of Pure refrigerant	100	80	30	200	100	85	200	200	200	200	30
Particulate Content: ppm by Weight of Pure Refrigerant Characterized by[1]	80	80	NA	80	80	80	80	80	80	80	NA
Acid Content: ppm by Weight of Pure Refrigerant—(mg KOH per kg Refrigerant) Characterized by[2]	500	100	NA	500	400	200	500	100	100	100	NA
Mineral Oil Content:											
% by Weight of Pure Refrigerant	20	5	NA	5	20	20	20	5	5	5	NA
Viscosity (SUS)	300	150		300	300	300	300	150[3]	150	150	
Non-Condensable Gases (Air Content): % by Volume	NA	3	3	3	NA	3	NA	3	3	3	3

[1]Particulate content shall consist of inert materials and shall comply with particulate requirements in appendix B.

[2]Acid consists of 60% oleic acid and 40% hydrochloric acid on a total number basis.

[3]Synthetic ester-based oil.

Figure 1. Test Apparatus for Self-Contained Equipment



View or download PDF

6.3 *Size.* The size of the mixing chamber shall be a minimum of .09 m^3 . The bottom port and the refrigerant feed shall depend on the size of the equipment. Typically, the mixing valves and piping shall be 9.5 mm. For large equipment to be used on chillers, the minimum inside diameter of ports, valves and pipings shall be the smaller of the manufacturer's recommendation or 37 mm.

6.4 *System Dependent Equipment Test Apparatus.* This test apparatus is to be used for final recovery vacuum rating of all system dependent equipment.

6.4.1 *Test Setup.* The test apparatus shown in Figure 2 consists of a complete refrigeration system. The manufacturer shall identify the refrigerants to be tested. The test apparatus can be modified to facilitate operation or testing of the system dependent equipment if the modifications to the apparatus are specifically described within the manufacturer's literature. (*See* Figure 2.) A 6.3 mm balance line shall be connected across the test apparatus between the high and low-pressure sides, with an isolation valve located at the connection to the compressor high side. A 6.3 mm access port with a valve core shall be located in the balance line for the purpose of measuring final recovery vacuum at the conclusion of the test.

Section 7. Performance Testing

7.1 *General Testing.*

7.1.1 *Temperatures.* Testing shall be conducted at an ambient temperature of 24 °C ±1K except high temperature vapor recovery shall be at 40 °C ±1K. The evaporator conditions of 6.2.3 shall be maintained as long as liquid refrigerant remains in the mixing chamber.

7.1.2 *Refrigerants.* The equipment shall be tested for all designated refrigerants (*see* 11.2). All tests in Section 7 shall be completed for each refrigerant before starting tests with the next refrigerant.

7.1.3 *Selected Tests.* Tests shall be as appropriate for the equipment type and ratings parameters selected (*see* 9.9, 11.1 and 11.2).

7.1.4 *Hose Assemblies.* For the purpose of limiting refrigerant emissions to the atmosphere, hose assemblies shall be tested for permeation according to ANSI/UL Standard 1963, Section 40.10.

7.2 *Equipment Preparation and Operation.* The equipment shall be prepared and operated per the operating instructions.

7.3 *Test Batch.* The test batch consisting of refrigerant sample (*see* Section 5) of the test refrigerant shall be prepared and thoroughly mixed. Continued mixing or stirring shall be required during the test while liquid refrigerant remains in the mixing chamber. The mixing chamber shall be filled to 80% level by volume.

7.3.1 *Control Test Batch.* Prior to starting the test for the first batch for each refrigerant, a liquid sample will be drawn from the mixing chamber and analyzed per Section 8 to assure that contaminant levels match Table 1 within ±10 ppm for moisture, ±20 ppm for particulate, ±20 ppm for oleic acid and ±0.5% for oil.

7.4 *Recovery Tests (Recovery and Recovery/Recycle Equipment).*

7.4.1 *Determining Recovery Rates.* The liquid and vapor refrigerant recovery rates shall be measured during the first test batch for each refrigerant (*see* 9.1, 9.2 and 9.4). Equipment preparation and recovery cylinder changeover shall not be included in elapsed time measurements for determining vapor recovery rate and liquid refrigerant recovery rate. Operations such as subcooling the recovery cylinder shall be included. Recovery cylinder shall be the same size as normally furnished or specified in the instructions by the equipment manufacturer. Oversized tanks shall not be permitted.

7.4.1.1 *Liquid Refrigerant Recovery Rate.* If elected, the recovery rate using the liquid refrigerant feed means (*see* 6.2.5) shall be determined. After the equipment reaches stabilized conditions of condensing temperature and/or recovery cylinder pressure, the recovery process shall be stopped and an initial weight shall be taken of the mixing chamber (*see* 9.2). The recovery process shall be continued for a period of time sufficient to achieve the accuracy in 9.4. The recovery process shall be stopped and a final weight shall be taken of the mixing chamber.

Configuration of standard air conditioning or refrigeration system for use as a test apparatus

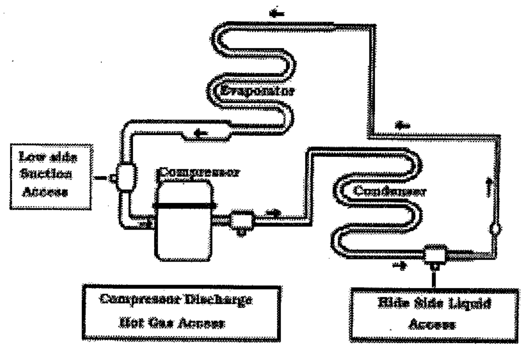


Figure 2. System Dependent Equipment Test Apparatus

View or download PDF

7.4.1.2 *Vapor Refrigerant Recovery Rate.* If elected, the average vapor flow rate shall be measured to accuracy requirements in clause 9.4 under conditions with no liquid refrigerant in the mixing chamber. The liquid recovery feed means shall be used. At initial conditions of saturated vapor at the higher of 24 °C or the boiling temperature (100 kPa absolute pressure), the weight of the mixing chamber and the pressure shall be recorded. At final conditions representing pressure in the mixing chamber of 10% of the initial condition, but not less than the final recovery vacuum (*see* 9.6) nor more than 100 kPa, measure the weight of the mixing chamber and the elapsed time.

7.4.1.3 *High Temperature Vapor Recovery Rate.* Applicable for equipment having at least one designated refrigerant (*see* 11.2) with a boiling point between −50 °C and +10 °C. Measure the rate for R–22, or the refrigerant with the lowest boiling point if R–22 is not a designated refrigerant. Repeat the test in 7.4.1.2 at saturated conditions at 40 °C and continue to operate equipment to assure it will achieve the final recovery vacuum (*see* 7.4.3).

7.4.2 *Recovery Operation.* This test is for determining the final recovery vacuum and the ability to remove contaminants as appropriate. If equipment is rated for liquid recovery (*see* 7.4.1.3), liquid recovery feed means described in 6.2.5 shall be used. If not, vapor recovery means described in 6.2.3 or 6.2.4 shall be used. Continue recovery operation until all liquid is removed from the test apparatus and vapor is removed to the point where equipment shuts down by automatic means or is manually shut off per operating instructions.

7.4.2.1 *Oil Draining.* Capture oil from the equipment at intervals as required in the instructions. Record the weight of the container. Completely remove refrigerant from oil by evacuation or other appropriate means. The weight difference shall be used in 9.5.2.

7.4.3 *Final Recovery Vacuum.* At the end of the first test batch for each refrigerant, the liquid valve and vapor valve of the apparatus shall be closed. After waiting 1 minute, the mixing chamber pressure shall be recorded (*see* 9.6).

7.4.4 *Residual Refrigerant.* This test will measure the mass of remaining refrigerant in the equipment after clearing and therefore the potential for mixing refrigerants (*see* 4.6).

7.4.4.1 *Initial Conditions.* At the end of the last test for each batch for each refrigerant, the equipment shall be disconnected from the test apparatus (Figure 1). Recycle per 7.5, if appropriate. Perform refrigerant clearing operations as called for in the instruction manual. Capture and record the weight of any refrigerant which would have been emitted to the atmosphere during the clearing process for use in 9.5. If two loops are used for recycling, trapped refrigerant shall be measured for both.

7.4.4.2 *Residual Trapped Refrigerant.* Evacuate an empty test cylinder to 1.0 kPa absolute. Record the empty weight of the test cylinder. Open all valves to the equipment so as to provide access to all trapped refrigerant. Connect the equipment to the test cylinder and operate valves to recover the residual refrigerant. Record the weight of the test cylinder using a recovery cylinder pressure no less than specified in 6.2.2. Place the test cylinder in liquid nitrogen for a period of 30 minutes or until a vacuum of 1000 microns is reached, whichever occurs first.

7.5 *Recycling Tests (Recovery/Recycle Equipment).*

7.5.1 *Recycling Operation.* As each recovery cylinder is filled in 7.4.2, recycle according to operating instructions. There will not necessarily be a separate recycling sequence. Note non-condensable purge measurement in 9.5.

7.5.1.1 *Recycle Flow Rate.* While recycling the first recovery cylinder for each refrigerant, determine the recycling flow rate by appropriate means (*see* 9.3) to achieve the accuracy required in 9.4.

7.5.2 *Non-Condensable Sample.* After completing 7.4.3, prepare a second test batch (7.3). Recover per 7.4.2 until the current recovery cylinder is filled to 80% level by volume. Recycle per 7.5.1. Mark this cylinder and set aside for taking the vapor sample. For equipment having both an internal tank of at least 3 kg refrigerant capacity and an external recovery cylinder, two recovery cylinders shall be marked and set aside. The first is the cylinder described above. The second cylinder is the final recovery cylinder after filling it to 80% level by volume and recycling.

7.5.3 *Liquid Sample for Analysis.* Repeat steps 7.3, 7.4.2 and 7.5.1 with further test batches until indication means in 4.2 show the filter/drier(s) need replacing.

7.5.3.1 *Multiple Pass.* For equipment with a separate recycling circuit (multiple pass), set aside the current cylinder and draw the liquid sample (*see* 7.4) from the previous cylinder.

7.5.3.2 *Single Pass.* For equipment with the single pass recycling circuit, draw the liquid sample (*see* 7.4) from the current cylinder.

7.6 *Measuring Refrigerant Loss.* Refrigerant loss due to non-condensables shall be determined by appropriate means (*see* 9.5.1). The loss could occur in 7.4.1, 7.4.2 and 7.5.1.

Section 8. Sampling and Chemical Analysis Methods

8.1 *Chemical Analysis.* Chemical analysis methods shall be specified in appropriate standards such as ARI 700–95 and Appendix C to ARI Standard 700–95.

8.2 *Refrigerant Sampling.*

8.2.1 *Water Content.* The water content in refrigerant shall be measured by the Karl Fischer Analytical Method or by the Karl Fischer Coulometric techniques. Report the moisture level in parts per million by weight.

8.2.2 *Chloride Ions.* Chloride ions shall be measured by turbidity tests. At this time, quantitative results have not been defined. Report chloride content as “pass” or “fail.” In the future, when quantitative results are possible, report chloride content as parts per million by weight.

8.2.3 *Acidity.* The acidity test uses the titration principle. Report the acidity in parts per million by weight (mg KOH/kg) of sample.

8.2.4 *High Boiling Residue.* High boiling residues shall use measurement of the volume of residue after evaporating a standard volume of refrigerant. Using weight measurement and converting to volumetric units is acceptable. Report high boiling residues as percent by volume.

8.2.5 *Particulates/Solids.* The particulates/solids measurement employs visual examination. Report results as "pass" or "fail."

8.2.6 *Non-condensables.* The level of contamination by non-condensable gases in the base refrigerant being recycled shall be determined by gas chromatography. Report results as percent by volume.

Section 9. Performance Calculation and Rating

9.1 *Vapor Refrigerant Recovery Rate.* This rate shall be measured by weight change of the mixing chamber divided by elapsed time (*see* 7.4.1.2). The units shall be kg/min and the accuracy shall be per 9.4.

9.1.1 *High Temperature Vapor Recovery Rate.*

9.2 *Liquid Refrigerant Recovery Rate.* This rate shall be measured by weight change of the mixing chamber divided by elapsed time (*see* 7.4.1.3). The units shall be kg/min and the accuracy shall be per 9.4.

9.3 *Recycle Flow Rate.* The recycle flow rate shall be as defined in 3.10, expressed in kg/min, and the accuracy shall be per 9.4.

9.3.1 For equipment using multi-pass recycling or a separate sequence, the recycle rate shall be determined by dividing the net weight W of the refrigerant to be recycled by the actual time T required to recycle. Any set-up or operator interruptions shall not be included in the time T.

9.3.2 If no separate recycling sequence is used, the recycle rate shall be the higher of the vapor refrigerant recovery rate or the liquid refrigerant recovery rate. The recycle rate shall match a process which leads to contaminant levels in 9.9. Specifically, a recovery rate determined from bypassing a contaminant removal device cannot be used as a recycle rate when the contaminant levels in 9.9 are determined by passing the refrigerant through the contaminant removal device.

9.4 *Accuracy of Flow Rates.* The accuracy of test measurements in 9.1, 9.2 and 9.3 shall be ±008 kg/min or flow rates up to .42 kg/min and ±2.0% for flow rates larger than .42 kg/min. Ratings shall be expressed to the nearest .02 kg/min.

9.5 *Refrigerant Loss.* This calculation will be based upon the net loss of refrigerant which would have been eliminated in the non-condensable purge process (*see* 7.5.1), the oil draining process (*see* 7.4.2.1) and the refrigerant clearing process (*see* 7.4.4.1), all divided by the net refrigerant content of the test batches. The refrigerant loss shall not exceed 3% by weight.

9.5.1 *Non-Condensable Purge.* Evacuate an empty container to 2 kPa absolute. Record the empty weight of the container. Place the container in a dry ice bath. Connect the equipment purge connection to the container and operate purge according to operating instructions so as to capture the non-condensables and lost refrigerant. Weigh the cylinder after the recycling is complete. Equivalent means are permissible.

9.5.2 *Oil Draining.* Refrigerant removed from the oil after draining shall be collected and measured in accordance with 7.4.2.1.

9.5.3 *Clearing Unit.* Refrigerant captured during the clearing process shall be measured in accordance with 7.4.4.1.

9.6 *Final Recovery Vacuum.* The final recovery vacuum shall be the mixing chamber pressure in 7.4.3 expressed in kPa. The accuracy of the measurement shall be within 0.33 kPa.

9.7 *Residual Trapped Refrigerant.* The amount of residual trapped refrigerant shall be the final weight minus the initial weight of the test cylinder in 7.4.4.2, expressed in kg. The accuracy shall be ±0.02 kg and reported to the nearest 0.05 kg.

9.8 *Quantity Recycled.* The amount of refrigerant processed before changing filters (*see* 7.5.3) shall be expressed in kg to an accuracy of ±1%.

9.9 *Contaminant Levels.* The contaminant levels remaining after testing shall be published as follows:

Moisture content, ppm by weight

Chloride ions, pass/fail

Acidity, ppm by weight

High boiling residue, % (by volume)

Particulates-solid, pass/fail (visual examination)

Non-condensables, % (by volume)

9.10 *Minimum Data Requirements for Published Ratings.* Published ratings shall include all of the parameters as shown in Tables 2 and 3 for each refrigerant designated by the manufacturer.

Section 10. Tolerances

10.1 *Tolerances.* Performance related parameters shall not be less favorable than the published ratings.

Section 11. Marking and Nameplate Data

11.1 *Marking and Nameplate Data.* The nameplate shall display the manufacturer's name, model designation, type of equipment, designated refrigerants, capacities and electrical characteristics where applicable. The nameplate shall also conform to the labeling requirements established for certified recycling and recovery equipment established at 40 CFR 82.158(h).

Recommended nameplate voltages for 60 Hertz systems shall include one or more of the utilization voltages shown in Table 1 of ARI Standard 110–90. Recommended nameplate voltages for 50 Hertz systems shall include one or more of the utilization voltages shown in Table 1 of IEC Standard Publication 38, IEC Standard Voltages.

11.2 *Data for Designated Refrigerants.* For each refrigerant designated, the manufacturer shall include all the following that are applicable per Table 2:

a. Liquid Recovery Rate

b. Vapor Recovery Rate

c. High Temperature Vapor Recovery Rate

d. Final Recovery Vacuum

e. Recycle Flow Rate

f. Residual Trapped Refrigerant

g. Quantity Recycled

Table 2—Performance

Parameter/Type of equipment	Recovery	Recovery/Recycle	Recycle	System dependent equipment
Liquid Refrigerant Recovery Rate	(1)	(1)	N/A	N/A
Vapor Refrigerant Recovery Rate	(1)	(1)	N/A	N/A
High Temp. Vapor Recovery Rate	(1)	(1)	N/A	N/A
Final Recovery Vacuum	(X)	(X)	N/A	(X)
Recycle Flow Rate	N/A	(X)	(X)	N/A
Refrigerant Loss	(3)	(X)	(X)	(3)
Residual Trapped Refrigerant	(2)	(2)	(2)	(2)
Quantity Recycled	N/A	(X)	(X)	N/A

[X]Mandatory rating.

[1]For a recovery or recovery/recycle unit, one must rate either liquid refrigerant recovery rate or vapor refrigerant recovery rate or one can rate for both. If rating only the one, the other shall be indicated by N/A, "not applicable."

[2]Mandatory rating for equipment tested for multiple refrigerants.

[3]Mandatory rating if multiple refrigerants, oil separation or non-condensable purge are rated.

Note: For recovery equipment, these parameters are optional. If not rated use N/A, "not applicable."

Table 3—Contaminants

Contaminant/Type of equipment	Recovery	Recovery/Recycle	Recycle	System dependent equipment

Moisture Content	(*)	(X)	(X)	N/A
Chloride Ions	(*)	(X)	(X)	N/A
Acidity	(*)	(X)	(X)	N/A
High Boiling Residue	(*)	(X)	(X)	N/A
Particulates	(*)	(X)	(X)	N/A
Non-Condensables	(*)	(X)	(X)	N/A

*For recovery equipment, these parameters are optional. If not rated, use N/A, "not applicable."

XMandatory rating.

Attachment 1 to Appendix B2 to Subpart F of Part 82—References

Listed here are all standards, handbooks, and other publications essential to the formation and implementation of the standard. All references in this appendix are considered as part of this standard.

• ANSI/UL Standard 1963, *Refrigerant Recovery/Recycling Equipment,* First Edition, 1989, American National Standards Institute/Underwriters Laboratories, Inc.

• ARI Standard 110–90, *Air-Conditioning and Refrigerating Equipment Nameplate Voltages,* Air-Conditioning and Refrigeration Institute

• ARI Standard 700–95, *Specifications for Fluorocarbon and Other Refrigerants,* Air-Conditioning and Refrigeration Institute

• ASHRAE Terminology of Heating, Ventilation, Air Conditioning, Refrigeration, & Refrigeration, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1991

• IEC Standard Publication 38, *IEC Standard Voltages,* International Electrotechnical Commission, 1983

Attachment 2 to Appendix B2 to Subpart F of Part 82-Particulate Used in Standard Contaminated Refrigerant Sample

1. Particulate Specification

B1.1 The particulate material (pm) will be a blend of 50% coarse air cleaner dust as received, and 50% retained on a 200-mesh screen. The coarse air cleaner dust is available from: AC Spark Plug Division; General Motors Corporation; Flint, Michigan.

B1.2 *Preparation of Particulate Materials.*

To prepare the blend of contaminant, first wet screen a quantity of coarse air cleaner dust on a 200-mesh screen (particle retention 74 pm). This is done by placing a portion of the dust on a 200-mesh screen and running water through the screen while stirring the dust with the fingers. The fine contaminant particles passing through the screen are discarded. The +200-mesh particles collected on the screen are removed and dried for one hour at 110 °C. The blend of standard contaminant is prepared by mixing 50% by weight of coarse air cleaner dust as received (after drying for one hour at 110 °C) with 50% by weight of the +200 mesh screened dust.

B1.3 *Particle Size Analysis.*

The coarse air cleaner dust as received and the blend used as the standard contaminant have the following approximate particle size analysis:

Wt. % in various size ranges, pm.

Size range	As received	Blend
0–5	12	6
5–10	12	6
10–20	14	7
20–40	23	11
40–80	30	32
80–200	9	38

[68 FR 43815, July 24, 2003; 68 FR 54678, Sept. 18, 2003]

Appendix C to Subpart F of Part 82—Method for Testing Recovery Devices for Use With Small Appliances

Recovery Efficiency Test Procedure for Refrigerant Recovery Equipment Used on Small Appliances

The following test procedure is utilized to evaluate the efficiency of equipment designed to recover ozone depleting refrigerants (or any substitute refrigerant subject to the recycling rules promulgated pursuant to section 608 of the Clean Air Act Amendments of 1990) from small appliances when service of those appliances requires entry into the sealed refrigeration system or when those appliances are destined for disposal. This procedure is designed to calculate on a weight or mass basis the percentage of a known charge of CFC-12 refrigerant removed and captured from a test stand refrigeration system. Captured refrigerant is that refrigerant delivered to a container suitable for shipment to a refrigerant reclaimer plus any refrigerant remaining in the recovery system in a manner that it will be transferred to a shipping container after additional recovery operations.

The test stand refrigeration system required for this procedure is constructed with standard equipment utilized in currently produced household refrigerator and freezer products. The procedure also accounts for compressor oils that might be added to or removed from the test stand compressor or any compressor used in the recovery system.

I. Test Stand

Test stands are constructed in accordance with the following standards.

1. Evaporator—5/16in. outside dia. with 30 cu. in. volume.

2. Condenser—1/4in. outside dia. with 20 cu. in volume.

3. Suction line capillary heat exchanger—appropriate for compressor used.

4. An 800–950 Btu/hr high side case (rotary) compressor; or (depending on the test senario);

5. An 800–9500 Btu/hr low side case (reciprocating) compressor.

A person seeking to have its recovery system certified shall specify the compressors by manufacturer and model that are to be used in test stands constructed for evaluation of its equipment, and the type and quantity of compressor to be used in those compressors. Only a compressor oil approved for use by the compressor's manufacturer may be specified, and the quantity of compressor oil specified shall be an appropriate quantity for the type of oil and compressor to be used. In order to reduce the cost of testing, the person seeking certification of its recovery system may supply an EPA approved third party testing laboratory with test stands meeting these standards for use in evaluating its recovery system.

II. Test Conditions

Tests are to be conducted at 75 degrees F, plus or minus 2 degrees F (23.9 C ±1.1 C). Separate tests are conducted on both high side case compressor stands and low side case compressor stands. Separate tests are also conducted with the test stand compressor running during the recovery operation, and without the test stand compressor running during the recovery operation, to calculate the system's recovery efficiency under either condition.

These tests are to be performed using a representative model of all equipment used in the recovery system to deliver recovered refrigerant to a container suitable for shipment to a refrigerant reclaimer. The test stands are to be equipped with access valves permanently installed as specific by the recovery system's vendor to represent the valves used with that system in actual field operations.

A series of five (5) recovery operations are to be performed for each compressor scenario and a recovery efficiency is calculated based on the total quantity of refrigerant captured during all five (5) recoveries. Alternatively, at the request of the recovery system's vendor, a recovery efficiency is to be calculated for each recovery event. In this case, a statistically significant number of recovery operations are to be performed. Determination of what is a statistically significant number of recoveries is to be calculated as set out below. These individual recovery efficiencies are then averaged.

There are four (4) compressor scenarios to be tested. These are a high side case compressor in working condition; a high side case compressor in nonworking condition; a low side case compressor in working condition; and a low side case compressor in nonworking condition. Recovery efficiencies calculated for the two working compressor scenarios are to be averaged to report a working compressor performance. The two nonworking compressor efficiencies are also to be averaged to report a nonworking compressor performance.

If large scale equipment is required in the system to deliver recovered refrigerant to a refrigerant reclaimer (eg. carbon desorption equipment) and it is not possible to have that equipment evaluated under the procedure, the system's vendor shall obtain engineering data on the performance of that large scale equipment that will reasonably demonstrate the percentage refrigerant lost when processed by that equipment. That data will be supplied to any person required to evaluate the performance of those systems. The following procedure will also be modified as needed to determine the weight of refrigerant recovered from a test stand and delivered to a container for shipment to the large process equipment for further processing. The percentage loss documented to occur during processing is then to be applied to the recovery efficiencies calculated in this modified procedure to determine the overall capture efficiency for the entire system.

The following are definitions of symbols used in the test procedure.

Test Stand:

"TSO" means an original test stand weight.

"TSC" means a charged test stand weight.

Shipping Containers:

"SCO" means the original or empty weight of shipping container(s).

"SCF" means the final or full weight of shipping container(s).

Recover/Transfer System:

"RSO" means the original weight of a recovery/transfer system.

"RSF" means the final weight of a recovery/transfer system.

"OL" means the net amount of oil added/removed from the recovery device and/or transfer device between the beginning and end of the test for one compressor scenario.

Weighing steps are conducted with precision and accuracy of plus or minus 1.0 gram.

III. Test Procedure

1. Evacuate the test stand to 20 microns vacuum (pressure measured at a vacuum pump) for 12 hours.

2. Weigh the test stand (TSO).

3. If this is the first recovery operation being performed for a compressor scenario (or if a recovery efficiency is to be calculated for each recovery event), then weigh all devices used in the recovery system to deliver recovered refrigerant to a container suitable for shipment or delivery to a refrigerant reclaimer. Weigh only devices that can retain refrigerant in a manner that it will ultimately be transferred to a shipping container without significant release to the atmosphere (RSO).

4. Weigh final shipping containers (SCO).

5. Charge the test stand with an appropriate CFC-12 charge (either 6 oz. or 9 oz.).

6. Run the test stand for four (4) hours with 100% run time.

7. Turn off the test stand for twelve (12) hours. During this period evaporate all condensation that has collected on the test stand during step 6.

8. Weigh the test stand (TSC).

9. Recover CFC-12 from the test stand and perform all operations needed to transfer the recovered refrigerant to one of the shipping containers weighed in step 4. All recovery and transfer operations are to be performed in accordance with the operating instructions provided by the system's vendor. The compressor in the test stand is to remain "off" or be turned "on" during the recovery operation depending on whether the test is for a nonworking or working compressor performance evaluation. If a recovery efficiency is to be calculated for each recovery event, transfer the captured refrigerant to a shipping container and then skip to step 13. Otherwise continue. If the system allows for multiple recovery operations to be performed before transferring recovered refrigerant to a shipping container, the transfer operation can be delayed until either the maximum number of recovery operations allowed before a transfer is required have been performed, or the last of the five (5) recovery operations has been performed.

10. Perform any oil removal or oil addition operations needed to properly maintain the test stand and the devices used for recovery or transfer operations. Determine the net weight of the oil added or removed from the recovery device and/or transfer device. (OP1 for oil added, OP2 for oil removed).

11. Evacuate the test stand to 20 microns vacuum for 4 hours.

12. Return to step 2 unless five (5) recovery operations have been performed.

13. Weigh all final shipping containers that received recovered refrigerant (SCF).

14. Weigh the equipment weighed in step three (3) above (RSF). If a recovery efficiency is to be calculated for each recovery event, perform calculations and return to step one (1) for additional recoveries.

IV. Calculations

A. *For Five (5) Consecutive Recoveries*

Refrigerant Recoverable equals the summation of charged test stand weights minus original test stand weights.

$$\text{Refrigerant Recoverable} = \sum_{i=1}^{5} (TSC_i - TSO_i)$$

Oil Loss equals the net weight of oil added to and removed from the recovery device and/or transfer device.

$$OL = \sum_{i=1}^{5} (OP1_i - OP2_i)$$

Refrigerant Recovered equals the final weight of shipping containers minus the initial weight of final shipping containers, plus final recovery system weight, minus original recovery system weight, plus the net value of all additions and removals of oil from the recovery and transfer devices.

$$\text{Refrigerant Recovered} = \left(\sum_{i=1}^{n} SCF_i - SCO_i \right) + RSF - RSO - OL$$

n=number of shipping containers used.

Recovery Efficiency equals Refrigerant Recovered divided by Refrigerant Recoverable times 100%.

$$\text{Recovery Efficiency} = \frac{\text{Refrigerant Recovered}}{\text{Refrigerant Recoverable}} \ 100\%$$

B. *For Individual Recoveries*

Refrigerant Recoverable equals the charged test stand weight minus the original test stand weight.

$$\text{Refrigerant Recoverable} = TSCO - TSO$$

Refrigerant Recovered equals the final weight of the shipping container minus the initial weight of the shipping container plus the final weight of the recovery system minus the original recovery system weight.

$$\text{Refrigerant Recovered} = SCF - SCO + RSF - RSO$$

Recovery Efficiency equals Refrigerant Recovered divided by Refrigerant Recoverable times 100 percent.

$$\text{Recovery Efficiency} = \frac{\text{Refrigerant Recovered}}{\text{Refrigerant Recoverable}} \; 100\%$$

C. *Calculation of a Statistically Significant Number of Recoveries*

$$N_{add} = \left((t * sd) / (.10 * X)\right)^2 - N$$

Where:

N_{add}=the number of additional samples required to achieve 90% confidence.

sd=Standard deviation, or $(X/(N-1)^{5})$

X=Sample average

N=Number of samples tested

Number of samples	t for 90% confidence
2	6.814
3	2.920
4	2.353
5	2.132
6	2.015
7	1.943
8	1.895
9	1.860
10	1.833

Procedure:

1. Compute N_{add}after completing two recoveries.

2. If $N_{add}>0$, then run an additional test.

3. Re-compute N_{add}. Continue to test additional samples until $N_{add}<0$.

V. Test Procedure Approval and Certification

Each vendor of capture equipment for small appliances desiring certification will provide a representative model of its capture system and its recommended recovery procedures to an EPA approved third party laboratory for testing in accordance with this procedure. The third party laboratory will certify recovery systems that when tested in accordance with this procedure demonstrate a sufficient recovery efficiency to meet EPA regulatory requirements.

Appendix D to Subpart F of Part 82—Standards for Becoming a Certifying Program for Technicians

Standards for Certifying Programs

a. Test Preparation

Certification for Type II, Type III and Universal technicians will be dependent upon passage of a closed-book, proctored test, administered in a secure environment, by an EPA-approved certifying program.

Certification for Type I technicians will be dependent upon passage of an EPA-approved test, provided by an EPA-approved certifying program. Organizations providing Type I certification only, may chose either an on-site format, or a mail-in format, similar to what is permitted under the MVACs program.

Each certifying program must assemble tests by choosing a prescribed subset from the EPA test bank. EPA expects to have a test bank with a minimum of 500 questions, which will enable the certifying program to generate multiple tests in order to discourage cheating. Each test must include 25 questions drawn from Group 1 and 25 questions drawn from each relevant technical Group. Tests for Universal technicians will include 100 questions (25 from Group 1 and 25 from each relevant technical Group). Each 50-question test represents 10 percent of the total test bank. Questions should be divided in order to sufficiently cover each topic within the Group.

Each certifying program must show a method of randomly choosing which questions will be on the tests. Multiple versions of the test must be used during each testing event. Test answer sheets or (for those testing via the computer medium) computer files must include the name and address of the applicant, the name and address of the certifying program, and the date and location at which the test was administered.

Training material accompanying mail-in Type I tests must not include sample test questions mimicking the language of the certification test. All mail-in material will be subject to review by EPA.

Certifying programs may charge individuals reasonable fees for the administration of the tests. EPA will publish a list of all approved certifying programs periodically, including the fees charged by the programs. This information will be available from the Stratospheric Ozone Protection Hotline.

b. Proctoring

A certifying program for Type II, Type III and Universal technicians must designate or arrange for the designation of at least one proctor registered for each testing event. If more than 50 people are taking tests at the same time at a given site, the certifying organization must adhere to normal testing procedures, by designating at least one additional proctor or monitor for every 50 people taking tests at that site.

The certification test for Type II, Type III and Universal technicians is a closed-book exam. The proctors must ensure that the applicants for certification do not use any notes or training materials during testing. Desks or work space must be placed in a way that discourages cheating. The space and physical facilities are to be conducive to continuous surveillance by the proctors and monitors during testing.

The proctor may not receive any benefit from the outcome of the testing other than a fee for proctoring. Proctors cannot know in advance which questions are on the tests they are proctoring.

Proctors are required to verify the identity of individuals taking the test by examining photo identification. Acceptable forms of identification include but are not limited to drivers' licenses, government identification cards, passports, and military identification.

Certifying programs for Type I technicians using the mail-in format, must take sufficient measures at the test site to ensure that tests are completed honestly by each technician. Each test for Type I certification must provide a means of verifying the identification of the individual taking the test. Acceptable forms of identification include but are not limited to drivers' licenses numbers, social security numbers, and passport numbers.

c. Test Security

A certifying program must demonstrate the ability to ensure the confidentiality and security of the test questions and answer keys through strict accountability procedures. An organization interested in developing a technician certification program will be required to describe these test security procedures to EPA.

After the completion of a test, proctors must collect all test forms, answer sheets, scratch paper and notes. These items are to be placed in a sealed envelope.

d. Test Content

All technician certification tests will include 25 questions from Group I. Group I will ask questions in the following areas:

I. Environmental impact of CFCs and HCFCs

II. Laws and regulations

III. Changing industry outlook

Type I, Type II and Type III certification tests will include 25 questions from Group II. Group II will ask questions covering sector-specific issues in the following areas:

IV. Leak detection

V. Recovery Techniques

VI. Safety

VII. Shipping

VII. Disposal

Universal Certification will include 75 questions from Group II, with 25 from each of the three sector-specific areas.

e. Grading

Tests must be graded objectively. Certifying programs must inform the applicant of their test results no later than 30 days from the date of the test. Type I certifying programs using the mail-in format, must notify the applicants of their test results no later than 30 days from the date the certifying programs received the completed test and any required documentation. Certifying programs may mail or hand deliver the results.

The passing score for the closed-book Type I, Type II, Type III and Universal certification test is 70 percent. For Type I certification tests using the mail-in format, passing score is 84 percent.

f. Proof of Certification

Certifying programs must issue a standard wallet-sized identification card no later than 30 days from the date of the test. Type I certifying programs using mail-in formats must issue cards to certified technicians no later than 30 days from the date the certifying program receives the completed test and any required documentation.

Each wallet-sized identification card must include, at a minimum, the name of the certifying program including the date the certifying program received EPA approval, the name of the person certified, the type of certification, a unique number for the certified person and the following text:

[name of person] has been certified as [Type I, Type II, Type III and/or Universal—as appropriate] technician as required by 40 CFR part 82, subpart F.

g. Recordkeeping and Reporting Requirements

1. Certifying programs must maintain records that include, but are not limited to, the names and addresses of all individuals taking the tests, the scores of all certification tests administered, and the dates and locations of all testing administered.

2. EPA must receive an activity report from all approved certifying programs by every January 30 and June 30, the first to be submitted following the first full six-month period for which the program has been approved by EPA. This report will include the pass/fail rate and testing schedules. This will allow the Agency to determine the relative progress and success of these programs. If the certifying program believes a test bank question needs to be modified, information about that question should also be included.

3. Approved certifying programs will receive a letter of approval from EPA. Each testing center must display a copy of that letter at their place of business.

4. Approved technician certification programs that voluntarily plan to stop providing the certification test must forward all records required by this appendix, §§82.161, and 82.166 to another program currently approved by EPA in accordance with this appendix and with §82.161. Approved technician certification programs that receive records of certified technicians from a program that no longer offers the certification test must inform EPA in writing at the address listed in §82.160 within 30 days of receiving these records. The notification notice must include the name and address of the program to which the records have been transferred. If another currently approved program willing to accept the records cannot be located, these records must be submitted to EPA at the address listed at §82.160.

5. Technician certification programs that have had their certification revoked in accordance with §82.169 must forward all records required by this appendix, §§82.161, and 82.166 to EPA at the address listed in §82.160.

h. Additional Requirements

EPA will periodically inspect testing sites to ensure compliance with EPA regulations. If testing center discrepancies are found, they must be corrected within a specified time period. If discrepancies are not corrected, EPA may suspend or revoke the certifying programs's approval. The inspections will include but are not limited to a review of the certifying programs' provisions for test security, the availability of space and facilities to conduct the administrative requirements and ensure the security of the tests, the availability of adequate testing facilities and spacing of the applicants during testing, a review of the proper procedures regarding accountability, and that there is no evidence of misconduct on the part of the certifying programs, their representatives and proctors, or the applicants for certification.

If the certifying programs offer training or provide review materials to the applicants, these endeavors are to be considered completely separate from the administration of the certification test.

i. Approval Process

EPA anticipates receiving a large number of applications from organizations seeking to become certifying programs. In order to certify as many technicians as possible in a reasonable amount of time, EPA will give priority to national programs. Below are the guidelines EPA will use:

First: Certifying programs providing at least 25 testing centers with a minimum of one site in at least 8 different states will be considered.

Second: Certifying programs forming regional networks with a minimum of 10 testing centers will be considered.

Third: Certifying programs providing testing centers in geographically isolated areas not sufficiently covered by the national or regional programs will be considered.

Fourth: All other programs applying for EPA approval will be considered.

Sample application forms may be obtained by contacting the Stratopheric Ozone Hotline at 1–800–296–1996.

j. Grandfathering

EPA will grandfather technicians who successfully completed voluntary programs whose operators seek and receive EPA approval to grandfather these technicians, in accordance with §82.161(g). As part of this process, these certifying programs may be required to send EPA-approved supplementary information to ensure the level of the technicians' knowledge. Technicians will be required to read this supplementary information as a condition of certification. The certifying programs will also issue new identification cards meeting the requirements specified above.

k. Sample Application

EPA has provided a sample application. The Agency designed the application to demonstrate the information certifying programs must provide to EPA. Programs are not required to use this form or this format.

[58 FR 28712, May 14, 1993, as amended at 59 FR 42960, 42962, Aug. 19, 1994; 59 FR 55927, Nov. 9, 1994; 68 FR 54678, Sept. 18, 2003]

Browse Previous | Browse Next

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER A STATUS UPDATE ON THE ZERO EMISSION VEHICLE REGULATION

The Air Resources Board (ARB or Board) will conduct a public meeting at the time and place noted below to consider an informational update on the Zero Emission Vehicle (ZEV) regulation.

DATE: December 9-10, 2009

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., December 9, 2009, and will continue at 8:30 a.m., December 10, 2009. This item may not be considered until December 10, 2009. Please consult the agenda for the meeting, which will be available at least ten days before December 9, 2009, to determine the day on which this item will be considered.

Summary
In September 1990, ARB adopted a low-emission vehicle regulation aiming to drastically reduce pollution from passenger cars and light-duty trucks. As part of the newly created program, the Board included a goal of requiring large automakers to commercialize vehicles with no direct emissions, known as ZEVs. While the ZEV Program prompted automakers to manufacture several thousand ZEVs, these vehicles have not yet been offered commercially. Since its 1990 adoption, the ZEV regulation has been modified several times to align the regulatory timeline with the status of ZEV technology development and commercialization and reflect the development of near-zero emission conventional, alternative fuel, and hybrid electric vehicles.

At the March 2008 Board hearing, the Board adopted modifications to the ZEV regulation as stated in Resolution 08-24. Resolution 08-24 directs staff to:

- Review the low emission vehicle (LEV), Pavley, and ZEV programs, keeping in mind the need to reduce criteria pollutant emissions, climate change emissions, and dependence on petroleum;
- Strengthen the ZEV program for model years 2015 and subsequent years, focusing on zero emission vehicles and enhanced advanced technology partial zero emission vehicles (enhanced AT PZEVs);
- Ensure California is the center of ZEV commercialization development; and
- Return to the Board by the end of 2009.

The purpose of this public meeting is to share staff's preliminary assessment of possible changes to the ZEV regulation with the Board. No regulatory changes will be made at this time. The objective of this meeting is to receive feedback on staff's preliminary assessment, and to provide the Board with staff's views of how a revised ZEV program could complement the revisions to the low emission vehicle program (including both criteria and greenhouse gas emission standards) that staff intends to propose for Board consideration late next summer. Later in 2010, staff will propose formal regulatory changes to the ZEV program.

At the December 2009 meeting, staff will discuss its assessment of the status of ZEV technology, and its evaluation of the role ZEVs can contribute to achieving the State's 2050 greenhouse gas (GHG) reduction goal. Staff will also discuss possible regulatory structures for a revised ZEV program. Finally, staff will share its assessment of current and possible future complementary policies that can play a role in establishing alternative fueling infrastructure and help assure consumers purchase ZEVs.

