

# CLIMATE CHANGE DRAFT SCOPING PLAN

*a framework for change*

## APPENDICES

JUNE 2008 DISCUSSION DRAFT

*Pursuant to AB 32*

*The California Global Warming Solutions Act of 2006*

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the California Air Resources Board  
for the State of California

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**Appendix A: AB 32: The Global Warming  
Solutions Act of 2006**

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**Assembly Bill No. 32**

**CHAPTER 488**

An act to add Division 25.5 (commencing with Section 38500) to the Health and Safety Code, relating to air pollution.

[Approved by Governor September 27, 2006. Filed with Secretary of State September 27, 2006.] LEGISLATIVE COUNSEL'S DIGEST

AB 32, Nunez. Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006.

Under existing law, the State Air Resources Board (state board), the State Energy Resources Conservation and Development Commission (Energy Commission), and the California Climate Action Registry all have responsibilities with respect to the control of emissions of greenhouse gases, as defined, and the Secretary for Environmental Protection is required to coordinate emission reductions of greenhouse gases and climate change activity in state government.

This bill would require the state board to adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with this program, as specified. The bill would require the state board to adopt a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020, as specified. The bill would require the state board to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions, as specified. The bill would authorize the state board to adopt market-based compliance mechanisms, as defined, meeting specified requirements. The bill would require the state board to monitor compliance with and enforce any rule, regulation, order, emission limitation, emissions reduction measure, or market-based compliance mechanism adopted by the state board, pursuant to specified provisions of existing law. The bill would authorize the state board to adopt a schedule of fees to be paid by regulated sources of greenhouse gas emissions, as specified.

Because the bill would require the state board to establish emissions limits and other requirements, the violation of which would be a crime, this bill would create a state-mandated local program.

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.

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

SECTION 1. Division 25.5 (commencing with Section 38500) is added to the Health and Safety Code, to read:

Division 25.5. CALIFORNIA GLOBAL WARMING SOLUTIONS ACT OF 2006

PART 1. GENERAL PROVISIONS

CHAPTER 1. TITLE OF DIVISION

38500. This division shall be known, and may be cited, as the California Global Warming Solutions Act of 2006.

CHAPTER 2. FINDINGS AND DECLARATIONS

38501. The Legislature finds and declares all of the following:

(a) Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.

(b) Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry. It will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state.

(c) California has long been a national and international leader on energy conservation and environmental stewardship efforts, including the areas of air quality protections, energy efficiency requirements, renewable energy standards, natural resource conservation, and greenhouse gas emission standards for passenger vehicles. The program established by this division will continue this tradition of environmental leadership by placing California at the forefront of national and international efforts to reduce emissions of greenhouse gases.

(d) National and international actions are necessary to fully address the issue of global warming. However, action taken by California to reduce emissions of greenhouse gases will have far-reaching effects by encouraging other states, the federal government, and other countries to act.

(e) By exercising a global leadership role, California will also position its economy, technology centers, financial institutions, and businesses to benefit from national and international efforts to reduce emissions of greenhouse gases. More importantly, investing in the development of innovative and pioneering technologies will assist California in achieving the 2020 statewide limit on emissions of greenhouse gases established by this division and will provide an opportunity for the state to take a global economic and technological leadership role in reducing emissions of greenhouse gases.

(f) It is the intent of the Legislature that the State Air Resources Board coordinate with state agencies, as well as consult with the environmental justice community, industry sectors, business groups, academic institutions,

## Text of AB 32

environmental organizations, and other stakeholders in implementing this division.

(g) It is the intent of the Legislature that the State Air Resources Board consult with the Public Utilities Commission in the development of emissions reduction measures, including limits on emissions of greenhouse gases applied to electricity and natural gas providers regulated by the Public Utilities Commission in order to ensure that electricity and natural gas providers are not required to meet duplicative or inconsistent regulatory requirements.

(h) It is the intent of the Legislature that the State Air Resources Board design emissions reduction measures to meet the statewide emissions limits for greenhouse gases established pursuant to this division in a manner that minimizes costs and maximizes benefits for California's economy, improves and modernizes California's energy infrastructure and maintains electric system reliability, maximizes additional environmental and economic co-benefits for California, and complements the state's efforts to improve air quality.

(i) It is the intent of the Legislature that the Climate Action Team established by the Governor to coordinate the efforts set forth under Executive Order S-3-05 continue its role in coordinating overall climate policy.

### CHAPTER 3. DEFINITIONS

38505. For the purposes of this division, the following terms have the following meanings:

(a) "Allowance" means an authorization to emit, during a specified year, up to one ton of carbon dioxide equivalent.

(b) "Alternative compliance mechanism" means an action undertaken by a greenhouse gas emission source that achieves the equivalent reduction of greenhouse gas emissions over the same time period as a direct emission reduction, and that is approved by the state board. "Alternative compliance mechanism" includes, but is not limited to, a flexible compliance schedule, alternative control technology, a process change, or a product substitution.

(c) "Carbon dioxide equivalent" means the amount of carbon dioxide by weight that would produce the same global warming impact as a given weight of another greenhouse gas, based on the best available science, including from the Intergovernmental Panel on Climate Change.

(d) "Cost-effective" or "cost-effectiveness" means the cost per unit of reduced emissions of greenhouse gases adjusted for its global warming potential.

(e) "Direct emission reduction" means a greenhouse gas emission reduction action made by a greenhouse gas emission source at that source.

(f) "Emissions reduction measure" means programs, measures, standards, and alternative compliance mechanisms authorized pursuant to this division, applicable to sources or categories of sources, that are designed to reduce emissions of greenhouse gases.

(g) "Greenhouse gas" or "greenhouse gases" includes all of the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

(h) "Greenhouse gas emissions limit" means an authorization, during a specified year, to emit up to a level of greenhouse gases specified by the state board, expressed in tons of carbon dioxide equivalents.

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(i) “Greenhouse gas emission source” or “source” means any source, or category of sources, of greenhouse gas emissions whose emissions are at a level of significance, as determined by the state board, that its participation in the program established under this division will enable the state board to effectively reduce greenhouse gas emissions and monitor compliance with the statewide greenhouse gas emissions limit.

(j) “Leakage” means a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state.

(k) “Market-based compliance mechanism” means either of the following:

(1) A system of market-based declining annual aggregate emissions limitations for sources or categories of sources that emit greenhouse gases.

(2) Greenhouse gas emissions exchanges, banking, credits, and other transactions, governed by rules and protocols established by the state board, that result in the same greenhouse gas emission reduction, over the same time period, as direct compliance with a greenhouse gas emission limit or emission reduction measure adopted by the state board pursuant to this division.

(l) “State board” means the State Air Resources Board.

(m) “Statewide greenhouse gas emissions” means the total annual emissions of greenhouse gases in the state, including all emissions of greenhouse gases from the generation of electricity delivered to and consumed in California, accounting for transmission and distribution line losses, whether the electricity is generated in state or imported. Statewide emissions shall be expressed in tons of carbon dioxide equivalents.

(n) “Statewide greenhouse gas emissions limit” or “statewide emissions limit” means the maximum allowable level of statewide greenhouse gas emissions in 2020, as determined by the state board pursuant to Part 3 (commencing with Section 38850).

## CHAPTER 4. ROLE OF STATE BOARD

38510. The State Air Resources Board is the state agency charged with monitoring and regulating sources of emissions of greenhouse gases that cause global warming in order to reduce emissions of greenhouse gases.

## PART 2. MANDATORY GREENHOUSE GAS EMISSIONS REPORTING

38530. (a) On or before January 1, 2008, the state board shall adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with this program.

(b) The regulations shall do all of the following:

(1) Require the monitoring and annual reporting of greenhouse gas emissions from greenhouse gas emission sources beginning with the sources or categories of sources that contribute the most to statewide emissions.

(2) Account for greenhouse gas emissions from all electricity consumed in the state, including transmission and distribution line losses from electricity generated within the state or imported from outside the state. This requirement applies to all retail sellers of electricity, including load-serving

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entities as defined in subdivision (j) of Section 380 of the Public Utilities Code and local publicly owned electric utilities as defined in Section 9604 of the Public Utilities Code.

(3) Where appropriate and to the maximum extent feasible, incorporate the standards and protocols developed by the California Climate Action Registry, established pursuant to Chapter 6 (commencing with Section 42800) of Part 4 of Division 26. Entities that voluntarily participated in the California Climate Action Registry prior to December 31, 2006, and have developed a greenhouse gas emission reporting program, shall not be required to significantly alter their reporting or verification program except as necessary to ensure that reporting is complete and verifiable for the purposes of compliance with this division as determined by the state board.

(4) Ensure rigorous and consistent accounting of emissions, and provide reporting tools and formats to ensure collection of necessary data.

(5) Ensure that greenhouse gas emission sources maintain comprehensive records of all reported greenhouse gas emissions.