A white paper summarizing possible changes to the ZEV regulation along with attachments on ZEV technology status, a 2050 GHG analysis, and complementary policies are available electronically on ARB's program website at **http://www.arb.ca.gov/msprog/zevprog/2009zevreview/2009zevreview.htm**

Interested members of the public may present comments orally or in writing at the meeting, and may be submitted by postal mail or electronic submittal before the meeting. To be considered by the Board, written comments or submissions not physically submitted at the meeting must be received **no later than 12:00 noon, December 8, 2009,** and addressed to the following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Please note that under the California Public Records Act (Government Code section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. In addition, this information may become available via Google, Yahoo, and any other search engines.

To request a special accommodation or language needs for any of the following:

- An interpreter to be available at the hearing.
- Have documents available in an alternate format (i.e. Braille, large print) or another language.
- A disability-related reasonable accommodation.

Please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled Board hearing. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

Para solicitar alguna comodidade especial o si por su idioma necesita cualquiera de los siguientes:

- Un intérprete que esté disponible en la audiencia.
- Documentos disponibles en un formato alternativo (es decir, sistema Braille, letra grande) u otro idioma.
- Una acomodación razonable relacionados con una incapacidad.

Porfavor llame a la officina del Consejo a (916) 322-5594 o envie un fax a (916) 322-3928 lo mas pronto possible, pero no menos de 10 dias de trabajo antes del el dia programado para la audencia del Consejo. TTY/TDD/ Personas que nesessitan este servicion pueden marcar el 711 para el Servicio de Retransmisión de Mensajes de California.

The Board requests, but does not require 20 copies of any written submission. Also, ARB requests that written and e-mail statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment. Further inquiries regarding this matter should be directed to Ms. Anna Gromis, Air Pollution Specialist, at (916) 323-2410, or to Ms. Elise Keddie, Manager, ZEV Implementation Section, at (916) 323-8974.

CALIFORNIA AIR RESOURCES BOARD

Michael N. Scheible

for James N. Goldstene
Executive Officer

Date: November 24, 2009

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.arb.ca.gov.

State of California
AIR RESOURCES BOARD

White Paper:

Summary of Staff's Preliminary Assessment of the Need for Revisions to the Zero Emission Vehicle Regulation

Release Date: November 25, 2009
Board Meeting Date: December 10, 2009

TABLE OF CONTENTS

List of Acronyms

AB ....Assembly Bill
ARB ....California Air Resources Board or the Board
AT PZEV .....Advanced Technology Partial ZEV Allowance Vehicle
BAU ....Business As Usual
BEV..............Battery Electric Vehicle
BOP ....Balance of Plant
CFO ....Clean Fuels Outlet regulation
CNG ....Compressed Natural Gas
CO_2e ....Carbon Dioxide emissions equivalent
CPUC...........California Public Utility Commission
DTI ....Directed Technologies Incorporated
EAER ....Equivalent All Electric Range
FCV..............Fuel Cell Vehicle
GDL ....Gas Diffusion Layer
GGE.............Gasoline Gallon Equivalent
GHG.............Greenhouse Gas
HDV ....Heavy Duty Vehicle
HEV ....Hybrid-Electric Vehicle
HICE ....Hydrogen Internal Combustion Engine
HOV.............High Occupancy Vehicle
ICE...............Internal Combustion Engine
IOU ....Investor Owned Utility
ISOR ....Initial Statement of Reasons
kW................Kilowatt
LCFS............Low Carbon Fuels Standard
LEV ....Low Emission Vehicle regulation
LEV III ....Future Low Emission Vehicle regulations, including criteria pollutant standards and greenhouse gas standards (formerly known as the Pavley Regulation, or Assembly Bill 1493)
$LiFePO_4$ ....Iron Phosphate Cathode Material (Battery)
Li Ion ....Lithium Ion Battery technology
LMS ....Lithium Manganese Spinel
LVM ....Large Volume Manufacturers
MEA ....Membrane Electrode Assembly
MIT...............Massachusetts Institute of Technology
MMT.............Million metric tonnes
MSCD ....Mobile Sources Control Division
MWh ....Megawatt Hours
NCA ....Mixed oxide of nickel, cobalt, and aluminum
NCM.............Mixed oxide of nickel, cobalt, and magnesium
NEV ....Neighborhood Electric Vehicle
OEM.............Original Equipment Manufacturer
PEM ....Proton Exchange Membrane
PGM.............Platinum Group Metal
PHEV ....Plug-in Hybrid-Electric Vehicle

PUC ....Public Utilities Commission
PZEV ....Partial ZEV Allowance Vehicle
R&D ....Research and Development
SIE ....Spark Ignition Engine
SMR.............Steam Methane Reformation
SOC ....State of Charge
SOH ....State of Health
SULEV ....Super Ultra Low Emission Vehicle
TSD..............Technical Support Document
USABC ....United States Advanced Battery Consortium
U.S. DOE .....United States Department of Energy
U.S. EPA......United States Environmental Protection Agency
VMT ....Vehicle Miles Traveled
ZEV ....Zero Emission Vehicle

1. Introduction

Why is staff considering changes to the ZEV regulation?

Resolution 08-24

At the March 2008 Board Hearing, the California Air Resources Board (ARB or the Board) adopted modifications to the zero emission vehicle (ZEV) regulation as stated in Resolution 08-24[1]. According to Resolution 08-24, staff is to:

- Review the low emission vehicle (LEV), Pavley (GHG), and ZEV programs, keeping in mind the need to reduce criteria pollutant emissions, climate change emissions, and dependence on petroleum,
- Strengthen the ZEV program for model years 2015 and subsequent, focusing on ZEVs and enhanced advanced technology partial zero emission vehicles (Enhanced AT PZEVs),
- Ensure California is the center of ZEV commercialization development, and
- Return to the Board by the end of 2009.

To develop the framework for redesigning the ZEV regulation, staff undertook a review of the status of current ZEV technologies, included herein as Attachment A (Technical Support Document), and analyzed numerous pathways to illustrate how the passenger vehicle subsector can contribute to meeting California's long term 2050 greenhouse gas (GHG) reduction goal (Attachment B to this white paper). Additionally, staff conducted a review of current and possible future complementary policies, included as Attachment C, which could help the ZEV regulation achieve successful ZEV commercialization in California.

GHG Emission Reduction in California

In recognizing the potential for large, damaging impacts from climate change, California Governor Arnold Schwarzenegger enacted Executive Order S-03-05[2], requiring a reduction in state-wide GHG emissions to 80% below 1990 levels by 2050. In addition to the Governor's Executive Order, the State Legislature adopted and the Governor signed Assembly Bill (AB) 32, which has initiated programs to reduce GHG emissions across most sectors. The Board called for a redesign of the ZEV regulation to help meet the goals outlined in the Governor's Executive Order and in AB 32. As a result, the ZEV regulation needs to provide greater focus on achieving GHG emission reductions.

What does this mean for the future of the ZEV regulation?

As adopted in 1990, the ZEV regulation had the goal of helping meet the ambient air quality standard for ozone. The regulation envisioned one in every ten new cars sold would be a ZEV. Manufacturers developed ZEVs which were placed in demonstration fleets, and this continues today. They also developed

---

[1] ARB. California Air Resources Board (ARB). Resolution 08-24. March 2008.
[2] Executive Order. Governor Arnold Schwarzenegger. Executive Order S-03-05. June 2005

conventional gasoline engine vehicles and hybrid electric vehicles (HEV) with drastically lower smog-forming emissions that approach the zero emission goal. The Board modified the ZEV regulation several times to allow vehicle manufacturers to choose from this broader array of vehicle technologies in complying with the regulation. Although ZEVs (battery electric vehicles, or BEVs, and fuel cell vehicles, or FCVs) have not yet achieved a commercial status, very low emitting conventional gasoline vehicles (partial zero emission vehicles or PZEVs) and HEVs such as the Prius (advanced technology partial zero emission vehicles or AT PZEVs) have been commercialized and are being sold by most vehicle manufacturers in growing volumes. Over one million PZEVs and 250,000 AT PZEVs have been delivered for sale in California as a result of the ZEV regulation.

This situation suggests that the PZEVs and AT PZEVs no longer need to be part of a ZEV regulation whose goal is achieving commercialization of zero and near-zero emitting technologies, because these two technologies are now commercial. Commercial PZEV technology can be best considered in establishing revised hydrocarbon (HC), oxides of nitrogen (NOx), and particulate matter (PM) emission standards for the LEV program, whose purpose remains achieving the lowest smog-forming emissions possible, as needed to meet federal ambient air quality standards. AT PZEV technologies, principally the HEV, also have lower GHG emissions. This commercial technology can be considered in establishing more stringent GHG emission standards, which we plan to integrate into the LEV program. The revised LEV program, including more stringent standards for both smog and GHG emissions, will be considered by the Board in the second half of 2010.

What remains in the ZEV regulation are pre-commercial technologies, many of which have the potential to achieve very low GHG emissions, and thus contribute to meeting the Governor's 2050 GHG reduction target. The goal of the revised ZEV program should be to help move these demonstration, low GHG emitting technologies to commercialization, include FCVs, BEVs, and Enhanced AT PZEVs, which currently include plug-in HEVs (PHEV) and hydrogen internal combustion engine (HICE) vehicles. Following the successful mechanisms used to facilitate commercialization of PZEVs and AT PZEVs, the regulation would move ZEVs and Enhanced AT PZEVs from demonstration volumes, meaning hundreds (100s) and thousands (1,000s) per year, through pre-commercial volumes, meaning tens of thousands (10,000s) per year, to commercialization, meaning hundreds of thousands (100,000s) per year. Once this is achieved, the ZEV regulation would no longer be needed, and like the PZEV and AT PZEV technologies, they could be considered in setting future LEV performance-based emission standards.

How will this work within the LEV III Criteria Pollutant and GHG programs?
Starting in model year 2014, PZEV technologies would no longer be part of the ZEV program. Instead they would be considered in setting the stringency of the next criteria pollutant standard (hereafter, referred to as LEV III Criteria Pollutant). Starting in model year 2017, AT PZEV technologies would no longer be part of the ZEV program. Instead, they would be considered in setting the next greenhouse gas emission standard (hereafter, referred to as LEV III GHG). ARB staff is currently coordinating a series of studies to determine the potential GHG emission reductions and costs associated with wider spread use of HEVs, the main AT PZEV technology, especially when combined with light-weight vehicle structures. ARB staff will workshop both LEV III Criteria Pollutants and LEV III GHG program proposals during the first-half of 2010, with an initial statement of reasons (ISOR) presented to the Board for consideration in the summer or fall of 2010.

Will there be any criteria pollutant focus for the future ZEV regulation?
The Board has made significant reductions in criteria pollutants since the creation of the ZEV program in 1990. Resolution 08-24 requires staff to review the program keeping in mind the need for criteria pollutant emission reductions and GHG emission reductions. Most of the pre-commercial technologies which remain the focus of the ZEV program have the potential for extremely low criteria pollutants as well as very low GHG emissions. As these technologies become commercial, they will shift to being considered as part of the LEV standards, which will require that criteria emissions be near zero.

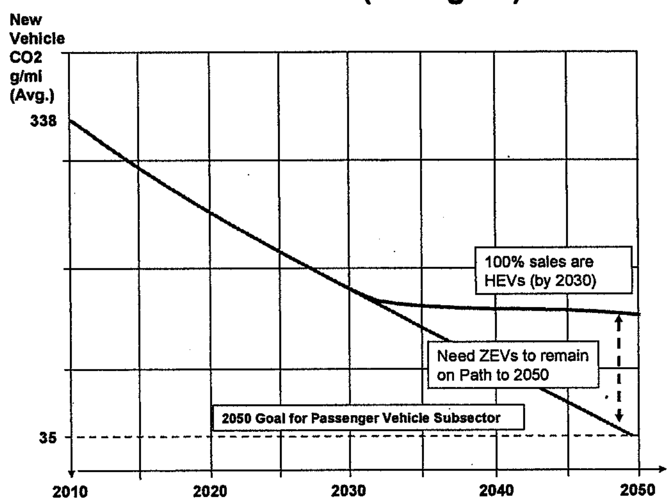
2. Meeting California's 2050 GHG Goal

What is needed in order to reach an 80% reduction in GHG emissions from 1990 levels by 2050?
The Governor's Executive Order establishes an overall 80% GHG reduction goal by 2050, compared to 1990 levels. In order to meet this goal, emissions from most sources of will need to be reduced substantially. Given that the transportation passenger vehicle subsector accounts for 28% of the state's GHG emissions today, it will be difficult to meet the 2050 goal unless this subsector achieves large reductions.[3,4,5] Graph 1 shows one path to meeting an 80% reduction in the passenger vehicle subsector.

---

[3] MIT. MIT Laboratory for Energy and the Environment. "On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emissions." LFEE 2008-05 RP, May 2008
[4] UC Davis. University of California, Davis (UC Davis) Institute of Transportation Studies. "Meeting an 80% in GHG Emissions from Transportation in 2050: A Case Study in California," Transportation Research Part D. 2009
[5] IEA. International Energy Agency (IEA). "Energy Technology Perspectives: Scenarios & Strategies to 2050." 2008

**Graph 1: Reaching 80% GHG Reductions by 2050
New Vehicles (CO2 g/mi)**



The red line in Graph 1 represents one path to achieving an 80% reduction in GHG emissions from the passenger vehicle subsector by 2050. To explore the importance of a specific technology in meeting the 2050 goal, the blue line coming off of the red line shows what kind of emission reductions can be achieved if by 2030 all new vehicles being sold were conventional hybrid vehicles such as the Prius. Conventional HEVs will not provide the reductions needed to reach 2050. This illustrates that other technologies that can achieve deeper cuts in GHG emissions will be needed to keep on the path towards the 2050 goal. Today these very low GHG emitting technologies are pre-commercial, and policies such as the ZEV program will likely be required to achieve commercialization in time to contribute the necessary emission reductions.

What is considered the passenger vehicle subsector's fair share of the overall reductions?

Staff's GHG analysis (Attachment B) assumes a 2050 target of 80% below 1990 passenger vehicle GHG emissions, which could be considered a "fair share" for the passenger vehicle subsector. We use this target in this paper to help frame the challenges ahead.[6] In reality, each sector will carry varying reduction levels to meet the state-wide average of 80%. A number of studies point out that GHG reductions in non-transportation sectors may be less costly, and therefore favored in a carbon market policy.[7,8] However due to the large contribution of passenger vehicles to overall emissions, it is unlikely that the overall GHG

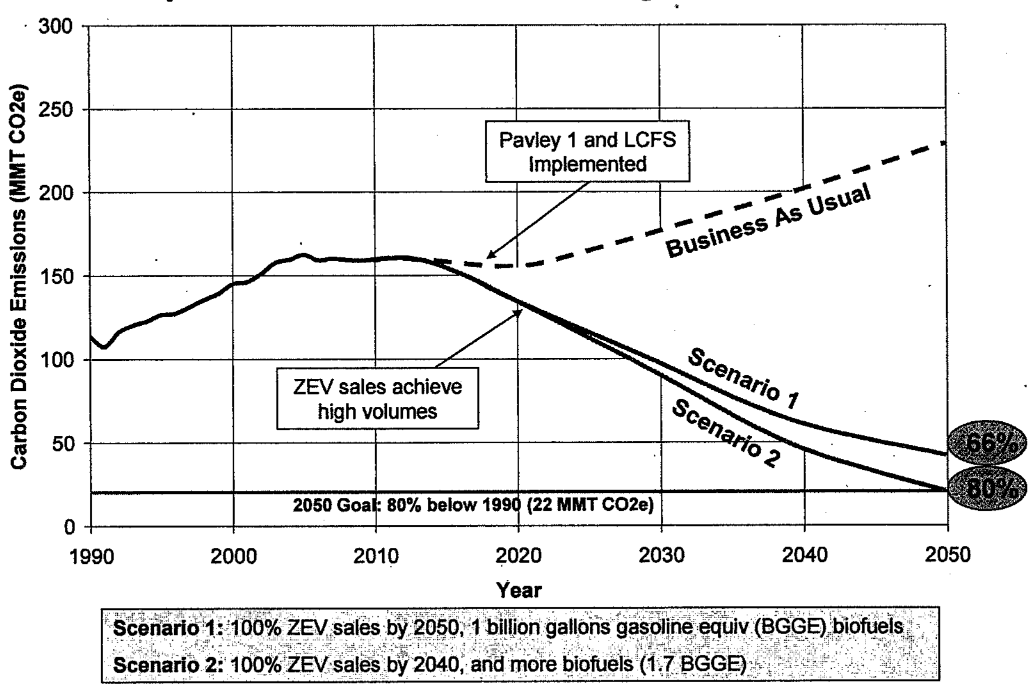
[6] 20% of 108.5 million metric tonnes (MMT) of carbon dioxide equivalent (CO2e) emissions
[7] McKinsey. McKinsey & Company. "Roads toward a low carbon future: reducing CO2 emissions from passenger vehicles in the global road transportation system." 2009
[8] IEA.

reduction goal can be met if passenger vehicle emissions are not reduced to near this subsector target.

What role can ZEVs play in contributing to the passenger vehicle subsector's long term GHG reductions?

Staff's analysis shows ZEVs will need to reach 100% of new vehicle sales between 2040 and 2050, with commercial markets for ZEVs launching in the 2015 to 2020 timeframe.[9]

Graph 2: ZEV Scenarios for Meeting 2050 GHG Goals



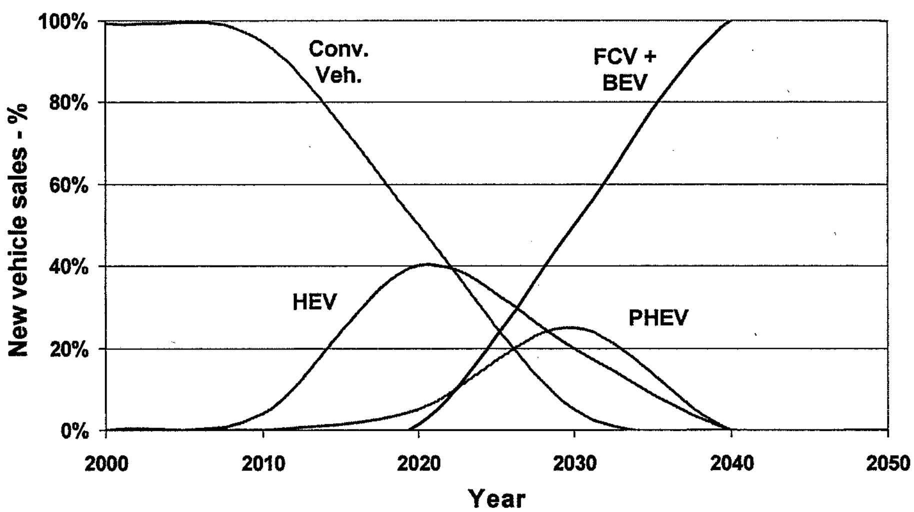
Graph 2 shows the GHG emissions between 1990 and 2050 for a "business as usual" (BAU) projection[10] and two scenarios, both assuming all advanced vehicle technologies are fully commercialized. Scenario 1 in this analysis achieves a 66% reduction in GHG emissions by 2050 using aggressive but plausible assumptions. This is shown by the green line and assumes ZEV sales reach a quarter of a million units annually by 2025 and become 100% of new vehicle sales by 2050. Scenario 2 was developed to show what would be required to achieve the full 80% GHG emission reduction goal. To achieve this, two key parameters were modified with more aggressive and uncertain assumptions. A steeper ZEV sales projection was simulated where ZEV sales reach half a million units by 2025 and are 100% of new vehicle sales by 2040. Additionally, the supply limit on biofuels was increased to 1.7 billion gallons gasoline equivalent (BGGE), where it was limited to 1 BGGE in Scenario 1.[11] The BAU projection

[9] See Attachment B for more details.
[10] The BAU projection does not reflect official ARB GHG inventory projections; it was developed solely for this modeling exercise and is purely hypothetical.
[11] Both cases have reductions in VMT per vehicle (20% below the VMT per vehicle projections for 2050

assumes the Pavley 1 Regulation and LCFS are both fully implemented, followed by a straight-line projection that assumes the vehicle fuel economy and fuel carbon intensity values from 2020 are fixed to 2050 as vehicle population grows ("2020 WTW Factor").[12]

How many ZEVs are needed to meet the goal? And when are they needed? It takes decades for a new propulsion system to capture a large fraction of the passenger vehicle fleet for two reasons. First, new technologies require time for vehicle manufacturers to incorporate them on many or most models. For example HEVs have been sold in the US for a decade, yet they account for only 2% of new vehicle sales, and only in the past few years have a wider variety of HEV models been available. Second, once a new technology dominates the number of new models being offered for sale, it takes roughly 15 years for these vehicles to replace existing vehicles in the fleet. For example if the goal is to have most vehicles on the road in 2050 to be ZEVs, then most vehicles being sold in 2035 need to be ZEVs. Because of the first reason discussed above, this means that ZEV commercialization must begin well before 2035. Because of these considerations, it is important to accelerate[13] the introduction of low-carbon vehicle alternatives to ensure markets emerge between 2015 and 2020.

Graph 3: New Vehicle Sales, Passenger Vehicle Subsector[14]



Graph 3 shows the annual new vehicle sales projections for each type of vehicle technology in Scenario 2. The figure shows how conventional vehicle sales decline as advanced vehicle sales increase. HEV and PHEV sales also eventually decline as ZEV sales grow to maximize GHG reductions in the subsector.

---

[12] It is important to note that the exact BAU projection does not affect the scenario results given the 80% GHG goal is referenced to the 1990 emission level; they are shown purely for context.

[13] Accelerate advanced technology relative to how the automotive industry would introduce it if only complying with the vehicle GHG regulation (AB 1493).

[14] Scenario presented is the "Aggressive scenario"

Can any single ZEV technology provide all the necessary reductions?
Historically, the argument has been FCVs versus BEVs. This argument is irrelevant if an 80% GHG emission reduction by 2050 is the goal. In order to limit the risk in meeting California's long term goal, staff believes all ZEV technologies will be needed in order to achieve the necessary reductions for the passenger vehicle subsector. During private meetings with industry, most manufacturers showed all three technologies, FCVs, BEVs, and PHEVs as part of their long term product portfolios. Each technology is limited by various factors.

FCVs: that the fuel cell could potentially be used in all types and sizes of passenger vehicles and also achieve very low GHG emissions. However, most manufacturers see FCVs mainly used in mid-size sedan and larger sized vehicles, including trucks and SUVs.

BEVs: Some manufacturers believe BEVs will be able to fulfill 20-30% of the future fleet. Limited by vehicle range, weight, and cost, BEVs will more than likely be used in compact vehicle platforms for urban use where smaller batteries can be used. However, of the three vehicle technologies, all manufacturers agree that BEVs will play a key role in the 2050 fleet.

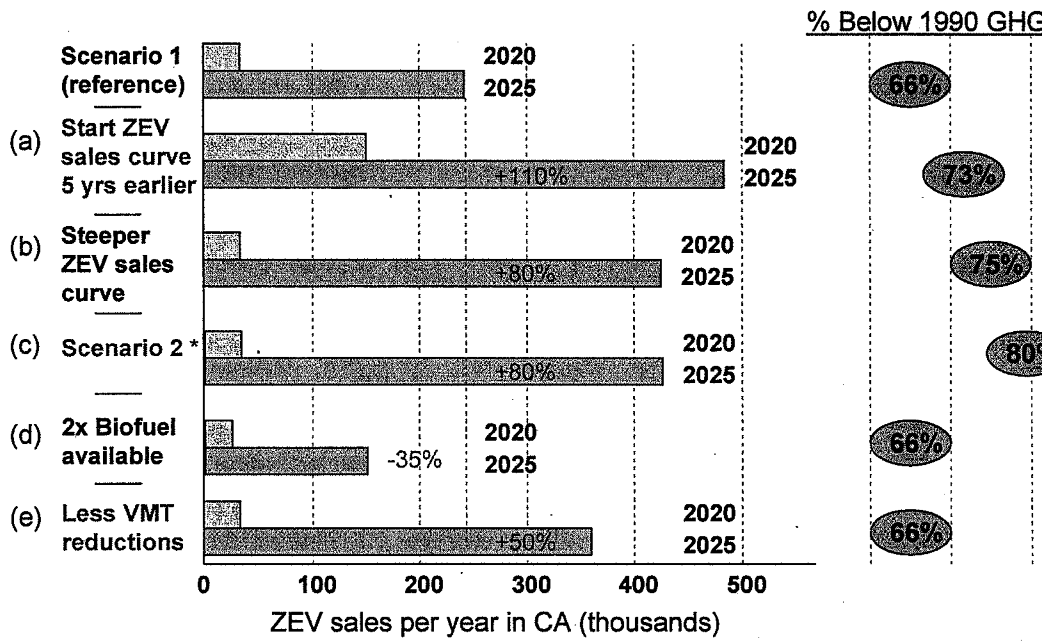
PHEVs: PHEVs could act as a stepping stone from conventional HEVs to full-function BEVs and FCVs. The primary advantages of PHEVs are the unlimited range provided by a conventional engine and modest all electric range allowing smaller battery packs. However, PHEVs with longer all electric range means significant battery cost and overall efficiency is compromised by the weight of both electric and conventional powertrains.

Future PHEVs will need to utilize advanced low carbon biofuels in order to deliver the large GHG emission reductions needed to meet the 2050 target. The availability of adequate volumes of advanced biofuels to fuel an all PHEV fleet is speculative. Thus PHEVs can reduce GHG emissions in the short and mid-term because of their use of electricity, but their ability to achieve the very low GHG emissions of BEVs and FCVs in the long term is uncertain as long as gasoline may be the fuel used when not operating on battery power. Graph 3 illustrates the role PHEVs may play under the assumption that the amount of low carbon biofuel available to passenger vehicles is limited to 1 billion gasoline gallon equivalent (BGGE) annually.

What are other important factors, in addition to ZEVs, that will help the passenger vehicle sector meet California's 2050 GHG goals?
Achieving an 80% reduction in the passenger vehicle subsector will require a broad mix of solutions. This includes reducing vehicle miles traveled (VMT) per vehicle, increasing vehicle fuel efficiency, increasing availability of low carbon fuels and electricity, and commercializing advanced vehicle technologies. Graph

4 below shows a sensitivity study from staff's analysis of how some of these factors impact achieving the 2050 goal and the needed ZEV annual sales in 2020 and 2025.

Graph 4: Sensitivity Study – Impact on ZEV 2020 and 2025 Sales



** Includes ZEV sales from (b) and an increase in biofuel usage (1.7 BGGE instead of 1 BGGE in Scenario 1)*

We use as a reference Scenario 1 shown in Graph 2 that achieves a 66% GHG reduction by 2050. We then vary assumptions regarding the ZEV sales projections, VMT per vehicle, and biofuel availability. The implications on the number of ZEVs that need to be sold in 2020 and 2025 are shown on the bar graph. We focus on 2020-2025 as this is the period that would be most affected by the changes in the ZEV regulation.

- **ZEV sales projections**: If the ZEV sales curve[15] to 2050 shown in Scenario 1 of Graph 3 is shifted 5 years earlier (a parallel shift with commercialization starting earlier and market saturation ending in 2045), GHG reductions in 2050 increase to 73% (case (a)). This shows that increasing early ZEV sales can make a difference. Alternatively, if the initial point of ZEV commercialization is not earlier (2020 sales the same as Scenario 1), but instead the rate of change of ZEV sales is increased so that ZEV sales reach the 100% level in 2040 instead of 2050, a 75% GHG reduction is achieved (case(b)).[16]

[15] The slope of the ZEV sales over multiple decades is highly uncertain. This analysis assumes an aggressive growth that is similar to assumptions in the NRC 2008c.
[16] Refer to Figure 12 in Attachment B for a graphical representation of the three ZEV sales projections.

- **Biomass supply**: Case (c) adds a higher availability of biofuels[17] (1.7 BGGE instead of 1.0) to the case (b) assumption of faster conversion to full ZEV sales. This combination achieves the 80% reduction goal (Scenario 2 in Graph 2). Returning to the lower rate of ZEV sales assumed in Scenario 1, doubling the biofuel supply available for passenger vehicles to 2 BGGE, increases the GHG reductions achieved in 2050 from 66% to 73%. Conversely, the number of ZEVs needed to be sold in 2025 could be reduced by 35% while still achieving a 66% reduction in GHG emissions by 2050 with this increased biofuel supply.
- **VMT reductions***:* If VMT per vehicle reductions only reach 10% (instead of 20%), ZEV sales in 2025 would have to be increased by 50% to maintain a 66% GHG reduction compared to Scenario 1.

What about PHEVs using ultra low carbon biofuels?
Some stakeholders think advanced low carbon biofuels may be the answer to reversing climate change in the transportation sector. One of staff's scenarios (not shown in Graph 4) shows that an 80% reduction in GHG emissions can be achieved with only PHEVs running on biofuels in the vehicle fleet. However, staff believes the amount[18] of advanced biofuels available to the passenger vehicle subsector in future years will be limited due to limits in feedstock and demands for the fuel by other sectors (e.g. aircraft). To limit the risk associated with depending solely on development and availability of future low carbon biofuels, staff believes the ZEV regulation should maintain a strong focus on ZEV commercialization in order to increase the odds of achieving California's long term GHG emission reduction goal.

3. Current status of ZEV technologies

What is the current status of FCVs?
While many technical barriers such as cold start difficulties, limited range, long refueling time, low power density, high stack weight and large stack volume have been overcome, challenges remain. High cost and insufficient durability are the two biggest challenges for fuel cell systems to meet U.S. DOE targets for FCV commercialization. The U.S. DOE estimates the 2009 cost of a fuel cell system to be \$61/kW (if produced in high volumes)[19], which is approximately a 16% reduction in one year from \$73/kW in 2008. The fuel cell system cost estimate includes the 80 kW_{net} direct hydrogen PEM fuel cell stack and balance of plant (BOP) at high production volumes (500,000 units per year). It is important to note that the U.S. DOE cost estimate excludes the hydrogen storage tank. The U.S. DOE 2015 fuel cell system target is \$30/kW and was set to drive down fuel cell system costs in order for fuel cell systems to be competitive with

---

[17] All scenarios assume biofuels are blended into gasoline and diesel at varying levels and consumed by any vehicle technology with a combustion engine (conv. Vehicles, HEVs, and PHEVs).
[18] 1 billion gallon gasoline equivalent (BGGE) limit on biofuels available to passenger vehicle subsector.
[19] U.S. DOE 2009a. Spendelow, Jacob and Marcinkoski, Jason. "DOE Hydrogen Program Record #9012". October 7, 2009.

gasoline internal combustion engines. Accordingly, the U.S. DOE estimates that automotive engines cost between $25-35/kW.[20] As a result, 2009 fuel cell system cost (at high volumes) is approximately two times the cost of an internal combustion engine. All industry stakeholders agree that continued fuel cell research and design need to occur in order to reach commercial viability. Most automakers that are aggressively pursing FCVs believe the U.S. DOE targets are reasonable and several companies believe FCV commercialization can be achieved before U.S. DOE cost targets are reached. Additionally, automakers aggressively pursuing FCV technology – Daimler, Ford, General Motors, Honda, Hyundai/Kia, Toyota and alliance Renault SA and Nissan – issued a joint letter of understanding in September 2009 regarding development and commercialization of FCVs. The auto manufacturers strongly anticipate that from 2015 onwards, a significant number –"a few hundred thousand units over the initial products' lifecycles of FCVs could be commercialized".[21] For more information regarding the status of FCV technology and FCV commercialization, please see Attachment A, staff's Technical Support Document.

What is the current status of automotive battery technology?
Large Li Ion battery development and production capacity buildup are proceeding at the pace necessary to meet the PHEV and BEV deployments required by the Board's ZEV Regulation through 2014. These batteries are now described as "pre-commercial" by most large automakers moving forward with PHEV and BEV deployments prior to 2014.

What is the current status of BEVs and PHEVs?
Since 2007, PHEV development programs have expanded and are now underway at every large auto company. Automakers with the earliest development programs have further expanded those 2007 programs and have progressed to pre-production prototype evaluations.

While PHEVs looked promising even back in 2007, the Expert Panel[22] was unable to find any significant BEV development activity at any large auto manufacturer. Within a span of two years, staff believes that there are now BEV development programs at every medium and large auto manufacturer. Although some of this activity is admittedly driven by ARB's ZEV regulation, this is a remarkable shift in only two years. The automakers with the largest and most significant of these near-commercial BEV development programs claim that meeting the California ZEV Regulation has become a secondary consideration, and that long-term commercial success and corporate environmental

---

[20] U.S. DOE 2009b. United States Department of Energy. Office of Energy Efficiency and Renewable Energy. "Hydrogen, Fuel Cells & Infrastructure Multi-Year Research, Development and Demonstration Plan". Updated April 2009.

[21] Green Car Congress 2009. Green Car Congress. "Automakers Issue Joint Statement in Support of Commercial Introduction of Fuel Cell Vehicles from 2015 Onward". September 9, 2009. http://www.greencarcongress.com/2009/09/automakers-fcv- 20090909.html

[22] At a 2003 Board Hearing, the Board directed that an independent panel of experts (Panel) be convened to report on the status of ZEV technologies and their readiness for commercialization. The Panel's findings were presented to the Board in May 2007.

stewardship are now their primary motivations. Steady progress in automotive Li Ion battery performance is believed to have helped enable this shift in automotive technology.

While there has been extraordinary progress with electric vehicles, every automaker has cautioned ARB staff that there are extraordinary challenges to be overcome in order to sell and support large numbers of PHEVs and BEVs in California, and that these challenges will require considerable and coordinated efforts on the part of federal, state, and local governments to make electric vehicles a reality. No automaker has stated that current designs, or even next generation Li Ion batteries, will achieve sufficiently low cost to make them competitive with conventional vehicles without government incentives and/or tax credits. Several automakers do, however, believe that Li Ion battery systems will evolve sufficiently to allow automakers to sell cost competitive PHEVs and BEVs sometime prior to 2020, and that these electric-fueled vehicles will play a key role in automaker efforts to meet both corporate and California vehicle emissions reduction objectives. For more information regarding the status of BEV technology and BEV and PHEV commercialization, please see Attachment A, staff's Technical Support Document.

How does current ZEV status compare with what may be needed to meet long term GHG emission reduction goals?
In June 2009, staff sent out a formal survey to all automotive manufacturers, fuel cell manufacturers, and battery suppliers requesting information regarding current status of ZEV technologies.[23] Staff met with every large volume manufacturer in person to discuss survey results as well as future ZEV policy. Manufacturers indicated much progress had been made since the 2007 review; however more time is needed before ramping up to commercial volumes.[24]

The challenge facing the Board is determining when ZEV technologies can be ready for commercialization, what is their likely rate of uptake into the fleet (in the absence of a regulatory requirement), and deciding if this is consistent with achieving the Governor's 2050 GHG reduction target. Based on staff's analysis of what needs to occur to achieve this goal, it appears likely that market forces alone will not be sufficient. In the absence of regulation, it is likely that the conversion of conventional models to ZEV technologies will be slower than needed, which will also slow the uptake of these technologies into the fleet. In addition, fuel infrastructure needs and market pull policies will likely be needed to support the initial entry of these technologies into the market. This suggests to staff the necessity of a regulatory requirement to identify the need for ZEVs and provide some degree of certainty to investors in these technologies, combined with industry/government efforts to establish fueling infrastructure and provide consumer incentives to purchase these vehicles in their initial years of sales.

---

[23] See Appendix 1 and 2 in Attachment A for the full survey and participating stakeholders.
[24] Survey findings and staff's assessment can be found in Attachment A.

Staff believes this approach would increase the chances of achieving the GHG target on time.

4. Future ZEV Policy

What about using a performance standard rather than a mandate?
In recognizing the important role that ZEVs can play in meeting California's future GHG reductions and air quality goals, staff believes that some version of a ZEV regulation should be maintained. The current ZEV program requires specified numbers of ZEVs be sold each year by larger vehicle manufacturers. The numbers are relatively low through 2014, and are designed to accelerate the pre-commercial phase of vehicle development. Based on manufacturer announcements, staff believes there will be several BEV and PHEV models offered in much higher, commercial volumes by 2015. Vehicle manufacturers have also suggested that commercial volumes of FCVs could be available by 2015 if fueling infrastructure is provided. Once many models are available and the technology is well established in the marketplace, a performance standard (e.g. a more stringent GHG tailpipe standard) can be used accelerate and increase the use of the technology in the marketplace. This has historically been the mechanism used in nearly all ARB regulations.

Technologies such as ZEVs will likely require a slower transition to high volume production. During early commercialization the number of ZEVs that can be produced is too low to materially affect the average emissions of all vehicles a manufacturer sells. Thus a performance standard can not provide a reasonable assurance that ZEVs will be produced in necessary volumes to provide a launch of the technology in the marketplace. (In other words, it would be easy for a vehicle manufacturer to lower the average emissions of all cars it sells rather than produce a small volume (e.g. a few percent of sales) of ZEVs). Thus staff believes the ZEV program should include specific regulatory mechanisms to reduce the risk of early ZEV market failure and reduce market barriers to ZEV commercialization (e.g. fueling infrastructure and higher initial costs). This would provide a higher degree of assurance that commercial volumes of ZEVs are offered for sale through the point where sales are sustainable along a path that could achieve the 2050 GHG goal. This of course assumes that remaining technical issues have been resolved, as staff believes they will be by 2015.

What are the options for modifying the ZEV regulation in model years 2015 and beyond?
Below are three policy alternatives staff would like to further develop for the 2010 rulemaking, based on the above discussion:

<u>Policy Alternative 1: ZEV Regulation Continues</u>
The ZEV regulation has been modified six times since its creation in 1990 to reflect the status of emerging zero and near-ZEVs. The program has demonstrated the technical viability of BEVs, provided for the successful

commercialization of PZEVs, helped launch the early markets for conventional HEVs, and supports the continuing development of FCVs. The program will simplify itself, a stated desire of the Board, as early credit multipliers, PZEV and AT PZEV allowances, and other early incentive allowances cease between model years 2011 and 2015. By trimming down and focusing the regulation on ZEVs and Enhanced AT PZEVs, the regulation could work as originally conceived: X-percent of a manufacturer's fleet must be ZEVs.

This structure would require a certain percentage of a manufacturer's new sales to be ZEVs and Enhanced AT PZEVs in a given year or years, similar to the current ZEV regulation. The required percentage of sales that are ZEVs would increase to the point where it is clear that the technology is more than a niche product, and growing, sustainable sales are likely. Staff would also consider modifications to the following in each of the alternatives:

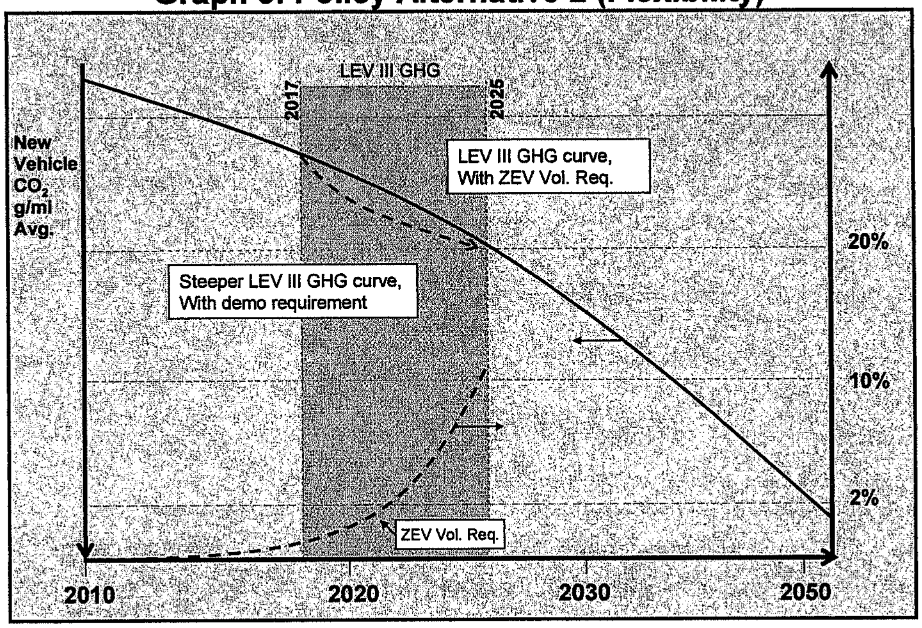
- Credit values and structure
- Travel provision
- Credit banking

Many manufacturers, including Toyota, Nissan, and General Motors, have announced plans to deploy PHEVs and BEVs between 2010 and 2014. This is an indication that the original structure of the regulation is working to place ZEVs on California's roads. Additionally, keeping a similar regulatory structure will continue to assure commercialization includes full function ZEVs that have the potential for a growing and sustainable market share, and provide a diverse mix of ZEV technologies, which appears to be necessary to achieve a large reduction in GHG emissions by 2050.

Policy Alternative 2: More Flexibility of When ZEV Commercialization Begins

In this alternative, manufacturers would have a choice to opt-in to some form of a ZEV mandate, or to continue with demonstrations of ZEVs. If a manufacturer were to elect a ZEV mandate, it would also to comply with the LEV III GHG performance standard (hereafter referred to Option 1). If a manufacturer were to elect to participate in a demonstration ZEV program (i.e. produce much lower volumes of ZEVs), the manufacturer would need to comply with a stricter LEV III GHG performance standard (hereafter, referred to as Option 2). These two options are illustrated in Graph 5 below. The dashed blue line illustrates the ZEV mandate for manufacturers that chose Option 1, and the corresponding solid blue line would be the required fleet average GHG standards for all vehicles sold.

Graph 5: Policy Alternative 2 (Flexibility)



For those choosing to continue with demonstration rather than pre-commercial volumes of ZEVs, more effort to reduce fleet wide GHG emissions would be required. Option 2 may be attractive to manufacturers that believe additional battery or fuel cell development for their vehicles is needed, or by vehicle manufacturers with exceptionally low emitting conventional vehicles that want to avoid the cost of introducing larger volumes of a new technology. In either case, ZEV technology would continue to develop and mature, whereas a straight performance standard would provide no assurance that ZEV technology would continue towards commercialization. Staff believes that this alternative could put California on the path to meet its 2050 GHG emission reduction goals in the passenger vehicle subsector, but may lead to delayed development of ZEV technologies and increased risk of slipping off that path in later years. .

Are there any concerns about either of these policy alternatives?
Policy alternative 1 is not a redesign of the program, and could fall into the same pattern and pitfalls as past ZEV regulations. Policy alternative 2 runs the risk that the number of ZEVs will not reach an adequate level of commercialization in order to successfully achieve the 2050 GHG target. Staff will weigh these concerns with the benefits of each alternative throughout the next year of regulatory development.

Where do we go from here?
Revised LEV III Criteria Pollutant and LEV III GHG standards will be presented for the Board's consideration in late summer 2010. Revisions to the ZEV will be proposed shortly after the Board's decision on LEV III. This will ensure PZEVs

and AT PZEVs are firmly part of new adopted performance standards, and can be dropped from the ZEV program requirements.

It is unclear at this time what LEV III requirements will be proposed since staff is currently developing these standards. Based on the performance standard required through LEV III GHG, ZEV staff will determine if the LEV III GHG standard is in line with the path to 2050. If ZEV staff determines further emission reductions are needed to put the passenger vehicle subsector on a path to 2050, staff may propose a stronger ZEV-specific mandate. If the LEV III proposal is inline with the path to 2050, staff will consider regulatory structures, like Option 2, which give more flexibility to industry. Both LEV III staff and ZEV staff will workshop regulatory proposals starting in quarter one of 2010.

5. Complementary Policies

What is the current status of ZEV fueling infrastructure?
Today, infrastructure for both BEVs and FCVs could be considered demonstration or experimental. For hydrogen, current vehicle needs are minimally being met and the stations to be built by the end of 2010 will meet the needs of the 2011 FCV fleet. More stations will be required beyond 2011.

For BEVs, a minimal charging infrastructure exists, but the connectors are not compatible with vehicles planned for introduction in the near future, so upgrades will be needed. The majority of charging will occur at home and off-peak charging will remain essential to achieving low-carbon electricity fuel. In response to OEM announcements about deploying significant numbers of BEVs in the next five years, the California Public Utility Commission (CPUC) has begun a rulemaking to understand and overcome the many barriers to developing charging infrastructure.[25] Staff will be conducting a review of electric infrastructure policies and will provide a California-specific infrastructure plan to the Board in the first half of 2010.

How much hydrogen infrastructure is needed in the near term to meet expected ZEV demand?
The California Fuel Cell Partnership (CaFCP) released its Action Plan in February 2009, which detailed OEM FCV rollout plans during the 2009 through 2017 timeframe as well as recommendations for meeting hydrogen demand and station placement though 2012.[26] The Action Plan included Table 1 below, a summary of OEM's near term FCV deployment plans, assuming no barriers to hydrogen fuel availability.

[25] CPUC. California Public Utilities Commission (CPUC). Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Tariffs, Infrastructure and Policies to Support California's Greenhouse Gas Emissions Reductions Goals. August 2009.
[26] CaFCP. California Fuel Cell Partnership. "Hydrogen Fuel Cell Vehicle and Station Deployment Plan: A Strategy for Meeting the Challenge Ahead". February 2009.

Table 1: FCV Deployment in California

	2009	2010	2011	2012-2014	2015-2017
Total CA	193	370	712	4,307	49,600

The CaFCP determined between 50 and 100 hydrogen fueling stations will be needed in the next eight years in order to support the projected number of FCV in California.

What are the options for establishing hydrogen infrastructure?
ARB staff believes a multi-pronged approach is needed to ensure sufficient hydrogen infrastructure. This approach has three key elements, which are discussed in the following paragraphs:

1. Financial Incentives
2. Regulatory Incentives
3. Hydrogen Station Mandate

Are financial incentives sufficient to get hydrogen infrastructure?
In the next two years, hydrogen fueling infrastructure needs may be sufficiently supported by stations currently funded and under development, and by monetary incentives for additional stations. However, the current amount of AB 118 funding proposed by the California Energy Commission (CEC) for hydrogen station deployment is only enough to build half the additional stations needed. Additional funds will be needed to further support and spur on hydrogen infrastructure.

Staff believes financial incentives alone will not provide sufficient assurance that enough hydrogen infrastructure will be in place to meet near and mid-term demand for hydrogen fuel. Also, financial incentives are not sufficient to take hydrogen infrastructure from the current demonstration stage to full commercialization of larger stations with high capacity.

If money alone can not ensure hydrogen infrastructure, what other incentives may work?
ARB could use existing regulatory tools to provide incentives to fuel providers. One possibility may be modifying the Low Carbon Fuel Standard (LCFS) to provide additional incentives for installing fueling infrastructure for very low carbon fuels such as hydrogen. This incentive could accelerate the installation of fueling stations at no financial cost to the state. Caps could be placed to limit how many extra credits a fuel provider may earn in order to minimize any loss of GHG reduction from the LCFS.

This approach, like the monetary incentives, may not guarantee installation of adequate fueling infrastructure. A "stick" approach, rather than a "carrot", also needs to be considered.

What about a hydrogen station mandate?
The third approach to establishing hydrogen infrastructure would be mandate on fuel transportation suppliers. This could be accomplished by modifying the existing Clean Fuels Outlet (CFO) regulation, originally adopted by the Board to address the possible need for alcohol and natural gas fueling. As currently written, the CFO requires alternative fueling stations to be built after a certain number of alternative fueled vehicles enter the fleet. The number of hydrogen vehicles required to trigger a mandate is currently set too high to effectively support initial placement of FCVs, and the current regulation does not apply to electricity as a transportation fuel.

The CFO could be modified by lowering the vehicle numbers that activate the regulation and shifting the compliance burden upstream to the fuel providers. In theory, this approach could both work to support near-term hydrogen and other fuel infrastructures. One downside is that mandated stations may not be able to compete for public funding under current statutory restrictions.

What is likely the best formula for success in getting sufficient hydrogen infrastructure?
ARB staff believes a multi-pronged approach of monetary incentives, regulatory incentives, and a regulatory mandate will be needed to effectively support hydrogen infrastructure. Continued near-term funding is critical to meet more immediate infrastructure demands while increasing the state's renewable hydrogen production. Regulatory incentives, such as an LCFS multiplier, could encourage some energy companies to choose ZEV fuels over other lower-cost options and, combined with a revised fuel station mandate, could offer a more cohesive compliance structure for motor vehicle fuel providers.

What is being done to guarantee ZEV fuels continue to provide a GHG benefit?
Senate Bill 1505, chaptered in 2006, requires that all state funded transportation hydrogen must be 33 percent renewable and produce 30 percent less GHG well-to-wheel. This requirement will extend to all transportation hydrogen once the statewide annual throughput reaches 3,500 metric tons.

For electricity, Executive Order S-21-09 directed ARB to use its authority under AB 32 to adopt a regulation consistent with the 33 percent renewable energy target established in Executive Order S-14-08 by July 31, 2010. ARB is working with the PUC and the CEC to ensure that this regulation builds upon the Renewable Portfolio Standard Program and regulates all California load serving entities. In addition, all load serving entities are expected to reduce their climate change emissions under California's proposed Cap and Trade Regulation with its firm and declining emissions cap. Finally, the CPUC rulemaking discussed earlier is focusing on rate structures that encourage charging during off-peak hours when current excess renewable energy resources, such as wind, can be better utilized.

None of staff's proposed regulatory alternatives guarantee ZEV market pull. Why is this?

Complementary policies (Attachment C) are important to ensuring success of ZEV commercialization. The sole purpose of the ZEV regulation is to put vehicles on the road in appropriate timeframes. State and Federal incentives for consumers will be important in near-term ZEV deployment, with some version of monetary incentives like feebates[27] likely needed in the longer term. Staff will continue to assess the status of market pull complimentary policies and need for additional incentives as it develops its proposed amendments to the ZEV regulation.

6. Backburner Issues

What about the PZEV 150,000 mile, 15 year warranty? Does this disappear when PZEVs leave the ZEV regulation?

The extended warranty requirement is tied to the ZEV regulation as an alternative to producing higher volumes of ZEVs. Thus once the PZEV requirements are removed form the ZEV regulation, the extended warranty can no longer be required. To preserve the benefits of the extended warranty, staff is considering providing extra emission credits under the LEV III Criteria Pollutants program to those manufacturers who chose to offer an extended warranty. Also, staff is considering making changes to the Environmental Performance Label that would place manufacturer warranty information clearly on every new car sold. Changes to the warranty provisions will be addressed as part of the proposed changes to the LEV regulation in 2010.

What is the role of PHEVs in the future ZEV regulation?

Staff believes PHEVs will be an effective technology to help reduce GHG emissions, especially in years prior to 2050. In the interim years, substantial PHEV sales will be needed to help achieve deep GHG emission reductions. They are efficient (very low GHG emissions) when operating on grid-provided electricity. However, it remains unclear how often over the vehicle's life gasoline will be used in lieu of electricity. Thus their ability to achieve the deep GHG reductions required to meet the 2050 target is uncertain unless the availability of very low carbon biofuels is assured. Therefore, PHEVs will likely continue to receive less credit than a ZEV in the future ZEV regulation.

What about everything else?

Many stakeholders are interested in potential modifications to specific current ZEV regulatory provisions. These include ZEV credit values, treatment of intermediate volume manufacturers, the travel provision, and transportation

[27] Feebates are a fiscal policy that set a benchmark for greenhouse gases (CO_2e) for new vehicles. For more information, see Attachment C.

system credits. Staff plans to address concerns related to these items during the rulemaking process in 2010.

7. Conclusion and Recommendations

What is staff recommending to the Board?

1. The focus of the ZEV regulation should be shifted to address GHG emission reductions as well as criteria pollutants emission reductions.
2. An important new goal for the ZEV program should be to help assure the transformation to very low carbon-emitting vehicles occurs in the timeframe necessary to meet the Governor's 2050 target of an 80% reduction in GHGs compared to 1990 levels.
3. The upcoming revision to the ZEV regulation should help assure the successful launch of commercial ZEVs in the next decade, which appears needed to meet the 2050 GHG target.
4. PZEVs, now a part of the ZEV regulation, are commercial, and can be removed from the ZEV regulation (effective in 2014). Their emission benefits are appropriately considered in next summer's revision to the LEV criteria emission standards.
5. AT-PZEVs, now a part of the ZEV regulation, are commercial, and can be removed from the ZEV regulation (effective in 2017). Their emission benefits are appropriately considered in next summer's revision to the LEV GHG emission standards.
6. The proposed structure and stringency of the revised ZEV program will depend in part on the Board's decision on establishing more stringent GHG standards for the overall fleet, next summer, and how well it places on the path to meeting an 80% reduction in GHG emissions by 2050.
7. The staff intends to further evaluate incentive and regulatory policies that can assure adequate fueling infrastructure is available for to support the commercialization of ZEVs.
8. The staff will also evaluate the adequacy of incentives to encourage purchase of ZEVs, and will recommend to the Board what complementary policies best support implementation of the ZEV program.

References

ARB. California Air Resources Board. Resolution 08-24. March 2008.

CaFCP. California Fuel Cell Partnership. "Hydrogen Fuel Cell Vehicle and Station Deployment Plan: A Strategy for Meeting the Challenge Ahead". February 2009.

CPUC. California Public Utilities Commission (CPUC). Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Tariffs, Infrastructure and Policies to Support California's Greenhouse Gas Emissions Reductions Goals. August 2009.

Executive Order. Governor Arnold Schwarzenegger. State of California. Executive Order S-03-05. June 2005

Green Car Congress 2009. Green Car Congress. "Automakers Issue Joint Statement in Support of Commercial Introduction of Fuel Cell Vehicles from 2015 Onward". September 9, 2009. http://www.greencarcongress.com/2009/09/automakers-fcv-20090909.html

IAE. International Energy Agency (IEA), "Energy Technology Perspectives: Scenarios & Strategies to 2050," 2008

McKinsey & Company, "Roads toward a low carbon future: reducing CO2 emissions from passenger vehicles in the global road transportation system," 2009

MIT. MIT Laboratory for Energy and the Environment. "On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emissions." LFEE 2008-05 RP, May 2008

UC Davis. University of California, Davis (UC Davis) Institute of Transportation Studies. "Meeting an 80% in GHG Emissions from Transportation in 2050: A Case Study in California," Transportation Research Part D. 2009

U.S. DOE 2009a. Spendelow, Jacob and Marcinkoski, Jason. United States Department of Energy. "DOE Hydrogen Program Record #9012". October 7, 2009.

U.S. DOE 2009b. United States Department of Energy. Office of Energy Efficiency and Renewable Energy. "Hydrogen, Fuel Cells & Infrastructure Multi-Year Research, Development and Demonstration Plan". Updated April 2009.

Attachment A
Status of ZEV Technology Commercialization
(Technical Support Document)

Table of Contents

1.0 Introduction

At the March 2008 Zero Emission Vehicle (ZEV) regulation hearing, the California Air Resources Board (ARB or the Board) directed staff to consider and redesign the ZEV regulation. In response to the Board's direction, ARB staff conducted a comprehensive review of ZEV technology and will present the review as an informational item to the Board at the December 2009 Board Meeting. The informational item will focus on ARB's vision for the ZEV program as presented in a White Paper including a 2050 greenhouse gas (GHG) analysis and this technical support document (TSD). The rulemaking process associated with ZEV program modifications will take place in 2010.

This TSD serves as a technical reference for the White Paper and staff's assessment of ZEV technology status. This document was developed from data presented in publically available, peer reviewed analyses and reports speaking to ZEV technology readiness and commercialization, as well as information obtained and aggregated from confidential stakeholder meetings. In addition, ARB surveyed manufacturers of automotive fuel cells and batteries to assess the technical status of ZEV technology, especially with regard to technology development, performance, timing of commercialization, and costs. The questionnaire pertained to fuel cell and battery technology currently in development, technical goals, technical issues impeding introduction of ZEVs, and commercialization challenges. Specifically, this document relies heavily on reports by the Massachusetts Institute of Technology (MIT), United States Department of Energy (U.S. DOE), Advanced Automotive Battery Conference (AABC), TIAX and Directed Technologies Incorporated (DTI). The objective of this report is to provide a thorough and accurate representation of the current status of ZEV technologies and the projection for ZEV technology advancement in both the near and long term.

California is a world-leader in climate change policy and is responsible for leading GHG emission limiting legislation. Most notable is Assembly Bill (AB) 32, the California Global Warming Solutions Act of 2006, which limits GHG emissions at 1990 level by 2020.[1] In addition, Governor Arnold Schwarzenegger enacted Executive Order S-3-05 requiring 80% GHG emission reduction from 1990 levels by the year 2050.[2] Since the transportation sector accounts for approximately 38% of California's GHG emissions and the passenger vehicle sub-sector accounts for approximately 74% of the transportation sector, it is a substantial challenge to meet the 2050 goals unless a portfolio of low-carbon vehicles are pursued in the near future.

Fossil fuel use and GHG emissions are rising at a significant rate around the globe due to continuous demand for passenger car transportation. With a limited supply of petroleum and potential negative impacts of climate change, the challenge is to counteract growth, reduce fossil fuel consumption, and limit GHG emissions.[3, 4, 5]

---

[1] California Assembly 2006. Assembly Bill 32. California Global Warming Solutions Act of 2006, Chapter 488, Division 255, Section 38500. Approved September 27, 2006.

[2] Executive Order S-3-05. Schwarzenegger, Arnold. Governor of the State of California. Signed June 6, 2005.

[3] ARB 2009a. California Air Resources Board, Greenhouse Gas Inventory. http://www.arb.ca.gov/cc/inventory/inventory.htm.

2.0 Zero Emission Vehicle Literature Review

ARB staff conducted a comprehensive literature review to assess the type of ZEVs that will likely appear on roads in the future. All trends expressed in this document are drawn from a variety of peer reviewed and publically available reports.
In order for California to meet its 2020 and 2050 goals, significant reduction of GHG emissions are required. California will need to reduce its GHG emissions by 173 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) emissions in order to reach it's 2020 goal (approximately a 30% reduction from 2020 BAU), and an additional reduction of 340 MMT of CO_2e is needed to reach 2050 GHG goals (approximately a 80% reduction compared to the 1990 baseline level).[3, 5] Multiple reports assess and project the changes that the passenger vehicle sub-sector will need to undergo in order to achieve fuel efficiency increases and GHG emission reduction goals. Most reports concur that it will take a combination of new, advanced technology vehicles and fuels with lower carbon content to transform the passenger vehicle fleet in California.[5, 6, 7]

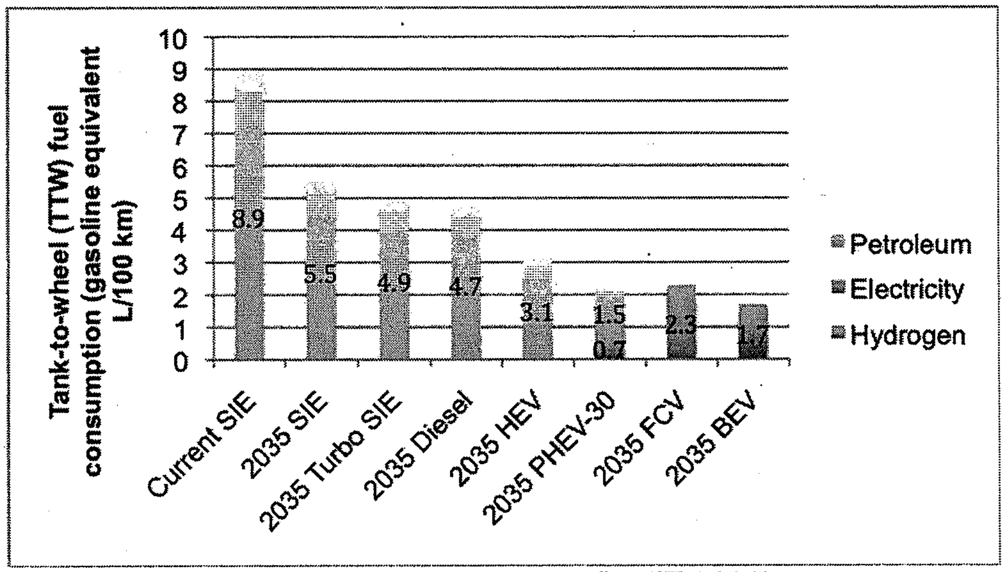
GHG emission reduction is now a major focus in the automotive industry and is the basis of automakers future production plans. Scenarios estimating the future passenger vehicle technology mix use a life cycle analysis, also known as well-to-wheel (WTW) to assess GHG emissions produced in fuel production, fuel transportation and vehicle operation.

Most reports indicate there is significant potential for fuel economy improvement in the conventional, spark-ignited engine (SIE) and these improvements can be achieved with technology available today.[6, 7] In the past, automakers have made significant advances in fuel economy. However, nearly all gains have been directed toward increasing vehicle size and performance rather than limiting environmental impacts. If California is to meet its long term environmental goals, automotive technical advances need to be directed toward further fuel economy improvements. This will include downsizing and light-weighting in order to increase fuel economy and decrease GHG emissions.[8, 9] MIT estimated that sales-weighted average vehicle weight could be reduced 20% over 25 years and the maximum weight reduction at a plausible cost is 35%.[8] Figure 1 and 2 provide anticipated fuel consumption and GHG emission levels from a range of vehicle technologies for the average mid-size car sold in the United States. Other technologies will increasingly be used to green the passenger vehicle fleet such as auto-start-stop, smaller displacement engines with turbo charge, direct injection, homogeneous charged compression ignition and six-speed automatic manual transmissions.[8]

---

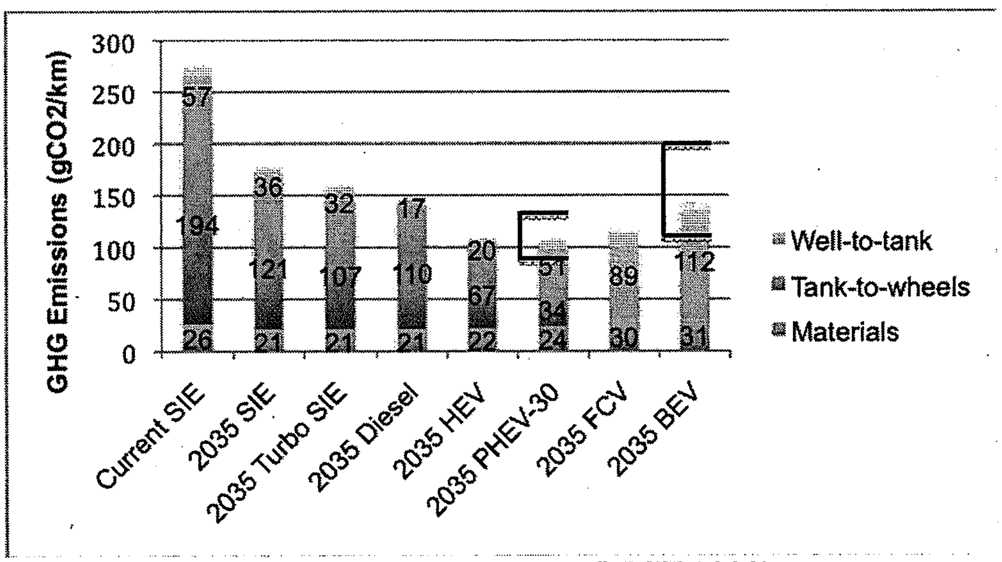
[4] ARB 2008. Climate Change Scoping Plan. December 2008. http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.
[5] UCD 2008. Cunningham, Joshua., et al. University of California, Davis (UCD) Institute of Transportation Studies, "Why Hydrogen and Fuel Cells are Needed to Support California Climate Policy". March 31, 2008. UCD-ITS-RR-08-06.
[6] MIT 2008. Bandivadekar, Anup, et al. "On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emission". Laboratory for Energy and the Environment. Massachusetts Institute of Technology. July 2008.
[7] American Physical Society 2008. American Physical Society. "Energy Future: How America Can Look Within to Achieve Energy and Security and Reduce Global Warming". September 2008.
[8] Bandivadekar 2008
[9] American Physical Society 2008

Figure 1: Tank-To-Wheel Gasoline Equivalent Fuel Consumption



* Data found in MIT "On the Road in 2035" (MIT 2008)

Figure 2: Lifecycle Greenhouse Gas Emissions



* Data found in MIT "On the Road in 2035" (MIT 2008)

Figure 1 and 2: Vehicle propulsion technology assessment for mid-size U.S. passenger cars. Well-to-tank energy consumption is not shown in (a) for different fuel sources, but (b) shows the contribution of well-to-tank energy use in terms of GHG emissions. All vehicles have same performance and interior size. 2035 vehicles have more efficient transmissions, 20% lower weight and reduced drag and tire resistances. Uncertainty bars denote well-to-tank GHG emissions for electricity generated from coal (upper bound) and natural gas (lower bound). FCV well-to-tank GHG emissions assume the hydrogen fuel is steam-reformed from natural gas at distributed locations and compressed to 10,000 psi. SIE = Spark-ignition engine vehicles / HEV = Hybrid electric vehicle / PHEV-30 = Plug-in vehicle / PHEV-30 = Plug-in with 30 mile all-electric range / FCV = Hydrogen fuel cell vehicle / BEV = Battery electric vehicle / Materials = Material lifecycle emissions.

Future efficient gasoline SIE vehicles have the cheapest cost differential compared to future advanced propulsion technology vehicles. It is projected that automaker's will continue to perfect and produce conventional internal combustion engine (ICE) vehicles for several decades. As shown in Table 1 below, the incremental price difference between an efficient, 2035 gasoline SIE vehicle and a 2007 gasoline SIE vehicle is projected to be $2,600. These vehicles offer significant efficiency gains and GHG emission benefits at the cheapest price point. While smaller, more efficient ICE vehicles will continue to be deployed, ZEV technologies are essential to achieve deep GHG emission reductions. In addition to efficient ICE vehicles, automakers will more than likely increase electrification of their fleets.[10] The gasoline hybrid electric vehicle (HEV) is a promising pathway to cost-effective reduction in fuel use and GHG emissions.[10] The price differential between a 2035 HEV and a 2035 gasoline SIE vehicle is projected to be $2,500 (Table 1). In the near-term, automakers will likely produce small, more efficient conventional ICE vehicles and rapidly hybridize their vehicle portfolios.

Table 1: Incremental retail price of current and future propulsion technologies
(MIT 2008)

	RETAIL PRICE INCREASE [$2007]	
VEHICLE TYPE		
	Cars	Light Trucks
Current Gasoline SIE* retail price	$19,000	$21,000
Incremental relative to current Gasoline SIE:		
Current Diesel	$1,700	$2,100
Current Turbo Gasoline	$700	$800
Current Hybrid	$4,900	$6,300
2035 Gasoline SIE	$2,000	$2,400
2035 Gasoline SIE retail Price	$21,600	$23,400
Incremental relative to 2035 Gasoline SIE:		
2035 Diesel	$1,700	$2,100
2035 Turbo Gasoline	$700	$800
2035 Hybrid	$2,500	$3,200
2035 Plug-in Hybrid	$5,900	$8,300
2035 Battery Electric	$14,400	$22,100
2035 Fuel Cell	$5,300	$7,400

Plug-in hybrid electric vehicles (PHEV) offer unique advantages and disadvantages when compared to fuel cell vehicles (FCV) and battery electric vehicles (BEV). Because PHEVs are powered by both the ICE and electricity from the battery there is less range anxiety associated with PHEVs compared to BEVs. Since PHEVs have dual fuel there is no additional range limitations and only minor changes to fueling infrastructure are required. However, like BEVs the main challenges for PHEVs are increasing storage capacity, reliability, durability, and cost reduction of lithium ion

[10] MIT 2008

batteries. These are significant hurdles but less daunting than some of the challenges facing FCVs and BEVs. The advantages of reduced range anxiety, adequate initial infrastructure, and GHG emission reduction potential, will likely encourage automotive manufacturers to pursue PHEVs as they also seek to increase electrification of their fleet.[11] MIT estimated that the price differential between a 2035 PHEV and a 2035 gasoline SIE vehicle will be $5,900 (Table 1).

According to MIT, BEVs are estimated to be the most expensive and least price competitive option of the advanced vehicle technologies. MIT estimates the price of a 2035 BEV (200 mile range) at a price premium of $14,400 (Table 1). [12] Thus, a BEV with 200-mile range would require a prohibitively expensive battery pack. However, automakers are pursuing short-range BEVs (<100 miles) and believe these cars will penetrate a segment of the passenger vehicle market. Regardless of range, BEVs are expensive and will require significant societal investment in terms of increase vehicle and infrastructure costs. For this reason, continued battery research and development (R&D) continue in order to reduce cost and increase durability.

Most stakeholders agree FCV technology indicates a high degree of technical and cost uncertainty. Real-world durability and cost is still being evaluated in terms of parity with conventional vehicles. FCVs have seen significant improvements over the last few years. If the rate of advancement continues, FCVs could compete with 2035 gasoline HEV and other conventional technologies. It is estimated that a 2035 FCV would have a price premium of $5,300 over a 2035 gasoline SIE vehicle (Table 1). The more challenging issue is rollout of marketable FCVs in conjunction with low-carbon hydrogen fuel generation and distribution.

Cost is a key factor in determining the probability of alternative fuel vehicle commercialization. Passenger vehicles with turbocharged gasoline engines, diesel engines and HEVs entering the market today are estimated to cost 5% to 30% more than a baseline gasoline vehicle.[12] PHEVs and FCVs would cost 25-35% more than a future gasoline vehicle. Since advanced technology vehicles are more expensive and require new, expensive infrastructure, it is crucial that federal, state and local governments remain committed and consistent in terms of policy development and investment during the early stages. For new advanced technology vehicles to have deep penetration into the passenger vehicle sub-sector, pre-commercialization needs to start now and mass-market commercialization must begin by 2015. [13]

3.0 Hydrogen Fuel Cell Vehicle Status

In 2007, during ARB's most recent ZEV technology review, an independent panel of experts (the Panel) reported findings on the technological status of FCVs and BEVs. Since the 2007 report, considerable efforts by major fuel cell developers and automotive manufacturers have resulted in notable advances in fuel cell technology. The intent of

[11] PHEVs with greater all electric range will be more expensive than even a short range BEV.
[12] MIT 2008
[13] UCD 2008

this section is to assess current technical advancements in fuel cells and their commercialization readiness.

The Panel concluded that automotive fuel cell technology was progressing but had not yet been proven commercially viable. In 2007, the consensus among the most stakeholders was that the following challenges needed to be overcome to reach commercialization: higher membrane electrode assembly, reduced catalyst loading, increased durability, and proton exchange membrane (PEM) materials that are more stable at extreme ambient operating temperatures - the two greatest challenges being cost and durability.[14]

This automotive fuel cell system review relies heavily on the U.S. DOE, TIAX and DTI independent cost assessments, academic reports and information gathered through stakeholder meetings.

3.1 Fuel Cell System Cost

Even though there has been major technology advances since the Panel's review in 2007, FCVs are still too expensive for commercialization. In order to achieve mass-market penetration in the near future, the U.S. DOE and other industry stakeholders continue to undergo extensive, bottom-up analyses to determine which components of FCVs should be targeted for cost reductions. While most FCV components will be improved over time, research teams are now focused on parts that have the greatest cost reduction benefits. Thus, current research funding and effort surrounds the fuel cell system and its most costly components.

The fuel cell system is composed of two main components: the fuel cell stack and the balance-of-plant (BOP).[15] The fuel cell stack contains multiple components including membrane, catalyst, gas diffusion layer (GDF), membrane electrode assembly (MEA) and bipolar plates. The BOP includes an air management system, fuel management system, thermal management system, and water management system. While the hydrogen fuel tank is an important component, it is not typically included in fuel cell system cost. Thus, the hydrogen tank targets and cost will be address in a separate section. In 2006, the fuel cell stack was $69/kW and the BOP was $36/kW. As stack costs have decreased, the BOP components account for a greater percentage of the costs. In 2008, the stack was estimated to have decreased to $34/kW and $37/kW for BOP. Presently, according to the U.S. DOE, fuel cell system cost has been determined to be $61/kW as shown in Table 2[16]. The 2009 cost estimates are more than a 16% reduction in one year and over a 75% reduction since 2002. These cost projections were validated by an independent panel and are widely accepted by industry as a good cost estimate for high-volume production.[17]

[14] Kalhammer 2007. Kalhammer, Fritz R., et al. "Status and Prospects for Zero Emissions Vehicle Technology: Report of the ARB Independent Expert Review Panel 2007".
[15] U.S. DOE 2009c. Satyapal, Sunita. "Hydrogen Program Overview". Annual Merit Review and Peer Evaluation Meeting. May 18, 2009, Arlington, Virginia.
[16] U.S. DOE 2009e. Spendelow, Jacob and Marcinkoski, Jason. "DOE Hydrogen Program Record # 9012". October 7, 2009.
[17] NREL, 2009. National Renewable Energy Lab (NREL). "Fuel Cell System Cost for Transportation-2008 Cost Estimate". May 2009.

Table 2 shows the 2008 status of the U.S. DOE FCV validation fleet (140 vehicles) compared to the U.S. DOE 2010 and 2015 targets. Most parameters of the hydrogen fuel cell system are close to meeting the targets. However, the two greatest challenges are fuel cell system cost and durability. In order to the meet the 2010 target, system cost must be reduced approximately 21% and durability must be increased 5 to 6% in real-world validation conditions. Automakers are nearing U.S. DOE targets and continue to push technology toward commercial readiness. For example, the Honda FCX Clarity has demonstrated 2,000 hour durability, a driving range of 240 U.S. EPA real world miles, cold start at -30 C, less than 5 minute refueling and significant volume and weight reductions in the fuel cell stack.[18] The Toyota Highlander (FCHV-adv) fuel cell vehicle can cold start at -30 C, has an estimated >300 mile driving range and has increased stack durability and cost reductions.[19] Toyota plans to continue research and development (R&D) to increase durability and decrease cost for 2015 commercialization. The Daimler B-Class F-Cell has a stack durability of 2,000 hours, range increase of 150%, cold start at -25 C and fast refueling.[20,18] These vehicles are all on the road and demonstrating real-world performance values as the companies push toward meeting the U.S. DOE targets.

Table 2: Current Status and U.S. DOE Targets for Automotive Fuel Cells

	2008 (Current Status)	**2009 (Current Cost Status)**	**2010 Target**	**2015 Target**
System Efficiency	53-58%	N/A	60%	60%
System Cost	$73 kW	$61 kW	$45 kW	$30 kW
Fuel Cell System Durability	1,900 hours (~57,000 miles)	N/A	2,000 hours (~60,000 miles)	5,000 hours (~150,000 miles)
Vehicle Range	254 miles	N/A	250 miles	300 miles
Fuel Cost	$3/gge	N/A	$3/gge	$2-3/gge
H_2 Quality (purity)	99.73-99.999%	N/A	99.99%	>99.99%
Average Refueling Rate	0.86 kg/min	N/A	1.0 kg/min	1.67 kg/min

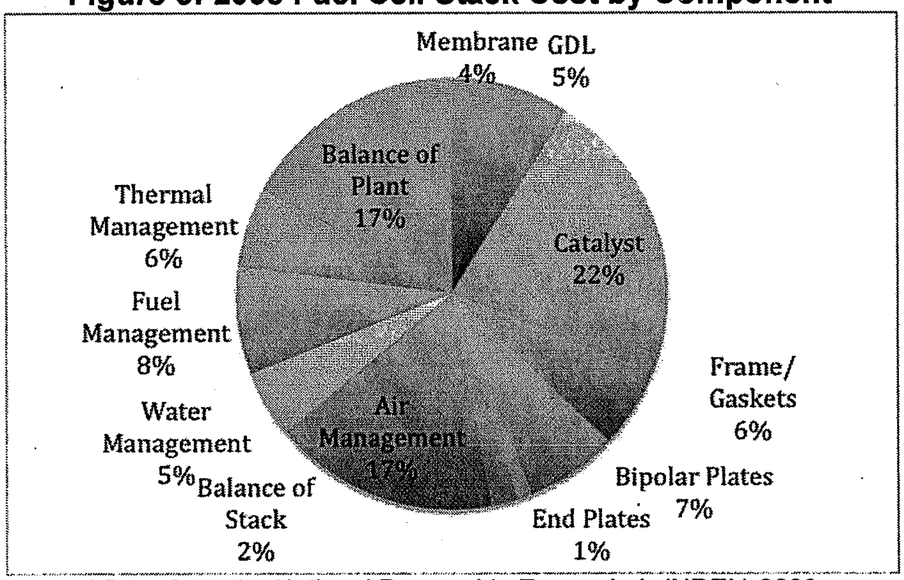
3.2 Catalyst

Since the fuel cell stack accounts for 50% of the overall system cost, tremendous effort is underway to reduce individual components within the fuel cell stack. A breakdown of fuel cell system cost by component is provided in Figure 3. The catalyst is the most

[18] Honda, 2009. Knight, Ben. Honda Motor Company. "Fuel Cell Vehicle Technology Performance and Steps Ahead Presentation". CARB ZEV Symposium, September 21, 2009
[19] Toyota 2009. Yokoyama, Tatsuaki. Toyota Motor Engineering and Manufacturing North America. "Progress and Challenges for Toyota's Fuel Cell Vehicle Development Presentation". CARB ZEV Symposium. September 21, 2009
[20] Daimler 2009. Berretta, Roasario, Daimler. "Fuel Cell Technology for Passenger Vehicles Presentation. CARB ZEV Symposium". September 21, 2009.

expensive component of the fuel cell system. The platinum catalyst is a precious metal that accelerates the rate of a chemical reaction without itself undergoing any permanent chemical change.[21] Currently, the cost of platinum is $1,100/ troy ounce but this price is very dynamic and fluctuates often.[22] Catalyst research has reduced the platinum group metal (PGM) content from $3,100 at 1.1 g/kW in 2006 to <$600 at <0.2 g/kW in 2008. The U.S. DOE platinum loading targets are 0.3 mg/cm^2 in 2010 and 0.2 mg/cm^2 in 2015 respectively (for an 80 kW stack).[23] Technology advances in the past few years have led to a reduction in platinum loading and an increase in stack power density that significantly contribute to the cost reduction for the fuel cell stack.[24] According to The 2.7 Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model conventional vehicles use 0.0165 lbs of platinum(catalytic converter) and a FCV uses 0.203 lbs of platinum (fuel cell stack). It is estimated that a light FCV uses 0.157 lbs of platinum.[25] In terms of platinum supply, South Africa, Russia and North American are major sources for platinum with South Africa having the largest platinum supply in the world. It is estimated that the total platinum reserves in the Bushveld Complex in South Africa total approximately 1,140 million ounces and a further 387 million are available worldwide. With an annual consumption rate of 5 million ounces of platinum worldwide, it is estimated that existing resources would supply worldwide demand through 2050.[26]

Figure 3: 2008 Fuel Cell Stack Cost by Component



* Data from the National Renewable Energy Lab (NREL) 2009

[21] Dictionary.com 2009. http://www.dictionary.com
[22] U.S. DOE 2008a. James, Brian, et. Al. "DOE Hydrogen Program Record: Fuel Cell System Cost-2008. December 16, 2008.
[23] U.S. DOE 2009a. Debe, Mark D., "Advanced Cathode Catalysts and Supports for PEM Fuel Cells." 2009 DOE Hydrogen Program Review. May 2009. http://www.hydrogen.energy.gov/pdfs/review09/fc_17_debe.pdf
[24] U.S. DOE 2008b. Garland, Nancy, et al. "DOE Hydrogen Program Record: Fuel Cell System Cost-2008". December 16, 2008.
[25] GREET Model. Version 2.7
[26] Cawthorn 1999. Cawthorn, R.G. "The Platinum and Palladium Resources of the Bushveld Complex". South Africa Journal of Science 95, November-December 1999.

3.3 Hydrogen Fuel Cell Stack Power Density and Weight

While the focus of this document is on cost, it is important to note fuel cell system volume and weight since these factors are essential to better overall vehicle performance and integration. In 2008, the fuel cell system volume was approximately 120 liters and weight approximately 115kg according to the DOE hydrogen validation program. The fuel cell stack alone accounted for 34% of the volume and 40% of the weight. Automakers are reducing stack volume and weight with each fuel cell stack generation. For example, the Honda FCX Clarity's fuel cell stack is 1/5 the weight and 1/4 the volume compared to the previous FCV model.[27] The weight and volume improvements are a result of changes in fuel cell materials (stamped metal flow plates, aromatic membrane structure, reductions in catalyst loading), fuel cell simplification (half the parts, higher recyclability, improved manufacturing) and fuel cell recyclability (light weight and compact, ease of disassembly, materials used, ease of material separation, ease of reprocessing, re-use yield).[24] Other automakers are also reporting significant improvements in weight and size of their fuel cell stacks.