(c) The state board shall do both of the following:

(1) Periodically review and update its emission reporting requirements, as necessary.

(2) Review existing and proposed international, federal, and state greenhouse gas emission reporting programs and make reasonable efforts to promote consistency among the programs established pursuant to this part and other programs, and to streamline reporting requirements on greenhouse gas emission sources.

### PART 3. STATEWIDE GREENHOUSE GAS EMISSIONS LIMIT

38550. By January 1, 2008, the state board shall, after one or more public workshops, with public notice, and an opportunity for all interested parties to comment, determine what the statewide greenhouse gas emissions level was in 1990, and approve in a public hearing, a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. In order to ensure the most accurate determination feasible, the state board shall evaluate the best available scientific, technological, and economic information on greenhouse gas emissions to determine the 1990 level of greenhouse gas emissions.

38551. (a) The statewide greenhouse gas emissions limit shall remain in effect unless otherwise amended or repealed.

(b) It is the intent of the Legislature that the statewide greenhouse gas emissions limit continue in existence and be used to maintain and continue reductions in emissions of greenhouse gases beyond 2020

(c) The state board shall make recommendations to the Governor and the Legislature on how to continue reductions of greenhouse gas emissions beyond 2020.

### PART 4. GREENHOUSE GAS EMISSIONS REDUCTIONS

38560. 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 reductions from sources or categories of sources, subject to the criteria and schedules set forth in this part.

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38560.5. (a) On or before June 30, 2007, the state board shall publish and make available to the public a list of discrete early action greenhouse gas emission reduction measures that can be implemented prior to the measures and limits adopted pursuant to Section 38562.

(b) On or before January 1, 2010, the state board shall adopt regulations to implement the measures identified on the list published pursuant to subdivision (a).

(c) The regulations adopted by the state board pursuant to this section shall achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from those sources or categories of sources, in furtherance of achieving the statewide greenhouse gas emissions limit.

(d) The regulations adopted pursuant to this section shall be enforceable no later than January 1, 2010.

38561. (a) On or before January 1, 2009, the state board shall prepare and approve a scoping plan, as that term is understood by the state board, for achieving the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from sources or categories of sources of greenhouse gases by 2020 under this division. The state board shall consult with all state agencies with jurisdiction over sources of greenhouse gases, including the Public Utilities Commission and the State Energy Resources Conservation and Development Commission, on all elements of its plan that pertain to energy related matters including, but not limited to, electrical generation, load based-standards or requirements, the provision of reliable and affordable electrical service, petroleum refining, and statewide fuel supplies to ensure the greenhouse gas emissions reduction activities to be adopted and implemented by the state board are complementary, nonduplicative, and can be implemented in an efficient and cost-effective manner.

(b) The plan shall identify and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based compliance mechanisms, and potential monetary and nonmonetary incentives for sources and categories of sources that the state board finds are necessary or desirable to facilitate the achievement of the maximum feasible and cost-effective reductions of greenhouse gas emissions by 2020.

(c) In making the determinations required by subdivision (b), the state board shall consider all relevant information pertaining to greenhouse gas emissions reduction programs in other states, localities, and nations, including the northeastern states of the United States, Canada, and the European Union.

(d) The state board shall evaluate the total potential costs and total potential economic and noneconomic benefits of the plan for reducing greenhouse gases to California's economy, environment, and public health, using the best available economic models, emission estimation techniques, and other scientific methods.

(e) In developing its plan, the state board shall take into account the relative contribution of each source or source category to statewide greenhouse gas emissions, and the potential for adverse effects on small businesses, and shall recommend a de minimis threshold of greenhouse gas emissions below which emission reduction requirements will not apply.

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(f) In developing its plan, the state board shall identify opportunities for emission reductions measures from all verifiable and enforceable voluntary actions, including, but not limited to, carbon sequestration projects and best management practices.

(g) The state board shall conduct a series of public workshops to give interested parties an opportunity to comment on the plan. The state board shall conduct a portion of these workshops in regions of the state that have the most significant exposure to air pollutants, including, but not limited to, communities with minority populations, communities with low-income populations, or both.

(h) The state board shall update its plan for achieving the maximum technologically feasible and cost-effective reductions of greenhouse gas emissions at least once every five years.

38562. (a) On or before January 1, 2011, the state board shall adopt greenhouse gas emission limits and emission reduction measures by regulation to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions in furtherance of achieving the statewide greenhouse gas emissions limit, to become operative beginning on January 1, 2012.

(b) In adopting regulations pursuant to this section and Part 5 (commencing with Section 38570), to the extent feasible and in furtherance of achieving the statewide greenhouse gas emissions limit, the state board shall do all of the following:

(1) 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.

(2) Ensure that activities undertaken to comply with the regulations do not disproportionately impact low-income communities.

(3) 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.

(4) 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.

(5) Consider cost-effectiveness of these regulations.

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

(7) Minimize the administrative burden of implementing and complying with these regulations.

(8) Minimize leakage.

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(9) Consider the significance of the contribution of each source or category of sources to statewide emissions of greenhouse gases.

(c) In furtherance of achieving the statewide greenhouse gas emissions limit, by January 1, 2011, the state board may adopt a regulation that establishes a system of market-based declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emissions, applicable from January 1, 2012, to December 31, 2020, inclusive, that the state board determines will achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions, in the aggregate, from those sources or categories of sources.

(d) Any regulation adopted by the state board pursuant to this part or Part 5 (commencing with Section 38570) shall ensure all of the following:

(1) The greenhouse gas emission reductions achieved are real, permanent, quantifiable, verifiable, and enforceable by the state board.

(2) For regulations pursuant to Part 5 (commencing with Section 38570), 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.

(3) 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.

(e) 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 this section.

(f) The state board shall consult with the Public Utilities Commission in the development of the regulations as they affect electricity and natural gas providers in order to minimize duplicative or inconsistent regulatory requirements.

(g) After January 1, 2011, the state board may revise regulations adopted pursuant to this section and adopt additional regulations to further the provisions of this division.

38563. Nothing in this division restricts the state board from adopting greenhouse gas emission limits or emission reduction measures prior to January 1, 2011, imposing those limits or measures prior to January 1, 2012, or providing early reduction credit where appropriate.

38564. The state board shall consult with other states, and the federal government, and other nations to identify the most effective strategies and methods to reduce greenhouse gases, manage greenhouse gas control programs, and to facilitate the development of integrated and cost-effective regional, national, and international greenhouse gas reduction programs.

38565. The state board shall ensure that the greenhouse gas emission reduction rules, regulations, programs, mechanisms, and incentives under its jurisdiction, where applicable and to the extent feasible, direct public and private investment toward the most disadvantaged communities in California and provide an opportunity for small businesses, schools, affordable housing associations, and other community institutions to participate in and benefit from statewide efforts to reduce greenhouse gas emissions.

## PART 5. MARKET-BASED COMPLIANCE MECHANISMS

38570. (a) The state board may include in the regulations adopted pursuant to Section 38562 the use of market-based compliance mechanisms to comply with the regulations.

(b) Prior to the inclusion of any market-based compliance mechanism in the regulations, to the extent feasible and in furtherance of achieving the statewide greenhouse gas emissions limit, the state board shall do all of the following:

(1) Consider the potential for direct, indirect, and cumulative emission impacts from these mechanisms, including localized impacts in communities that are already adversely impacted by air pollution.

(2) Design any market-based compliance mechanism to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants.

(3) Maximize additional environmental and economic benefits for California, as appropriate.

(c) The state board shall adopt regulations governing how market-based compliance mechanisms may be used by regulated entities subject to greenhouse gas emission limits and mandatory emission reporting requirements to achieve compliance with their greenhouse gas emissions limits.

38571. The state board shall adopt methodologies for the quantification of voluntary greenhouse gas emission reductions. The state board shall adopt regulations to verify and enforce any voluntary greenhouse gas emission reductions that are authorized by the state board for use to comply with greenhouse gas emission limits established by the state board. The adoption of methodologies is exempt from the rulemaking provisions of the Administrative Procedure Act (Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code).

38574. Nothing in this part or Part 4 (commencing with Section 38560) confers any authority on the state board to alter any programs administered by other state agencies for the reduction of greenhouse gas emissions.

## PART 6. ENFORCEMENT

38580. (a) The state board shall monitor compliance with and enforce any rule, regulation, order, emission limitation, emissions reduction measure, or market-based compliance mechanism adopted by the state board pursuant to this division.

(b) (1) Any violation of any rule, regulation, order, emission limitation, emissions reduction measure, or other measure adopted by the state board pursuant to this division may be enjoined pursuant to Section 41513, and the violation is subject to those penalties set forth in Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.

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(2) Any violation of any rule, regulation, order, emission limitation, emissions reduction measure, or other measure adopted by the state board pursuant to this division shall be deemed to result in an emission of an air contaminant for the purposes of the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.

(3) The state board may develop a method to convert a violation of any rule, regulation, order, emission limitation, or other emissions reduction measure adopted by the state board pursuant to this division into the number of days in violation, where appropriate, for the purposes of the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.

(c) Section 42407 and subdivision (i) of Section 42410 shall not apply to this part.

## PART 7. MISCELLANEOUS PROVISIONS

38590. If the regulations adopted pursuant to Section 43018.5 do not remain in effect, the state board shall implement alternative regulations to control mobile sources of greenhouse gas emissions to achieve equivalent or greater reductions.

38591. (a) The state board, by July 1, 2007, shall convene an environmental justice advisory committee, of at least three members, to advise it in developing the scoping plan pursuant to Section 38561 and any other pertinent matter in implementing this division. The advisory committee shall be comprised of representatives from communities in the state with the most significant exposure to air pollution, including, but not limited to, communities with minority populations or low-income populations, or both.

(b) The state board shall appoint the advisory committee members from nominations received from environmental justice organizations and community groups.

(c) The state board shall provide reasonable per diem for attendance at advisory committee meetings by advisory committee members from nonprofit organizations.

(d) The state board shall appoint an Economic and Technology Advancement Advisory Committee to advise the state board on activities that will facilitate investment in and implementation of technological research and development opportunities, including, but not limited to, identifying new technologies, research, demonstration projects, funding opportunities, developing state, national, and international partnerships and technology transfer opportunities, and identifying and assessing research and advanced technology investment and incentive opportunities that will assist in the reduction of greenhouse gas emissions. The committee may also advise the state board on state, regional, national, and international economic and technological developments related to greenhouse gas emission reductions.

38592. (a) All state agencies shall consider and implement strategies to reduce their greenhouse gas emissions.

(b) Nothing in this division shall relieve any person, entity, or public agency of compliance with other applicable federal, state, or local laws or

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regulations, including state air and water quality requirements, and other requirements for protecting public health or the environment.

38593. (a) Nothing in this division affects the authority of the Public Utilities Commission.(b) Nothing in this division affects the obligation of an electrical corporation to provide customers with safe and reliable electric service.

38594. Nothing in this division shall limit or expand the existing authority of any district, as defined in Section 39025.

38595. Nothing in this division shall preclude, prohibit, or restrict the construction of any new facility or the expansion of an existing facility subject to regulation under this division, if all applicable requirements are met and the facility is in compliance with regulations adopted pursuant to this division.

38596. The provisions of this division are severable. If any provision of this division or its application is held invalid, that invalidity shall not affect other provisions or applications that can be given effect without the invalid provision or application.

38597. The state board may adopt by regulation, after a public workshop, a schedule of fees to be paid by the sources of greenhouse gas emissions regulated pursuant to this division, consistent with Section 57001. The revenues collected pursuant to this section, shall be deposited into the Air Pollution Control Fund and are available upon appropriation, by the Legislature, for purposes of carrying out this division.

38598. (a) Nothing in this division shall limit the existing authority of a state entity to adopt and implement greenhouse gas emissions reduction measures.

(b) Nothing in this division shall relieve any state entity of its legal obligations to comply with existing law or regulation.

38599. (a) In the event of extraordinary circumstances, catastrophic events, or threat of significant economic harm, the Governor may adjust the applicable deadlines for individual regulations, or for the state in the aggregate, to the earliest feasible date after that deadline.

(b) The adjustment period may not exceed one year unless the Governor makes an additional adjustment pursuant to subdivision (a).

(c) Nothing in this section affects the powers and duties established in the California Emergency Services Act (Chapter 7 (commencing with Section 8550) of Division 1 of Title 2 of the Government Code).

(d) The Governor shall, within 10 days of invoking subdivision (a), provide written notification to the Legislature of the action undertaken.

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.

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**Appendix B: List of Acronyms and Glossary**

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## ACRONYMS

AB	Assembly Bill
A/C	Air Conditioning
Ag	Agriculture
ATCM	Airborne Toxic Control Measure
ARB	Air Resources Board
ARMINES	School of Mining Engineering of Paris
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
BACT	Best Available Control Technology
BAR	(California) Bureau of Automotive Repair
BAU	Business as Usual
BC	British Columbia (Canada)
BEAR	Berkeley Energy and Resources
BIPV	Building Integrated Photovoltaic
BMP	Best Management Practices
BTUs	British Thermal Units
CAFO	Confined Animal Feeding Operation
CAISO	California Independent System Operator
CalEPA	California Environmental Protection Agency
CalTrans	California Department of Transportation
CAPCOA	California Air Pollution Control Officers Association
CAT	Climate Action Team
CBSC	California Building Standards Commission
CCA	Community Choice Aggregators
CCAR	California Climate Action Registry
CCRC	Climate Change Research Center
CCS	Carbon Dioxide Capture and Sequestration
CDE	California Department of Education
CDFA	California Department of Food and Agriculture
C-E	Cost Effectiveness
CEC	California Energy Commission
CEQA	California Environmental Quality Act
C <sub>2</sub> F <sub>6</sub>	Hexafluoroethane
CFC	Chlorofluorocarbons
CFL	Compact Fluorescent Light Bulb
CFR	Code of Federal Regulations

## Acronyms and Glossary

CH <sub>4</sub>	Methane
CHP	Combined Heat and Power
CHPS	Collaborative for High Performance Schools
CIF	Carbon Intensity Factor
CIWMB	California Integrated Waste Management Board
CMUA	California Municipal Utilities Association
CNG	Compressed Natural Gas
CO	Carbon Monoxide`
CO <sub>2</sub>	Carbon Dioxide
CO <sub>2</sub> E	Carbon Dioxide Equivalent
CPUC	California Public Utilities Commission
CRC	Carbon Regenerated Catalyst
CREB	Clean Renewable Energy Bonds
CSA	Consumer Service Agent
CSAC	California State Association of Counties
CSI	California Solar Initiative
CSU	California State University
CVD	Chemical Vapor Deposition
DCA	(California) Department of Consumer Affairs
DFG	(California) Department of Fish and Game
DPH	(California) Department of Public Health
DG	Distributed Generation
DGS	Department of General Services
DIY	Do-it-yourself
DMV	(California) Department of Motor Vehicles
DOC	(California) Department of Conservation
DOE	(California) Department of Energy
DWR	(California) Department of Water Resources
DX	Direct Expansion
EBI	Energy Bioscience Institute
E-DRAM	Environmental Dynamic Revenue Assessment Model
EE	Energy Efficiency
EF	Efficiency Factor
EIA	Energy Information Administration
EJ	Environmental Justice
EJAC	Environmental Justice Advisory Committee
EMFAC	Emission Factors Model
EMS	Environmental Management System

## Acronyms and Glossary

EO	Executive Order
EOL	End-of-life
EPAct	Energy Policy Act
EPP	Environmentally Preferable Purchasing
EPRI	Electric Power Research Institute
EPEAT	Electronic Product Environmental Assessment Tool
EPS	Emissions Performance Standard
ESCO	Energy Services Companies
ESPs	Electric Service Providers
ETAAC	Economic and Technology Advancement Advisory Committee
EU	European Union
FAMS	Fleet Assessment Management System
FCC	Fluidized Catalytic Cracking
FJD	First Jurisdictional Deliverer
FRAP	Fire and Resources Assessment Program
GBI	Green Building Program
gCO <sub>2</sub> E/MJ	Grams of CO <sub>2</sub> Equivalent per Mega-Joule
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Gas Insulated Substations
GPS	Global Positioning System
GSP	Gross State Product
GVW	Gross Vehicle Weight
GWh	Gigawatt Hours
GWP	Global Warming Potential
HCCI	Homogenous Charge Compression Ignition
HCD	(California Department of) Housing and Community Development
HCFC	Hydrochlorofluorocarbons
HERS	Home Energy Rating System
HFC	Hydrofluorocarbons
HFE	Hydrofluoroethers
HSC	Health and Safety Code
HSR	High Speed Rail
HVAC	Heating, Ventilation, and Air Conditioning
I.C.	Internal Combustion
ICAP	International Carbon Action Partnership
ICLEI	International Council for Local Environmental Initiatives
IEPR	Integrated Energy Policy Report