3.4 Hydrogen Tank

The U.S. DOE and industry goal for on-board hydrogen storage is to achieve a vehicle range of greater than 300 miles without compromising passenger space, cargo space and passenger safety in order to facilitate commercialization of FCV across multiple vehicle platforms.[28] In 2009, the U.S. DOE performance targets were revised based on real-world FCV experience. Table 3 shows the old performance targets parallel to the revised targets. Currently, there is no technology that reaches the revised 2015 targets and the new ultimate targets remain very challenging. The new focus is material-based technologies to meet the ultimate target. Metal hydrides, chemical hydrogen storage and hydrogen sorption are all potential options to increase storage and decrease size and cost of the tank. A large number of the second generation U.S. DOE FCVs demonstrated range of 200-250 miles (up from 103-190 miles). The new TIAX cost estimates (at 500,000 units) are $23/kWh for a 700 bar tank which is a 13% reduction in cost compared to 2008 and $15.5/kWh for a 350 bar tank which is a 9% reduction compared to 2008 costs.

[27] Honda 2009
[28] U.S. DOE 2008b

Table 3: Hydrogen Tank and Performance Targets
(Dillich, 2009)

	2015 (new)	2015 (old)	Ultimate Target
System Gravimetric Density [wt. %] (kWh/kg)	[5.5] (1.8)	[9] (3.0)	[7.5] (2.5)
System Volumetric Density [g/L] (kWh/L)	[40] (1.3)	[81] (2.7)	[70] (2.3)
System Fill Time for 5-kg fill [min] (kgH_2/min)	[3.3] (1.5)	[2.5] (2.0)	[2.5] (2.0)
System Cost [$/$kgH_2$] ($$kWh_{net}$)	TBD	[67] (2)	TBD

3.5 Hydrogen Production

Hydrogen can be produced via multiple pathways. The U.S. DOE has evaluated and funded research for the most common routes such as steam reformation of natural gas, bio-derived renewable liquids and by splitting water (electrolysis).[9] To date, hydrogen produced from steam methane reformation (SMR) is the most cost effective pathway[29]. Currently, hydrogen produced from distributed natural gas is $2-3/gasoline gallon equivalent (gge).[29] The other two pathways have achieved significant efficiency increases but the $2-3/gge delivered hydrogen is not projected to be achieved until 2015-2020 timeframe (assume 1,500 kg/day and 500 units/year).

The California GREET Model describes the pathway for compressed gaseous hydrogen in terms of energy consumption and GHG emissions (pathway assumes North American natural gas feedstock). Table 4 indicates the relative contribution of each distinct component of this pathway. From an energy perspective, hydrogen production (16.5%), hydrogen liquefaction (31.9%) and hydrogen compression (10%) require the most energy in the hydrogen production pathway on a well to tank basis. In terms of CO_2 emissions hydrogen production (80.9%), hydrogen liquefaction (43.4%) and hydrogen compression (9.2%) contribute the largest to GHG emissions.[25] The modeled high-volume cost of gaseous hydrogen delivery via tube trailer is approximately $2.60/gge (terminal cost = $0.36, tube trailer = $0.76, station compression = $0.77, on-site storage = $0.48, and other station cost = $0.23) and the cost of liquid hydrogen delivery via tanker truck is approximately $3.32/gge (terminal cost = $1.83, liquid hydrogen truck = $0.28, on-site storage = $0.68, and other station cost = $0.53).[30]

[29] U.S. DOE 2009c
[30] U.S. DOE 2009g. Standford, Joseph. "Modeled High-volume Cost of Major Hydrogen Production Pathways and Modeled High-volume Cost of Major Hydrogen Delivery Pathways". Received November, 12, 2009.

Table 4: Energy Contribution and GHG Emissions for Production of Compressed Hydrogen (CA GREET Model)

Percent Energy Contribution for Compressed Gaseous H_2		GHG Emissions Compressed Gaseous H_2 (gCO_2e/MJ)
Well to Tank (WTT)		
Feedstock	2.8%	8.2%
Hydrogen Production	16.5%	80.9%
Hydrogen Liquefaction	31.9%	43.4%
Distribution and Storage	0.4%	0.55%
Compression	10%	9.2%
Tank to Well (TTW)	**61.6**	**142.25**
Carbon/Energy in Fuel	38.4%	0%
Vehicle CH_4 and N_2O	0%	0%
Total Well to Wheel (WTW)	**100%**	**142.25**

3.6 Fuel Cell Vehicle Technology Status Conclusions

While many technical barriers such as cold start difficulties, limited range, long refueling time, low power density, high stack weight and large stack volume have been overcome, challenges remain. High cost and insufficient durability are the two biggest challenges according to U.S. DOE and industry stakeholders for fuel cell stacks to meet targets and for FCV commercialization. The U.S. DOE estimates the 2009 cost assessment of fuel cell systems to be $61/kW, which is a 16% reduction in one year.[31] However, this cost still prevents FCVs from mass-market commercialization. The fuel cell system cost estimate includes the 80 kW_{net} direct hydrogen PEM fuel cell stack and balance of plant (BOP) at high production volumes (500,000 units per year). It is important to note that the U.S. DOE cost estimate excludes the hydrogen storage tank. The U.S. DOE 2015 fuel cell system target is $30/kW and was set to drive down fuel cell system costs in order for fuel cell systems to be competitive with gasoline internal combustion engines. Accordingly, the U.S. DOE estimates that automotive engines cost between $25-35/kW.[32] As a result, 2009 fuel cell system cost (at high volumes) is approximately two times the cost of an internal combustion engine.[32] All industry stakeholders agree that continued fuel cell R&D needs to occur in order to reach commercial viability. Most companies that are aggressively pursing FCVs believe the U.S. DOE targets are reasonable and several companies believe FCV commercialization can be achieved before U.S. DOE cost targets are reached.

Durability of the fuel cell system is improving and some reports indicate achieving U.S. DOE targets in laboratory testing. However, there has been little real-world validation of 2010 and 2015 durability targets. It is important to note that durability can be "bought"

[31] U.S. DOE 2009e
[32] U.S. DOE 2009f. United States Department of Energy. Office of Energy Efficiency and Renewable Energy. "Hydrogen, Fuel Cells & Infrastructure Multi-Year Research, Development and Demonstration Plan". Updated April 2009.

by adding additional fuel cells but at extreme cost (and volume concessions). Several companies suggest that the next iteration of the ZEV regulation should allow for additional time before high numbers of ZEVs are required. These companies believe with more time they will be able to devote additional efforts to increasing fuel cell stack durability and to achieving cost reductions.

While infrastructure is not directly part of the FCV, it is a vital component of FCV commercialization success. At present, hydrogen-fueling infrastructure in California is inadequate and many automakers will base future commercialization plans on hydrogen fuel availability. Hydrogen fueling stations are expensive and require government support to build. It is essential that federal and state government show a strong signal of sustained support for FCVs by investing in R&D of FCVs as well as hydrogen infrastructure. ARB will continue to pursue hydrogen fueling infrastructure implementation through the Alternative and Renewable Fuel and Vehicle Technology Program (AB 118).

Given the high cost, low durability and lack of hydrogen fueling infrastructure, hydrogen FCVs are not commercially viable within this decade. However, many reports indicate that FCVs play a critical role in providing zero tailpipe emissions and GHG emission reductions in the passenger vehicle sub-sector and could be commercialized around 2015.

There is consensus in industry that continued investments should be made in the following areas:

- develop membranes for high temperature, low-relative humidity operation,
- increase catalyst activity and reduce platinum group metal loading to lower fuel cell cost,
- design strategies to reduce stack component degradation,
- optimize water management properties,
- reduce on-board hydrogen tank cost while increasing quantity of hydrogen stored,
- continued government support to fund hydrogen FCV R&D and hydrogen fueling infrastructure over the long-term.

4.0 Current Status of Battery Technology

In 2007, the Panel reported:

> "The prospects of PHEVs ... were judged negatively by most major automobile manufacturers until recently. However, several manufacturers are now active in modeling, designing, and evaluating various PHEV architectures and technologies, with consequent attention to candidate battery technologies and their prospects."[33]

[33] Kalhammer 2007. Kalhammer, Fritz R., et al. "Status and Prospects for Zero Emissions Vehicle Technology: Report of the ARB Independent Expert Review Panel 2007".

Since 2007, PHEV development programs have expanded and are now underway at every large volume OEM. Automakers with the earliest development programs have further expanded those 2007 programs and have progressed to pre-production prototype evaluations. Additionally, staff believes that there are now BEV development programs at every intermediate[34] and large volume auto manufacturer. Although some of this activity is admittedly ARB ZEV regulation-driven, this is a remarkable shift in only 2 years.

4.1 Battery-based Energy Storage Systems and Vehicles

While past ARB reviews of vehicle energy storage technologies have covered a wide variety of battery chemistries, this review will focus only on an update of lithium ion (Li Ion) based energy storage technology. This narrow focus does not imply that alternatives to Li Ion batteries will not be implemented in commercial BEVs. Li Ion alternatives are still expected to be applied to commercial BEVs, but all large volume automakers[35] are currently planning to use Li Ion in their near-to-mid term PHEVs and BEVs for deployment in California. It should be noted that at least 2 of the recently announced American Recovery and Reinvestment Act (ARRA) grant awards were allocated to advanced lead acid batteries,[36]. It is still likely that lead acid, nickel-metal hydride (NiMH), sodium-based, and other batteries will continue to be developed for electric-drive vehicles. Still, the majority of near-term PHEV and BEV light-duty vehicles will make use of Li Ion technologies. This report will focus on near-to-mid term (2010-2020) Li Ion or Li Ion derivative batteries with sufficient capacity for application in PHEVs and BEVs (~5-95 kWhr)[37].

There has been a recent increase in both government and private research funding allocated to longer-term energy storage technologies based on alternative electrode couples (materials). These batteries would have significantly higher storage capability and lower $/kWhr cost than is achievable with Li Ion derivatives. With specific energy goals of more than 1,000 whr/kg, these long-term "super batteries" are the subject of extensive and increasingly well-funded world-wide research efforts. However, even if these "super batteries" began demonstrating feasibility in laboratory demonstrations, they would not be sufficiently proven for utilization in more demanding automotive applications for quite some time.

There are significant efforts underway to further develop Li Ion technology for the non-vehicle consumer market in the next several years, and some of these improvements may be applicable to automotive applications in 2015+. The primary focus of small consumer product Li Ion formulations is continued progress in increasing energy capacity, with 200 watt-hour per kilogram (whr/kg) cell level performance expected in the very near future. It remains to be seen whether these upcoming energy

---

[34] Intermediate volume manufacturers produce between 4,500 and 60,000 vehicles per year in California, as defined in California Code of Regulations, Section 1900.
[35] A large volume manufacturer produces 60,000 vehicles per year in California, as defined in California Code of Regulations, Section 1900.
[36] These PbA-related ARRA awards include $34.3M to Exide (lead carbon electrodes), and $32.5M to East Penn Manufacturing (PbA-carbon supercapacitor combination).
[37] Smaller Li Ion battery systems for application in conventional HEVs are under development, but NiHM technology is expected to dominate in HEVs for many more years.

improvements will also result in reduced cost per unit energy ($/kWhr) or have applicability to automotive applications.

4.2 Near-term Battery Cost, Durability, & Performance Status (2010-2015)

The most significant challenges to widespread application of large Li Ion battery systems in vehicles still remain the same as the Panel's 2007 findings:

- High cost, particularly in transitional low-to-mid production volume applications in 2010-2015,
- Unknown durability in real-life, on-vehicle, variable-climate conditions, and
- Safety and abuse tolerance.

Several automakers reported that U.S. DOE/ and United States Advanced Battery Consortium (US ABC) battery performance and cost targets are no longer relevant and should be ignored, updated, or expressed in an alternative method that periodically adapts to external circumstances. US ABC performance and cost targets are based upon a fixed set of historical assumptions. However, these assumptions are dynamic values and should be periodically re-examined and targets revised in the same way that Federal fuel cell performance and cost targets are periodically revised.

There are a variety of Li Ion formulations under consideration for use in near-term automotive applications; in particular, there are several different cathode materials and material combinations. Selection of a particular formulation involves tradeoffs in specific energy, abuse tolerance, stability at elevated temperature, and other considerations. While iron phosphate ($LiFePO_4$) is frequently mentioned as a highly desirable future cathode material, the majority of Li Ion batteries destined for near-to-mid term automotive deployments will also include mixed oxide of nickel, cobalt, aluminum (NCA), mixed oxide of nickel, cobalt, and manganese (NCM), lithium manganese spinel (LMS), or combinations of these oxides. Proponents of $LiFePO_4$ claim that its lower specific energy performance is partially offset by its ability to operate over a wider SOC (state of charge) window, resulting in a higher "usable" whr/kg fraction than with other competing cathode materials. While cost differences in cathode materials are frequently cited as an important consideration in material selection, a recent TIAX cost modeling assessment of PHEV batteries[38] indicates that there may be:

> "...significant cost range overlap between the cathode classes (chemistries), with battery costs "bottoming" just below $300/ kWhr, and ... wider variation within each chemistry than between chemistries".

While this TIAX modeling conclusion was directed at cost modeling for a 5.5 kWhr PHEV battery system and may not be applicable to larger 16+ kWhr capacity PHEVs or 24+ kWhr BEV systems, it does indicate that as long as safety requirements can be met, near-term cathode materials selection tradeoffs are more likely to be made on the basis of specific energy and durability considerations.

---

[38] U.S. DOE 2009d. Barnett, Brian, et al. "PHEV Battery Cost Assessment". Annual Merit Review. TIAX LCC, May 19, 2009

During the 2007 review, the Panel reported that a cost range of $340- $420/kWh (@500 MWh/year production rate) and $240- $280/kWh (@2,500 MWh/year) were representative of manufacturers' specific cost projections for Li Ion modules[39]. When these results are combined with the Panel's module-to-system scaling factors, the Panel report system-level battery costs are summarized in Table 5 below.

Table 5: 2007 Expert Panel Long-Term Battery System Cost Summary

		500 MWhr/ year[40]		2,500 MWhr/ year	
Application	Scaling Factor (module-to-pack) [41]	Module Cost Range ($/ kWhr)	Pack Cost Range ($/ kWhr)	Module Cost Range ($/ kWhr)	Pack Cost Range ($/ kWhr)
Type II + BEV	1.2	340- 420	410-500	240-280	290-340
Type II BEV	1.25	340- 420	425-525	240-280	300-350
Type 1.5 BEV or ~40 mile PHEV (~16 kWhr)	1.33	340- 420	450-560	240-280	320-370
PHEV (~7 kWhr)	1.42	340- 420	480-600	240-280	340-400

TIAX LLC recently reported that the full range of PHEV battery manufacturing modeled in their recent study[42] resulted in cost projections ranging from $264/ kWhr to $710/ kWhr for 5.5 kWhr of usable power in cylindrical can format. Somewhat lower cost results would be expected if modeling battery systems suitable for PHEVs and BEVs in lower cost "pouch" formats and higher system energy capacities. The range of values from the Panel estimates ($340- $400 /kWhr) fall within the range of values from this TIAX study.

Tesla Motors manufactures their battery systems with laptop cells that are already made on high-volume production lines. These "18650" type cylindrical Li Ion cells are primarily designed for the laptop consumer industry and cost in the range of $200-$250/ kWhr.[43]. When these cells are integrated into laptop battery pack systems, costs range from $400-$700/ kWhr. The additional components and assembly needed

---

[39] Using 45Ah high energy-design cells

[40] Production volume of 500 MWhr/ year is approximately equal to 20,000 Nissan Leaf EVs/ year (assuming 24-25 kWhr/ pack)

[41] P45 of ARB Independent Expert Panel 2007 Report (note: applies to higher amp hour cell sizes of the type expected for automotive-specific Li Ion cell designs, and not for 18650 cell application to automotive battery systems. This 18650 automotive scaling factor is believed to be much higher than the values shown above)

[42] U.S. DOE 2009d. Assumptions for this statistical, multi-variable sensitivity analysis included: cylindrical cell design, 10-90% SOC range cap in addition to a further capacity reduction "fade" variable, and all supplied materials were treated as outside-purchased and included supplier mark-ups

[43] AABC 2009a. Spotnitz, Dr. Robert. "Large Lithium-Ion Battery Design Principles". Tutorial A. Advanced Automotive Batteries Conference. June 8, 2009. Other sources indicate laptop (cell?) costs are higher- on the order of ~$300-$400/ kWhr.

[44] to build an 8-cell laptop battery pack is a higher fraction of cell cost than the expected 1.2-1.42X [45] cell-to-pack scaling factor for a PHEV, EREV, or BEV battery system constructed from much larger, high Ahr cells. If high-volume laptop cells were processed on a medium-volume pack assembly processing line at a near future Tesla Motors plant (scaling factor 1.6X, lower in future) then these systems would cost on the order of $320-$400 /kWhr. These assumptions would also seem to be validated by a current program at Tesla Motors where customers may pre-pay $12,000 now, and in return, receive a replacement battery pack after seven years. If a future value of $17,000 is assumed, this works out to a retail price of approximately $309/ kWhr, and if a manufacturer-to-customer markup of 1.2- 1.6X is also assumed, this may indicate that Tesla Motors anticipates their battery systems cost will drop below $260 / kWhr within 7 years.

While comparisons to laptop cell derived systems may give some indication of the lower cost limit in future automotive design battery costs, large risk-averse automakers may have more stringent requirements for long-life (more than 10 years versus 1 to 4 years in laptops, or perhaps 7 years in a Tesla) and superior cell-level abuse tolerance. Because of these differences, laptop battery costs may not be applicable to estimation of near-term automotive-specification battery system costs.

Regardless of Li Ion chemistry, industry is divided into two camps when it comes to choosing how to package Li Ion battery cells: Welded steel or aluminum can versus polymer flat package "pouches." Both packaging types have their advantages and disadvantages:

Welded Can (steel or aluminum):

(+) reliable sealing, high mechanical strength, may contain pressure
(-) higher cost
(-) harder to extract heat
(-) heavier

Pouch Packaging Approach:

(+) lower cost potential
(+) simple headers, more current collector options
(+) light weight
(+) large aspect ratio for superior heat transfer
(-) potential (or unknown) oxygen and water ingress rates
(-) need to provide additional mechanical support
(-) cannot contain pressure/ cell cannot be allowed to "balloon"
(will rupture for safety, but no longer usable after rupture)

This can versus pouch packaging choice may have a very large impact on cost, but some industry experts still consider pouch construction to be of higher risk. However,

[44] These additional battery system parts include packaging, cooling components, sensors, charge control electronic, safety systems, etc. The full system cost is sometimes estimated using "scaling factors" which vary by PHEV or BEV pack size, but are usually 1.2-1.4X cell cost (additional parts are 20-40 % of the cell costs).
[45] Kalhammer 2007.

two of the largest electric vehicle programs destined for near-term production incorporate pouch-construction cells (Nissan/ AESC: Leaf, and GM/ LG Chem: Volt).

Some automakers indicated that several battery cell suppliers, all free to compete, must reach volumes of greater than 100,000 systems per year to meet aggressive cost targets, and that an industry-wide standard for the large cell formats must be developed in order to help drive down costs. Others disagree or believe that it is premature to begin efforts to set any industry standards at this time. Advocates argue that a standard could incorporate a large degree of flexibility, for example, one that would lock a pouch cell size in 2 of its 3 dimensions. No cell standardization efforts are underway in the United States at this time.

The automotive market is proceeding with application of existing and "evolutionary" Li Ion technology that is becoming increasingly well characterized, while the consumer market may move forward more aggressively with significantly higher energy technologies as a result of more "revolutionary" changes.[46] If "Super" Li Ion batteries become available in the consumer market in 2010, they would not be implemented in automotive applications until 2015 or even later, which is beyond the scope of this technology review.

Staff believes that the range of potential costs reported by the Panel for existing Li Ion battery technology in high volume production has not changed since 2007 and remains valid ($290-$400 / kWhr, depending on application). The more immediate challenge is how to introduce and build a market for large automotive Li Ion battery systems before high production volumes provide greater economies of scale and lower battery cost.

While high production volume Li Ion battery system costs are expected to drop below $400 / kWhr sometime after 2015, and less than $300 / kWhr in future high production volumes they will, unfortunately, cost 2 to 3 times more in the next 5 years as PHEVs and BEVs are first introduced into the automotive market. Automakers reported widely varying costs during this introductory period, with some claiming current industry prices for small PHEV systems "around $800/ kWhr", and others as high as $1,000/ kWhr. Some automakers reported PHEV and BEV near-term, moderate volume costs would be on the order of $500-$600 /kWhr, with evolutionary changes and moderate volume production "next generation" design changes necessary before costs move further down into the $400-500/ kWhr range.[47] For comparison, current retail price (not OEM cost) for a Tesla Roadster replacement pack is $36,000 [48]. While Tesla has not revealed what their markup is on this system, it is reasonable to assume it is in the range of 1.2 to1.6 times. If true, this would mean that, in very low volume production (<100 MWhr/yr), Tesla Motors' present cost for a 55 kWhr battery system may be

---

[46] For example, silicon-based anode materials may replace carbon, etc.

[47] Small PHEV systems cost much more on a per-kWhr basis due to differences in cell design and larger system integration costs relative to the batteries themselves (higher scaling factor).

[48] From Tesla Motors website, http://www.teslamotors.com/blog2/?p=70 "Customers may pay $12,000, €10,000 or £9,000 up front and in return receive a replacement battery pack after seven years. Customers will also have the option of replacing the pack earlier at a premium or later for a partial refund. With the low production volume of the Tesla Roadster, the current replacement price of the pack is almost three times that number."

somewhere in the range of $409 to $545/ kWhr. Staff believes that this is probably representative of where manufacturers will be within five years.

Large Li Ion Battery System Safety and Abuse Tolerance
In the past, safety was a key concern with automakers that were considering the application of Li Ion in vehicle applications. Considerable progress has been made in the recent years to the point where most automakers now believe that safety still requires care in design and engineering, but is now a manageable issue. In the near term, some have also chosen to limit cell size for safety considerations until further "intrinsic" safety features can be incorporated into cells. This is done because smaller cells contain less energy, and if critical limits are reached, there is less likelihood that a fire can propagate to adjacent cells in the battery system. Battery manufacturers are busy developing less reactive cathodes, improved electrolytes, and many are already incorporating new ceramic-coated separators to enhance safety. Improvements with heat transfer also yield higher safety margins by limiting peak temperatures during runaway conditions, and by reducing energy transferred to adjacent cells.[49]

Although further improvements at both cell and systems levels are sought after and expected in coming years, most automakers, battery suppliers, and industry experts are confident that near-term automotive systems are now safe enough for automotive deployments, with one key exception. Industry experts warn that non-OEM vehicles, so-called "conversion" PHEVs, are

> "actually the highest risk for the success of Lithium ion in automotive...The less of this (that) happens, the better for the industry longer term... It can be done, but it will take mature, responsible engineering with a long term view."[50]

The challenge is that there are presently no safety standards to sell Li Ion conversion vehicles to the public as there are, for example, with CNG conversions. OEMs are highly motivated to engineer safe automobiles because they must maintain a reputation for quality in the marketplace to ensure their own long-term survival. Small conversion companies usually cannot afford this investment in engineering expense and are not motivated by the same long-term considerations.

Large Li Ion Battery System Durability
Substantial progress continues to be made in the cycle life of Li Ion batteries: durability may eventually be calendar-life-limited in many electric vehicle applications. Cycle life limitations may be much more of a challenge for small PHEV systems than for BEVs. This is because cycle life is an exponential function of depth of discharge, and the larger capacity PHEV and BEV systems may not see full discharges on a frequent basis. This is one area where customer behavior, and in particular, workplace charging infrastructure availability may become a key issue.

---

49 One advantage of pouch packaging is that they have very large aspect ratios that enable good heat transfer
50 AABC 2009b. Anderman, Dr. Menahem. "Value Proposition Analysis for Lithium-Ion Batteries in Automotive Applications". Tutorial E. Advanced Automotive Batteries Conference. June 8, 2009.

Most manufacturers agree that storage temperature is probably the most important factor when it comes to Li Ion battery system durability. The calendar life of most Li Ion batteries[51] is significantly degraded at elevated temperatures during the 90% of the time that PHEVs or BEVs are parked, and in particular, when batteries are at both high SOC and temperature. Accurate and reliable control of cell voltage and temperature are critical requirements for achieving long life and adequate safety of Li Ion batteries. While all automakers continue to engineer reliable systems to monitor and limit cell voltages, control of temperature is an area where their design solutions greatly diverge. Some are planning sealed batteries with no air or liquid cooling systems at all. Others consider the need to limit long-term elevated battery temperature critical enough to incorporate "active" systems to pump heat out of the battery, even when the vehicle is not being driven or actively charging. The remaining automakers are planning to make use of "passive" systems that divert sometimes-conditioned passenger cabin air into their battery systems for cooling; similar to the existing systems in most conventional NiMh-equipped HEVs. DOE funded researchers at NREL have been developing thermal analysis models to evaluate potential climate effects on battery life. Their preliminary results indicate that warmer climate conditions may have a significant negative impact on life; for example, an additional 15% battery power loss in 15 years for electric vehicles in Phoenix, AZ relative to other areas[52]. While active battery cooling systems add hardware cost and increase energy usage in warm climates, advocates of secondary use of batteries claim that these costs may be recouped by increasing a battery's potential usefulness at vehicle end-of-life.

There are also severe challenges with cool climate application of PHEVs and BEVs, but automakers are now confident that the safety issues associated with attempting to charge in cold weather can be adequately addressed. Automakers are, however, universally in agreement that Li Ion battery systems, and in particular, BEVs, may not be functionally appropriate for all climates in the United States. While ARB is tasked with examining the suitability of technologies for automotive application in California, the conclusions reached might not be universally applicable to other states. If it were possible that BEV batteries could be heated and maintained at optimal temperatures in cold climates, this increased energy use would have to be considered when computing upstream CO_2e emissions and operating costs relative to BEVs in California.[53]

4.3 Large Li Ion Vehicle Application & Engineering Challenges

One of the challenges in applying many of the current Li Ion battery chemistries to PHEV and BEV applications is that they are likely to spend most of their lives at or near maximum SOC unless equipped with user-selectable end-of-charge SOC control features. For drivers who are not planning to drive again soon or to not drive very far (tomorrow), it does not make sense to charge their vehicles to maximum range capacity. Extended storage time at both maximum SOC and elevated temperatures will

[51] AABC 2009a.
[52] AABC 2009c. Pesaran, Ahmad. "Impacts of 3C's of Battery on PHEV Value Proposition". Advanced Automotive Batteries Conference. NREL. June 8, 2009.
[53] The only highway-capable BEV currently for sale in California, the Tesla Roadster, is equipped with two key design features intended to extend battery life: (1) an active battery thermal control system, and (2) a user specified upper SOC control.

greatly reduce calendar life. Tesla Motors allows drivers to choose from four different charge/operation modes with different SOC targets at the end of the charge cycle:

Tesla Roadster Mode Setting	SOC at end of charge cycle	
Standard (default setting)	80%	of max. usable range
Storage	35-45%	of max. usable range
Performance or Range mode	100%	of max. usable range

More than one large automaker is also considering a similar user control feature for upper SOC limit in order to extend the lifetime of batteries. This might be particularly useful for BEVs used in predictable commuter applications with workplace charging.

Tesla Motors is already exploring the warranty contract challenges that large automakers will encounter as they begin to sell BEVs and PHEVs in the next five years. It is difficult to fully understand proposed business models where batteries (or vehicles with large batteries) are leased instead of owned. The long-term performance (and value) of a large Li Ion battery system on a vehicle will be greatly affected by driver choices and climate history. For example, the Tesla Roadster Energy Storage System (Battery) warranty does not cover damage caused by:

- Exposing an unplugged vehicle to ambient temperatures above 120°F (50°C) for over 24 hours,
- Storing an unplugged vehicle in temperatures below -40°F (-40°C) for over seven days, or
- Leaving your vehicle unplugged where it discharges the battery to at or near zero state of charge.

While it is true that the lifetime of the Lithium cobalt batteries currently used in the Tesla Roadster may be more susceptible to driver choices and climate conditions than other battery chemistries, the same temperature and SOC considerations will still apply, to some degree, to other Li Ion batteries about to be introduced to the automotive market.

It is likely that leased batteries (those owned by a second party) will not be subject to the same care as those owned by vehicle operators. Leased battery lifetimes cannot be assumed to be equivalent to self-owned batteries. One possible way to address this issue is to further restrict driver choices with leased batteries; for example, to limit their SOC swing to a smaller percent than with non-leased batteries. A self-owned Type II BEV is assumed to be able to achieve a 100 mile range when the driver desires it, but the same BEV that is leased and is software restricted to a "standard" mode with only 80 miles of maximum range, would no longer be certified as a Type II BEV. Alternatively, leased battery systems may be restricted to use of battery chemistries that are more tolerant of diverse driver treatment (abuse?), but these may compromise performance in other regards. Lease rates may also have to vary according to local climate. No matter how these issues are addressed, it would seem that the durability of leased batteries will not be as good as owned ones, that long-term costs of leased batteries will be higher than customer-owned batteries, and that leases for large batteries will be much more complex than sales.

One further challenge with battery or BEV leasing is the requirement of a performance warranty, even on very old systems. Unlike conventional vehicles, which maintain consistent performance for up to 250k miles, vehicle electrochemical system performance will deteriorate with age. Most issues with batteries that are sold are likely to occur sometime after the original warranty has expired. No matter how old the leased battery systems or leased BEV is, it will always require an agreement that clearly describes and guarantees a verifiable minimum battery performance level. Lease rates might also have to be decreased as performance deteriorates, even if the vehicle still meets a drivers commute requirements. PHEVs and BEVs will need to be equipped with a means to assess battery performance relative to when it was new, a state of health (SOH) indicator, in order for a leased battery business model to work. An on-road range test would provide inconsistent results and even if it could be carefully implemented, would be cost prohibitive[54].

On-Vehicle SOC and SOH Determination

Automakers and battery developers have made good progress in developing accurate, on-vehicle systems to determine the SOC of a battery. This is a very important parameter for drivers who need to know exactly how much further they can drive. On-vehicle determination of SOH[55], however, has proven to be a much more challenging task that was originally expected. While automakers had assumed that SOH systems would be ready in time for the 2010-2014 introductions of PHEVs and BEVs, the first vehicles will not yet be equipped with fully-proven SOH determination capability. On-vehicle SOH determination is necessary to address the need for a way to assess whether a battery has failed under warranty, but is also critically needed for lease applications (see above), to address the needs of those who may someday want to purchase used PHEVs and BEVs, for insurance companies to value used equipment, and for pre-screening of batteries under consideration for secondary use.

4.4 Large Li Ion Automotive Battery Production Status

The Panel found that large manufacturers of Li Ion batteries "do not appear to be pursuing development of Li Ion batteries for Full Performance BEVs or for PHEVs". The Panel was much more specific about application in BEVs, stating that they "... found no major battery manufacturer interest in high energy Li Ion batteries for FPBEV[56] applications."[57] This situation has changed considerably since 2007. Large battery manufacturers are now demonstrating strong interest in producing high energy Li Ion

[54] Range test service visit for 100 mile BEV: Diagnosis, charging, testing, and re-charging: >=5? hours of technician time for a single evaluation (not fully counting charge time)
[55] SOH is usually expressed as a fraction of current battery maximum capacity divided by rated (or new) capacity
[56] FPBEV = "Full Performance Battery Electric Vehicle". As late as 2007, it was uncertain whether automakers would be introducing commercial City EVs into the U.S. market that lacked sufficient performance capability for U.S. freeway driving. Since 2007, all EV products announced by major automakers have speed capability that greatly exceeds the (low performance) City EVs of the 1990s and will be "full performance". The use of "full performance" terminology is no longer necessary except perhaps to distinguish these from NEVs, and the term "CityEV" is now more frequently applied to lower-range EV categories (50 – 75 mile).
[57] Kalhammer, 2007.

batteries for both PHEV and BEVs. This interest is most clearly expressed in the post 2007 announcements of joint ventures and purchase agreements between battery manufacturers and automakers / suppliers to produce automotive Li Ion batteries listed in Table 6 below.

Table 6: Publicly Announced Battery Manufacturer-Automaker/Supplier Joint Ventures

Automaker/ Suppliers	Battery Manufacturer	Joint Venture	Publicly Announced	Vehicle Application	Plant Location(s)
Toyota	Panasonic	Panasonic EV Energy	(1990s)	HEV + PHEV	
Nissan	NEC Corp.	Automotive Energy Supply Corporation (AESC)	3/09	HEV + BEV	Tokyo region (+ Tennessee?)
Honda	GS Yuasa	Blue Energy Co. Ltd.	4/09	HEV	Fukuchiyama, Kyoto
Volkswagen	Sanyo	(TBD)			
Mitsubishi	GS Yuasa	Lithium Energy Co. Ltd		BEV	Kusatsu
Coda Automotive	Yardney Technical Products	Coda Battery Systems LLC	6/09	BEV	
Bosch	Samsung SDI Co	SB LiMotive	8/09	BEV (BMW "Megacity")	South Korea
Daimler AG	Evonik Industries AG	*Deutsche Accumotive GmbH & Co. KG*	7/08		*Kamenz, Saxony*
Hyundai Mobis Co.	LG Chem Ltd.			HEV and BEV (Hyundai and Kia)	
Ford	JCI/ SAFT	Not JV- Described as a "partnership"			

The most common arrangement in these joint ventures is for battery companies to put up approximately one-half the cost of the joint venture manufacturing facilities, which is a strong indicator of their confidence in future sales of Li Ion to the automobile industry. In addition to these joint ventures, some automakers plan to purchase cells directly from large battery manufacturers, fully engineer their own battery systems, and assemble these systems within automaker-owned facilities. U.S. DOE has announced awards totaling $1.5 billion for national manufacturing facilities to produce advanced automotive batteries. In addition to the DOE grants, the ARRA also included $8 billion in loans to Ford, Nissan, and Tesla under its Advanced Technology Vehicles Manufacturing Loan

Program. Nissan's $1.6 billion loan will be used to build manufacturing facilities for their Leaf BEV, and for plants to manufacture batteries for the Leaf. Tesla received $465 million to build production facilities for the upcoming Model S BEV, and for battery manufacturing equipment to support the Daimler Smart BEV.

Significant amounts of public funds and private capital are being invested in Li Ion battery production facilities, and most of this investment is for the manufacture of PHEV and BEV specific Li Ion batteries. This level of widespread pre-commercial progress has never been observed for a ZEV technology under review as part of the ARB's ZEV program. These investments are also the most significant indicator of Li Ion progress and acceptance in automotive applications since the 2007 technology assessment.

4.5 Battery Electric Vehicle Technology Status Conclusions

Large Li Ion battery development and production capacity buildup are proceeding at the pace necessary for the PHEV and BEV deployments required by the Board's ZEV Regulation through 2014. These batteries are now described as "pre-commercial" by most large automakers that are moving forward with PHEV and BEV deployments prior to 2014. While there has been extraordinary progress with electric vehicles, every automaker has cautioned ARB staff that there are extraordinary challenges to be overcome in order to sell and support large numbers of PHEVs and BEVs in California, and that these challenges will require considerable and coordinated efforts on the part of Federal, State, and local governments to make electric vehicles a reality. No automaker has stated that current design, or even next generation Li Ion batteries, will achieve sufficiently low cost to make them competitive with conventional vehicles without ongoing government incentives and/or tax credits. Several automakers do, however, believe that Li Ion battery systems will evolve sufficiently to allow automakers to sell cost competitive PHEVs and BEVs sometime prior to 2020, and that these electric-fueled vehicles will play a key role in automaker efforts to meet both corporate and California vehicle emissions reduction objectives.

5.0 2009 Survey Results

Survey Details
In June 2009, staff surveyed automotive companies, fuel cell suppliers and academic institutions to determine the latest in fuel cell technology and commercialization strategies. ARB staff carefully reviewed all surveys and has aggregated data in order to maintain business confidentiality while providing meaningful information. A total of 14 respondents provided extensive information on their organizations' environmental programs, GHG emission reduction strategies, current advanced technology vehicles, and planned advanced technology vehicles.

Manufacturer GHG Emission Reduction Goals
Automakers were asked to indicate the various types of ZEVs they plan to produce and to give a timeframe when advanced technology vehicles should begin commercialization in light of the GHG emission reduction goals. All automotive respondents described specific environmental programs aimed at reducing GHG

emissions and increasing efficiency in their light duty vehicle fleets. Many of the companies have done extensive GHG analyses in order to transform their vehicle fleet to meet California's AB 32 GHG reduction targets. The 2050 GHG emission reduction goals are a significant challenge for the passenger vehicle sub-sector and most companies are pursuing multiple advanced technology vehicles. While most stakeholders agree that increasing fuel efficiency in conventional ICE vehicles and reducing vehicle miles traveled (VMT) are important, they believe that conventional ICE efficiency increases alone will not come close to GHG emission reduction goals and VMT will be hard to reduce. Thus, a substantial effort must be placed on low-carbon fueled vehicles and low-carbon fuels. Companies have a variety of low-carbon fueled vehicles in their product strategies including BEVs (short-range), PHEVs, and FCVs.

Automakers believe GHG emission reductions required of the passenger vehicle sub-sector are massive and efforts must be made immediately to have any hope of achieving climate change reduction goals. Since the turnover rate in the passenger vehicle fleet typically requires multiple years, it is imperative that automakers begin early to commercialize advanced fuel vehicles.

In addition to placing low carbon fueled vehicles on the road, it is important to have a supply of low carbon fuels. All automakers agree that complementary infrastructure needs to be built in parallel with vehicle rollout. Many companies believe advanced vehicles should rollout by the middle of the next decade (~2015). In order to achieve the GHG emission levels, automakers believe a coordinated effort amongst all stakeholders in the transportation and energy supply sectors is vital. In 2009, the Board passed the Low Carbon Fuel Standard (LCFS) which requires a 10% reduction in carbon intensity of California's transportation fuels by 2020. Long term policies such as the LCFS will continue to require deep reductions in carbon from fuels, as manufacturers introduce ZEVs.

Vehicle Technologies

In the near term, all automotive manufacturers project that the conventional ICE will dominate the powertrain concepts for some time. A wide range of improvements will be made to increase fuel economy and decrease GHG emissions rather than focus on performance and increasing vehicle size. In the mid-term, conventional technologies will still dominate, however projections indicate an increase in market share of advanced technologies. In particular, electrification of passenger vehicles appear promising but depends on many variables including cost reduction, vehicle weight, and supporting infrastructure. Many companies are looking into PHEVs and short-range BEVs as mid-term solutions. In the long-term, short to mid-range BEVs, PHEVs with greater electric range and FCVs. Most companies are investing in multiple advanced vehicle technologies at the present time.

All automotive companies have a global market focus but recognize that there are significant differences in the various markets around the world. Automakers will place advanced vehicles in the countries based on many factors: regulatory climate (e.g. CO2e emission reduction regulations), government incentives, infrastructure deployment, consumer choice, local energy prices and cost effectiveness.

Survey responses suggested that automotive companies with strong FCV commercialization plans are optimistic and indicate they will be ready to commercialize the technology in 2015. Other companies with FCVs in their portfolios commonly cite 2025 as a commercialization launch year. Overall, respondents stated it was a huge challenge to indicate $/kW at current volumes or at large volumes (500,000 per year) due to the many uncertainties. Over half the survey respondents included FCVs in their projected product portfolios. Some have demonstration fleets on the road and have performed extensive real-world testing. Others have less aggressive demonstration FCV programs but are pursuing fuel cells at the R&D level. While most companies agree there are multiple challenges to fuel cell commercialization, all companies believe cost and durability are the two greatest challenges. Half of the companies with aggressive FCV plans agree that the U.S. DOE targets are possible based on historical progress and current projections of cost reductions and durability increases. Some companies that are seriously pursuing FCVs believe that volumes alone cannot reduce cost but that there are still technical advances that need to be achieved before commercialization.

The survey responses indicate small, short-range BEVs and PHEVs will likely appear on the market within the next few years. While some companies are enthusiastic about market penetration of BEVs, most manufacturers are anxious about market acceptance, flooding the market with BEVs and battery costs. Automakers appear to be making small, short-range BEVs (~100 miles/charge) in the near-term as the most cost-effective ZEV compliance option. These vehicles offer a great alternative to conventional ICE vehicles for urbanites and commuters (<100 mile range).