## Acronyms and Glossary

IGEM	Institution of Gas Engineers and Managers
IID	Imperial Irrigation District
I/M	Inspection and Maintenance (Smog Check)
IOU	Investor- Owned Utilities
IPCC	Intergovernmental Panel on Climate Change
ISR	Indirect Source Rule(s)
IT	Information Technology
kWh	Kilowatt Hours
kWh/y	Kilowatt Hours per Year
LADWP	Los Angeles Department of Water and Power
Lb/yd <sup>3</sup>	Pound per Cubic Yard
LCCP	Lifecycle Climate Performance
LCD	Liquid Crystal Display
LCFS	Low Carbon Fuel Standard
LDAR	Leak Detection and Repair
LDT	Light-Duty Truck
LDV	Light-Duty Vehicle
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
LEED- EB	Leadership in Energy and Environmental Design for Existing Buildings
LEED- NC	Leadership in Energy and Environmental Design for New Commercial Buildings
LID	Low Impact Development
LIOB	Low-Income Oversight Board
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LSI	Large-Spark Ignition
MAC	Market Advisory Committee
MAF	Million Acre Feet
MIT	Massachusetts Institute of Technology
MMBtu	Million British Thermal Units
MMT	Million Metric Tons
MMTCO <sub>2</sub>	Million Metric Tons of Carbon Dioxide
MMTCO <sub>2</sub> E	Million Metric Tons of Carbon Dioxide Equivalents
MPO	Metropolitan Planning Organization
MRF	Material Recovery Facility
MTCO <sub>2</sub> E	Metric Ton of CO <sub>2</sub> Equivalent
MVAC	Motor Vehicle Air Conditioning

## Acronyms and Glossary

MW	Megawatt
MWH/AF	Megawatt Hours per Acre-foot
MY	Model Year
N/A	Not Applicable
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollution
NF <sub>3</sub>	Nitrogen Trifluoride
NGO	Non-Governmental Organization
NH <sub>3</sub>	Ammonia
Nm	Nautical Miles
N <sub>2</sub> O	Nitrous Oxide
NO <sub>x</sub>	Oxides of Nitrogen
NPV	Net Present Value
NRC	National Research Council
NSHP	New Solar Homes Partnership
ODS	Ozone-Depleting Substances
OEM	Original Equipment Manufacturers
O&G	Oil and Gas
OPR	(Governor's) Office of Planning and Research
OPSC	Office of Public School Construction
PAYD	Pay-As-You-Drive
PC	Passenger Cars
PERS	(California) Public Employees Retirement System
PFC	Perfluorocarbon
PFPE	Perfluoropolyethers
PG&E	Pacific Gas and Electric
PIER	Public Interest Energy Research
PM	Particulate Matter
PM <sub>2.5</sub>	Particulate Matter less than 2.5 microns
POU	Publicly Owned Utilities
PPM	Parts Per Million
PUC	Public Utilities Commission
PV	Photovoltaic
RA	Resources Agency
RAC	Refrigeration and Air Conditioning
RCx	Retro-commissioning
RD&D	Research, Development, and Demonstration
RECLAIM	Regional Clean Air Incentive Market

## Acronyms and Glossary

RETI	Renewable Energy Transmission Initiative
RGGI	Regional Greenhouse Gas Initiative
RIN	Renewable Identification Number
RFS	Renewable Fuel Standard
ROG	Reactive Organic Gas
RPS	Renewables Portfolio Standard
RTP	Regional Transportation Plan
SAB	State Allocation Board
SACOG	Sacramento Area Council of Governments
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCM	Supplementary Cementitious Material
SDG&E	San Diego Gas and Electric
SF <sub>6</sub>	Sulfur Hexafluoride
SFP	School Facility Programs
SGIP	Self Generation Incentive Program
SHWEA	Solar Hot Water Efficiency Act
SIA	Semiconductor Industry Association
SIP	State Implementation Plan
SL	Secondary Loop
SMUD	Sacramento Municipal Utility District
SO <sub>x</sub>	Sulfur Oxide
SO <sub>2</sub>	Sulfur Dioxide
STAR	Science to Achieve Results
STIP	State Transportation Improvement Program
STRS	(California) State Teachers Retirement System
SUV	Sports Utility Vehicle
SWP	State Water Project
SWRCB	State Water Resources Control Board
TBD	To Be Determined
TCR	The Climate Registry
T&D	Transmission and Distribution
TEAP	Technology and Economic Assessment Panel
TRU	Transport Refrigeration Units
UC	University of California
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency

## Acronyms and Glossary

UTO	Useful Thermal Output
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound
VSR	Vessel Speed Reduction
WECC	Western Electricity Coordinating Council
WCI	Western Climate Initiative
ZNE	Zero Net Energy

## GLOSSARY OF CLIMATE CHANGE TERMS

**Afforestation:** Planting of new forests on lands that historically have not contained forests.

**Allocation:** Process by which emission allowances are periodically distributed both initially and on an on-going basis under an emissions cap and trade system.

**Allowance:** An authorization to emit, during a specified year, up to one ton of carbon dioxide equivalent. (HSC §38505(a))

**Berkeley Energy and Resource (BEAR) Model:** A dynamic general equilibrium forecasting model that simulates the way that changes in energy investment, price and use affect how Californians live their lives.

**Cap:** A limit on emissions.

**Cap and Trade:** An environmental regulatory program that limits (caps) the total emissions of a certain pollutant by issuing tradable allowances and requiring that allowances be surrendered to cover actual emissions. The limit on the number of tradable allowances issued ensures that emissions will not exceed the desired amount.

**Carbon Dioxide Equivalent (CO<sub>2</sub>E):** A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential. Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents (MMT<sub>CO<sub>2</sub>E)</sub>".

**Carbon Intensity:** Intensity of an energy supply, defined as the amount of carbon emitted per unit of energy.

**California Climate Action Registry (CCAR):** A private non-profit organization originally formed by the State of California. The California Registry serves as a voluntary greenhouse gas (GHG) registry to protect and promote early actions to reduce GHG emissions by organizations.

**Cost-Effectiveness:** The cost per unit of reduced emissions of greenhouse gases adjusted for its global warming potential. (HSC §38505(d))

**Criteria Pollutants:** U.S. EPA has identified six "criteria pollutants," ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead as indicators of air quality, and for each is an established maximum concentration above which adverse effects on human health may occur.

**Discrete Early Action:** Greenhouse gas reduction measures enforceable by January 1, 2010. (HSC §38560.5)

**Early Action:** Greenhouse gas reduction measures to be initiated by ARB in the 2007-2012 timeframe. These measures may be regulatory or non-regulatory.

**Environmental Dynamic Revenue Assessment Model (E-DRAM):** A dynamic general equilibrium forecasting model that simulates the way that changes in energy investment, price and use affect how Californians live their lives.

**Energy 2020:** An economy-wide energy use model that predicts the investment behavior of both energy suppliers and consumers.

**Economic and Technology Advancement Advisory Committee (ETAAC):** A committee which advises ARB on activities that will facilitate investment in and implementation of technological research and development opportunities including, but not limited to, identifying new technologies, research, demonstration projects, funding opportunities, developing state, national, and international partnerships and technology transfer opportunities, and identifying and assessing research and advanced technology investment and incentive opportunities that will assist in the reduction of greenhouse gas emissions. (HSC §38591(d))

**Environmental Justice Advisory Committee (EJAC):** A committee created by AB 32 whose mission is to advise ARB in developing the Scoping Plan and any other pertinent matter in implementing AB 32. (HSC §38591(a))

**Global Warming Potential (GWP):** The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emissions of one kilogram of a greenhouse gas to that from emission of one kilogram of carbon dioxide over a period of time (usually 100 years).

**Greenhouse Gas (GHG):** Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), halogenated fluorocarbons (HCFCs), ozone (O<sub>3</sub>), perfluorocarbons (PFCs), sulfur hexafluoride (SF<sub>6</sub>) and hydrofluorocarbons (HFCs). (HSC §38505(g))

**Intergovernmental Panel on Climate Change (IPCC):** Established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988 for the purpose of assessing information in the scientific and technical literature related to all significant components of the issue of climate change.

**Investor Owned Utilities (IOUs):** A private company that provides a utility, such as water, natural gas or electricity, to a specific service area.

**Kyoto Gases:** Carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>), sulfur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons, and perfluorocarbons.

## Acronyms and Glossary

**Leakage:** A reduction in emissions of greenhouse gases within California that is offset by an increase in emissions of greenhouse gases outside the state. (HSC §38505(j))

**Montreal Gases:** Ozone depleting substances covered by the Montreal Protocol, including chlorofluorocarbons, hydrochlorofluorocarbons, carbon tetrachloride, methyl chloroform, and brominated gases.

**Offsets:** Verifiable emission reductions whose ownership can be transferred to others.

**Ozone Depleting Substance (ODS):** A compound that contributes to stratospheric ozone depletion. These substances include chlorofluorocarbons, hydrochlorofluorocarbons, halons, methyl bromide, carbon tetrachloride, and methyl chloroform.

**Public Owned Utilities (POUs):** Non-profit utility providers owned by a community and operated by municipalities, counties, states, public power districts, or other public organizations.

**Reforestation:** Planting of forests on lands that have previously contained forests but that have been converted to some other use.

**Sequestration:** The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through land-use change, afforestation, reforestation, and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases or from processing fossil fuels to produce hydrogen- and carbon dioxide-rich fractions and long-term storage in underground in depleted oil and gas reservoirs, coal seams, and saline aquifers.

**Voluntary Measures:** Measures to reduce GHG emissions that are adopted in the absence of government mandates.

**Western Electricity Coordinating Council (WECC):** A regional forum for promoting regional electric service reliability in Western Canada and the Western United States.