PHEVs offer considerable advantages to BEVs and are slated to emerge within the next 2 to 3 years. They offer significant GHG emissions reductions and unlimited range at a fraction of the cost of BEVs. In order to achieve deep GHG emission reductions, PHEVs will need to use sustainable biofuels and be charged consistently. However, it is estimated that other transportation sectors such as heavy duty, marine and aviation will consume a majority of the future biofuel supply. As a result, PHEVs will likely have a limited market share due to inadequate biofuel supply. Furthermore, it is extremely difficult to estimate emissions from PHEVs given the difficulty in estimating charge frequency. The batteries onboard are significantly lighter and less expensive and will likely result in PHEVs being readily accepted in the marketplace. As with BEVs, PHEVs have the same infrastructure challenge and need government financial commitment to build-out adequate charging stations. In spite of the challenges, it seems reasonable that PHEVS will come to market in the near-term due to lower incremental cost different compared to conventional ICE vehicles.

Technology Stratification

There are a number of market advantages and disadvantages of FCVs, PHEVs and BEVs, with each automaker having a slightly different perspective. However, there is a general consensus regarding the main advantages and disadvantages of each technology. Most companies believe FCVs offer excellent range, significant environmental benefits and similar driving experience compared to conventional gasoline vehicles. Still, FCV commercialization currently cost prohibitive and refueling infrastructure is inadequate. Like FCVs, BEVs offer considerable environmental advantages but are extremely expensive and durability is not well defined. PHEVs offer environmental gains over conventional ICE vehicles but have a cost premium and battery life is a major concern. Therefore, most automakers are pursing multiple technologies at this time.

Most automakers are taking a portfolio approach in their ZEV product planning because they believe there is no single technology that will meet the 2050 goal. This multiple technology approach ensures that R&D continues on all technologies to reduce cost and increase durability.

Most also believe that these technologies will be applied non-uniformly across their product lines, and will vary according to a combination of vehicle size, duty cycle[58], application, local climate, and price range. Some believe that BEVs may even be the dominant technology in a new class of 2-seat mini-compact size vehicles, with BEV applications also extending throughout compact-size up to mid-size vehicles in urban and regional applications. PHEVs are expected to overlap with BEVs in the small-to-mid size range, and dominate in mid-size mixed applications and where longer distance travel is required. Fuel cell technology will be applied to mid-to-large vehicles with continuous or high-load applications and where range or refueling time restrictions cannot be accommodated. Lower range BEVs will be well-suited for commute, shared-car, and fleet-specific applications. Automaker product plans now include BEVs in ARB's lowest-range ZEV Regulation categories: Type I 50 mile and Type I.5 75 mile range BEVs.

Most automakers believe that the size of conventional vehicles they sell in the U.S., and in particular, the California market, will be getting significantly smaller. This downshift in size is due to a variety of contributing factors. However, if this downward trend is considered in conjunction with the suitability of BEVs and PHEVs in small-to-mid size classes, the end result of this fleet-wide size reduction could be an increase in the potential market share of BEVs and PHEVs.

FCVs offer major environmental benefits compared to the conventional ICE vehicle and some companies have publicly announced FCV commercialization in the 2015 timeframe. All automakers developing FCVs are aggressively working to address cost and durability issues. Several automakers believe cost can be reduced sufficiently for FCVs to enter the market by 2015 if hydrogen infrastructure is adequate. Automakers believe that consistent government funding of vehicle R&D and infrastructure is essential to reach commercial launch. While FCVs are needed to reduce GHG emissions, there is no single advanced technology that will achieve 80% GHG emission reductions alone. Therefore, it is necessary that all ZEVs succeed and a play a role in sustainable transportation. Top automaker's of FCV technology – Daimler, Ford, General Motors, Honda, Hyundai, Kia, Toyota and alliance Renault SA and Nissan issued a joint letter of understanding in September 2009 regarding development and commercialization of FCVs. The auto manufacturers strongly anticipate that from 2015

[58] In this regard, "duty cycle" is meant to describe power VS time requirements, for example, continuous highway VS stop-and-go urban driving.

onwards, a significant number –"a few hundred thousand units over the initial products' lifecycles-of FCVs could be commercialized".[59]

Consumer Demand and Additional Policies
All organizations surveyed strongly support government incentives at the local, state and federal level to bring advanced technology vehicles to market. Furthermore, they believe government support and other complementary policies (e.g. infrastructure investment, incremental cost buy-down incentives, etc.) are required for a long-term GHG emission reduction strategy to be effective. To date, automotive manufacturers have fronted most of the investment in advanced technology vehicles with little-to-no investment required of energy providers and no cost passed to the consumer. Most automakers are radically shifting their production plans to make advance technology vehicles and will need all stakeholders to invest and share the risk in the sustainable transportation future.

All automotive manufacturers support a political climate that remains technology neutral with consistent financial support. Without consistent government support it will be near impossible to achieve GHG emission reduction goals in the passenger vehicle sub-sector. While early adopters will bear the incremental cost burden between conventional vehicles and advanced technology vehicles, the majority of consumers will not be inclined to purchase these vehicles due to the significant cost differential. Some companies suggest government funding should be sufficient to have initial incremental cost paid back by fuel savings over a 3-year period and these incentives should be phased out as volumes grow. Auto manufacturers recommend that government incentives for ZEVs should include:

- federal and state vehicle incentives for R&D,
- allow ZEVs to be exempt from motor vehicle tax, sales tax and vehicle registration fees,
- provide purchase incentives for consumers at point-of-sale (to buy-down upfront incremental price),
- fund ZEV infrastructure (home, workplace and public),
- offer HOV lane access, free parking, preferential parking in public spaces,
- give higher credit in ZEV program and GHG gas regulation program,
- offer free charging, toll road exemptions,
- grant incentives to offset fleet purchases or require a percentage of new fleet purchases be advanced technology vehicles,
- continue to develop Low Carbon Fuel Standard and Cap and Trade policies,
- require utilities to offer free home inspections for off-peak charging, and
- create or reform building codes to facilitate home/public refueling.[20]

Most automakers now have specific environmental strategies for their passenger vehicle product line in order to achieve California's GHG emission reduction goals.

---

[59] OEM LOU 2009. OEM Letter of Understanding on the Development and Market Introduction of Fuel Cell Vehicles. Dated September 8, 2009.

While each company has a unique approach, most are converging on electrification of the passenger car through various advanced vehicle technologies. A majority of automakers have produced a few ZEV demonstration vehicles or have made public announcements of planned ZEV test fleets. All advanced technology vehicles will come at a significant cost premium and automakers strongly agree that the investment in sustainable transportation should be shared amongst all stakeholders including the consumer.

6.0 Conclusion

Governments around the world are increasingly concerned about energy security, fluctuating petroleum prices, and reducing smog and GHG emissions. Since the passenger vehicle sub-sector contributes to a large portion of smog forming and GHG emissions, it is essential to increase vehicle efficiency and reduce smog and GHG emissions from passenger cars.[3]

Most auto manufacturers have publically announced plans to deploy ZEVs to decrease criteria pollutants and GHG emissions from their light duty vehicles. All survey respondents have indicated specific sustainable program plans aimed at greening their vehicles. The 2050 GHG emission reduction goals are a huge challenge for the passenger vehicle sub-sector and all automakers believe there is no single advanced technology vehicle that will enable the deep reductions that must occur and therefore are pursing multiple advanced technology vehicles.

Rather than some technologies "winning" over others, manufacturers agree that FCVs, PHEVs and BEVs all have unique market opportunities within sustainable transportation. For example, small, short-range BEVs could be used for intercity travel and daily commutes, PHEVs could be medium sized cars and used for intra-city travel, FCVs could be medium-to-large sized vehicles and used for long distance travel.

In the near-term, it is likely that conventional vehicles will continue to make efficiency gains and make up most of new vehicle sales. Therefore, it is essential that all technical advances be directed toward decreasing fuel consumption rather than compensate for increased performance and weight. In addition to conventional ICE vehicles, HEV technology is a promising pathway to cost-effective reduction in fuel use.[2] Within the next several years, automaker's will likely produce small, more efficient conventional ICE vehicles as a cheaper approach to GHG reductions and slowly hybridize their vehicle portfolios.

References

AABC 2009a. Spotnitz, Dr. Robert. "Large Lithium-Ion Battery Design Principles". Tutorial A. Advanced Automotive Batteries Conference. June 8, 2009.

AABC 2009b. Anderman, Dr. Menahem. "Value Proposition Analysis for Lithium-Ion Batteries in Automotive Applications". Tutorial E. Advanced Automotive Batteries Conference. June 8, 2009.

AABC 2009c. Pesaran, Ahmad. "Impacts of 3C's of Battery on PHEV Value Proposition". Advanced Automotive Batteries Conference. NREL. June 8, 2009.

American Physical Society 2008. American Physical Society. "Energy Future: How America Can Look Within to Achieve Energy and Security and Reduce Global Warming". September 2008.

ARB 2008. Climate Change Scoping Plan. December 2008. http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

ARB 2009a. California Air Resources Board, Greenhouse Gas Inventory. http://www.arb.ca.gov/cc/inventory/inventory.htm.

ARB 2009b. Aggregated Automaker Information from ARB's Confidential Zero Emission Vehicle Technology Status Survey. June 29, 2009.

California Assembly 2006. Assembly Bill 32. California Global Warming Solutions Act of 2006, Chapter 488, Division 255, Section 38500. Approved September 27, 2006.

Cawthorn 1999. Cawthorn, R.G. "The Platinum and Palladium Resources of the Bushveld Complex". South Africa Journal of Science 95, November-December 1999.

UCD 2008. Cunningham, Joshua, et al, University of California, Davis, Institute of Transportation Studies, "Why Hydrogen and Fuel Cells are Needed to Support California Climate Policy". March 31, 2008. UCD-ITS-RR-08-06.

Daimler 2009. Berretta, Rosario. Daimler. "Fuel Cell Technology for Passenger Vehicles Presentation. CARB ZEV Symposium". September 21, 2009.

Dictionary.com 2009. http://www.Dictionary.com

Executive Order S-3-05. Schwarzenegger, Arnold. Governor of the State of California. Signed June 6, 2005.

GREET. The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model. Version 2.7

Honda 2009. Knight, Ben. Honda Motor Company. “Fuel Cell Vehicle Technology Performance and Steps Ahead Presentation”. CARB ZEV Symposium. September 21, 2009.

International Battery Seminar 2009. Deveney, B., Spotnitz, R., March 2009.

Kalhammer 2007. Kalhammer, Fritz R., et al. “Status and Prospects for Zero Emissions Vehicle Technology: Report of the ARB Independent Expert Review Panel 2007”.

MIT 2008. Bandivadekar, Anup, et al,. “On the Road in 2035: Reducing Transportation’s Petroleum Consumption and GHG Emission”. Laboratory for Energy and the Environment. Massachusetts Institute of Technology. July 2008.

NREL 2009. National Renewable Energy Lab (NREL). “Fuel Cell System Cost for Transportation-2008 Cost Estimate”. May 2009.

OEM LOU 2009. OEM Letter of Understanding on the Development and Market Introduction of Fuel Cell Vehicles. Dated September 8, 2009.

TIAX 2008. Sinha, Jayanti, et al. TIAX LCC. “Direct Hydrogen PEMFC Manufacturing Cost Estimation for Automotive Application: Fuel Cell Tech Team Review”. September 24, 2008.

Toyota 2009. Yokoyama, Tatsuaki. Toyota Motor Engineering and Manufacturing North America. “Progress and Challenges for Toyota’s Fuel Cell Vehicle Development Presentation”. CARB ZEV Symposium. September 21, 2009.

U.S. DOE 2008a. James, Brian, et. Al. “Mass Production Cost Estimation for Direct H_2 PEM Fuel Cell Systems for Automotive Applications”. U.S. DOE Hydrogen Program Review. June 10, 2008.

U.S. DOE 2008b. Garland, Nancy, et al. “DOE Hydrogen Program Record: Fuel Cell System Cost-2008”. December 16, 2008.

U.S. DOE 2009a. U.S. DOE 2009a. Debe, Mark D., “Advanced Cathode Catalysts and Supports for PEM Fuel Cells.” 2009 DOE Hydrogen Program Review. May 2009. http://www.hydrogen.energy.gov/pdfs/review09/fc_17_debe.pdf

U.S. DOE 2009b. Dillich 2009. Dillich, Sara. “Hydrogen Storage”. 2009 DOE Hydrogen Program and Vehicle Technologies Program Merit Review and Peer Evaluation Meeting. May 19, 2009.

U.S. DOE 2009c. Satyapal, Sunita. “Hydrogen Program Overview”. Annual Merit Review and Peer Evaluation Meeting. May 18, 2009, Arlington, Virginia.

U.S. DOE 2009d. Barnett, Brian, et al. “PHEV Battery Cost Assessment”. Annual Merit Review. TIAX LCC, May 19, 2009

U.S. DOE 2009e. Spendelow, Jacob and Marcinkoski, Jason. "DOE Hydrogen Program Record # 9012"., October 7, 2009.

U.S. DOE 2009f. United States Department of Energy. Office of Energy Efficiency and Renewable Energy. "Hydrogen, Fuel Cells & Infrastructure Multi-Year Research, Development and Demonstration Plan". Updated April 2009.

U.S. DOE 2009g. Standford, Joseph. "Modeled High-volume Cost of Major Hydrogen Production Pathways and Modeled High-volume Cost of Major Hydrogen Delivery Pathways". Received November, 12, 2009.

APPENDIX A

CONFIDENTIAL ZERO EMISSION VEHICLE TECHNOLOGY STATUS SURVEY

JUNE 25, 2009

California Air Resources Board
Sustainable Transportation Technology Branch
Zero Emission Vehicle Implementation Section

OVERVIEW

The California Air Resources Board (ARB or the Board) is conducting a confidential survey to augment stakeholder discussions and ARB staff research for the Zero Emission Vehicle (ZEV) 2.0 Technical Support Document (TSD). This survey will be used, along with publicly available reports, data and analyses, to assess the prospects of ZEV technology commercialization. The survey is intended to:

- capture information regarding ZEV technology status: cost, current state of technology, future production plans, timelines, key technical issues/barriers, and commercialization timeframe, and
- be one source, among several, in ARB's development of the TSD.

ARB acknowledges each type of ZEV is in a different state of commercial readiness, with varying market entry barriers. ARB also acknowledges that the survey questions request information that may be sensitive in a competitive aspect. However, accurate information is critical for staff's ability to realistically assess the status of each ZEV technology prior to ZEV regulation revisions.

ARB staff requests documentation, data and written answers be submitted in response to this survey. A phone or in-person meeting with staff may also be requested to further discuss your organization's answers to survey questions.

CONFIDENTIALITY

ARB protects survey documentation, data records, written responses, and other records designated as confidential business information or trade secret from disclosure to extent permitted by state law and ARB regulations. Please clearly mark survey materials or portions of materials as "business confidential" to indicate those materials that ARB staff is asked to protect from disclosure consistent with state law and ARB regulations.

TIMELINE

June 22, 2009 – August 31, 2009	Teleconferences, in-person meetings with manufacturers and other stakeholders
August 31, 2009	Survey response deadline
Tuesday, September 8, 2009	Draft TSD release date
Tuesday, November, 10, 2009	TSD release date
Thursday, December, 10, 2009	Informational item presented at December Board Meeting

Acronyms

- AER..All-Electric Range
- AT-PZEV............... Advanced Technology Partial Zero Emission Vehicle
- BEV..Battery Electric Vehicle
- CNG...Compressed Natural Gas
- EAER...Equivalent All-Electric Range
- Enhanced AT-PZEV.....................Enhanced Advanced Technology PZEV
- FCEV..Fuel Cell Electric Vehicle
- GHG...Greenhouse Gases
- HEV..Hybrid Electric Vehicle
- HICE...........................Hydrogen Internal Combustion Engine Vehicle
- HOV..High Occupancy Vehicle
- ICE...Internal Combustion Engine
- kW..Kilowatt
- kWh..Kilowatt-hour
- LDV...Light Duty Vehicle
- Li-Ion..Lithium Ion
- NEV...Neighborhood Electric Vehicle
- OEM.......................................Original Equipment Manufacturer
- R_{cda}..Actual Charge Depleting Range
- SULEV.......................................Super Ultra Low Emission Vehicle
- PHEV..Plug-in Hybrid Electric Vehicle
- PZEV...Partial Zero Emission Vehicle
- TSD...Technical Support Document
- UDDS.................................Urban Dynamometer Driving Schedule
- USABC...........................United States Advanced Battery Consortium
- USDOE.................................United States Department of Energy
- ZEV...Zero Emission Vehicle

Definitions

- Actual Charge Depleting Range or R_{cda} means the actual distance achieved by a hybrid electric vehicle on a specified driving cycle at the point when the zero emission energy storage device is depleted of off vehicle charge and regenerative braking derived energy.

- All-Electric Range means the total miles driven electrically (with engine off) before the engine turns on for the first time, after the battery has been fully charged. For a blended plug-in hybrid electric vehicle, the equivalent all electric range shall be considered the "all-electric range" of the vehicle.

- Advanced Technology Partial Zero Emission Vehicle means any partial zero emission vehicle with an allowance greater than 0.2 before application of the partial zero emission vehicle early introduction phase-in multiplier. Examples: hybrid electric vehicle or compressed natural gas-fueled vehicle meeting super ultra low emission vehicle emission standard.

- Battery Electric Vehicle means any vehicle that operates solely by use of a battery or battery pack, or that is powered primarily through use of electric battery or battery pack but uses a flywheel or capacitor that stores energy produced by the electric motor or through regenerative braking to assist in vehicle operation.

- Blended Plug-In Hybrid Electric Vehicle means a vehicle using both internal combustion engine and off-vehicle charge energy during the charge depleting mode of operation.

- Equivalent All-Electric Range means the portion of the total charge depleting range attributable to the use of electricity from the battery over a charge depleting range test.

- Enhanced Advanced Technology Partial Zero Emission Vehicle means any partial zero emission vehicle that has an allowance of 1.0 or greater per vehicle without multipliers and makes use of a zero emission vehicle fuel. Examples: plug-in hybrid vehicle or hydrogen internal combustion engine meeting super ultra low emission vehicle emission standard and applicable partial zero emission vehicle requirements.

- Global Fleet Size means the number of zero emission vehicles placed worldwide.

- Global Demonstration means 100's of vehicles placed worldwide.

- Global Pre-Commercialization means 1,000's of vehicles placed worldwide.

- Global Early Commercialization means 10,000's of vehicles placed worldwide.

- Global Full Commercialization means 100,000's of vehicles per year placed worldwide.

- Neighborhood Electric Vehicle means any motor vehicle that meets the definition of Low-Speed Vehicle in section 385.5 of the Vehicle Code or in 49 CFR 571.500 (as it existed on July 1, 2000), and is certified to zero emission vehicle standards.

- Non Blended Plug-In Hybrid Electric Vehicle means a vehicle that uses off-vehicle charge energy exclusively for motive power during the charge depleting mode of operation.

- Plug-in Hybrid Electric Vehicle means a vehicle using motive power supplied by an internal combustion engine and off-vehicle electricity stored in batteries or other energy storage systems.

- Partial Zero Emission Vehicle means any vehicle that is delivered for sale in California and that qualifies for a partial zero emission vehicle allowance of at least 0.2. Among other requirements, a partial zero emission vehicle meets the super ultra low emission standard tailpipe standard, zero evaporative emission standard, and provides an extended emissions warranty of 15 years/150,000 miles.

- Urban Dynamometer Driving Schedule means a United States Environmental Protection Agency dynamometer test for light duty vehicles that represents city driving conditions as set forth in Appendix I 40 Code of Federal Regulations Part 86.

- Zero Emission Vehicle means any vehicle certified to zero emission standards, producing zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions.

- ZEV Fuel means any fuel that provides traction energy in on-road zero emission vehicles. Examples: electricity, hydrogen, and compressed air.

Automotive Manufacturer Questionnaire

This automotive manufacturer questionnaire is intended to assist ARB staff in assessing the technical status of your organization's zero emission vehicle (ZEV) program, especially with regard to technology development, performance, timing of commercialization, and costs. The questionnaire pertains to general questions regarding projected ZEV technology commercialization, technology and vehicle technical information, and volume and cost challenges for ZEVs.

Wherever possible, reference your technical answers to the United States Department of Energy (US DOE) and United States Advanced Battery Consortium (US ABC) technical goals (attachments 1 and 2). This will improve our ability to assess all survey responses on a consistent level.

Not all questions are applicable to each company or organization. Please respond to the questions appropriate to your development and/or commercialization program. Any additional comments and suggestions not covered by the technical questionnaire are welcomed.

QUESTIONS:

1. To meet California's 2050 greenhouse gas (GHG) emission reduction goals (Executive Order S-03-05), the light duty vehicle (LDV) segment will likely need to reduce emissions by 80% below 1990 levels.

    a. What is your organization's vision for the types of vehicles such as zero emission vehicles and plug-in hybrid electric vehicles that would be commercialized in response to this goal?

    b. When do you envision advanced technology vehicle markets needing to evolve in order to achieve these 2050 goals?

    c. More specifically, what are your organization's advanced vehicle technology portfolio plans through 2020 (the next 10 years) as related to GHG emissions?

2. What are your organizations plans for advanced vehicle deployment in general regions around the world (e.g. United States, Europe, and Japan)? What are the motivating factors that drive those choices?

3. What are the market advantages and disadvantages of each technology listed below (e.g. vehicle purchase cost, operating cost, fueling convenience, perceived infrastructure access, "green" aspect of vehicle, etc.)?

    - Fuel Cell Electric Vehicle
    - Battery Electric Vehicles

- Plug-in Hybrid Electric Vehicles
- Hybrid Electric Vehicles
- Conventional Vehicles
- Alternative Fuel Vehicles (compressed natural gas, biodiesel, etc.)

4. What is the status of your organization's current and future ZEV programs under development? Please fill out a vehicle specification sheet (Attachment 3) for each vehicle your organization produces or intends to produce.

5. What challenges remain to meeting USDOE cost and performance goals and how do you foresee addressing them? Please refer to Attachment 1. If you do not feel the USDOE targets are appropriate, describe why the targets are not appropriate.

6. What will the cost per vehicle be at the following levels and what are the remaining challenges? Please use in the following tables as guides.

FUEL CELL VEHICLES

	When will production volumes reach the following levels (model year)?	Vehicle Cost ($)	Operating Cost ($)	Technical/Performance Issues	Other Commercialization Issues (infrastructure, codes and standards, etc.)
100's of vehicles					
1,000's of vehicles					
10,000's of vehicles					
100,000's of vehicles					

BATTERY ELECTRIC VEHICLES

	When will production volumes reach the following levels (model year)?	Vehicle Cost ($)	Operating Cost ($)	Technical/Performance Issues	Other Commercialization Issues (infrastructure, codes and standards, etc.)
100's of vehicles					
1,000's of vehicles					
10,000's of vehicles					
100,000's of vehicles					

PLUG-IN HYBRID VEHICLES

	When will production volumes reach the following levels (model year)?	Vehicle Cost ($)	Operating Cost ($)	Technical/Performance Issues	Other Commercialization Issues (infrastructure, codes and standards, etc.)
100's of vehicles					
1,000's of vehicles					
10,000's of vehicles					
100,000's of vehicles					

7. Does your organization recommend federal purchase incentives to support early market sales of ZEVs? If so, what level of funding is appropriate? What are other complementary policies that could aid in early market sales (e.g. HOV lane access)?

Fuel Cell Manufacturer Questionnaire

This fuel cell manufacturer questionnaire is intended to assist ARB staff in assessing the technical status of fuel cell systems, especially with regard to technology development, performance, timing of commercialization, and costs. The questionnaire pertains to fuel cell technology currently in development, technical goals for automotive fuel cell systems, technical issues impeding introduction of automotive fuel cell systems, and commercialization challenges.

Wherever possible, reference your technical answers to the US DOE technical targets (Attachment 1). This will improve our ability to assess all survey responses on a consistent level.

Not all questions are applicable to each company or organization. Please respond to the questions appropriate to your development and/or commercialization program. Any comments and suggestions not covered by the technical questionnaire are welcomed.

QUESTIONS:

1. Is your organization a vehicle system integrator (original equipment manufacturer), direct system component supplier (Tier 1) or second/third tier supplier (Tier II, III)?

2. Is the fuel cell application for primary propulsion power, traction power, auxiliary power or other?

3. What is the fuel cell type (e.g. proton exchange membrane, solid oxide fuel cell) and general performance characteristics of your system? Please provide your answers relative to the USDOE fuel cell technical targets in Attachment 1.

4. What are the first and subsequent automotive applications, e.g. cars, sport utility vehicle, trucks and/or buses?

5. Do you anticipate non-automotive applications for your fuel cell technology?

6. Please review the US DOE fuel cell system targets outlined in Attachment 1, and state your systems performance relative to these targets.

7. Which of the following performance topics still require research and development before commercialization? Please rank your answers in order of the difficulty of finding a solution.
   - Energy efficiency at part load and rated power
   - Fuel consumption on standard driving cycles (e.g. urban dynamometer

driving schedule)
- Durability
- Balance of plant requirements, e.g. thermal management, humidification,
air and fuel
- Start up, shut down and storage issues
- Extreme environmental hot and cold ambient conditions
- Cold start time
- On-board hydrogen storage and purity requirements
- Noise, harshness and vibration
- Others?

8. Does your organization have plans to commercialize your automotive fuel cell technology? If so, in what volume and timeframe?

9. What are the challenges associated with developing and building an adequate OEM supplier base for the fuel cell industry? Characterize your answer in terms of what is needed to support varying production volumes (e.g. 1,000 vs. 10,000 vs. 100,000 vehicles).

Battery Manufacturer Questionnaire

This battery manufacturer questionnaire is intended to assist ARB staff in assessing the technical status of batteries, especially with regard to technology development, performance, timing of commercialization, and costs. The questionnaire pertains to: battery technology currently in development, technical goals for automotive batteries,technical issues impeding introduction, and commercialization challenges for automotive batteries.

Wherever possible, reference your technical answers to the US ABC technical targets (Attachment 2). This will improve our ability to assess all survey responses on a consistent level.

Note: Please provide separate answers in each question for battery technologies used in BEVs or PHEVs.

Not all questions are applicable to each company or organization. Please respond to the questions appropriate to your development and/or commercialization program. Any comments and suggestions not covered by the technical questionnaire are welcomed.

<u>QUESTIONS:</u>

1. What kind of battery chemistry is your organization developing? Please provide details of each battery chemistry.

2. Is your organization developing and/or marketing battery technologies in cell sizes suitable for BEVs (for example 40-100 Ah) and for PHEVs (15-50 Ah)? If yes, in which state of development is this technology (laboratory R&D; laboratory prototype cells or modules; pilot production of cells or modules; manufacturing [on which scale])?

3. What are the technical problems that still need to be overcome to achieve commercial production of the technology (e.g. performance, cycle life, calendar life, safety issues, cost)?

4. What are the most prevalent non-technical barriers to commercial production?

5. Please review the US ABC battery system targets outlined in Attachment 2, and state your systems performance relative to these targets.

6. What is the cost of your organization's battery technology for BEV applications:
   (cell size 30-100 Ah, capacity 20-40 kWh) and PHEV applications
   (cell size 15-50 Ah, capacity 5-20 kWh).

Please provide separate answers if you produce both types of vehicles.

- Capacity, voltage and estimate cost of modules
    - at maximum current production rate (please indicate rate)
    - at 3,000 kWh per year
    - at 30,000 kWh per year
    - at 300,000 kWh per year

- Cost of balance of battery system (battery management system, case/tray, wiring, other hardware)
    - at maximum current production rate (please indicate rate)
    - at 3,000 kWh per year
    - at 30,000 kWh per year
    - at 300,000 kWh per year

7. Which technology advances are most likely to reduce battery cost? When does your organization expect these cost reductions to become part of commercially available technology?

8. Which technology advances are most likely to increase battery safety? When does your organization expect these safety increases to become part of commercially available technology?

Government, Academia, and Other Questionnaire

This questionnaire is intended to assist ARB in assessing the technical status of zero emission vehicle (ZEV) technologies, especially with regard to technology development, performance, timing of commercialization, and costs. The questionnaire pertains to your organization's perspectives on ZEV and ZEV enabling technology commercialization trends, and well as your organization's assessment of the current ZEV market. ARB sent specific surveys to original equipment manufacturers (OEM), battery manufacturers, and fuel cell manufacturers worldwide. This survey is being distributed to non-industry stakeholders, academia, and federal government agencies to gauge general trends of the status of ZEV technology and commercialization.

Not all questions are applicable to each company or organization. Please respond to the questions appropriate to your company or organization. Any comments and suggestions not covered by the technical questionnaire are welcomed.

1. To meet California's 2050 greenhouse gas (GHG) emission reduction goals (Executive Order S-03-05), the light duty vehicle (LDV) segment will likely need to reduce emissions by 80% below 1990 levels.
    a. What is your organization's vision for commercialization of the types of vehicles needed to meet California's 2050 goals, such as zero emission vehicles and plug-in hybrid electric vehicles?
    b. When do you envision advanced vehicle markets needing to evolve in order to achieve these 2050 goals?
    c. More specifically, what are your organization's thoughts on advanced vehicle technology portfolio plans needed by 2020 (the next 10 years) as it relates to GHG emissions and fuel economy?

2. What are the market advantages and disadvantages of each type of vehicles compared to the following vehicles? (e.g. vehicle purchase cost, operating cost, fueling convenience, perceived infrastructure access, "green" aspect of the vehicle, etc.)

    a. Fuel Cell Electric Vehicles
    b. Battery Electric Vehicles
    c. Plug-in Hybrid Electric Vehicles
    d. Hybrids Vehicles
    e. Conventional Vehicles
    f. Alternative Fuel Vehicles (Compressed Natural Gas, Biodiesel, etc.)

3. Please evaluate the US DOE Hydrogen Fuel Cell Vehicle Goals and the US ABC Goals (see Attachment 1 and 2). Explain any discrepancies your organization may have with goals listed, and provide additional goals your organization feels are necessary for successful ZEV and PHEV commercialization.

4. Does your organization recommend federal purchase incentives to support early market sales of ZEVs? If so, what level of funding is appropriate? What are other complementary policies that could aid in early market sales (e.g. HOV lane access, fueling infrastructure incentives, etc.)?

5. What are the challenges associated with developing and building an adequate OEM supplier base for the fuel cell or battery industry? Characterize your answer in terms of what is needed to support varying production volumes (e.g. 1,000 vs. 10,000 vs. 100,000 vehicles).

6. What are the technical problems that still need to be overcome to achieve commercial production of fuel cells (examples: performance, starts, calendar life, safety issues, cost)?
    a. Which technology advances are most likely to reduce battery cost?

    b. Which technology advances are most likely to increase battery safety?

7. What are the technical problems that still need to be overcome to achieve commercial production of batteries (examples: performance, cycle life, calendar life, safety issues, cost)?

8. What are the most prevalent non-technical barriers to commercial production of fuel cells and fuel cell vehicles?

9. What are the most prevalent non-technical barriers to commercial production of battery and battery electric vehicles?

Companies or Organizations Receiving Survey

Automobile Manufacturers

- BMW
- Chrysler
- Coda
- Daimler
- Fisker
- Ford
- General Motors
- Honda
- Hyundai
- Jaguar
- Kia
- Mazda
- Mitsubishi Motors
- Nissan
- Subaru
- Tesla
- Toyota
- Volkswagen
- Volvo

Battery Manufacturers

- A123 Battery
- Automotive Energy Supply Corporation (AESC)
- Altairnano
- BYD
- Compact Power
- Electrovaya
- Enerdel
- GAIA Akkumulatorenwerke
- GS/Yuasa
- Johnson Controls-Saft
- Kokam America
- Lithium Energy Japan
- Panasonic EV Energy (PEVE)
- Sanyo
- SK Energy

Fuel Cell Manufacturers

- ATCC
- Hydrogenics
- UTC Power

Government, Academia and Other

- Argonne National Laboratory
- Electric Power Research Institute (EPRI)
- Massachusetts Institute of Technology
- National Renewable Energy Laboratory
- Oak Ridge National Laboratory
- United States Department of Energy
- University of California Davis (UC Davis)
- University of California, Irvine (UC Irvine)

Survey References

The following reference list is a summary of the information ARB will review to support the development of the ZEV Regulation revisions. This information will support various tasks, including the TSD, the greenhouse gas scenario analysis, and the infrastructure assessment that will inform the potential need for complementary policies.

Long-term scenarios: Energy consumption, GHG Emissions, and Resource Limitations

Primary Sources:

- "Meeting an 80% in GHG Emissions from Transportation in 2050: A Case Study in California," Transportation Research Part D, 2009 (ITS-Davis)
- "A Wedge Analysis of the US Transportation Sector," US Environmental Protection Agency (EPA), EPA420-R-07-007, 2007
- "Energy Technology Perspectives: Scenarios & Strategies to 2050," International Energy Agency (IEA), 2008
- "Electric Powertrains: Opportunities and Challenges in the US LDV Fleet," MIT Sloan Automotive Lab, LFEE 2007-02 RP, 2007 (Heywood, Kromer)
- "Factor of Two: Halving the Fuel Consumption of New US Automobiles by 2035," MIT Sloan Automotive Lab, LFEE 2007-04 RP, 2007
- "On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emissions," MIT Laboratory for Energy and the Environment, LFEE 2008-05 RP, 2008
- "Prioritizing Climate Change Mitigation Alternatives: Comparing Transportation Technologies to Options in Other Sectors," PhD dissertation, UC Davis, 2008 (N. Lutsey)
- "Reducing US GHG Emissions: How Much at What Cost," McKinsey & Company, US GHG Abatement Mapping Initiative, 2007
- "Roads toward a low carbon future: reducing CO2 emissions from passenger vehicles in the global road transportation system," McKinsey & Company, 2009
- "Optimizing US Mitigation Strategies for the Light-Duty Transportation Sector: What We Learn from a Bottom Up Model," Environmental Science and Technology, 2008 (ITS-Davis)
- "State alternative fuels plan (AB 1007)," California Energy Commission, December 2007
- "America's Energy Future: A National Academies Summit," National Research Council, 2008
- "Reducing Greenhouse Gas Emissions from US Transportation," Pew Center on Global Climate Change, 2003 (D. Greene, A. Schafer)
- Review of US DOE's Multi-Path vehicle and fuel characterization study material when available, expected fall 2009 (S. Plotkin, P. Patterson, M. Singh)

Secondary Sources:

- "Climate Change 2007: Synthesis Report," United Nations IPCC, 2007
- "Energy Future: Think Efficiency," American Physical Society (APS), 2008 (Sperling)
- "Stabilizing Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," Science Magazine Vol 305, 2004 (Socolow, Pacala)
- "The King Review of Low Carbon Cars: Part I, the Potential for CO2 Reduction," UK Treasury, 2007
- "World Energy Outlook 2008," International Energy Agency (IEA), 2008
- "Building a Sustainable Energy Future," National Science Foundation, NSB-09-35, 2009
- "A New Vision for California's ZEV Program: An Analysis of the Impact of the ZEV Program on CA's Long-Term Global Warming Pollution Goals," Union of Concerned Scientists, 2008
- "International Energy Outlook 2009," Energy Information Administration (EIA), 2009
- "BP Statistical Review of World Energy," BP, 2008
- "Using Energy Scenarios to Explore Alternative Energy Pathways in California," Energy and Resources Group, UC Berkeley, 2005
- "Fuel and Vehicle Technology Choices for Passenger Vehicles in Achieving Stringent CO2 Targets: Connections between Transportation and Other Energy Sectors," Environmental Science and Technology, vol 43, 2009
- "Comparison of Transportation Options in a Carbon-Constrained World," C.E. Thomas, National Hydrogen Association Annual Meeting, Sacramento, CA, March 31, 2008 (revised June 24, 2008).
- "Modeling Endogenous Technology Change for Climate Policy Analysis," RFF-DP-07-14, Resources For the Future, May 2007

Advanced Vehicle Comparison & General Automotive Material

- "Well to Wheel Greenhouse Gas Emissions and Petroleum Use," DOE Hydrogen Program Record #9002, 2009
- "Status and Prospects for Zero Emission Vehicle Technology," Report of the ARB Independent Expert Panel 2007 (Kalhammer, Kopf, Swan, Roan, Walsh), April 2007.
- "Review of the Research Program of the FreedomCAR and Fuel Partnership: Second Report," Board on Energy and Environmental Systems, National Research Council, 2008
- "Fixing Detroit: How far, how fast, how fuel efficient," UMTRI-2009-26, University of Michigan, June 2009 (McManus, Kleinbaum)

Fuel Cells and Hydrogen
Primary Sources:

- "Transitions to Alternative Transportation Technologies: A Focus on Hydrogen," National Research Council, 2008 (J.Ogden)
- "Hydrogen and Fuel Cell Activities: Progress and Plans," US Department of Energy Report to Congress, Jan 2009
- "Analysis of the Transition to H2 FCVs & the Potential Hydrogen Energy Infrastructure Requirements," US DOE Oak Ridge National Laboratory, 2008
- "DOE Annual Hydrogen Program FY 2008 Annual Progress Report," US Department of Energy, 2008
- "Learning Demonstration Interim Progress Report," US DOE National Renewable Energy Laboratory, 2007
- "Hydrogen and Fuel Cell Technical Advisory Committee Biennial Report to the Secretary of Energy," HTAC, 2007
- "Direct Hydrogen PEMFC Manufacturing Cost Estimation for Automotive Applications," TIAX LCC, Presentation to the FC Tech Team, Sept, 2008
- "Mass Production Cost Estimation for Direct H2 PEM Fuel Cell Systems for Automotive Applications," Directed Technologies Inc, Presentation to the FC Tech Team, Sept 2008
- Proceedings of the Annual Merit Review and Peer Evaluation Meeting, 2009 DOE Hydrogen Program and Vehicle Technologies Program, May 2009.

Secondary Sources:

- "Hydrogen Fuel Cell Vehicle and Station Deployment Plan: A Strategy for Meeting the Challenge Ahead – Action Plan," California Fuel Cell Partnership, 2009
- "The State of Hydrogen and Fuel Cell Commercialization and Technical Development," Hydrogen and Fuel Cell Technical Advisory Committee, 2008
- "The Impact of Increased use of Hydrogen on Petroleum Consumption and CO2," Energy Information Agency, 2008
- "HyWays: The European Hydrogen Roadmap," European Commission Project Report, 2008
- "Hydrogen Fueling Infrastructure Assessment," General Motors & Shell Hydrogen, 2007
- "Why Hydrogen and Fuel Cells are Needed to Support California Climate Policy," ITS-Davis, 2008

PHEV, BEV, Batteries
Primary Sources:

- "Potential Impacts of PHEVs on Regional Power Generation," US DOE Oak Ridge National Laboratory, 2008
- "Batteries for PHEVs: Goals and the State of Technology," ITS-Davis, UC Davis, 2008 (Burke, Kurani, Axsen)

- "Lifecycle Assessment of GHG Emissions from PHEVs: Implications for Policy," Environmental Science and Technology, 2007 (Carnegie Mellon University)
- "Plug-in and Regular Hybrids: A National and Regional Comparison of Costs and CO2 Emissions," Climate Change Policy Partnership, Duke University, 2008
- "Impact of battery weight and charging patterns on the economic and environmental benefits of PHEVs," Carnegie Mellon University, 2009
- Proceedings of the Ninth International Advanced Automotive Battery & EC Capacitor Conference (AABC), June 10-12, 2009, Long Beach, California.
- "DOE Annual Progress Report: Energy Storage Research and Development," US DOE, January 2009
- "Well to wheels energy use and GHG emissions analysis of PHEVs," Argonne National Lab, February 2009
- "Plug-in Hybrid Electric Vehicle Charging Infrastructure Review," Idaho National Laboratory, US Department of Energy, 2008
- "Current status of DOE funded R&D on energy storage for automotive applications," US DOE, EVS-24, May 2009
- "Factors determining the manufacturing costs of lithium ion batteries for PHEVs," Argonne National Lab, EVS-24, May 2009

Secondary Sources:
- "Environmental Assessment of PHEVs: Volume 1, Nationwide GHG Emissions," EPRI – NRDC, 2007
- "PHEVs: An Environmental and Economic Performance Outlook," American Council for an Energy Efficient Economy (ACEEE), 2006
- "The Comeback of the Electric Car: How Real, How Soon, and What Must Happen Next," The Boston Consulting Group, 2009
- "Impacts of Electric Drive Vehicles on California's Energy System," ITS-Davis, 2008
- "Impacts Assessment of PHEVs on Electric Utilities and Regional US Power Grids, Part I Technical Analysis," Pacific Northwest National Laboratory, 2007
- "Electric Cars: Plugged In, Batteries Must Be Included," Global Markets Research Company, Deutsche Bank, 2008
- "Lithium Ion for hybrid vehicles and electric vehicles: ready for mass market introduction?" MAGNA STEYR, EVS-24, May 2009
- "Economic Assessment of All Electric Vehicles," Energy and Resources Group, UC Berkeley, 2009 (Kammen)
- "Strategies for Transportation Electric Fuel Implementation in CA: Lowering Bettery First-Cost Hurdles". White Paper prepared for CEC PIER Program. B. Williams and T. Lipman. Transportation Sustainability Research Center, UC Berkeley 2009
- "Recommendations for the Future of Next Generation Vehicle Batteries," Ministry of Economy, Trade and Industry (Japan), Presentation at EVS-22, 2006

- "Light-Duty Vehicle Electrification in California: Potential Barriers and Opportunities," Staff White Paper, CA Public Utilities Commission (CPUC), May 22, 2009

Power Generation
Carbon intensity of the fuel supply, primarily relevant for battery charging & hydrogen production

- "The Future of Coal: Options for a Carbon Constrained World," An Interdisciplinary MIT Study, 2007
- "Future of Nuclear Power (Update of the 2003 MIT report)," An Interdisciplinary MIT Study, 2009
- *Renewable electricity growth potential and challenges* – Refer to "Environmental Assessment of PHEVs: Volume 1" listed above (EPRI-NRDC)
- "Carbon capture and storage: assessing the economics," McKinsey and Company, 2008
- "PIER Renewable energy technologies program: research development and demonstration roadmap," California Energy Commission, August 2007
- "The green grid: energy savings and carbon emissions reductions enabled by a smart grid," EPRI, June 2008
- "The power to reduce CO2 emissions: The full portfolio," EPRI, 2007

Biofuels
Secondary Sources (primarily relevant regarding WTW emissions of PHEVs with biofuels):

- "Increasing Feedstock Production for Biofuels: Economic Drivers, Environmental Implications, and the Role of Research," US Biomass Research and Development Board, 2008
- "Strategic Assessment of Bioenergy Development in the West: Spatial Analysis and Supply Curve Development," Final Report to the Western Governors Association, 2008 (UC Davis)
- "National Biofuels Action Plan," US Biomass Research and Development Board, 2008
- "Use of US Croplands for Biofuels Increases GHGs Through Emissions from Land Use Change," Science Express, 2008 (Searchinger, Princeton)
- "Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply," US DOE & US DA, 2005
- "Biofuels for Transport: An International Perspective," International Energy Agency, 2005
- "Biofuels, Land Use Change, and GHG Emissions: Some Unexplored Variables," Environmental Science and Technology, 2009 (Michigan State University)
- "Sustainable Biofuels: Prospects and Challenges," The Royal Society, 2008
- "An assessment of biomass resources in California, 2007," CA Biomass Collaborative, CEC PIER Collaborative, March 2008
- "A Roadmap for the development of biomass in California," CA Biomass Collaborative, CEC PIER Collaborative, Nov 2006

- "Liquid Transportation Fuels from coal and biomass technology status, costs, and environmental impacts," National Academy of Sciences, 2009
- "Greater transportation energy and GHG offsets from bioelectricity than ethanol," Science, May 2009
- "Proposed regulation to implement the Low Carbon Fuel Standard: Initial Statement of Reasons," California Air Resources Board, March 5, 2009

Survey Addendum

CONFIDENTIAL ZERO EMISSION VEHICLE TECHNOLOGY STATUS SURVEY

Addendum Release Date: July 29, 2009
Survey Release Date: June 25, 2009

Survey Clarifications

P. 5 - Definitions

The following definitions have been modified: (italics indicate additions)

- Global fleet size means the number of zero emission vehicles placed *by a single manufacturer in a single model year* worldwide
- Global demonstration means 100's of vehicles placed *by a single manufacturer in a single model year* worldwide
- Global pre-commercialization means 1000's of vehicles placed *by a single manufacturer in a single model year* worldwide
- Global early commercialization means 10,000's of vehicles placed *by a single manufacturer in a single model year* worldwide
- Global full commercialization means 100,000's of vehicles placed *by a single manufacturer in a single model year* worldwide

P. 7 – Automotive Manufacturer Questionnaire

The following are clarifications regarding questions 1a., 1b., and 1c.:

1a. What is your organization's vision for the types of vehicles such as zero emission vehicles and plug-in hybrid electric vehicles that would be commercialized in response to this goals?

This question is meant to be manufacturer specific, i.e. which type of vehicles each manufacturer plans to produce in order to meet California's long term greenhouse gas reduction goals.

1b. When do you envision advanced technology vehicle markets needing to evolve in order to achieve these 2050 goals?

This is an industry trend question, asking what the market sales & fleet penetration trends are for various advanced technology vehicles. Specifically, ARB Staff are looking for the following trends in the California market (global trends are also valuable if CA specifics can't be provided):

- *Market launch dates.*
- *Speed of technology introduction*

- *Ultimate market limits once fully commercialized for many years (i.e. are certain technologies limited by resource supply or customer expectations?)*

1c. More specifically, what are your organization's advanced vehicle technology portfolio plan through 2020 (the next 10 years) as related to GHG emissions?

This question is asking for each specific manufacturer's advanced vehicle technology portfolio, meaning conventional hybrids, plug-in hybrids, and zero emission vehicles.

P. 8,9 – Automotive Manufacturer Questionnaire

The following are definitions for questions asked in the tables regarding fuel cell vehicles, battery electric vehicles, and plug-in hybrid vehicles:

- *Vehicle cost means the manufacturing cost of the vehicle. Please supply research and development costs separately, if applicable.*
- ~~*Operating cost*~~ *(does not need to be answered)*
- *100's of vehicles per manufacturer, per model year, globally*
- *1,000's of vehicles per manufacturer, per model year, globally*
- *10,000's of vehicles per manufacturer, per model year, globally*
- *100,000's of vehicles per manufacturer, per model year, globally*

P. 12 – Battery Manufacturer Questionnaire

The following are clarifications regarding questions 1 and 6:

1. What kind of battery chemistry is your organization developing? Please provide details of each battery chemistry.

   Please be as specific as possible. Staff intends to use the answers provided to show general trends in battery chemistry for specific applications, i.e. "it appears that manufacturers will continue to use NiMH battery technology for conventional hybrids" or some similar conclusion that will be able to be drawn from the answers to this questions. It is not staff's intent to have a discussion about which specific lithium battery material combination is best suited for battery electric vehicles.

6. What is the cost of your organization's battery technology for BEV applications: (cell size 30-100 Ah, capacity 20-40kWh) and PHEV applications: (cell size 15-50 Ah, capacity 5-20 kWh)?

Cost in this question refers to the cost to the vehicle manufacturer of the battery system, as apposed to the cell cost.

APPENDIX B

U.S. Department of Energy Automotive Fuel Cell Targets

Technical targets for automotive applications: 80 kWe (net) integrated transportation fuel cell power systems operating on direct hydrogen.

Characteristic	Units	2010	2015
Energy efficiency [b] @ 25% rated power	%	60	60
Energy efficiency @ rated power	%	50	50
Power density	W / L	650	650
Specific power	W / kg	650	650
Cost [c]	$ / kWe	45	30
Transient response (10-90% of rated power)	Seconds	1	1
Cold start-up time to 50% of rated power @ - 20C ambient temp @ + 20C ambient temp	seconds seconds	30 5	30 5
Start-up and shut down energy [d] from - 20C ambient temp from + 20C ambient temp	MJ MJ	5 1	5 1
Durability with cycling	Hours	5,000 [e]	5,000 [e]
Unassisted start from low temperatures [i]	C	- 40	- 40

Source: USDOE Fuel Cell Technical Plan, 2007

Notes

a. Targets exclude hydrogen storage, power electronics and electric drive
b. Ratio of DC output energy to the lower heating value of the input fuel (hydrogen).
c. Based on 2002 dollars and cost projected to high-volume production (500,000 systems per year)
d. Includes electrical energy and the hydrogen used during the start-up and shut-down procedures
e. Based on test protocol to be issued by USDOE in 2007
f. 8-hour soak at stated temperature most not impact subsequent achievement targets

APPENDIX C

US Advanced Battery Consortium Technical Targets

Technical targets for PHEVs

Characteristics at EOL (End of Life)		High Power/Energy Ratio Battery	High Energy/Power Ratio Battery
Reference Equivalent Electric Range	miles	10	40
Peak Pulse Discharge Power (10 sec)	kW	45	38
Peak Regen Pulse Power (10 sec)	kW	30	25
Available Energy for CD (Charge Depleting) Mode, 10 kW Rate	kWh	3.4	11.6
Available Energy for CS (Charge Sustaining) Mode	kWh	0.5	0.3
Minimum Round-trip Energy Efficiency (USABC HEV Cycle)	%	90	90
Cold cranking power at -30°C, 2 sec - 3 Pulses	kW	7	7
CD Life / Discharge Throughput	Cycles/MWh	5,000 / 17	5,000 / 58
CS HEV Cycle Life, 50 Wh Profile	Cycles	300,000	300,000
Calendar Life, 40°C	year	15	15
Maximum System Weight	kg	60	120
Maximum System Volume	Liter	40	80
Maximum Operating Voltage	Vdc	400	400
Minimum Operating Voltage	Vdc	>0.55 x Vmax	>0.55 x Vmax
Maximum Self-discharge	Wh/day	50	50
System Recharge Rate at 30°C	kW	1.4 (120V/15A)	1.4 (120V/15A)
Unassisted Operating & Charging Temperature Range	°C	-30 to +52	-30 to +52
Survival Temperature Range	°C	-46 to +66	-46 to +66
Max. Current (10 sec pulse)	Amps	300	300
Maximum System Production Price @ 100k units/yr	$	$1,700	$3,400

Source: US Advanced Battery Consortium (USABC)

Technical targets for BEVs

Parameter of fully burdened system	Units	Min goals, long-term commercialization	Long term goal
Power density	W / L	460	600
Specific power – discharge, 80% DOD/30 sec	W / kg	300	400
Specific power – regen, 20% DOD/10 sec	W / kg	150	200
Energy density – C/3 discharge rate	Wh / L	230	300
Specific energy – C/3 discharge rate	Wh / kg	150	200
Specific power / specific energy ratio		2 : 1	2: 1
Total pack size	kWh	40	40
Life	Years	10	10
Cycle life – 80% DOD	Cycles	1,000	1,000
Power & capacity degradation	% of rated spec	20	20
Selling price – 25,000 units @ 40 kWh	$ / kWh	<150	100
Operating environment	C	-40 to +50 [a]	-40 to +85
Normal recharge time	Hours	6 [b]	3 to 6
High rate charge		20 – 70% SOC in <30 min @ 150 W/kg [c]	40 – 80% SOC in 15 min
Continuous discharge in 1 hour – no failure	% of rated energy capacity	75	75

Notes

a. 20% performance loss (10% desired)   c. <20 min @ 270 W/kg desired

b. 4 hours desired

Source: US Advanced Battery Consortium (USABC)

ATTACHMENT B

2050 Greenhouse Gas Emissions Analysis:
Staff Modeling in Support of the Zero Emission Vehicle Regulation

Disclaimer:
This modeling exercise was conducted to support the development of the Zero Emission Vehicle Regulation and does not represent ARB positions or assumptions in other greenhouse gas regulations or policies.

Table of Contents

1. Introduction & Results Summary

In recognizing the potential for large, damaging impacts from climate change, California Governor Arnold Schwarzenegger enacted Executive Order S-03-05, requiring a reduction in statewide greenhouse gas (GHG) emissions to 80-percent below 1990 levels by 2050.[1] In addition to the Governor's Executive Order, the State Legislature and the California Air Resources Board (ARB or the Board) have adopted a number of policies that address GHG emissions in the transportation sector.[2]

In developing the policy for Assembly Bill (AB) 32, ARB and other State agencies carefully studied the specific impacts of climate change on the State of California.[3] The AB 32 goal of reducing emissions to 1990 GHG levels by 2020 is the first step towards longer-term, deeper, reductions needed to stabilize the climate. The 2020 requirement is critical for two reasons. First, achieving deep GHG reductions in 2050 requires multiple decades of concerted effort. Secondly, climate change is a function of cumulative emissions in the atmosphere. Early reductions (2020) are therefore essential.

Given that the transportation passenger vehicle sub-sector accounts for 28% of the state's GHG emissions today, it will be difficult to meet the 2050 goal unless a portfolio of near-zero carbon transportation solutions is pursued in the very near future.[4] Because it takes decades for a new propulsion system to capture a large fraction of the passenger vehicle market due to vehicle fleet turn-over rates, it is important to accelerate[5] the introduction of low-carbon vehicle alternatives to ensure markets enter into pre-commercial volumes (10,000s) between 2015 and 2020.

In March 2008, the Board directed staff in Resolution 08-24 to enhance the focus on GHG emissions within the Zero Emission Vehicle (ZEV) Regulation, in addition to its historical criteria pollutant focus, in order to meet California's long term climate change reduction goals.[6] This report summarizes the results and conclusions of a modeling exercise that simulated GHG emissions from the passenger vehicle sector to 2050.

The goal of this analysis was to identify how large of a role ZEVs[7] have in meeting California's 2050 GHG goals. Specifically, the analysis addresses two policy questions: (1) what are the cumulative ZEVs necessary by 2050 to help the passenger vehicle sector achieve an 80% GHG reduction, and (2) what annual ZEV

---

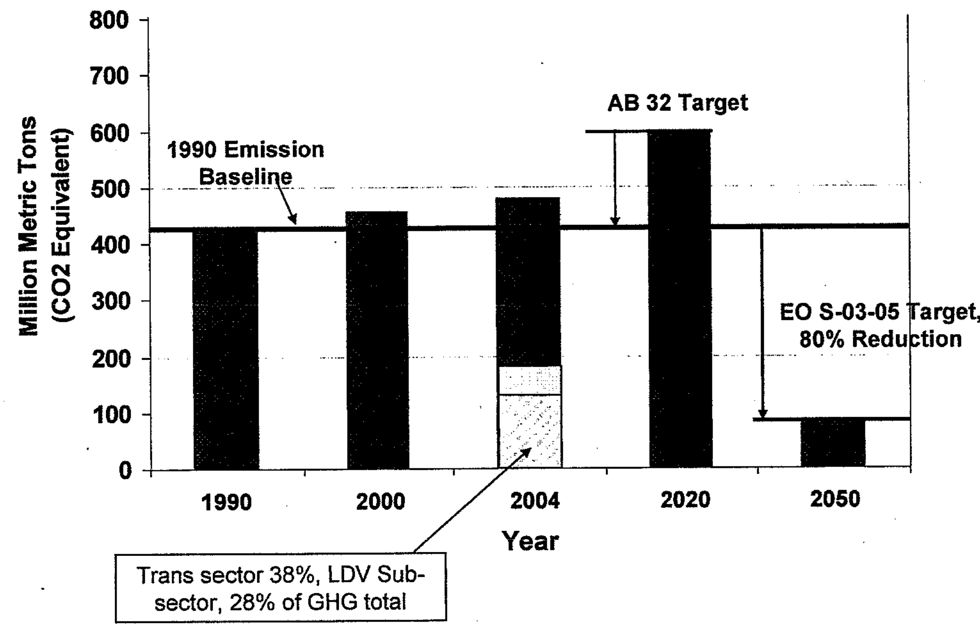
[1] California's 2020 and 2050 GHG emission reduction goals are consistent with where the international scientific community believes developed nations need to be in order for world-wide GHG concentrations to peak at 450 parts per million (ppm) by mid-century, a level thought necessary to avoid catastrophic climate impacts [UN]
[2] These include the vehicle GHG regulation (Assembly Bill 1493, 2004), the Low Carbon Fuel Standard (ARB, 2008), and the regional GHG targets (Senate Bill 375, 2008). Most importantly, the state adopted Assembly Bill 32, the California Global Warming Solutions Act of 2006, which caps GHG emissions at 1990 levels by 2020.
[3] This work is summarized in the Scoping Plan [http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm]
[4] A number of studies have shown that multiple solutions will be required to achieve the GHG reductions [UC Davis 2009, U.S. EPA, IEA 2008a, MIT 2007b, MIT 2008, McKinsey, Pew, Princeton, NRC 2008c]
[5] Accelerate advanced technology relative to how the automotive industry would introduce it if only complying with the vehicle GHG regulation (AB 1493).
[6] ARB Resolution 08-24
[7] In this analysis, ZEVs include fuel cell vehicles (FCVs) and battery electric vehicles (BEVs), not plug-in hybrids.

sales are necessary between 2015 and 2025 to initiate these fleet volumes? The modeling exercise was conducted to support the development of the ZEV Regulation and does not represent ARB positions or assumptions in other GHG policies, such as LCFS, Pavley, SB 375, AB 32, etc.

This analysis assumed a 2050 target of 80% below the passenger vehicle portion of 1990's GHG inventory, or 20% of 108.5 million metric tons (MMT) of carbon dioxide equivalent (CO2e) emissions. This represents a "fair share" for the passenger vehicle sector. In reality, each sector will carry varying reduction levels to meet the statewide average of 80%. However, it is not likely that the target can be met unless passenger vehicles achieve large reductions in GHG emissions, given its 28% contribution to overall emissions.

Figure 1 below shows California's actual GHG emissions through 2004 and projected emissions in 2020, along with the emissions reduction goals for all sectors. Meeting the 2020 goals will require over 170 MMT reductions of CO2e emissions from projected 2020 levels (30%). For 2050, an additional reduction of 341 MMT is required to meet the 80% reduction goal.

Figure 1: California GHG Projections and Policy Goals



According to the California Department of Finance (DOF), the State's population is projected to reach 60 million people by 2050[8], double what it was in 1990, increasing pressure on limited resources. Energy demand will increase substantially, though not at the rate of population growth given the need for dramatic efficiency and conservation efforts. None the less, new biorefineries, electricity production, and hydrogen facilities will be needed along with distribution infrastructure to meet increasing fuel demand, adding to local and regional development requirements. Traffic congestion will increase and public infrastructure in urban areas will be stressed. Potentially the most dramatic change will be the integration of technology

[8] California Department of Finance (DOF), http://www.dof.ca.gov/research/demographic/reports/projections/p-1/

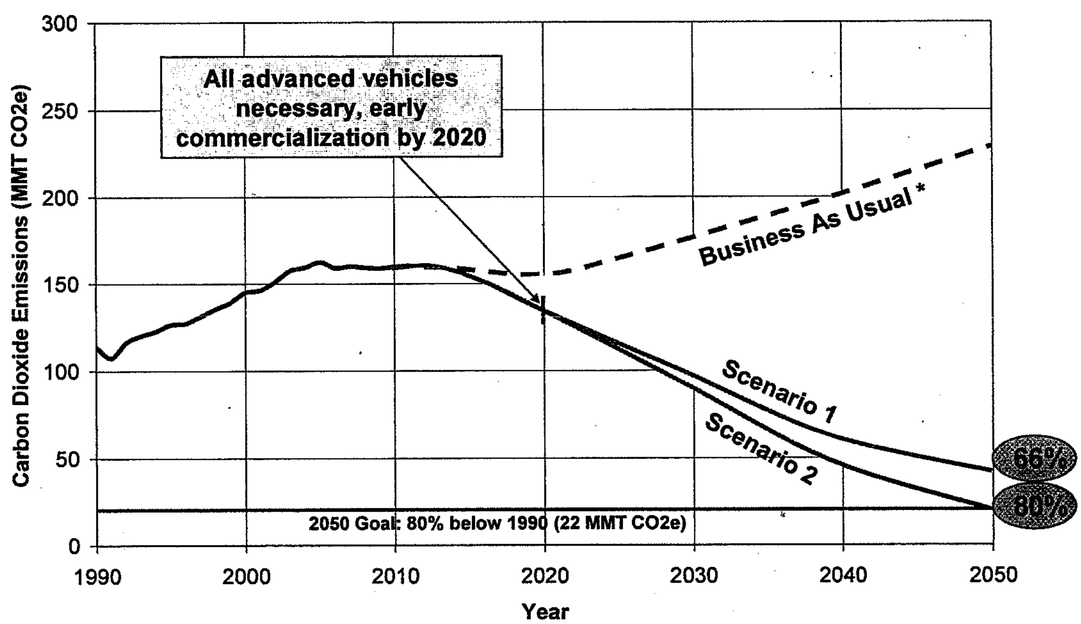
in personal transportation and residential buildings through home charging/fueling and smart communications.

Summary of Results

Figure 2 shows the GHG emissions between 1990 and 2050 for a "business as usual" (BAU) projection[9] and two scenarios, both assuming all advanced vehicle technologies are fully commercialized. Scenario 1 in this analysis achieves a 66% reduction in GHG emissions by 2050 using aggressive but plausible assumptions. This scenario assumes ZEV sales reach a quarter of a million units annually by 2025 and become 100% of new vehicle sales by 2050. Scenario 2 was developed to show what would be required to achieve the full 80% GHG goal. To achieve this, two key parameters were modified with more aggressive and uncertain assumptions. A steeper ZEV sales projection was simulated where ZEV sales reach half a million units by 2025 and are 100% of new vehicle sales by 2040. Additionally, the availability of biofuels was increased to 1.7 billion gallons gasoline equivalent (BGGE), where it was limited to 1 BGGE in Scenario 1.[10]

The BAU projection assumes the Pavley 1 Regulation and LCFS are both fully implemented, followed by a straight-line projection that assumes the vehicle fuel economy and fuel carbon intensity values from 2020 are fixed to 2050 as vehicle population grows.[11] It is important to note that the exact business as usual projection does not affect the scenario results given the 80% GHG goal is referenced to the 1990 emission level, they are shown purely for context.

Figure 2: Passenger Vehicle GHG Emissions – Historical and BAU



[9] The BAU projection does not reflect official ARB GHG inventory projections; it was developed solely for this modeling exercise and is purely hypothetical. Population data from CA Dept of Finance (34 million people in 2000, 59 million in 2050). Total vehicle population grows from 20 million (2000) to 40 million vehicles (2050).
[10] Both cases have reductions in VMT per vehicle (20% below the VMT/veh projections for 2050)
[11] It is important to note that the exact BAU projection does not affect the scenario results given the 80% GHG goal is referenced to the 1990 emission level; they are shown purely for context.

The following are the key conclusions from this GHG analysis.

- Market growth by 2020. Commercial markets for the advanced vehicles need to be established by 2020 to ensure sufficient time for vehicle fleet growth and turn-over. This includes fuel cell vehicles (FCVs), battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Specifically, ZEV sales need to move from pre-commercial scale (10,000s) by 2020 to full commercial scale (100,000s) by 2025. This is evident in Graph 3 of the White Paper and Figure 9 below. In specifically addressing the policy questions above, the scenarios in this analysis show:
    - **Cumulative on-road**:
      Scenario 1: 100,000 ZEVs (FCVs + BEVs) in CA by 2020, accelerating to 900,000 ZEVs by 2025.[12]
      Scenario 2: 120,000 ZEVs by 2020, 1.4 million ZEVs by 2025
    - **Annual ZEV sales**:
      Scenario 1: 25,000 in 2020, and 230,000 in 2025
      Scenario 2: 25,000 in 2020, and 425,000 in 2025
- ZEV sales projections. If the ZEV sales curve[13] to 2050 shown in Figure 9 is shifted 5 years earlier, a 73% GHG reduction results. This shows that increasing early ZEV sales can make a difference, though ZEV technological readiness may prevent this. If, instead, the slope were increased so that ZEV sales reach the 100% level in 2040 instead of 2050, a 75% GHG reduction is achieved. These concepts are shown in Figures 13 and 17.
- PHEVs & Biofuels. In addition to the ZEV volumes, Scenario 2 includes over 1 million PHEVs cumulative by 2025, showing that PHEVs will also have an important role in reducing transportation GHG.[14] Additionally, an increasing amount of low-carbon biofuel is blended into gasoline and diesel.
- Fuel carbon intensity. To achieve the large GHG reductions with plug-in vehicles and FCVs, the carbon intensity of hydrogen, electricity, and biofuels is largely reduced by 2050, relying on sustainable feedstocks and carbon capture solutions. Refer to Figures 5, 6, and 7 in Section II. The carbon intensity of electricity, hydrogen, and biofuels is reduced by 80%, 65%, and 90% respectively, from today's levels.
- VMT & Efficiency. Large vehicle efficiency improvements (via powertrain efficiency, vehicle weight reduction, vehicle downsizing) and reductions in vehicle miles traveled (VMT) per vehicle were assumed. Efficiency and VMT reduction solutions are especially important as they reduce energy usage. Refer to Figure 4 in Section II.

[12] The analysis assumes aggressive sales trajectories between 2010 and 2050. This analysis relied on external studies of how rapid advanced vehicle sales rates could become.
[13] The slope of the ZEV sales over multiple decades is highly uncertain. This analysis assumes an aggressive growth that is similar to assumptions in NRC 2008c
[14] An increasing amount of PHEV all-electric range (AER) over time was assumed as batteries improve: 10 miles in 2020; 50 miles in 2050

Literature Review

A large number of references were identified with direct relevance to this analysis.[15] Although many of the references provided isolated information for specific assumptions, a few of the references listed were studied critically as they relate to broad 2050 GHG projections.[16]

Each of these studies had varying contexts and assumptions, but they all arrived at a few common conclusions. First, achieving large GHG reductions by 2050 will require dramatic changes in the way we use and produce energy. This includes the need for the majority of the on-road vehicle fleet to be near zero emission alternatives, along with an electricity and fuel supply that is largely de-carbonized. This will require aggressive policies to ensure GHG reductions occur in a timely and coordinated way. A combination of regulation and market incentive policies will be needed.
A second common conclusion is the need to act soon to ensure the passenger vehicle fleet changes over multiple decades for robust, widespread GHG reductions.[17] Specifically, the next 10 years are important to experiment with low-volume, early commercialization before aggressive sales need to begin.

A few excerpted quotes from key references follow to emphasize these conclusions:

> *A global revolution is needed in ways that energy is supplied and used. Far greater energy efficiency is a core requirement. Renewables, nuclear power, and CO2 capture and storage (CCS) must be deployed on a massive scale, and carbon-free transport developed. A dramatic shift is needed in government policies, notably creating a higher level of long-term policy certainty over future demand for low carbon technologies, upon which industry's decision makers can rely. Unprecedented levels of co-operation among all major economies will also be crucial, bearing in mind that less than one-third of "business-as-usual" global emissions in 2050 are expected to stem from OECD countries.*
>
> - International Energy Agency "Energy Technology Perspectives: Scenarios & Strategies to 2050", pg 38.
>
> *A portfolio of technologies including hydrogen fuel cell vehicles, improved efficiency of conventional vehicles, hybrids, and use of biofuels—in conjunction with required new policy drivers—has the potential to nearly eliminate gasoline use in light-duty vehicles by the middle of this century, while reducing fleet greenhouse gas emissions to less than 20 percent of current levels. This portfolio approach provides a hedge against potential shortfalls in any one technological approach and improves the probability that the United States can meet its energy and environmental goals. Other technologies also may hold promise as part of a portfolio, but further study is required to assess their potential impacts.*

---

[15] The appendix includes a full list of the references reviewed for the analysis
[16] These included the California Energy Commission's AB 118 investment report [CEC 2009], MIT 2008, McKinsey, IEA 2008a, UC Davis 2009, and NRC 2008c.
[17] Passenger vehicle fleet turn-over rates are roughly 15 years.

Sustained, substantial, and aggressive energy security and environmental policy interventions will be needed to ensure marketplace success for oil-saving and greenhouse-gas-reducing technologies, including hydrogen fuel cell vehicles.

- National Research Council, "Transitions to Alternative Transportation Technologies: A Focus on Hydrogen," pg 6.

While no individual "Silver Bullet" strategy exists that can achieve the goals, a portfolio approach that combines strategies could yield success.

- University of California, Davis, "Meeting an 80% reduction in GHG emissions from transportation by 2050: A case study in California," pg 1.

This report and modeling exercise

The content of the report is organized to provide a relatively high-level perspective on the analysis and the conclusions. The following sections will provide additional details on how major assumptions were developed, why scenario concepts where chosen as they were, and expanded results of the analysis. The final section revisits the key conclusions and highlights which assumptions carry the most risk, due to either technical, market, or stakeholder coordination challenges. An appendix is included that provides a list of references used for the analysis.

This analysis is the first phase of the scenario modeling for the ZEV Regulation.[18] A second phase of modeling will continue through the spring of 2010 taking into account stakeholder input and refined modeling techniques and assumptions. This will support the ZEV Regulation proposal in a staff report in late 2010.

[18] By conducting this analysis within ARB, a better understanding was gained of the tradeoffs and limitations of specific assumptions. Collaboration and/or detailed discussions have been established with other organizations conducting similar analysis, including the CEC, the U.S. DOE, U.S. EPA and UC Davis.

2. Scenario Development

To develop an analysis of California's transportation sector GHG emissions over the next several decades, an energy and vehicle stock turn-over model was employed to simulate the vehicle fleet and its changing emission profile. The tool used was the United States Department of Energy's (U.S. DOE) Vision model, developed by the Argonne National Laboratory.[19] Staff made changes to the model to simulate a California passenger vehicle fleet and energy system. This section outlines the primary input assumptions for the model along with how the varying advanced vehicle scenarios were chosen.

Scenarios represent a projection of what could be possible – a "what if" story that can help provide context for decision makers. In the case of GHG policy development, scenarios help illuminate the bounds of how large emissions could grow, and what kinds of solutions could be employed to reduce them. Scenarios can reveal how large specific solutions would have to be, and over what timescales they need to be implemented. Scenarios are not, however, predictions of what the future will be, nor are they roadmaps for specific policies to 2050.

In developing the scenarios for this analysis, assumptions were identified based on extensive review of the literature and stakeholder discussion. The majority of assumptions in this analysis are fixed for all the scenarios for consistency. The factors that vary between scenarios are vehicle sales projections, the vehicle technology mix in the market, biofuel supply levels, and VMT per vehicle reductions.

Achieving an 80% reduction in the transportation sector will require a broad mix of solutions. This includes reduced vehicle miles traveled (VMT) per capita, increased use of transit, increased vehicle fuel efficiency, reduced fuel carbon content, and implementation of advanced vehicle technologies. This analysis includes all of these solutions, but most carefully studies the vehicle technologies. Hydrogen fuel cell vehicles (FCV), battery-electric vehicles (BEV), and plug-in hybrid-electric vehicles (PHEV) with low carbon biofuels are the three most viable candidates for near-zero carbon transportation. This analysis shows all three vehicle technologies will be necessary in order to achieve an 80% reduction target, and to lessen the risk of technology or market failures.

Vehicle sales and fleet turn-over

California vehicle annual sales projections are based on ARB's EMission FACtors 2007 (EMFAC 2007) dataset, which includes historical data through 2008 and projections to 2040.[20] Trends were extrapolated to 2050 to complete the dataset for this model. The fleet turnover rates are based on the national trends in the U.S. DOE's Vision model, the tool used for this analysis.[19] Fleet turn-over rates determine how many vehicles remain on the road in any given year, and account for vehicle

[19] U.S. DOE Vision Model 2008, http://www.transportation.anl.gov/modeling_simulation/VISION/. Refer to Appendix A for background information.
[20] ARB EMFAC 2007, http://www.arb.ca.gov/msei/onroad/latest_version.htm

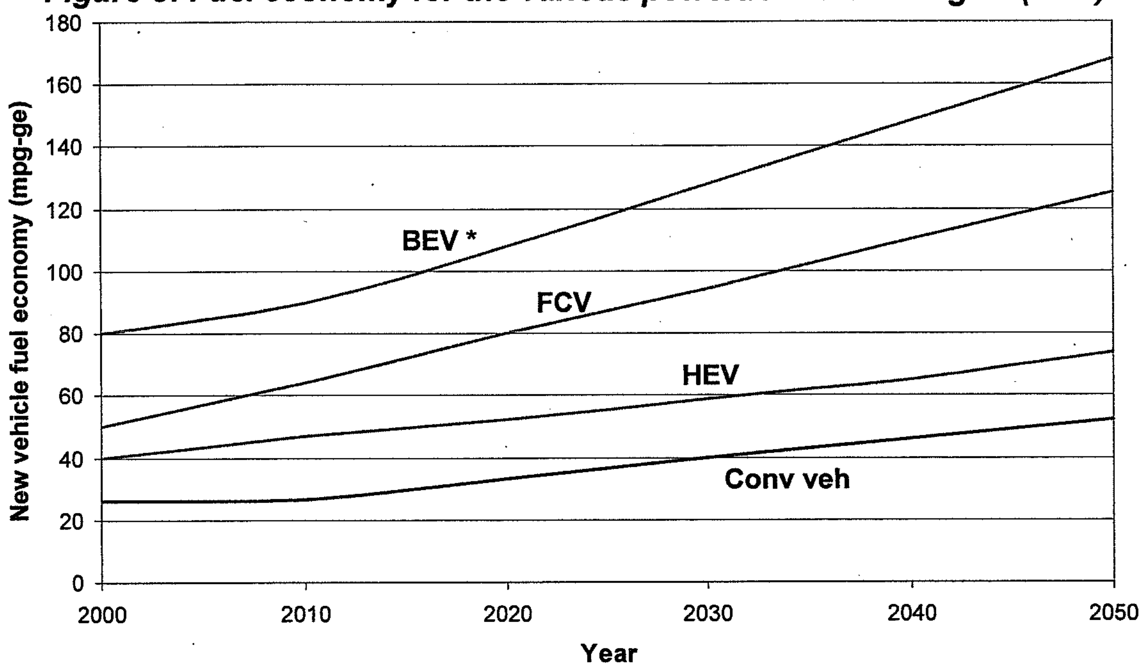
age, scrapage rates, declining VMT per vehicle based on age, etc. The dataset assumes roughly 22 million vehicles are on the road in 2000, increasing to 40 million vehicles in 2050.[21] Annual sales rates start from roughly 1.5 million vehicles sold per year in 2000 and grow to 2.7 million in 2050. Additionally, the analysis assumed a sales mix of cars and trucks shifted to a 70%/30% respectively by 2050.

These assumptions will be carefully reviewed in the next phase of the modeling analysis, including a review of whether California's fleet turnover rates are different than the national average. The average lifetime of a passenger vehicle in the United States is roughly 15 years. Generally, the market diffusion is slow, resulting in several decades for a new technology to substantially replace older vehicles[22].

Efficiency and VMT reductions

Fuel economy improvements are assumed and result from a number of factors, including vehicle down-sizing and vehicle weight reduction, in addition to powertrain efficiency improvements. Specifically, the analysis in MIT 2008 was heavily leveraged for conventional vehicle fuel economy and the ratio of fuel economy between technology alternatives (although the exact projection of fuel consumption for each technology may vary from the MIT study). The MIT analysis was based on a mid-sized vehicle platform. This analysis assumes that by 2050, the average vehicle size has been reduced to a compact vehicle platform. This is represented as a steeper increase in fuel economy than would be expected if the platform size remained constant.

Figure 3: Fuel economy for the various powertrain technologies (cars)



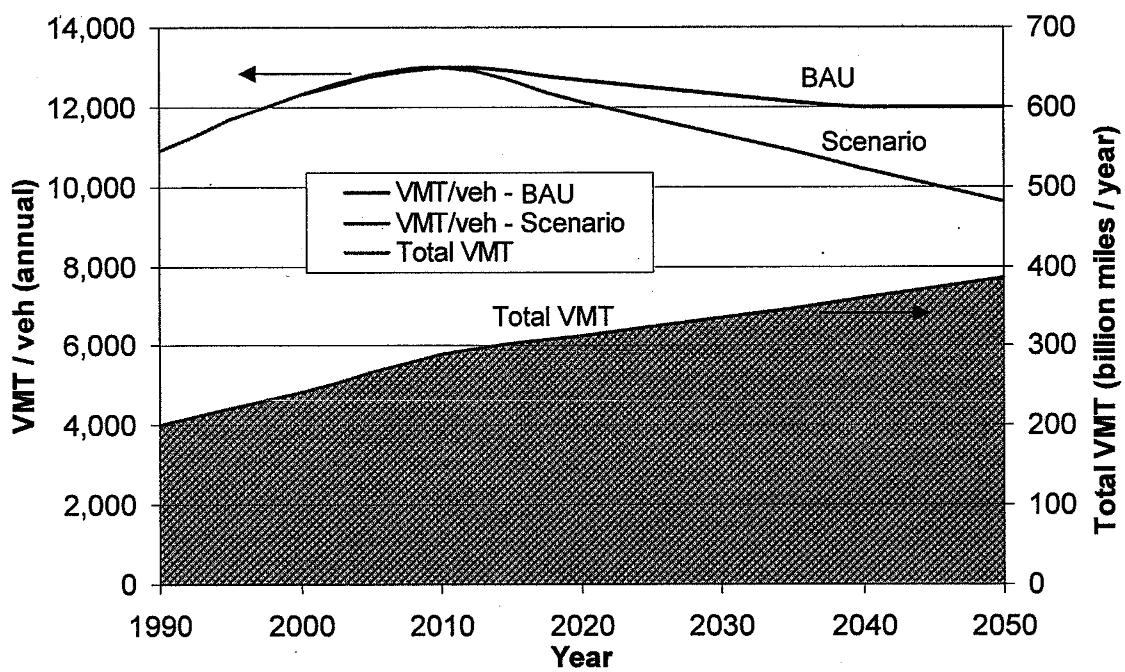
** Includes AC to DC energy loss from grid battery charging*

[21] The vehicle population numbers are derived using both the vehicle sales projections from ARB's EMFAC model, and the national fleet turn-over rates used in the Vision model.
[22] IEA 2008a, MIT 2008, Pew, NRC 2008c.

Figure 3 above shows the assumed fuel economy values in the analysis for autos, separate fuel economy assumptions were developed for light trucks. All technology alternatives are based on vehicle platforms with the same improvements relative to today's vehicle (weight reduction, down-sizing, aerodynamics, etc). Note that the BEV fuel economy assumes an energy loss associated with the AC-DC battery charging. Also note that the PHEV fuel economy is not shown. The model accounts for the fuel economy of PHEVs on both grid-electricity and liquid fuels separately. For simplicity, this analysis assumes that when a PHEV is operating on grid supplied electricity, the fuel economy is the same as a BEV; when the PHEV is operating on liquid fuels, the fuel economy is the same as an HEV.[23] In reality, this will depend on the specific vehicle design, weight, and control algorithms.

VMT reduction goals will target regional development and transportation planning, and will include solutions such as mass transit, compact urban design, carsharing, and more. The VMT per vehicle reductions in the scenarios were assumed to be 20% below the projected "business as usual" (BAU) per vehicle VMT in 2050. These projections for the BAU assume VMT per vehicle will stagnate at approximately 12,000 miles/yr, therefore the VMT in the scenarios are 9,600 miles per year per vehicle (20% reduction). Figure 4 shows the scenario trends for VMT. Total VMT increases as State population grows. [24]

Figure 4: VMT Trends in Scenarios 1 & 2



[23] The scenarios all assume an increasing amount of all electric range for PHEVs over time.
[24] As noted above, DOF estimates California's population will grow to nearly 60 million people by 2050.

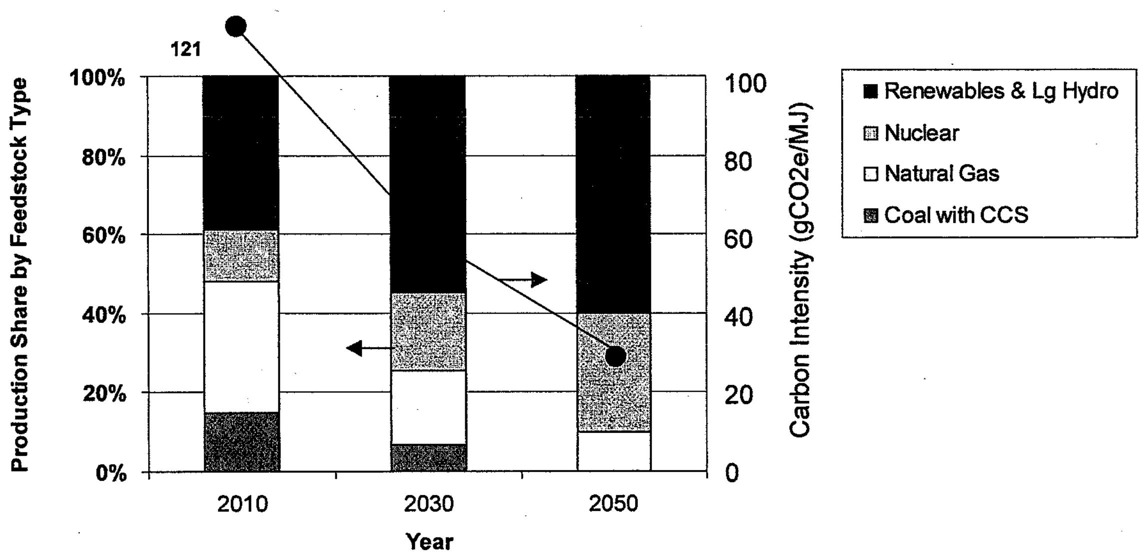
Electricity and fuels carbon intensity

Electricity, hydrogen, and bio-hydrocarbon fuel carbon intensities were modeled with large reductions through 2050. The carbon intensity values from the LCFS were used in this model for each type of fuel production and feedstock, and were assumed to be relevant out to 2050.[25] This is a change from the Vision model where the carbon intensity numbers were from Argonne National Laboratory's Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) model. All of the fuels assume an extremely aggressive change over time that results in significant reductions in average fuel carbon intensity. These changes will be challenging to achieve, and will require expanded transmission lines, fuel distribution and large investments in sustainable power production facilities, along with technology innovation. Note that the scenarios ensured the 2020 policy goal was achieved for the LCFS, a 10% reduction in average carbon intensity by 2020.