**Appendix C: Sector Overviews and  
Emission Reduction Strategies**

## **INTRODUCTION**

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This appendix describes each of the economic sectors and individual measures outlined in the Draft Plan. The measure descriptions include estimated emission reductions and the associated estimated net cost of the measure, the lead agencies associated with each measure, and the timeframe for adoption and implementation of the measure. Please note that there are additional greenhouse gas emission reduction strategies included in this Appendix, that are not listed in, or counted upon, in the Draft Scoping Plan. These additional strategies, which are still under evaluation, could provide additional GHG emission reductions to fill potential shortfalls in emission reductions as discussed in the *Tracking Progress* section of the Draft Plan.

The measures identified in this Appendix were developed by ARB with input from state agencies, sector specific Climate Action Teams subgroups (Sub-CATs) and the public. Many of these measures are in developmental stages and the estimated costs, emission reductions, applicable technologies, and other factors will likely change as they move through the regulatory process.

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## 1. CAP AND TRADE

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Includes the following measure:

### Preliminary Recommendation

#### California Cap-and-Trade Program Linked to Western Climate Initiative

##### **Background**

A cap-and-trade program can help meet the requirements of AB 32 by providing cost-effective GHG reductions. The cap establishes a limit on emissions that declines over time. The ability to trade gives regulated sources greater incentive to pursue low-cost emission reduction strategies at their facilities than a source by source program would. Like all regulatory programs, an effective cap-and-trade system must be well designed, and include strong monitoring, reporting and enforcement rules, including strict penalties for non-compliance. In addition, AB 32 includes specific criteria that ARB must consider before adopting regulations for market-based measures, and directs the Board to the extent feasible to design any market-based compliance mechanisms to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants. (HSC §38570(b))

A well-designed cap-and-trade system provides certainty that the program will meet the emissions limit while creating a price for GHG emissions that reflects the cost of the reductions needed to meet the environmental goal. This price signal affects decisions by both producers and consumers about the energy they use or supply and the services and products they buy. Facilities have a continuous incentive to reduce emissions in order to reduce their compliance costs. The market creates an opportunity for facilities that can reduce emissions at lower cost to do so. One example of a cap-and-trade program is the U.S. EPA's acid rain trading program, a national program to decrease acid rain by reducing emissions of sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) from power plants. The acid rain program has successfully achieved the environmental goal of the cap at a cost of several billion dollars less than originally expected.<sup>1</sup>

California is working closely with other States and Provinces in the Western Climate Initiative (WCI) to design a cap-and-trade program that can deliver equitable and roughly equivalent GHG reductions throughout the west from each of the partner jurisdictions. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI partner States and Provinces. Other WCI partners will do the same, creating a western regional emissions reduction program. ARB will continue to work with the WCI Partners to ensure that the resulting program design is one that provides real emission reductions and that enables the California program to meet all the requirements of AB 32, including the need to consider any potential localized impacts, ensures market security (avoid gaming), and is enforceable .

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<sup>1</sup> "The Acid Rain Program and Environmental Justice: Staff Analysis" (September 2005)  
U.S. Environmental Protection Agency, Office of Air and Radiation, Clean Air Markets Program.

### **Fundamentals of Cap-and-Trade**

A cap-and-trade program establishes an enforceable limit (or cap) on the total emissions for those entities covered by the program. The cap is set for each compliance period of the program by the State, and emission reductions increase as the cap declines over time.

A key component of a cap and trade program is a permit, typically called an allowance. Each allowance represents a permit to emit one unit of GHG emissions. In California, this unit would most likely be one metric ton of carbon dioxide equivalent (MTCO<sub>2</sub>E). Allowances are distributed in the program in an amount equal to the total emissions limit for a compliance period. At the end of each compliance period, all entities in a cap-and-trade program must surrender allowances equal to their total emissions during the compliance period.

The limited number of allowances issued creates a binding cap on emissions, while issuing fewer allowances over time ensures declining emissions. The allowances can be bought and sold by firms in the program. This creates an allowance value or price that reflects the cost of reducing emissions. Unneeded allowances held by one entity can be sold to another source or banked for future use.

The rules for a cap-and-trade program define specific compliance periods. At the end of each compliance period, facilities would be required to surrender allowances equal to what they emitted. Failure of a facility to surrender sufficient allowances to cover their emissions would result in significant penalties. To maintain the environmental integrity of the system, non-compliance penalties must include purchasing and surrendering allowances at least equal to the facility's excess emissions.

New facilities that begin operation in sectors included in a cap-and-trade program would need to purchase allowances through an auction, from a reserve, or from other allowance holders. This process provides a mechanism for new facilities to operate while guaranteeing that there is no increase in overall greenhouse gas emissions when new facilities are built.

A cap-and-trade system would also allow facilities to retain or "bank" allowances for future use. Allowance banking provides an incentive for capped sources to over-comply in early periods with the knowledge that they can use or sell the extra reductions in the future. Where allowed, banking has been used extensively, resulting in much greater early emissions reductions than would otherwise have taken place. Having allowances in the bank creates a hedge against any number of unexpected developments that could lead to higher-than-expected market prices.

### **Cap-and-trade program and regulatory measures**

Because it sets a firm limit on the quantity of greenhouse gases emitted, a well-designed cap and trade program complements regulatory measures for capped sectors. A broad cap-and-trade program could cover up to 85% of the State's emission sources by 2020.

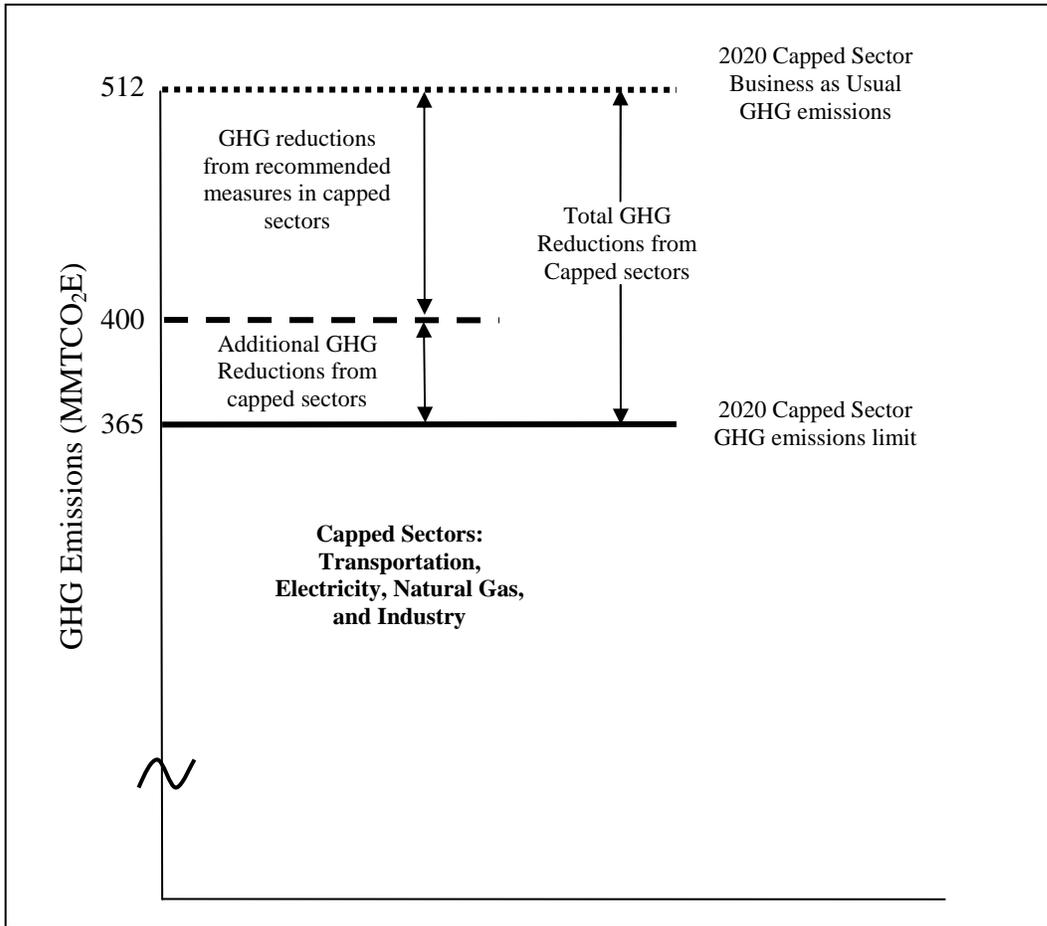
This includes the electricity, transportation fuels, natural gas, and large industrial sectors. Emissions or energy use from most of the capped sectors would also be reduced by other measures, including performance standards, efficiency programs, and direct regulations. These measures assist affected entities in meeting their compliance obligation under the cap.

Figure 1 illustrates the relationship between the emission limit established by the cap-and-trade program and the emission reductions obtained through other recommended measures. By 2020, the business-as-usual emissions forecast for these sectors is projected to be 512 MMTCO<sub>2</sub>E, as depicted by the top line. Implementation of the other recommended measures for these sectors is expected to reduce emissions by 112 MMTCO<sub>2</sub>E, resulting in total GHG emissions of 400 MMTCO<sub>2</sub>E, as depicted by the heavy-dashed line. To ensure compliance with AB 32 goals, the allowable emissions from the capped sectors would be about 365 MMTCO<sub>2</sub>E in 2020. The additional reduction requirement of 35 MMTCO<sub>2</sub>E are the responsibility of the capped sectors to reduce and are shown directly below the heavy-dashed line. These additional reductions will come from sources in the program that are able to reduce emissions in the most cost-effective manner.<sup>2</sup> All measures for capped sectors will contribute to achieving the cap by reducing the need for facilities in the program to surrender allowances. Overall, the cap represents a 147 MMTCO<sub>2</sub>E reduction from projected business-as-usual (BAU) emissions from the 85 percent of GHG emission sources proposed to be included under the cap.

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<sup>2</sup> For a further discussion of this issue, see Box 2-2, page 13 of the California Market Advisory report at: [http://www.climatechange.ca.gov/market\\_advisory\\_committee/index.html](http://www.climatechange.ca.gov/market_advisory_committee/index.html)

**Figure 1. 2020 Emissions from sectors in cap-and-trade program**



**Western Climate Initiative**

California is working within the Western Climate Initiative (WCI) to design a western regional market system. WCI is a collaboration of states and Canadian provinces established to develop regional strategies to reduce GHG emissions. Launched in February 2007, the WCI currently consists of California, Arizona, New Mexico, Oregon, Washington, Utah, and Montana, and the Canadian provinces of British Columbia, Manitoba, and Quebec. In addition to these partner jurisdictions, six U.S. states, two Canadian provinces, and six Mexican states are participating in WCI as observers. The WCI partner states and provinces have set an overall regional goal for reducing GHG emissions, and are working together to develop a framework for the regional program. The partners plan to release the cap-and-trade program design framework in September 2008. By participating in a western regional system, California maximizes its potential to achieve greenhouse reductions in the most cost-effective manner possible and significantly reduces the concerns about leakage.

A cap-and-trade program is one element of the effort by the WCI partners to identify, evaluate, and implement ways to reduce GHG emissions and achieve related co-benefits.

WCI released draft recommendations for a regional cap-and-trade program in May 2008, which are presented in Appendix D.<sup>3</sup> These recommendations were developed collaboratively by the WCI Partners, including California, with a goal of achieving regional GHG reduction targets equitably and effectively. The May 2008 WCI's draft recommendations are consistent with the recommendations provided in June 2007 by the California Market Advisory Committee,<sup>4</sup> and with the recommendations provided to ARB by the California Public Utilities Commission and the California Energy Commission in March 2008.

In addition to the work on developing a regional cap-and-trade program, the WCI partners have committed to promoting increased energy efficiency, vehicle performance standards, promoting the development and use of clean and renewable energy resources, and advocating national and regional climate policies that reflect the needs and interests of western states, tribes and provinces. The partners recognize that emission reduction limits ultimately established under the cap-and-trade program will need to be augmented with other strategies to reach the individual partner goals and the regional goal. Therefore, all the WCI partners will continue to examine a wide range of complementary policies, including regulations, laws, and other measures at the state and provincial level as part of the analyses for a cap-and-trade approach.

While ARB is looking to participate in a regionally coordinated cap-and-trade program as developed through the WCI, the California program will need to meet the requirements of AB 32. The program would be integrated with the overall implementation of the range of regulatory measures and policies that the Board includes in the Adopted Scoping Plan. Participating in a cap-and-trade program will not excuse facilities from obligations imposed on them by other measures adopted under AB 32. Rather, reductions achieved through those other measures will result in reduced emissions and the need for fewer allowances to comply with the cap-and-trade program. With appropriate environmental safeguards in place, a regional cap-and-trade approach will result in statewide co-benefits of improved air quality, reduced emissions, and lower health-based risk from air toxics.

ARB would develop regulations to implement the cap-and-trade system by the end of 2010, based on the authority and requirements of AB 32, with the program beginning in 2012. This rule development schedule would be coordinated with that of the WCI timeline for a regional cap-and-trade program.

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<sup>3</sup> A more detailed set of recommendations are scheduled to be released by the WCI partners in late July, 2008. All discussion of the WCI draft recommendations in this appendix refer to the version released on May 16, 2008.

<sup>4</sup> The Report, "Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California," was released in June 2007 and can be found online at: [http://climatechange.ca.gov/market\\_advisory\\_committee/index.html](http://climatechange.ca.gov/market_advisory_committee/index.html). The Market Advisory Committee (MAC) consisted of a consortium of economists, policy makers, academics, government sector public servants, and environmental advocates who came together through the auspices of Cal/EPA, pursuant to Executive Order S-20-06 from Governor Arnold Schwarzenegger.

### **Draft program design summary**

**Scope:** The scope of a cap-and-trade program defines the emission sources and types of gases included within the program. Compared to direct regulations alone, a broad-based cap-and-trade program is likely to yield additional opportunities for lower cost reductions, thereby reducing the cost of achieving the overall emission target. However, other considerations must also be weighed in determining program scope. These include the ability to monitor, report, and verify emissions to a high degree of accuracy; the incorporation of adequate environmental safeguards to prevent harm in communities that already experience disproportionate impacts that affect their health and air quality; the potential for economic impacts on industry or consumers; and the effectiveness of the cap in providing incentives for emission reductions in different sectors.

In the May 2008 WCI draft recommendations, the proposed scope for the first phase of the cap-and-trade program is to include electricity generation emissions, large stationary combustion emissions, industrial process and waste management emissions, and fossil fuel production and processing emissions. As required under AB 32, California will account for and regulate emissions from all electricity produced and consumed in the state, including electricity from both in-state generation and out-of-state generation. This requirement could be met through a regionally coordinated cap-and-trade program with a generator-based approach if all jurisdictions in the Western Electric Coordinating Council (WECC) were participating. If some WECC jurisdictions do not link with the WCI cap-and-trade program, a first jurisdictional deliverer approach that covers all emissions generated in WCI and all emissions attributable to electricity delivered in WCI but generated outside WCI, or some similar method, will be needed to address emissions from electricity imported into California from non-participating jurisdictions. This approach is generally consistent with the recommendations from the Market Advisory Committee and the approach recommended to ARB by the California Public Utilities Commission and the California Energy Commission based on their joint proceeding for implementing AB 32 in the electricity sector.

Also recommended for inclusion under the cap by 2020 are residential, commercial and small industrial fuel combustion sources through a cap on upstream deliverers of natural gas. Additional analysis is needed before making a specific recommendation on when to phase in these sources. WCI members have also expressed a strong interest in including transportation fuels in the cap-and-trade program, and California supports inclusion of transportation fuels under the cap at least by 2020. In the coming months, California will work with our WCI partners to develop a recommendation on how and when transportation fuels should be included under the cap.

To minimize the administrative burden of the cap-and-trade program, thresholds can be used to focus on large emitters that account for the overwhelming majority of emissions while exempting small facilities, at least initially. For example, at least 90 percent of fuel combustion GHG emissions from industrial point sources in California occur at facilities with at least 25,000 metric tons of emissions annually. The WCI partners are conducting analysis to establish thresholds which assure consistent coverage of facilities within industries and across jurisdictions.

**Setting the Cap for California:** The Scoping Plan must be designed to meet the AB 32 goal of reducing statewide emissions to 1990 levels by 2020. To meet that target, the emissions allowed under a cap-and-trade program, plus expected emissions from sources not included under the program’s cap, must be no greater than the 2020 emissions goal. This cap must also be realistic in terms of the emission reduction opportunities within the capped sectors.

As shown in Table 1, a preliminary estimate for the capped sectors GHG emissions is 365 MMTCO<sub>2</sub>E in 2020 for the broadest program under consideration. This covers about 85 percent of California total GHG emissions in 2020. Capped sectors would include electricity, transportation fuels, natural gas, and large industrial sources.<sup>5</sup> Emissions or energy use from most of the sectors covered by a cap-and-trade program would also be governed by other complementary measures, including performance standards, efficiency programs, and direct regulations.

**Table 1. Sector Responsibilities under Cap-and-Trade Program**  
(MMTCO<sub>2</sub>E in 2020)

Sector	Projected 2020 Business-as-Usual Emissions		Projected 2020 Emissions After Implementation of Other Recommended Measures		Preliminary 2020 Emissions Limit under Cap-and-Trade Program
	By Sector	Total	By Sector	Total	
Transportation	225	512	163	400	365
Electricity	139		94		
Commercial and Residential	47		42		
Industry	101		101		

As California links to the WCI partner programs to create a regional trading market, California’s cap must be consistent with the regional WCI program and the total regional emissions reduction goal. The WCI partners have set a regional goal of 15 percent reduction in GHG emissions below 2005 levels to be achieved by 2020.