In deriving the carbon intensity, the fuel production assumptions, which included changing feedstock mix over time, were developed by reviewing external sources and engaging stakeholders. However, the choice of fuel feedstocks was limited to the existing set of options in U.S. DOE's Vision model. This is an area of improvement in a later modeling effort, and will more fully incorporate California specific feedstocks expected from the energy industry.

The following three figures (Figures 5, 6, and 7) show two trends for each vehicle fuel. The bar chart for each figure (left hand Y-axis) shows the fraction of the fuel production from each type of input resource (feedstock) for three key decades in the analysis. The figures also show the resulting average carbon intensity for the fuel and how it changes with the varying feedstock sources (right hand Y-axis). Figure 5 shows the production feedstock and carbon intensity for the electricity sector in California.

Figure 5: Electricity Production Share and Carbon Intensity



[25] Low Carbon Fuel Standard Initial Statement of Reasons (ISOR) report, March 5, 2009 [ARB].

California's electricity mix is already significantly lower in carbon emissions than the national mix, with over 40% of the production coming from natural gas, 20% from large hydro-electricity, and 10% from traditional renewables today. However, the carbon intensity of the State's electricity will have to be reduced significantly to achieve the 2050 goals. This analysis assumed the 2050 carbon intensity was roughly 29 gCO2e/MJ from the current 121 gCO2e/MJ. The scenario assumed the 2010 and 2020 renewable policy goals were achieved (20% in 2010, 33% in 2020). Traditional renewables continue to grow to 40% of the grid mix in 2050, with large hydro being maintained at 20% for a combined 60% "zero carbon" supply. A growth in nuclear energy is assumed as well as the commercialization of carbon capture and sequestration (CCS), where CO2 is captured from coal or natural gas power facilities and stored permanently underground. The commercialization and success of CCS is highly uncertain, and therefore represents a risky assumption.

Today, hydrogen is produced predominantly from natural gas, and is a widely used gas at industrial facilities, including oil refineries. As a hydrogen economy for transportation emerges, Figure 6 shows the hydrogen will initially be produced from natural gas to leverage existing industry experience and costs. However, over time, hydrogen will have to increasingly come from more sustainable sources.[26] The resulting low carbon intensity assumes a mix of electrolysis with renewable electricity, high temperature direct water separation, and coal with CCS in 2050. Although biomass is a feasible feedstock for hydrogen, and may be the least expensive sustainable hydrogen source, it was not modeled here given the limitations on biomass for the passenger vehicle segment. This is an assumption that could be revisited.

Figure 6: Hydrogen Production Share and Carbon Intensity

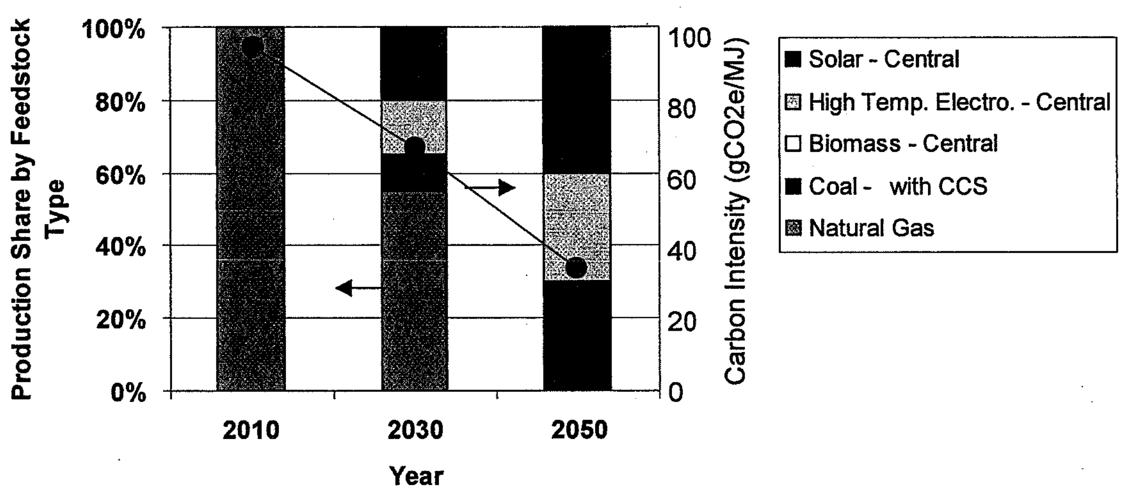
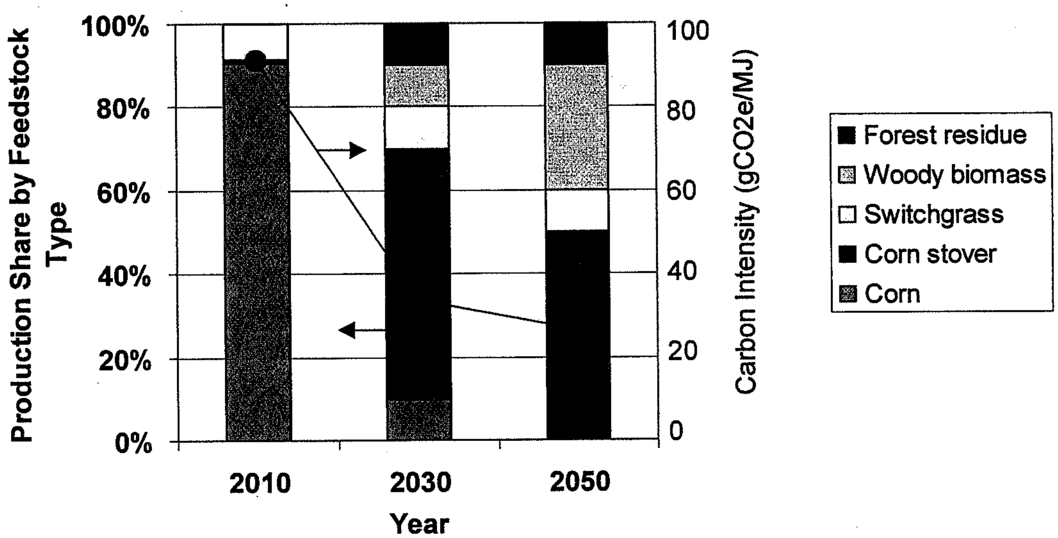


Figure 7 shows the carbon intensity and production feedstocks for biofuels. This analysis assumes ethanol will continue to be blended into gasoline in blends up to 10% (E10) through 2020. However, soon after that time, the analysis assumes a new biofuel chemistry will be commercialized, a "bio hydrocarbon fuel" that is more

[26] California's Senate Bill 1505 (2006) requires that once a certain amount of hydrogen is produced for markets, one third of the fuel must come from sustainable feedstocks.

similar chemically to gasoline and can be shipped in pipelines as a blend. As a result, after 2020, this analysis assumes biofuels can be blended in gasoline at any volume fraction. The carbon intensity trend in the figure shows a rapid decline through 2030, and a more gradual decline to 2050. This is a result of dramatic carbon reductions in biofuels to comply with the LCFS regulation by 2020.

Figure 7: Bio-hydrocarbon Fuel Production Share and Carbon Intensity



The LCFS will drive innovation through 2020 and is expected to incentivize significant quantities of low-carbon biofuels in the California market. This innovation will create development of new biorefinery technology and more sustainable feedstock choices. Hydrogen and electricity will be incentivized as well, though they will remain a small part of the transportation fuel mix by 2020.

An important bounding parameter in the scenario was the projected biomass availability in 2050.[27] If unlimited biomass supplies were available, theoretically conventional engines operating on very low-carbon biofuels could achieve the 2050 80% goal. In reviewing recent biomass assessments[28], as shown in Figure 8, an upper limit of 1 billion gallons of gasoline equivalent (BGGE) was set for the passenger vehicle sector (including biomass for H2) for Scenario 1. This limitation considers that large quantities of biofuels will be needed in the aviation, heavy-duty vehicle, and marine sectors to reach their 2050 GHG reductions. Additionally, there will be increasing competition for sustainable biomass resources from other states and non-transport sectors. Although it was not modeled in this analysis, future commercialization of algae-based biofuels could significantly increase biofuel supplies. However, algae biofuel development is highly uncertain though is showing increasing potential.

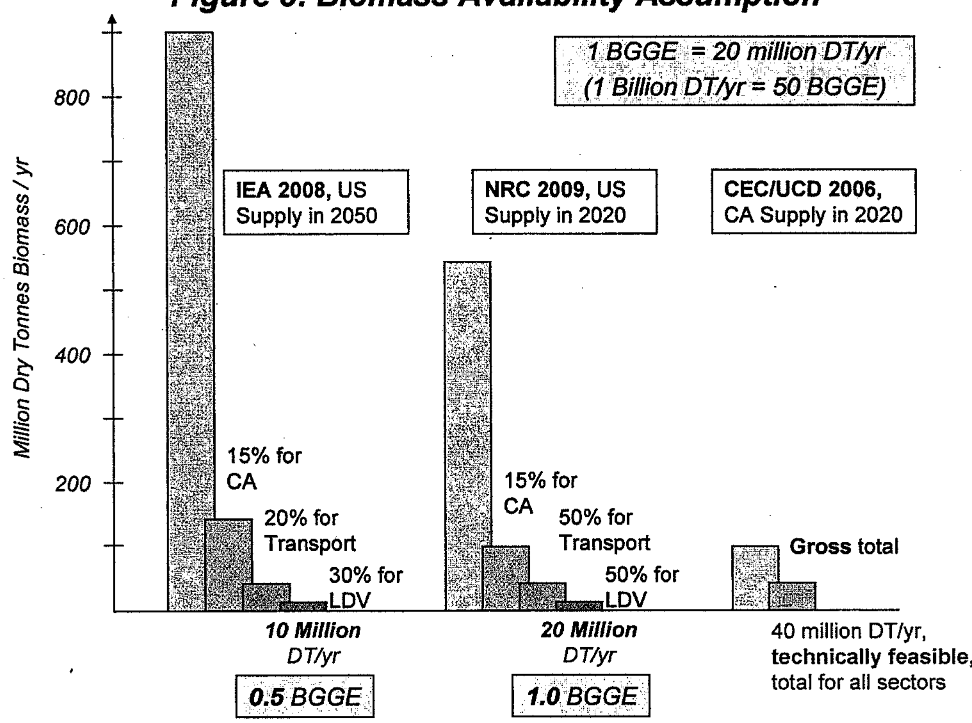
[27] This biofuel limitation does not reflect any assumption from other ARB policies, such as the LCFS, it is simply a hypothetical value used for this analysis
[28] IEA 2008a, UC Davis 2008b, U.S. DOE 2005, IEA 2005, CEC 2006, CEC 2008, NRC 2009.

Specifically, Figure 8 compares biomass resource assessments from three sources[29]. The bar chart, showing units of million dry tonnes of biomass per year, reveals how little of the biomass resource may be available for the passenger vehicle segment in California. The International Energy Agency (IEA) assessment starts with a national resource level for all energy consuming sectors, and then isolates the fraction of that available for passenger vehicles (approximately 7% of the total national resource). This analysis further reduced this to account for the fraction available in California.

A more recent National Research Council (NRC) study has more specific U.S. assumptions and shows the national resource at approximately 550 million DT/yr. Using the NRC total value, this analysis hypothesized a simple split between sectors: 50% consumed by the transportation sector, and then a further 50% by passenger vehicles specifically. After accounting for a 15% share used in California, the result is 1 BGGE for the passenger vehicle sector. The CEC reference shows biomass resources specifically in California, though does not isolate individual consuming sectors. But the total resources available in California from the IEA and NRC studies are similar in scale to the CEC study. Further study on this parameter is necessary given that the model is sensitive to the biomass value.

The resulting biofuel level from the NRC case in Figure 8 became the value used in the analysis for the biofuel availability. It is important to note that 1 BGGE of biofuels represents over 40% of all liquid fuels consumed in Scenario 1 in 2050 (approximately 2.5 BGGE). This is significantly less than today's California fuel consumption, and is largely because the 2050 on-road fleet are predominantly ZEVs. This is shown in Figure 16 later in the report.

Figure 8: Biomass Availability Assumption



[29] IEA 2008a, NRC 2009, and CEC 2006.

Advanced vehicle scenarios

Several scenarios were developed to evaluate various advanced vehicle market and technology assumptions. The unique aspect of each scenario focuses on the different technology sales projections over time. Most of the sales projections are aggressive to achieve the deep GHG reductions. The projections were developed by studying external sources for long-term trajectories[30] and using judgment of what is possible from the automotive industry for the near-term trajectories. Although this model does not simulate economic factors and consumer choice, the projections assume consumers will demand and purchase the advanced vehicles, either because of high gasoline and carbon prices or because the advanced vehicles offer new and attractive alternatives.

In addition to the vehicle sales projections, the use of biofuels was varied between scenarios. This was done by changing the fraction of biofuels blended into gasoline and diesel. Through 2020, a maximum of 10% ethanol in gasoline (E10) was assumed given the current national blend wall limit. To achieve the LCFS carbon reduction compliance in 2020, a large amount of E85 (85% ethanol fuel with 15% gasoline) fuel was assumed in addition to E10, but only for a limited timeframe between 2015 and 2025. After 2020, the model assumed a bio-hydrocarbon fuel was commercialized. This is a long-term goal of the energy industry as it creates large flexibility in the levels of biofuel blends in gasoline and diesel, and allows them to transport biofuels blended with fossil fuels in pipelines[31].

Among the various scenarios developed for this analysis, two will be featured in this report. Scenario 1 achieves a 66% GHG reduction, and represents a case where all major assumptions are aggressive compared to the business as usual. Scenario 2 achieves the full 80% GHG goal by pushing two key assumptions even further: ZEV sales projections, and the amount of biofuels used. Scenario 2 was developed to show it may be possible to achieve the 80% target, but will be extremely difficult. Both scenarios include all advanced vehicle technologies: FCVs, BEVs, and PHEVs, each with aggressive market growth assumptions.

The following key trends are captured in Scenarios 1 and 2. Figures 9 and 10 show the assumed sales projections for the major vehicle technologies in the automobile (car) segment, and Figure 11 shows the sales projections for the light-truck segment for Scenario 1.

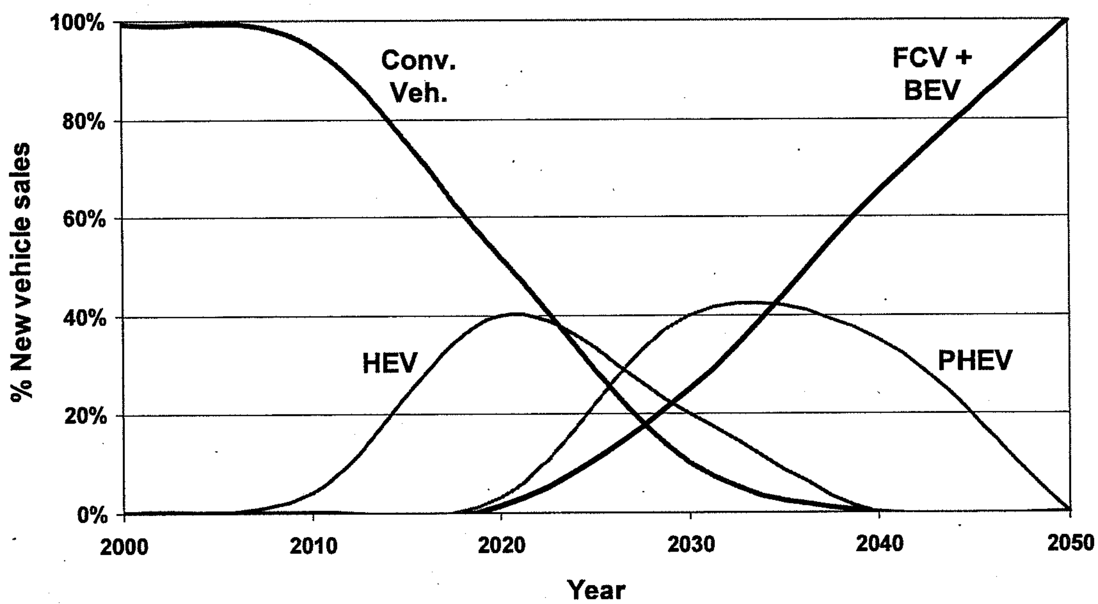
- The vehicle technology sales curves relied on the historical rate of hybrid electric vehicle (HEV) growth as a benchmark for the first 10 years, and realistic technology sales growth projections by 2020 based on known technical and infrastructure challenges.
- Scenario 1 assumes PHEV sales take off faster and decline long-term when FCVs + BEVs (ZEVs) reach high volumes. It also assumes BEV sales take off faster than FCVs initially, but reach a saturation limit (30% of sales market by

[30] IEA 2008, McKinsey, MIT 2008, NRC 2008c
[31] Ethanol is currently shipped separately by rail car and blended in gasoline close to regional markets. This creates additional infrastructure requirements and higher transport costs.

2050); FCVs take off last but become the dominant low-carbon alternative by 2050 in Scenario 1. The shape of the sales projections was partially derived by reviewing the literature[29].

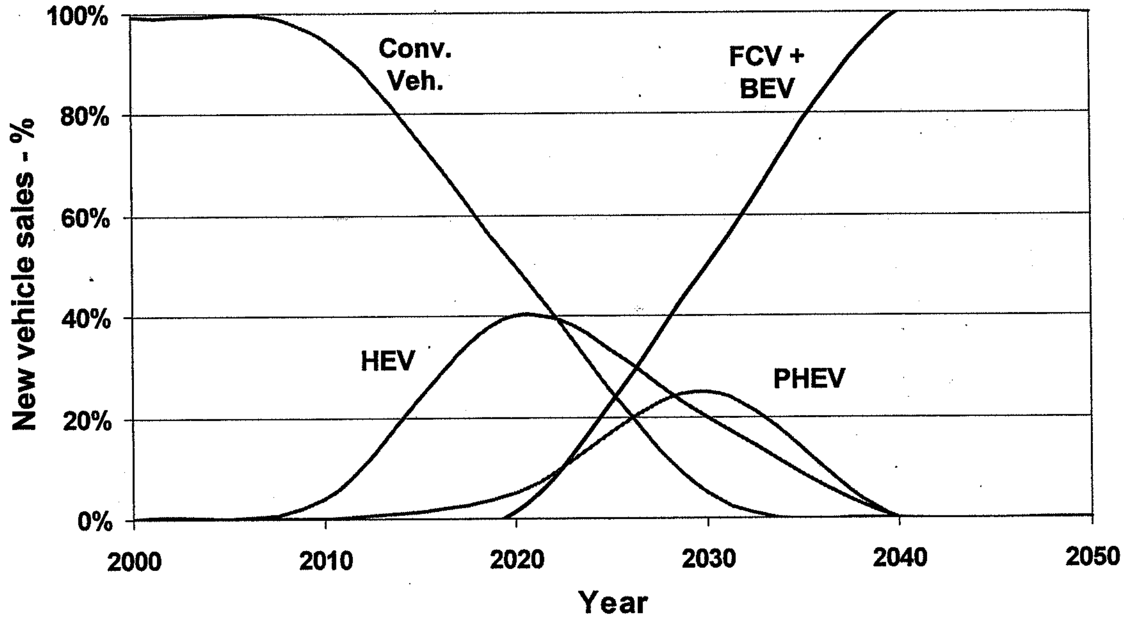
- A progression of battery technology improvements was assumed. For PHEVs, the amount of all-electric range (AER) that the batteries can support grows over time from 10 miles (2020) to 50 miles (2050). For BEVs, it is assumed range increases and infrastructure grows to justify market shares projected.
- Figure 11 shows sales trends for the truck segment. Although trends are similar, there is less reliance on BEVs in trucks and more reliance on PHEVs and diesel HEVs all the way to 2050.

Figure 9: New vehicle sales, Passenger Vehicle (cars) segment * - Scenario 1



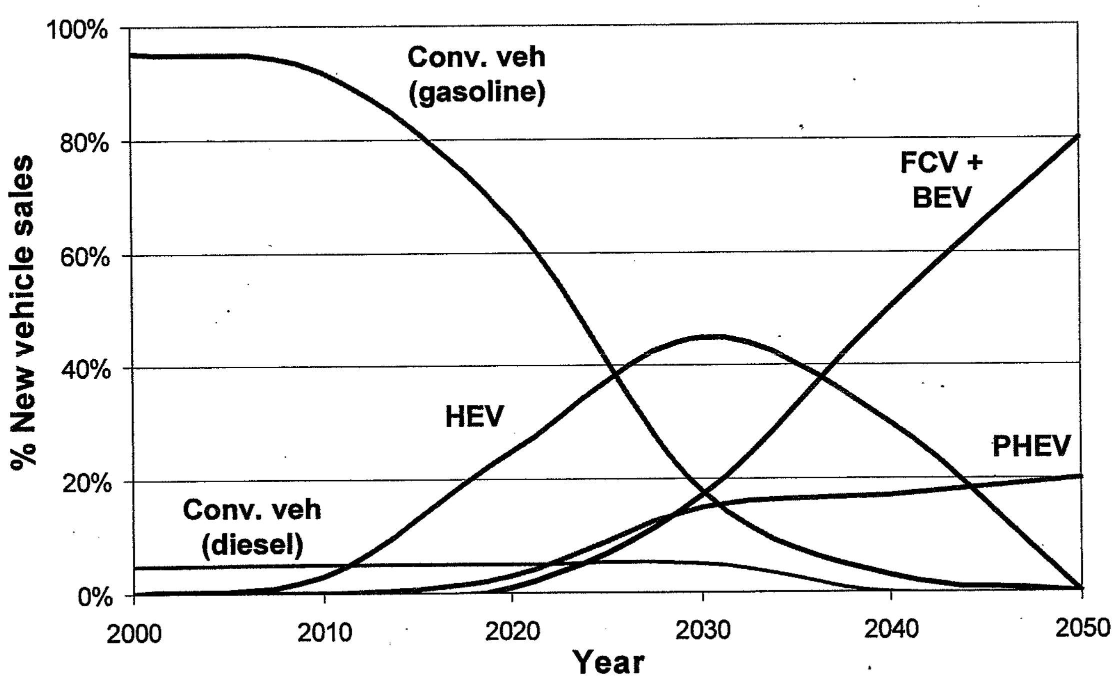
** Note: BEV = 30% of "FCV+BEV" in 2050*

Figure 10: New vehicle sales, Passenger Vehicle (cars) segment * - Scenario 2



** Note: BEV = 30% of "FCV+BEV" in 2040*

Figure 11: New vehicle sales, Passenger Vehicle (truck) segment * - Scenario 1



** Note: BEV = 10% of "FCV+BEV" in 2050; HEV includes both gasoline and diesel hybrids.*

Sidebar: General Technology Tradeoffs
(Discussed further in the Technical Support Document)

Battery Electric Vehicles (BEVs)
- (Pros) Efficient drivetrain, easier market launch compared to FCVs (less infrastructure challenges and lower early costs)
- (Cons) Potentially higher long-term vehicle costs, limited range, reliant on long charge times, limited vehicle sizes

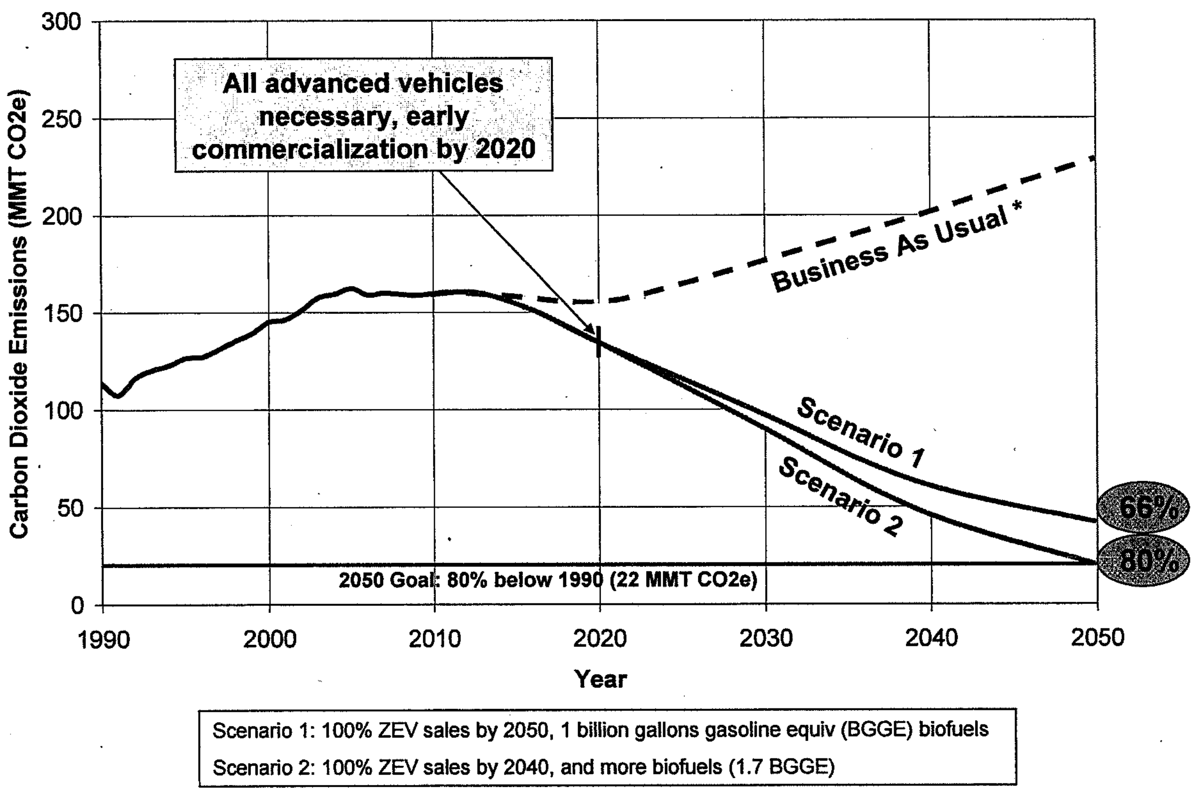
Fuel Cell Vehicles (FCVs)
- (Pros) Long range, fast refueling, wide range of vehicle sizes
- (Cons) hydrogen storage, and fuel infrastructure - largest hurdle and possible show stopper

Plug-in Hybrid Electric Vehicles (PHEVs)
- (Pros) Long range, fuel flexibility and convenience, wide range of vehicle sizes, straight forward market transition (build on HEVs, battery size can grow over time as costs improve)
- (Cons) reliant on low carbon biofuel supply for deep carbon reductions, fuel economy benefits depend on drive cycle and trip length

3. Results

This section provides a more detailed summary of the analysis results. Figures 12 and 13 show the difference in total GHG reductions between Scenario 1 and two variations on ZEV sales projections. Although these secondary ZEV sales scenarios achieve higher GHG reductions, their success is more uncertain. Two of the ZEV projections in Figure 13 correspond to the GHG scenarios in Figure 12. Refer to Figure 2 for a description of the "business as usual" emission projections shown in Figure 12.

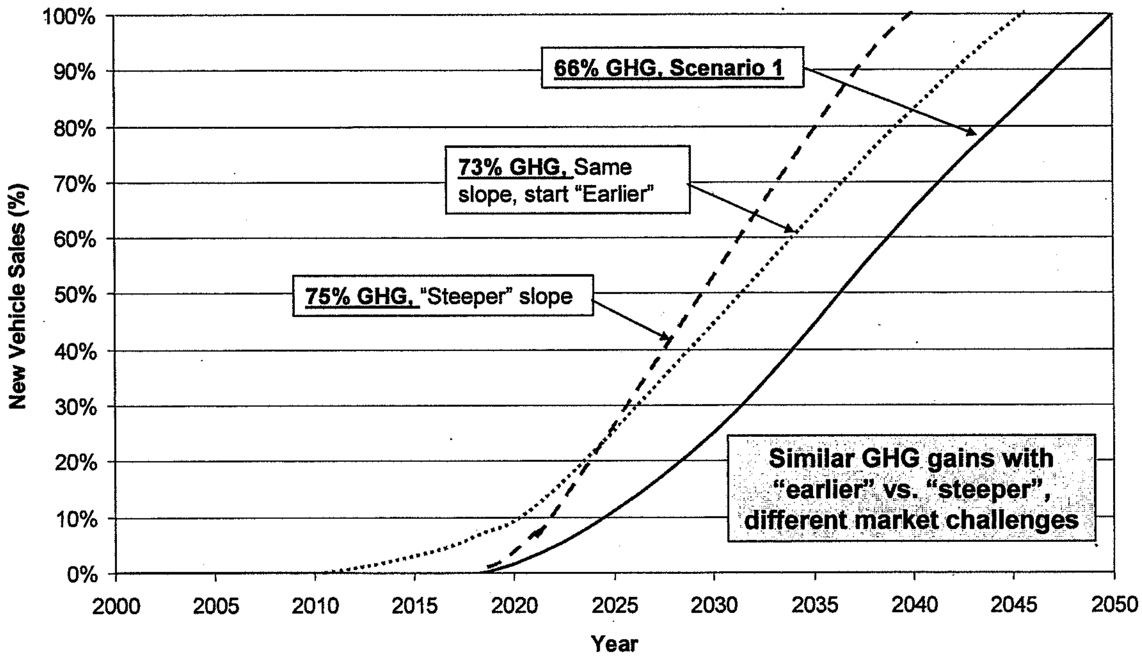
Figure 12: GHG Emissions for Three ZEV Sales Scenarios



* Hypothetical BAU for this analysis only, does not represent ARB projections. Assumes Pavley 1 and LCFS are implemented.

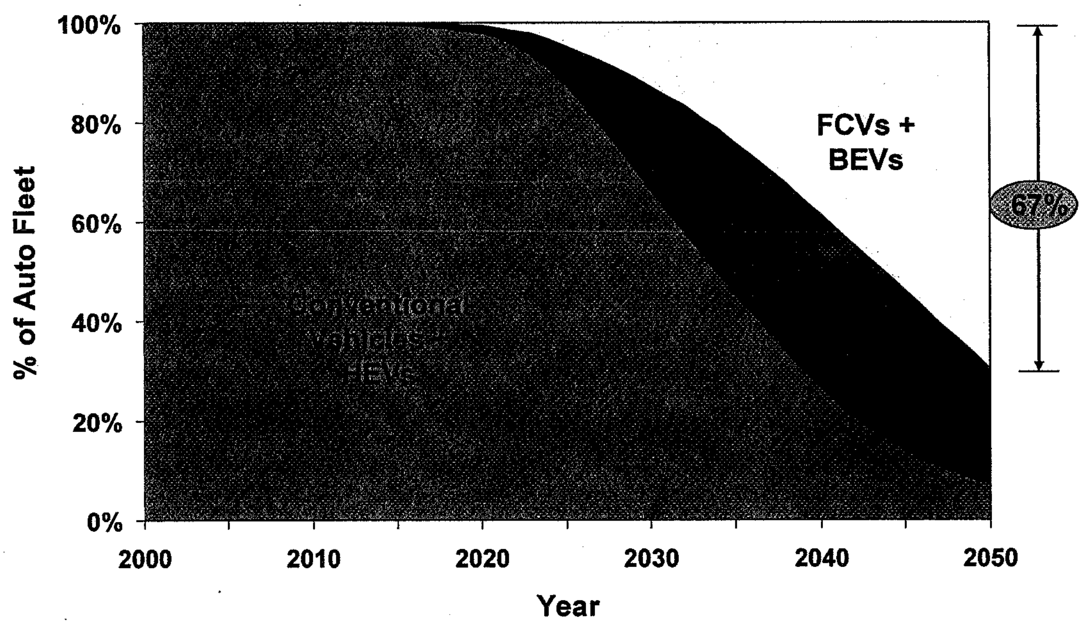
Figures 12 and 13 show that by increasing the 2020 ZEV annual sales six-fold (25,000 vs. 150,000), 2050 GHG reductions improve from 66% to 73%. This is achieved by starting ZEV sales earlier but maintaining the same long-term sales slope as in Scenario 1. The scenario that achieves 75% assumes ZEV sales in later years are more rapid and reach the full new market share 10 years earlier (2040 rather than 2050). Using this "steeper" ZEV sales projections along with a larger amount of biofuels (1.7 BGGE vs. 1 BGGE), results in Scenario 2 in Figure 12.

Figure 13: ZEV Sales Scenarios



As shown in Figure 12 above, Scenario 1 achieves a 66% reduction in GHG emissions from the 1990 level, missing the 2050 policy goal of 80%. The results from this scenario and others show that high-volume (100,000s) ZEV markets need to exist by 2020 in order for ZEV sales and fleet turn-over rates to result in enough ZEVs to achieve deep GHG levels. In other words, over three decades of strong ZEV sales are required to reach the policy goal. Figures 14 and 15 show the cumulative on-road vehicle mix for Scenarios 1 & 2.

Figure 14: On-Road Fleet, Passenger Vehicle (cars) Segment – Scenario 1 [32]



[32] The truck segment relies less on ZEVs. The combined passenger vehicle sector has a resulting 61% ZEV on-road penetration in 2050. For reference, the 2000 California vehicle population is 22 million, and increases to 40 million in 2050.

Figure 15: On-Road Fleet, Passenger Vehicle (cars) Segment – Scenario 2 [33]

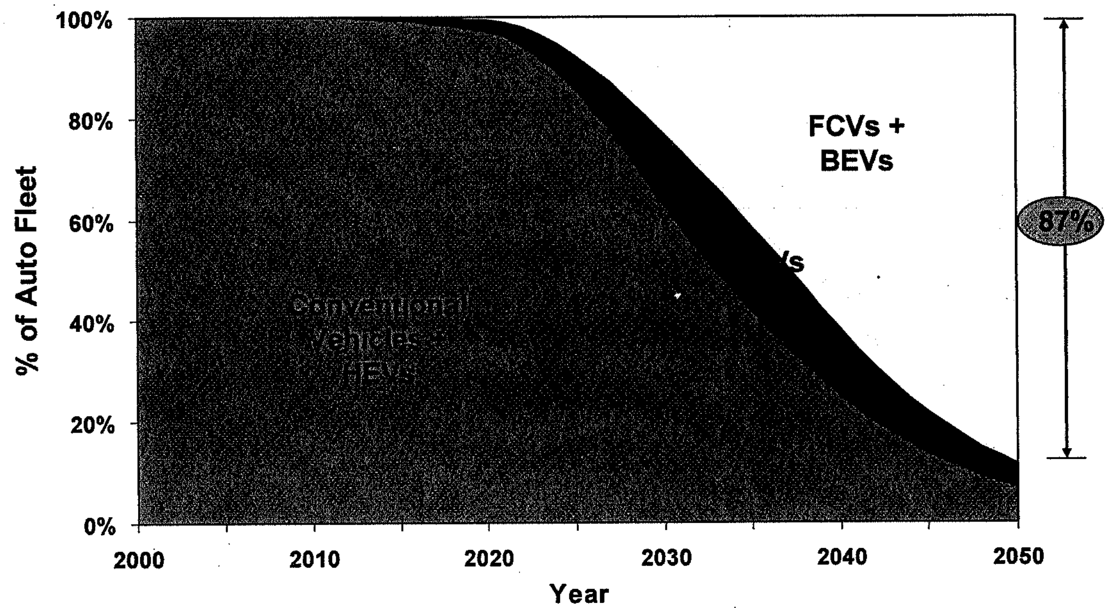
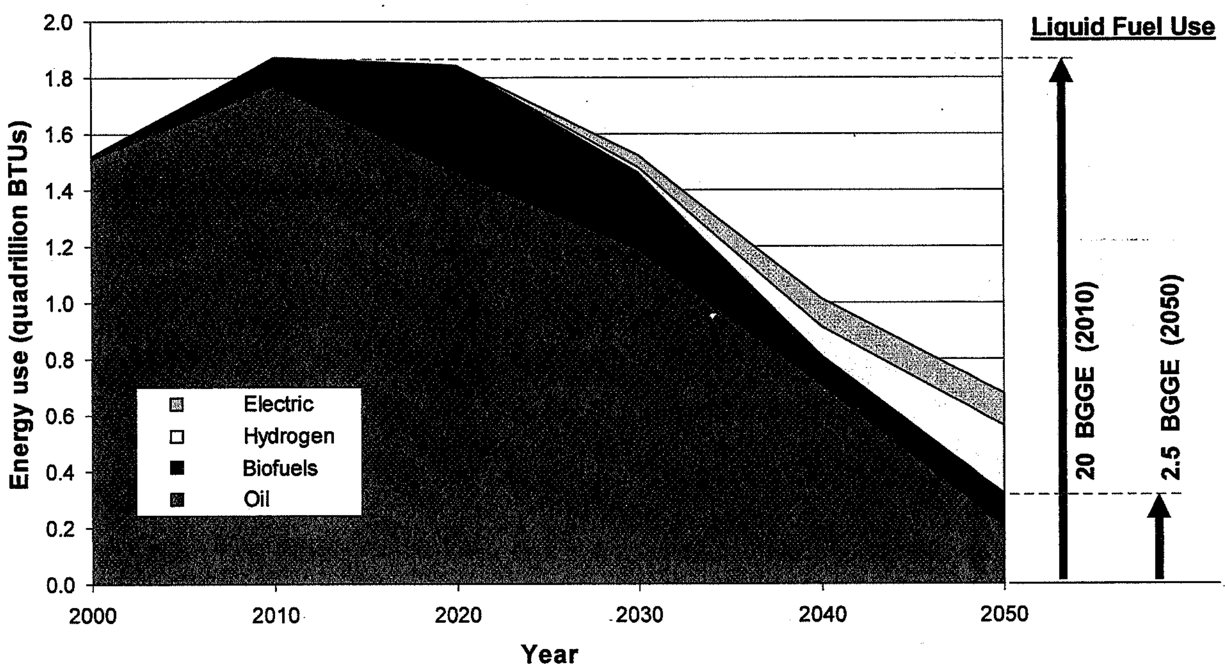


Figure 16 below shows the total energy usage by fuel type over the course of the scenario timeframes. A similar trend is revealed compared to Figure 14, where electricity and hydrogen are a minor part of energy consumption up through 2020, but expand quickly over the next three decades. A further trend to note is that of biofuels. Figure 16 shows that biofuel levels expand through 2030 and then somewhat decline by 2050. This trend is expected as the fuels industry aggressively moves to biofuels to comply with the LCFS by 2020, but then shifts to ZEV technology fuels after that point. Additionally, limited biofuel supply will slowly shift to other sectors, such as aviation and heavy-duty vehicles in the later years. For reference, the quantity of liquid fuels (combined gasoline, diesel, and biofuels) is plotted on the right of Figure 16. This shows that in 2010, California is projected to consume approximately 20 BGGE, but that by 2050, this is dramatically reduced to 2.5 BGGE (Scenario 1). This scale is important when considering the biofuel limit of 1 BGGE (nearly 40% of the total liquid fuels in 2050).

Figure 16: Total energy usage of various scenarios



Sensitivity analysis – Scenario Variations

The following scenario variations were all created starting from, and are referenced to, Scenario 1. The results from Scenario 1 can be summarized relative to the policy questions at the beginning of this report. Figure 17 below shows the resulting 2020 & 2025 ZEV annual sales, along with the 2050 GHG reduction levels, for each case.

(a) If the solid ZEV sales curve[33] to 2050, shown in Figure 13 (Scenario 1) is shifted 5 years earlier, a 73% GHG reduction results. This shows that increasing early ZEV sales can make a difference; though ZEV technical readiness may prevent this (this represents a 110% increase in annual ZEV sales in 2025 compared to Scenario 1)

(b) If, instead, the slope were increased so that ZEV sales reach the 100% level in 2040 instead of 2050, a 75% GHG reduction is achieved.