The ultimate success of WCI will depend on the ability and willingness of all partners to maintain their commitment to meeting their economy-wide GHG emission reduction goals. A firm regional cap with strong reporting and enforcement rules will provide a high degree of certainty that emissions will not exceed targeted levels. ARB will ensure the system as a whole has integrity before California participates in the WCI market system.

<sup>5</sup> While WCI has not yet made a decision that transportation fuels will be included in the cap-and-trade program design, California shares a strong interest with other WCI members in phasing transportation fuels into the cap-and-trade program before 2020.

**Reporting:** ARB’s mandatory GHG reporting regulations provide a solid foundation for establishing a cap-and-trade system. As a cap-and-trade program is developed, these reporting requirements will be tailored to that program design.

Because sources in the program would be required to submit allowances equivalent to the reported level of their GHG emissions, accurate measurement and reporting of all emissions covered by the cap would be required to assure accountability, establish the integrity of allowances, and sustain confidence in the program. Additionally, all market participants need accurate reporting to make decisions on whether or not to buy, sell, or bank allowances. Penalties for non-compliance need to be both certain and stringent enough to ensure that all those capped by the program have a clear incentive to comply rather than risk paying the penalty.

**Allocation:** Allocation is the process by which emissions allowances are periodically distributed under an emissions cap-and-trade system. Allowances can be distributed in a number of ways: through auctions, free distribution, or a combination. As was pointed out in the Market Advisory Committee (MAC) report, the allowance allocation method will have a significant effect on how “the economic impact of a cap-and-trade system is distributed among regulated entities, consumers and other parties.”<sup>6</sup> With free distribution, a decision has to be made on who should receive allowances and on what basis. For example, free distribution can be based on performance standards (benchmarks), historical emissions (grandfathering), or some other relevant metric. With an auction, the primary decisions relate to design of the auction process and what to do with the auction proceeds. The MAC recommended that the state initially retain flexibility to allocate some of the allowances free of charge as a means of managing competitiveness and economic transition issues, but that any initial free distribution be limited to those entities that are not able to pass through costs to consumers and should quickly transition to a full auction with strategic use of the proceeds. In addition, the MAC recommended that any free allocation of allowances be based on environmental performance benchmarks, and that the auction process be designed to encourage voluntary early reductions by firms, municipalities, and individual consumers.

In their May 2008 draft recommendations, the WCI calls for a portion of the allowances in the system to be auctioned in the first year, with a minimum level between 25 and 75 percent to be established for each Partner. Some free distribution of allowances is likely appropriate during the early stages of the program, but distribution of allowances would quickly transition from a system in which the State provides some free allowances to a system in which majority of allowances are auctioned in the trading market. ARB will continue to work with all stakeholders and our WCI partners to develop a cap-and-trade program design that is fair and equitable for all Californians. Many of the details of the allocation methodology will need to be worked out in the rulemaking process as ARB adopts regulations to implement the program.

**Offsets:** Within the context of a cap and trade program, ARB would adopt regulations for verifying and enforcing any offsets used. Offsets can provide regulated entities a

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<sup>6</sup> MAC report, p. 55

source of low-cost emission reductions, and can encourage the spread of clean, efficient technology outside California. The locations of offset projects are an important consideration. High quality offset projects located outside California can help lower compliance costs in California while reducing GHG emissions in areas that would otherwise lack the resources needed to do so. Projects in the Mexican border region may be of particular interest, considering the opportunity to realize considerable co-benefits on both sides of the border. Additionally, defining project types related to imported commodities (such as cement) would enable California to provide incentives to reduce emissions associated with products that are imported into the state for our consumption.

In developing this offsets program, California will work with the WCI partners to ensure that the western regional market includes clear and consistent rules for use of offsets. For compliance purposes, the WCI partners are considering allowing individual regulated entities to use tradable units (offsets and allowances) from other government-regulated GHG emission trading systems. To be used for compliance, the WCI participating jurisdictions would need to formally recognize such units as meeting similarly rigorous criteria for environmental integrity. Limits are also being considered on the amount of offsets and non-WCI tradable units that could be used for compliance by individual regulated entities. Such limits would be designed to ensure that sources in the program undertake meaningful emission reductions, and to avoid foregone emission reductions at facilities that have potential localized health co-benefits.

Allowing offset projects from outside California to count for compliance under AB 32 could reduce the amount of reductions occurring within the state, and which would reduce the local economic, environmental and public health co-benefits from GHG emission reduction. Therefore, ARB is considering limiting the use of offsets for regulatory compliance. A limit on offsets, such as 10 percent of the compliance obligation for an individual firm, would allow ARB (and WCI partners) to test the viability of the offset system while limiting the risk that unconstrained offsets could weaken the stringency of the overall cap-and-trade program. Even if limited to a small portion of allowable emissions, the use of offsets would provide an outlet to ensure that entities can meet their obligations with cost-effective reductions.

### **Next steps on program design**

ARB will hold stakeholder meetings to discuss several key program design issues that must be addressed in developing the California cap-and-trade program and in creating the western regional market through WCI. ARB is also completing economic modeling and evaluation of the environmental and public health effects of the Scoping Plan, and will issue an evaluation supplement later this summer. The WCI partners plan to publish draft final recommendations for the design of a regional cap-and-trade program in July, and final design recommendations in September.

ARB will use this proposed WCI program design, the results of the modeling and evaluation work, and the input from stakeholders to provide more detailed program design recommendations in the Proposed Scoping Plan, which will be released in early October.

## 2. TRANSPORTATION

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This section includes the following measures:

### Preliminary Recommendations

**California Cap-and-Trade Program Linked to the Western Climate Initiative**

**(T-1) Pavley I and Pavley II– Light-Duty Vehicle GHG Standards**

**(T-3) Vehicle Efficiency Measures**

**(T-2) Low Carbon Fuel Standard (Discrete Early Action)**

**(T-4) Ship Electrification at Ports (Discrete Early Action)**

**(T-5) Goods Movement Efficiency Measures**

**(T-6) Heavy-Duty Vehicle GHG Emission Reduction—Aerodynamic Efficiency  
(Discrete Early Action)**

**(T-7) Medium- and Heavy-Duty Vehicle Hybridization**

**(T-8) Heavy-Duty Engine Efficiency**

**(T-10) High Speed Rail**

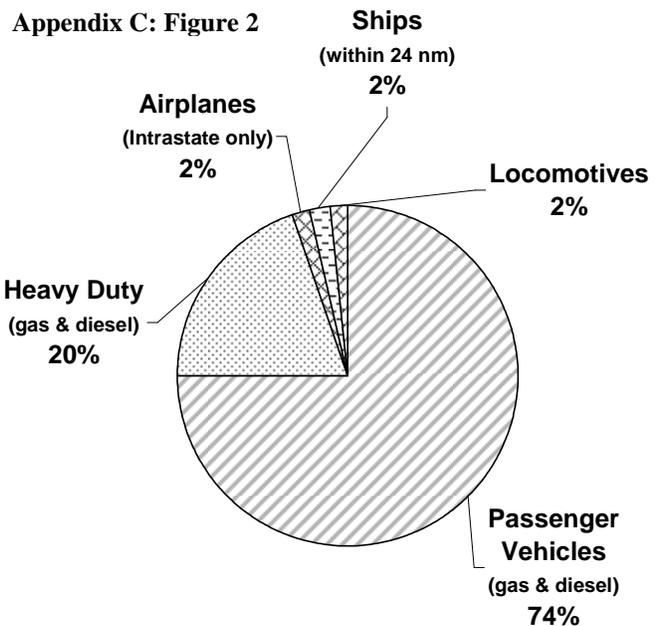
### Other Measures Under Evaluation

**Feebates**

## Overview

The transportation sector is integral to the people and economy of California. California has a long, successful history of improving the environmental footprint of transportation-related activities. These efforts have resulted in significant reductions of criteria and toxic air pollutants, improved air quality and public health. In addition, the clean vehicle technologies developed in response to California regulatory efforts have provided benefits across the nation and throughout the world. To achieve our GHG emission reduction goals, it is vital that we build on our past successes in reducing criteria and toxic air pollutants to achieve significant reductions in GHG emissions from transportation and goods movement activities. GHG emission reductions will come from three overarching strategies: more efficient vehicles, lower-carbon fuels, and reduction of vehicle use or vehicle miles traveled (VMT). The GHG emission reductions in this sector will be achieved largely through regulations, market mechanisms, incentives, and land use policy.