(c) If this most aggressive ZEV sales trajectory is used along with additional biofuels (1.7 BGGE vs. 1 BGGE), the full 80% GHG reduction level is achieved – Scenario 2.

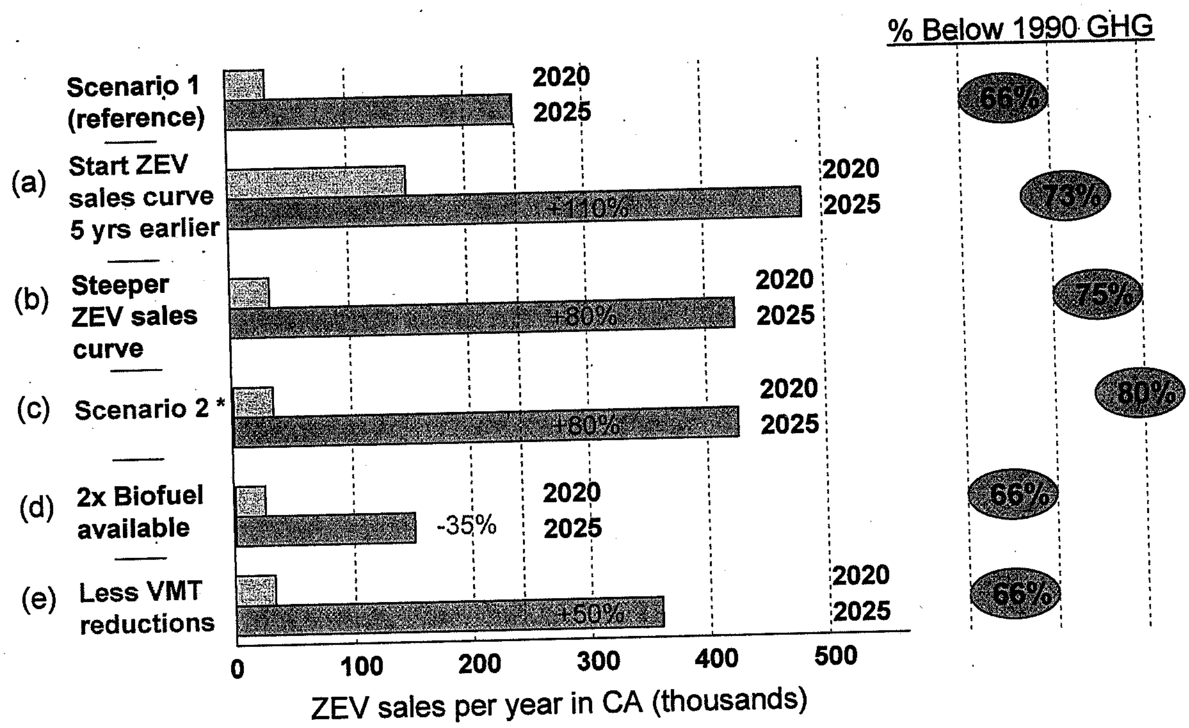
(d) The quantity of bio-hydrocarbon fuel for the passenger vehicle segment is doubled in this variation (2 BGGE vs. 1 BGGE). When this is added to the advanced vehicle sales assumptions in Scenario 1, the GHG reductions improve from 66% to 73%. Another variation on this is to maintain the same GHG levels by reducing the required ZEV volumes (35% reduction in 2025 ZEV sales compared to Scenario 1).

(e) A variation was created to see the sensitivity of the VMT per vehicle assumption. In this variation, the VMT per vehicle reductions were not as

[33] The slope of the ZEV sales over multiple decades is highly uncertain. This analysis assumes an aggressive growth that is similar to assumptions in the NRC 2008c.

aggressive as Scenario 1 – 10% below 2050 rather than 20%. As a result, additional ZEVs are required to simply maintain the same 2050 GHG reduction level as Scenario 1 (50% increase in ZEV sales in 2025 compared to Scenario 1).

Figure 17: Sensitivity Study – impact on ZEV 2020 and 2025 sales



** Includes ZEV sales from (b) and an increase in biofuel usage (1.7 BGGE instead of 1 BGGE in Scenario 1)*

4. Conclusions - Critical Factors Necessary for Success

This 2050 GHG modeling analysis has addressed two policy questions as they relate to California's 2050 GHG goals in Executive Order S-03-05.[34]

(1) What are the cumulative ZEVs necessary by 2050 to help the passenger vehicle sector achieve an 80% GHG reduction, and
(2) What annual ZEV sales are necessary between 2015 and 2025 to initiate these fleet volumes?

Several scenarios were developed to evaluate the passenger vehicle sector GHG emissions to 2050, and included detailed assumptions of vehicle sales of various technologies, fuel and electrical grid carbon intensity reductions, large VMT per vehicle reductions, and vehicle fuel economy improvements through vehicle platform, vehicle downsizing, and powertrain developments. Scenario 1 in this analysis achieved a 66% reduction in GHG emissions by 2050 using aggressive but plausible assumptions. Additional scenarios were developed with more aggressive, but more uncertain, ZEV sales projections to achieve the full 80% GHG goal. In specifically addressing the policy questions above, the scenarios in this analysis show:

- **Cumulative on-road**:
  Scenario 1: 100,000 ZEVs (FCVs + BEVs) in CA by 2020, accelerating to 900,000 ZEVs by 2025.[35]
  Scenario 2: 120,000 ZEVs by 2020, 1.4 million ZEVs by 2025
- **Annual ZEV sales**:
  Scenario 1: 25,000 in 2020, and 230,000 in 2025
  Scenario 2: 25,000 in 2020, and 425,000 in 2025

Given that these ZEV sales projections are aggressive, it is the staff conclusion that both market push policies, such as the ZEV Regulation, and market pull policies will be needed to ensure the sales materialize – if consumers don't buy the vehicles, advanced vehicle markets will not grow. Market policies are especially important in the next 10 years as the advanced vehicles are first introduced to consumers and production costs still remain high. These ideas are explored further in the Complementary Policies report included in the full White Paper.

Several parameters in the modeling analysis are particularly sensitive and therefore require further review of the assumptions and data. Biomass supply is expected to be limited for the passenger vehicle sector in 2050 as other sectors compete for the resource. This analysis assumed 1 BGGE of biofuels as a limit for passenger vehicles in 2050. Changing the value by +/- 50% has a noticeable impact on the number of ZEVs required to reach the 80% goal. A second parameter that is particularly sensitive is VMT per vehicle. Opinions vary widely among experts as to how large reductions will be in this parameter. Continued evaluation is important.

---

[34] 80% reduction in GHG emissions below 1990 levels by 2050.
[35] The analysis assumes aggressive sales trajectories between 2010 and 2050. This analysis relied on external studies of how rapid advanced vehicle sales rates could become.

A few other parameters may not be as sensitive, but their success is highly uncertain, either due to technical innovation required, market cost barriers, or large political will necessary to advance the solution. If any of these parameters are not as successful as assumed in this analysis, achieving the 80% GHG goal would require even more aggressive ZEV sales and success. This is part of the reason why pursuing multiple ZEV solutions are essential to hedge risks against non-vehicle assumptions. Uncertain parameters include:

- Hydrogen infrastructure. This requires a substantial amount of stakeholder coordination at all levels of government and industry. Political will and private investment motivations need to be aligned for this to emerge.
- Carbon capture & sequestration (CCS). This is critical for baseload power in addition to renewable electricity. Most scenario references reviewed recommend use of CCS to achieve deep GHG reductions, but challenges such as reliable storage and monitoring, and sufficient underground reservoirs must be overcome. Public support is also currently a challenge that will need to be addressed, and includes liability rules, and "not in my backyard (NIMBY)" concerns with pipelines and underground locations.
- Bio-hydrocarbon fuel. As a replacement for ethanol to be blended into gasoline, this fuel would be very similar in chemistry to gasoline. This future fuel eliminates the need for vehicle and pump changes, reduces the upstream fuel infrastructure burden by allowing blended fuel in long distance pipelines, and provides flexibility to energy firms for varying blends over time depending on oil prices, cap/trade requirements, etc. However, this fuel has not been developed and commercialization is not expected before 2020.
- Renewable electricity expansion. This will be very challenging given limits on transmission line development (costs and land rights) as well as local resistance in some cases (wind and solar farm locations). Growth in renewable electricity is expected, but achieving the 2010 and 2020 State targets will require large coordination and cooperation among all stakeholders.

Closing Thoughts – Risk Management

Each technology has a large set of challenges which makes market growth uncertain. All three (BEVs, FCVs, and PHEVs) offer energy security and fuel diversification over time. But it is too early to pick winners at this time. Doing so would dramatically increase the risk of missing the 2050 GHG goal because it would create no room for technology or market failures. Discussions between ARB and automotive firms confirm this – it is impossible for industry to know exactly what consumers will demand and accept in the future. BEVs will most likely play a role and obtain a sizable portion of the long-term market, focused on small vehicle platforms in urban areas.[36]

For long-range larger applications, both FCVs and PHEVs with biofuels offer deep GHG reductions, but both have large market uncertainties. FCVs offer deep well-to-wheel (WTW) GHG reductions and fast refueling, but creating the fuel infrastructure is a substantial challenge. PHEVs offer less infrastructure challenges

[36] The scenarios in this analysis assume BEVs saturate in the market at 30% of 2050 vehicle sales

but would rely on biofuels in quantities that may exceed the 2050 limit of supply for passenger vehicles.

WTW energy and GHG comparisons between advanced vehicle and fuel pathways are useful but should be used in a future context and should not be used in isolation from other comparison factors. The WTW comparisons should use future electrical grid and fuel production assumptions to be appropriate. Further, only studying the WTW performance ignores the consumer preferences in vehicles (range, cost, features, fueling time, access to fuel). Without consumer demand, advanced vehicle sales will not emerge and grow.

Early markets take time and are very slow to grow initially. Because of large uncertainties initially in how consumers will react to various advanced vehicle technologies, features and costs, automotive firms develop one advanced vehicle product and wait to receive market feedback before expanding the technology to additional vehicles and platforms. Historically this can be seen in the successful, but slow, growth of the HEV market in the US. It took 10 years for hybrids to reach 4% of the new vehicle market in California and for industry to determine the best vehicle tradeoffs that will allow the market to grow. PHEVs, BEVs, and FCVs have even larger uncertainties in consumer expectations creating larger market uncertainties.

In managing the large risks of climate change impacts and achieving California's 2050 GHG goals, the recommended policy is to pursue all promising advanced vehicle solutions and aggressively encourage advanced vehicle markets through the ZEV Regulation as well as market pull mechanisms.

5. References

ARB. Air Resources Board, "Proposed regulation to implement the Low Carbon Fuel Standard: Initial Statement of Reasons," March 5, 2009.

CEC 2006. California Energy Commission, "A Roadmap for the development of biomass in California," California Biomass Collaborative, CEC PIER Collaborative, Nov 2006.

CEC 2007a, "State alternative fuels plan (AB 1007)," December 2007.

CEC 2007b, "PIER Renewable energy technologies program: research development and demonstration roadmap," August 2007.

CEC 2008, "An assessment of biomass resources in California, 2007," California Biomass Collaborative, CEC PIER Collaborative, March 2008.

Carnegie. Carnegie Mellon University, "Lifecycle Assessment of GHG Emissions from PHEVs: Implications for Policy," Environmental Science and Technology, 2007.

CPUC. California Public Utilities Commission, "Light-Duty Vehicle Electrification in California: Potential Barriers and Opportunities," Staff White Paper, May 22, 2009

Duke. Duke University, "Plug-in and Regular Hybrids: A National and Regional Comparison of Costs and CO2 Emissions," Climate Change Policy Partnership, 2008.

EIA. Energy Information Administration, "International Energy Outlook 2009," 2009

EPRI. Electric Power Research Institute, "The power to reduce CO2 emissions: The full portfolio," 2007.

IEA 2005. International Energy Agency, "Biofuels for Transport: An International Perspective," 2005.

IEA 2008a, "Energy Technology Perspectives: Scenarios & Strategies to 2050," 2008

IEA 2008b, "World Energy Outlook 2008," 2008.

MIT 2007a. Massachusetts Institute of Technology, "Electric Powertrains: Opportunities and Challenges in the US LDV Fleet," Sloan Automotive Lab, LFEE 2007-02 RP, 2007.

MIT 2007b, "Factor of Two: Halving the Fuel Consumption of New US Automobiles by 2035," Sloan Automotive Lab, LFEE 2007-04 RP, 2007.

MIT 2007c, "The Future of Coal: Options for a Carbon Constrained World," An Interdisciplinary MIT Study, 2007.

MIT 2008, "On the Road in 2035: Reducing Transportation's Petroleum Consumption and GHG Emissions," Laboratory for Energy and the Environment, LFEE 2008-05 RP, 2008

MIT 2009, "Future of Nuclear Power (Update of the 2003 MIT report)," An Interdisciplinary MIT Study, 2009.

McKinsey. McKinsey & Company, "Roads toward a low carbon future: reducing CO2 emissions from passenger vehicles in the global road transportation system," 2009.

NRC 2008a. National Research Council, "America's Energy Future: A National Academies Summit," 2008.

NRC 2008b, "Review of the Research Program of the FreedomCAR and Fuel Partnership: Second Report," Board on Energy and Environmental Systems, 2008.

NRC 2008c, "Transitions to Alternative Transportation Technologies: A Focus on Hydrogen," 2008.

NRC 2009, "Liquid Transportation Fuels from Coal and Biomass Technological Status, Costs, and Environmental Impacts," America's Energy Future Panel on Alternative Liquid Transportation Fuels, 2009.

NSF. National Science Foundation, "Building a Sustainable Energy Future," NSB-09-35, 2009.

Pew. Pew Center on Global Climate Change, "Reducing Greenhouse Gas Emissions from US Transportation," 2003.

Princeton. Princeton University, "Stabilizing Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," Science Magazine Vol 305, 2004.

UK. United Kingdom Treasury, "The King Review of Low Carbon Cars: Part I, the Potential for CO2 Reduction," 2007.

UN. United Nations,"Climate Change 2007: Synthesis Report," International Panel on Climate Change (IPCC), 2007.

U.S. DOE 2005. U.S. Department of Energy and U.S. Department of Agriculture (USDA), "Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply," 2005.

U.S. DOE 2009a, "Well to Wheel Greenhouse Gas Emissions and Petroleum Use," DOE Hydrogen Program Record #9002, 2009.

U.S. DOE 2009b, "Well to wheels energy use and GHG emissions analysis of PHEVs," Argonne National Lab, February 2009.

U.S. EPA. U.S. Environmental Protection Agency, "A Wedge Analysis of the US Transportation Sector," EPA420-R-07-007, 2007.

UC Davis 2008a. University of California, Davis, "Prioritizing Climate Change Mitigation Alternatives: Comparing Transportation Technologies to Options in Other Sectors," PhD dissertation, N.Lutsey, 2008.

UC Davis 2008b, "Strategic Assessment of Bioenergy Development in the West: Spatial Analysis and Supply Curve Development," Final Report to the Western Governors Association (WGA), 2008.

UC Davis 2009, "Meeting an 80% in GHG Emissions from Transportation in 2050: A Case Study in California," Transportation Research Part D, 2009.

UM. University of Michigan, "Fixing Detroit: How far, how fast, how fuel efficient," UMTRI-2009-26, June 2009.

ATTACHMENT C

Complementary Policies

Table of Contents

Complementary Policies

1. Introduction

Zero emission vehicles (ZEV) will play an important roll in meeting California's long term air quality and greenhouse gas (GHG) emission reduction goals. The primary goal of the ZEV regulation is to ensure development, deployment, and commercialization of the most advanced and clean vehicle technologies.

However, the ZEV regulation will not likely be successful without additional policy tools that help ensure infrastructure and market demand for the vehicles. This suite of additional policies is called "complementary policies" in this report. To date, the vehicle volumes required by the ZEV regulation have been relatively small. However, as the regulation starts requiring larger volumes (e.g. 10,000s, or pre-commercial scale), robust consumer demand will be necessary. [1] The following are examples of existing complementary policies that will help the ZEV regulation reach its goal:

- The Low Carbon Fuel Standard (LCFS),
- Vehicle operator-use incentives: High-occupancy vehicle (HOV) lane access and free parking,
- Assembly Bill (AB) 118: Vehicle purchase incentives and infrastructure investment,
- Federal vehicle purchase incentives, and
- Federal tax credit for charging station and hydrogen station installations.

Many of these current policies successfully encourage ZEVs while the vehicle volumes remain low. However, as ZEVs move from the current demonstration volumes to the early commercial volumes within the next decade, additional complementary policies will likely be needed.[2] Some of these could include:

- The Low Carbon Fuel Standard (LCFS), with potential changes to incentivize ultra-low carbon fuels through and fueling infrastructure,
- AB 32 Cap and Trade Revenue Allocation,
- Modified Clean Fuels Outlet Regulation with emphasis on fueling infrastructure for vehicle technologies that align with GHG reduction goals (ARB),
- Efforts to address obstacles to home, workplace, and public charging infrastructure,
- Utility infrastructure investments (renewable electricity & potential upgrades to the distribution grid),

---

[1] Many of these policies may be needed to support a broader suite of low-carbon vehicles to meet California's 2050 goals.
[2] Necessary in order for California to meet Governor Schwarzenegger's long term goals in Executive Order S-3-05, which is 80% reduction in GHG emission from 1990 levels by the year 2050

- CPUC efforts to facilitate the development of electric vehicle charging infrastructure and review existing electric vehicle tariffs[3], and
- Feebate Regulations providing longer-term vehicle price incentives.

Table 1 lists a number of existing and potential policies that can encourage ZEV introduction and deployment. In recognizing the importance of these policies, this paper outlines current and future complementary policies, and the role they are playing and can play in aiding future ZEV commercialization.

Table 1: Policies that can support ZEV commercialization

Vehicle Volumes	ZEV Regulation Pavley Regulation
Vehicle Market Pull	Purchase Incentives Time-of Day Rates Feebate Regulations
Fuel Infrastructure	LCFS Clean Fuels Outlet Cap & Trade Revenue Utility infrastructure investment

2. Vehicle Market Pull Policies

To achieve the 2050 80% GHG reduction target successfully, existing public policy tools will need to succeed. Additional policies will likely also be needed, for example "market pull" mechanisms in early markets when advanced vehicle and fuel costs are high. In the long-term, more economy-wide carbon policies could create higher fuel prices, which would act as a permanent "vehicle market pull" for fuel efficient technologies. However, until carbon policy fuel price impacts are large enough, and until advanced vehicle markets achieve high volumes,[4] targeted complementary policies will likely be needed to address early market barriers.

Specifically, policies are needed that encourage and incentivize consumer acceptance and purchasing decisions during the 2015 to 2025 timeframe. These policies could include ZEV infrastructure investments and requirements, and consumer vehicle incentives. Polices such as these will help create demand for advanced vehicles as well as buy down the high initial cost of the technologies.

[3] CPUC 2009a. California Public Utilities Commission (CPUC). Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Tariffs, Infrastructure and Policies to Support California's Greenhouse Gas Emissions Reductions Goals. August 2009.
[4] Typically considered in the range of 500,000 vehicles

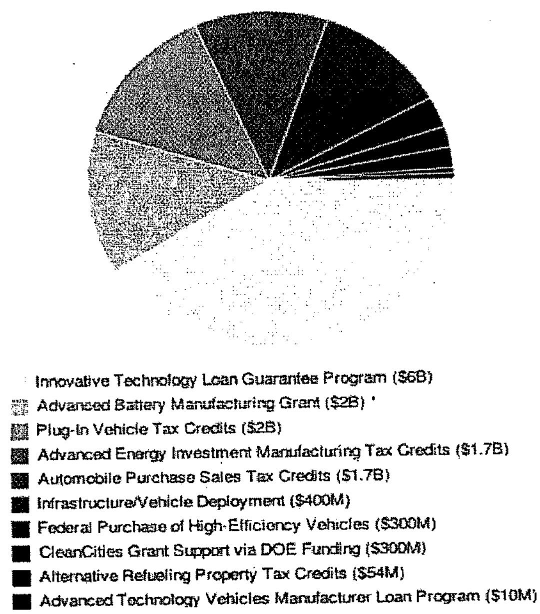
Existing Policies and Programs

Assemble Bill (AB) 118. Annually, beginning in 2010, ARB will offer monetary incentives for plug-in hybrid electric vehicle (PHEV), electric motorcycle, and ZEV purchases. Purchasers will be able to apply to ARB to receive up to a $5,000 rebate.

Federal Tax Incentives. Tax credits up to $7,500 are available for hybrid electric vehicles (HEV), PHEVs, battery electric vehicles (BEV), and fuel cell vehicles (FCV). The total number of vehicles awarded this tax credit is limited: up to the first 60,000 from any one manufacturer or up to the first 250,000 PHEVs. A recent National Academies Study (NAS)[5] recommended vehicle incentives that were durable over a 15-20 year period, but that ultimately phase out as vehicle costs decline. Durable incentives would provide more assurance for industry and private investors that advanced vehicle markets will emerge.

American Recovery and Reinvestment Act (ARRA, Federal stimulus funding, 2009). The ARRA established over $14.4 billion of investments for PHEVs, BEVs, and electric infrastructure as displayed in Figure 1. For vehicles, this includes manufacturing tax credits, vehicle purchase tax credits, and federal fleet purchases.

Figure 1: ARRA funding allocation for plug-in vehicles ($14.4B)[6]



HOV Lane Access. Some fuel efficient HEVs and compressed natural gas (CNG) vehicles are eligible to receive a yellow sticker, which allows these vehicles to travel in the HOV lane without additional passengers. All

[5] National Research Council, "Transitions to Alternative Transportation Technologies: A Focus on Hydrogen," 2008 (Executive Summary page 17)
[6] PIA. Plug In America. "Stimulus Federal Incentives". www.pluginamerica.org. 2009

freeway-capable ZEVs are eligible to receive a white sticker, which allows them to travel in HOV lanes as well. Many manufacturers and members of the public have viewed this as a successful incentive to encourage consumers in high congestion areas to purchase clean and efficient vehicles. All Clean Air Vehicle stickers will expire January 1, 2011 unless the law authorizing their use is extended beyond that date. There is support for new legislation to continue the program that will allow ZEVs to remain eligible for clean air stickers.

California Investor Owned Utilities (IOU) LEV Programs.[7] The California Public Utility Commission (CPUC) authorizes the IOU to have a ratepayer fee that generates funds for the Low Emission Vehicle (LEV) program. LEV program funding in 2009 and 2010 will amount to $47.9 million and can be used by utilities for the incremental cost to procure plug-in vehicles, as well to fund electric transportation programs.

Possible Future Policies and Programs

Feebate Regulation. ARB is currently investigating the benefits of applying feebates to new vehicles to complement other vehicle emission reduction strategies. Feebates are a fiscal policy that set a benchmark for greenhouse gases (CO_2e) for new vehicles. At the time of first purchase, vehicles whose emissions are greater than this benchmark would be assessed a one-time fee and vehicles below this threshold would receive a rebate. The fees collected would be used to pay for the rebates, making the program revenue neutral overall. The amount of the fee or rebate would be based on the difference between a vehicle's emission rate and the benchmark as well as rate schedule. Multiple options exist for designing this type of program.

It would be possible to set a rate schedule that is more favorable towards ZEVs, such that especially low-emitting vehicles receive proportionally greater rebates; or emission reductions from all vehicles could be valued equally, though ZEVs would still receive relatively larger rebates than conventional vehicles. In either case, this type of program could encourage manufacturers to produce vehicles that would be eligible for rebates while also encouraging consumers to purchase them. These rebates could be either in addition to any existing incentives (e.g. federal tax credits) or replacing them (e.g. state incentives). For ZEVs, it would need to decide whether only tailpipe emissions apply to this program or if upstream emissions should also need to be included.[8]

---

[7] CPUC 2009b. CPUC. Staff White Paper, "LDV Electrification in California," May 22, 2009

[8] Additional analysis would be necessary to determine the optimal program design in the context of total emission reductions and other policy considerations. The University of California is currently contracted by ARB to research the potential benefits of a feebate program in California; the results are anticipated by January 2010.

3. Fuel Infrastructure

Fueling infrastructure for ZEVs includes production and delivery of hydrogen fuel and electricity for passenger vehicles. In order for ZEV sales to successfully expand as mandated under the ZEV Regulation, fueling infrastructure will need to be in place, publicly accessible, and reliable to give future ZEV consumers and manufacturers confidence that their ZEV investment will be worthwhile. This is especially true for hydrogen.

The challenge is that private investment and a viable business opportunity for commercial ZEV infrastructure is lacking for the short term, and varies widely depending on the fuel. For example, a hydrogen station may not become profitable until demand reaches 500-1000 kilograms per day, meaning it could take as long as 10 to 15 years for major energy firms to see a return on their investment. Such investments are particularly risky when there is uncertainty in size and timing of FCV markets.

Infrastructure for electric vehicle charging also faces many challenges. Although early vehicle charging for PHEVs can take advantage of existing residential infrastructure, distribution upgrades and installations of home[9] and workplace charging stations will be needed as vehicle volumes increase. As the numbers of BEVs increase, the demand for home, workplace and eventually public charging infrastructure will also increase.

This section outlines existing and potential future policies that could help address market barriers for ZEV fueling infrastructure. Successful implementation of the ZEV Regulation will depend on progress towards such policies and installed infrastructure.

Existing Policies and Programs

<u>AB 118.</u> Along with vehicle incentives from AB 118[10], annual direct cost-share investments will be made in infrastructure. This will be managed by the California Energy Commission (CEC) and will have annual investment plans to identify funding priorities, followed by a competitive bid process for project awards. Various alternative fuels will be supported, including electric charging, biofuel stations, hydrogen stations, and natural gas stations.

<u>ARRA (Federal stimulus funding).</u> The ARRA established over $14.4 billion of investments for plug-in vehicles and electric infrastructure. For infrastructure, this includes facility tax credits and up to 50% cost-share for residential infrastructure. See Figure one for a complete cost breakdown of the ARRA funding.

---

[9] "Home" charging will be required wherever drivers park overnight, including at multi-family dwellings.
[10] AB 118 funding became available in 2008

U.S. Department of Energy (DOE) Incentive. The U.S. DOE offers a tax credit to fuel providers for the cost of installing alternative fueling equipment. For hydrogen, the maximum credit amount for equipment placed into service before January 1, 2015, is $200,000.

Federal and State Smart Grid Policies. The Federal Energy Regulatory Commission is implementing the Smart Grid Policy Statement from the 2007 Energy Independence and Security Act, which includes the deployment and integration of plug-in vehicles to the grid. The CPUC has also initiated a proceeding, R.8-12-009, which is a rulemaking to consider smart grid technologies[11].

Clean Fuels Outlet. The current Clean Fuels Outlet (CFO) regulation[12] was originally adopted in 1991 as a means of assuring that infrastructure was in place for vehicles that operate on alternative fuels such as alcohol fuels and natural gas. The regulation was last updated in 2000.

The current regulation sets the number of designated clean fuel vehicles that would trigger a clean fuel outlet requirement at 20,000, with discount factors assigned to fleet vehicles. The formula for calculating the number of mandated fuel outlets is based on the projected statewide fuel demand divided by clean fuel station throughput volumes set at 300,000 gasoline gallon equivalent (gge)/year for liquid fuels and 400,000 therms/year for gaseous fuels. With these volumes, each new outlet would be required to have enough clean fuel throughput to meet the daily demands of roughly 590 liquid fuel cars or 1,370 FCVs. Electric vehicles are not included in the current regulation. Because of the high threshold trigger, the CFO is not useful in providing fueling infrastructure during the transition from demonstration to commercial volumes.

The regulation places the compliance burden on owner/lessors of retail gasoline outlets. However, over the past 20 years, gasoline station ownership has shifted from the majority being oil company-owned to the majority being owned by small private entities. As indicated in Figure 2, currently two-thirds of the state's 10,900 gasoline stations are owned by entities that own 20 or fewer stations, and only 20 percent of the state's stations are owned by oil companies that own 200 or more stations.[13]

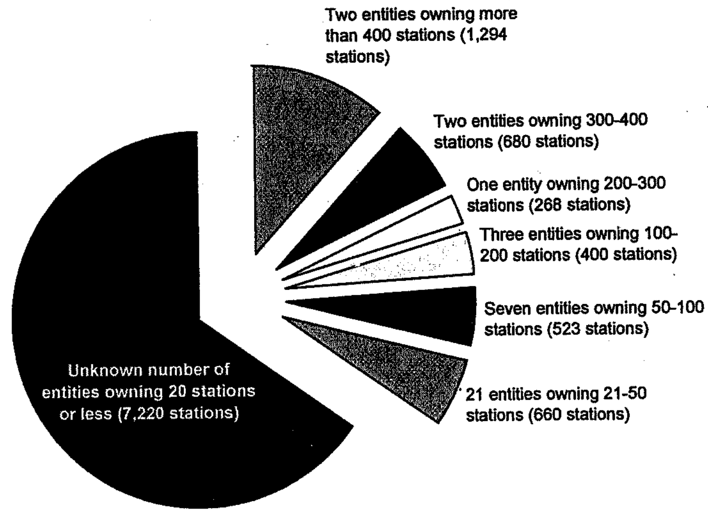
---

[11] "Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's own Motion to Actively Guide Policy in California's Development of a Smart Grid System." Filed by Public Utilities Commission, December 22, 2008, San Francisco, CA. Rulemaking 08-12-009.

[12] California Code of Regulations Title 13, Chapter 8

[13] SBE 2009 a. Data Source: Bill Benson, Research and Statistics Section, State Board of Equalization (SBE). Database search for entities registered under NAICS 4471 that own 20 gasoline stations or more, September 2009

Figure 2: Gasoline Station Owner Distribution



Possible Future Policies and Programs

CPUC Rulemaking 09-08-009: The CPUC has begun a rulemaking to consider alternative-fueled vehicle tariffs, infrastructure, and policies to support California's GHG emissions reduction goals. [14] The intent of the rulemaking is to develop consistent statewide policies and standards to guide and encourage development of electric vehicle metering, home electric vehicle charging infrastructure, commercial and public charging infrastructure, tariff schedules, and, if advisable, incentive programs. The rulemaking will address:

- The scope and role of CPUC's regulatory authority over BEV and PHEV service providers, including third-party resellers who provide electricity to ZEVs;
- Possible recommendations to ARB regarding aspects of the LCFS which apply to regulating entities which provide electricity fuel; and
- Possible changes to the current rate structure (i.e., separate BEV and PHEV tariff or separate time-of-use meters) to accommodate anticipated increases in electrical usage when customers charge BEVs and PHEVs at home on their residential accounts.

The CPUC invited interested parties to comment on this rulemaking and posed 43 questions for them to consider regarding charging policy (residential, commercial, and public), legal issues related to the ownership and operation of charging stations, codes and standards, electrical system impacts, tariff issues, LCFS, programs and incentives, and scope. As of October 14, 2009, 18 entities representing utilities, energy providers, third party resellers, infrastructure

---

[14] "Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Tariffs, Infrastructure and Policies to Support California's Greenhouse Gas Emission Reduction Goals." Filed by Public Utilities Commission, August 20, 2009, San Francisco, CA. Rulemaking 09-08-009. http://www.cpuc.ca.gov/PUC/hottopics/1Energy/090814_ev.htm

developers, auto makers, and environmental, renewable energy, and consumer advocacy non-governmental organizations have responded.

LCFS Credit Incentives. In the current LCFS, approved by the Board in April 2009, each type of fuel has a carbon intensity default value based on an assumed pathway of lifecycle emissions from fuel production, transport, and end-use (gCO_2e/MJ fuel delivered). As such, the carbon intensity values for each fuel vary, but are directly proportional to their lifecycle carbon dioxide equivalent emissions.

ARB is evaluating the concept of incentivizing very low carbon fuels such as electricity and hydrogen. The need for this evaluation is motivated by the fact that these fuels have larger market entry barriers compared to other fuels, and have the long-term potential for truly low carbon transportation fuels. Staff recognizes that this concept deviates from the intent of the current LCFS to evaluate fuels based solely on lifecycle GHG emissions; however, it may have the benefit of encouraging the availability of fuels and fueling infrastructure for a wider suite of alternative fuels that better support the expected advanced vehicle mix. Staff is evaluating a range of options for program changes and assessing potential impacts and means to maintain the benefits of the primary LCFS goals.

Public Financing Program for Hydrogen Infrastructure. Incentive and grant programs are important to helping build new fueling infrastructure. However, the on-going availability of funding is often unpredictable and thus fails to send a consistent signal to those considering investment in hydrogen fueling infrastructure. A comprehensive, durable and sustainable approach to hydrogen infrastructure investment may be needed to give the technology what it needs to advance through the early stages of commercialization. Financing for renewable and low-carbon hydrogen production essential to achieving long term sustainability.[15]

In contrast to hydrogen, development and long-term maintenance of electric vehicle charging infrastructure can conceivably be financed by the electrical utilities that will ultimately pass the costs on to their rate payers. Time of use charging rates will encourage off-peak low carbon charging. Likewise, natural gas infrastructure has received consistent public funding year after year to the extent that commercialization of CNG vehicle technology has not been hindered. Ethanol infrastructure is being incentivized through the LCFS and government funding.

Cap and Trade Revenue. Generally speaking, there are multiple ways of distributing cap and trade program revenue, including to regulated parties such as electric utility companies. In the case where emissions allowances are

---

[15] California Health & Safety Code Section 43868 and 43869 (Senate Bill 1505, Statute of 2006) requires that all state-funded transportation hydrogen be low-carbon and 33% renewable, and that all hydrogen produced for transportation be 33% renewable when 3,500 metric tons/year are dispensed.

distributed for free, distribution rules may stipulate how the value of the allowances should be used, including concepts such as investing in renewable electricity or smart grid programs. In the case where allowances are openly sold in a program auction, the State will decide how the revenue will be spent. This could be in the form of a direct rebate to all Californians, or revenue could be allocated as direct funding for low carbon projects.

Clean Fuels Outlet modifications. Staff is currently reviewing the CFO regulation to assess if modifications are needed to ensure adequate supply of low carbon fuels and fueling infrastructure for ZEVs. This review was prompted by the Board's response to the insufficient amount of activity and incentives being dedicated to developing hydrogen fueling infrastructure. Any proposed changes to the regulation would be designed to align near-term (2010-2020) fueling infrastructure growth with long term (2050) low carbon fuel needs. First, dedicated fuels and vehicles included in the regulation would be chosen based on their ability to meet long-term climate change goals, rather than their ability to meet criteria pollutant standards. The number of vehicles needed to initiate the mandate would be reduced and provisions would be added to ensure that fueling outlet locations and station throughput requirements match the needs of existing and future vehicle deployments.

Vehicle trigger: Staff will continue seeking auto industry projections on their alternative fueled vehicle production plans per the existing CFO regulation. Additionally, ARB will request specific geographic deployment projections. Auto projections, along with information on current and in-progress alternative-fuel vehicle infrastructure, will be evaluated and considered when developing a new and likely lower, vehicle trigger.

Pulling the trigger: ARB would use this data to evaluate the need for new infrastructure for each dedicated fuel vehicle technology. This evaluation would assess whether current needs for these alternative-fueled vehicles are being met by existing infrastructure, including home refueling and workplace or fleet stations that offer fuel to vehicles beyond their fleet. Availability of federal, state and local infrastructure incentives would be assessed, as would the effectiveness these incentives have on spurring infrastructure growth. If the vehicle trigger is reached, the Executive Officer would use this information to decide whether to require fueling infrastructure for this specific fuel (i.e., "pull the trigger").

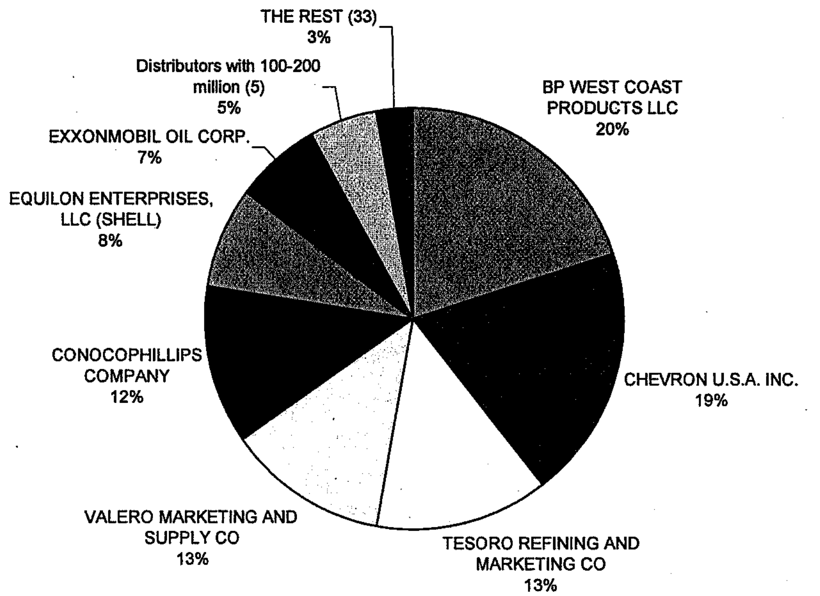
Regulated party. Finally, compliance responsibility could be shifted from owner/lessors of retail gasoline outlets to energy companies that supply gasoline to California. The larger of these entities (BP, Chevron, Tesoro, Valero, ConocoPhillips, Shell, and ExxonMobil), as indicated in Figure 3, benefit most from meeting California driver demands. [16] These companies supply the vast

---

[16] Data Source: SBE 2009b. SBE Monthly Motor Vehicle Fuel Distribution Reports, July 2008 through June 2009; http://www.boe.ca.gov/sptaxprog/spftrpts.htm. In-state production and imports are included in the

majority of California's gasoline regardless of whether they produce it in-state, import it, or manage the retail outlets and should, therefore, have a role in meeting the demands of tomorrow's alternative fueled vehicles.

Figure 3: Motor Vehicle Fuel Distributors
Gallons Distributed from July 2008 through June 2009
Percent of Total – 14,823,800,403 gallons



4. Conclusions and Recommendations

The ZEV Regulation can be successful if consumers demonstrate demand for advanced vehicles when offered for sale. This will become especially challenging once the regulation requires higher vehicle volumes (more than 10,000). Eventually, long-term vehicle sales will be successful if the automotive industry does not have to rely on market policies such as incentives. However, in the first few years of advanced vehicle sales, consumers will be apprehensive to buy the vehicles because of initially high vehicle costs and infrastructure challenges. Public policies will likely be needed during the period of 2015 to 2025 to encourage early buyers in California. And will likely need to be adjusted or revised every few years as the market for ZEVs develops.

---

reports submitted to BOE. All taxable, exempt, and reportable products imported into California must be reported by the BOE-licensed entity that owns the fuel when it crosses the border into the state.

5. References

CEC. California Energy Commission (CEC). Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program (AB 118). CEC-600-2009-008-CMF. April 2009. http://www.energy.ca.gov/2009publications/CEC-600-2009-008/CEC-600-2009-008-CMF.PDF

CPUC 2008. California Public Utilities Commission (CPUC). Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's own Motion to Actively Guide Policy in California's Development of a Smart Grid System. December 2008. http://docs.cpuc.ca.gov/published/proceedings/R0812009_doc.htm

CPUC 2009a. CPUC. Order Instituting Rulemaking to Consider Alternative-Fueled Vehicle Tariffs, Infrastructure and Policies to Support California's Greenhouse Gas Emissions Reductions Goals. August 2009. http://docs.cpuc.ca.gov/published/proceedings/R0908009.htm

CPUC 2009b. CPUC. Staff White Paper, "LDV Electrification in California," May 22, 2009. http://www.cpuc.ca.gov/NR/rdonlyres/AD8A4A5E-6ED9-4493-BDB6-326AB86A028E/0/CPUCPPDElectricVehicleWhitePaper2.pdf

NRC. National Research Council, "Transitions to Alternative Transportation Technologies: A Focus on Hydrogen," 2008

PIA. Plug In America. "Stimulus Federal Incentives". www.pluginamerica.org. 2009

SBE 2009a. Data Source: Bill Benson, Research and Statistics Section, State Board of Equalization (SBE). Database search for entities registered under NAICS 4471 that own 20 gasoline stations or more, September 2009

SBE 2009b. SBE Monthly Motor Vehicle Fuel Distribution Reports; http://www.boe.ca.gov/sptaxprog/spftrpts.htm, July 2008 through June 2009.