Transportation activities are responsible for 38 percent of the greenhouse gas (GHG) emissions in California – or 182 MMTCO<sub>2</sub>E



(2004). Because of its size, it is critical that the transportation sector achieve significant emission reductions toward the State's 2020 goal. If the transportation sector does not provide significant GHG reductions, it would be difficult for another sector to make up the emission reductions. These reductions in GHG emissions can be achieved through the use of currently available and emerging technologies and behavior change.

### **Vehicles**

Passenger vehicles (cars and light trucks) are responsible for 74 percent of the emissions from the transportation sector and are the primary focus of reduction strategies for the transportation sector. The Pavley (AB 1493) regulation, which has already been adopted by ARB, requires GHG emission reductions from passenger cars and light trucks. This regulation will provide about 27 MMTCO<sub>2</sub>E reductions in 2020—an 18 percent fleet wide reduction. The State of California is currently challenging a U.S. EPA decision that prevents the implementation of this regulation. Although ARB is confident that California will prevail, staff is also pursuing additional strategies to ensure that new California vehicles achieve the maximum feasible and cost-effective reductions in GHG emissions as required by law.

Although the Pavley regulation results in significant GHG reductions, more is needed. ARB is proposing additional strategies to ensure that new California vehicles achieve the maximum feasible and cost-effective reductions in GHG emissions including strengthening GHG tailpipe emission standards from passenger cars and light trucks and improving overall vehicle efficiencies.

Medium- and heavy-duty trucks account for about 20 percent of the transportation GHG emissions. ARB is pursuing strategies to increase the efficiency of medium and heavy duty vehicles through both engine specifications and devices that reduce aerodynamic drag and rolling resistance. These strategies will improve vehicle efficiency and reduce GHG emissions.

### **Fuel**

The fuel used in cars and trucks also has a significant impact on emissions. ARB is currently developing a regulatory proposal for the Low Carbon Fuel Standard (LCFS), which the Board will consider in late 2008 or early 2009. It is anticipated that the proposed regulation will provide a 10 percent reduction in carbon intensity by 2020, which translates to approximately 16.5 MMTCO<sub>2</sub>E of emission reductions.

Jet fuel used in intrastate plane trips accounts for approximately 2 percent of California's GHG emissions<sup>7</sup>. Emissions from the fuel used in planes is an important consideration, however, the State does not have regulatory authority over aviation. ARB has not identified aviation specific measures; however, successful deployment of High Speed Rail could divert some air passengers to rail.

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<sup>7</sup> These emissions do not include interstate air travel.

### **Transportation and Land Use**

The other factor in GHG emissions from transportation is the use of the vehicle. In the case of passenger vehicles, the metric for use is most commonly referred to as vehicle miles traveled (VMT). Statewide VMT increased about 35 percent from 1990 to 2007, and with current trends is expected to increase another 20 percent by 2020 and more than double between now and 2040. For California to meet its long term GHG emission reduction goal, this trend must be slowed.

The key to addressing the VMT challenge is providing people with more choices through diversified land use patterns, greater access to alternative forms of transportation including transit, biking and walking, and creating cities and towns where people can live work and play without having to drive great distances. Altering land use patterns to bring people closer to more destinations and enhance transit can result in VMT reduction over the long term. Current regional planning efforts are starting to move in a direction to create the choices that are needed to reverse projected VMT growth. A strategy of coordinated State, regional, and local land use and transportation planning, policies and finance, must be developed to encourage reductions in VMT. Land use strategies that provide for more compact growth not only reduce VMT, but can also reduce the carbon footprint of developments by reducing land consumption, energy use, water use, and waste. While these strategies are unlikely to provide significant reductions in GHG emissions by 2020 because of the time required to change land use patterns, they are a central element in ensuring that California gets on a low-carbon trajectory as we get to and beyond 2020.

Land use measures are described in detail in section 3 of this appendix.

### **Goods Movement**

A significant portion of the transportation activities are associated with the movement of freight or goods throughout the State. Reducing GHG emissions from the vehicles and equipment used in goods movement activities through increasing efficiency of the way goods move throughout the State and other measures has the dual benefit of reducing both GHG emissions and emissions of smog precursors and air toxics. With traffic at California ports projected to increase by 250 percent by 2020, reducing GHG emissions from this sector will be necessary to help meet the State's 2020 GHG goal. Proposed measures include implementation of two already adopted regulations for port drayage trucks and the use of shore power for ships at berth, and several new measures designed to improve the overall efficiency of goods movement throughout California, reduce fuel consumption, improve operational efficiencies such as improvements in dock-side container handling procedures, transportation mode shifts, and the application of new technologies and alternative fuels. Proposition 1B funds, as well as clean air plans being implemented by California's ports, will also help reduce greenhouse gases while cutting criteria pollutant and toxic diesel emissions. California's goal for the long-term is to identify and develop programs that will help bring the State closer to the 2050 target. Bringing the goods movement system to a low- or zero-carbon future will require California to begin work now on fostering the development of cutting edge low carbon technologies, creating partnerships to improve the overall efficiency of the goods

movement infrastructure, implementing programs to leverage the consumer in promoting a greener goods movement system, and identifying and implementing public policies that promote a low-carbon goods movement system.

## **Conclusion**

California has the opportunity to lead the nation in reducing emissions from the transportation sector. While the further deployment of existing technologies will allow California to achieve the 2020 goal, meeting California's long-term GHG goals will require substantial reductions from all areas including lower GHG vehicle/fuel systems, increased transportation efficiency, changes in the delivery of goods and services, expanded transit, and more efficient land use patterns.

## **Preliminary Recommendations**

### ***Cap-and-Trade Program***

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver GHG reductions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner states and provinces to create this regional market.

While WCI has not yet made a decision to include transportation fuels in the cap-and-trade program design, California shares a strong interest with other WCI Partners in phasing transportation fuels into the program before 2020. WCI and California are assessing potential points of regulation for including transportation fuels in the cap-and-trade program. WCI's work to date has identified the point at which transportation fuels enter into commerce in each state and province as a candidate point of regulation. In California, this point of regulation could be at the terminal rack or the point of final blending. By setting an overall limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will complement other regulatory measures for transportation fuels and achieve additional reductions in greenhouse gases in this sector.

### **A. LIGHT DUTY VEHICLES**

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#### ***(T-1) Pavley I and Pavley II– Light-Duty Vehicle GHG Standards***

AB 1493 (Pavley), Health and Safety Code Section 43018.5, directed the Air Resources Board (ARB) to adopt a regulation requiring the maximum feasible and cost effective reduction of greenhouse gas (GHG) emissions from new passenger vehicles.

In September 2004, the ARB approved regulations to reduce GHG emissions from new passenger vehicles. The regulations apply to new passenger vehicles and light-duty trucks beginning with the 2009 model year and phased-in through the 2016 model year.

These regulations add four GHG air contaminants to the vehicular criteria and toxic air contaminant emissions that California was already regulating – carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and hydrofluorocarbons (air conditioner refrigerants). The rulemaking established a declining fleet average standard for these pollutants, with separate standards for the lighter and heavier portions of the passenger vehicle fleet. The regulations also provide alternative compliance methods including credit generation from alternatively-fueled vehicles, and averaging, banking, and trading of credits within and among manufacturers.

The technical modifications needed to meet the standards will increase the cost of new vehicles. However, because these technology improvements will also reduce the operating cost of the vehicles, staff estimates that the average consumer will ultimately save \$30 per month. The estimated increase in initial cost is shown below:

**Appendix C Transportation  
Table 2**

Tier	Year	Average Cost of Control <sup>8</sup>	
		PC/LDT1 (Passenger cars and small trucks/SUVs)	LDT2 (Large trucks/SUVs)
Near-term	2009	\$17	\$36
	2010	\$58	\$85
	2011	\$230	\$176
	2012	\$367	\$277
Mid-term	2013	\$504	\$434
	2014	\$609	\$581
	2015	\$836	\$804
	2016	\$1,064	\$1,029

Under the Clean Air Act, California is required to apply for a waiver before implementing vehicle tailpipe emission standards. ARB applied for a waiver and was denied by the U.S. EPA. California and other states have challenged this ruling in court. Federal administration change over the next year may also affect the waiver denial. Nevertheless, AB 32 specifically states (section 38590) that if the Pavley (AB 1493) regulations do not stay in effect, the State shall implement alternative regulations to control mobile sources to achieve equivalent or greater GHG reductions. ARB currently plans to pursue one of two possible strategies to backstop the Pavley regulations if they cannot be implemented.

The first strategy requires the original equipment manufacturers (OEMs) to meet the equivalent of the emission reductions expected under the current Pavley regulations as a condition of vehicle certification in California. Before vehicles could be certified for sale in California, the OEM would need to submit verified GHG emission reductions equivalent to those that would have been achieved by the Pavley regulation. This obligation would cover the lifetime emissions of the vehicles.

<sup>8</sup> Initial Statement of Reasons, Regulations to Control Greenhouse Gases from Motor Vehicles. California Environmental Protection Agency, Air Resources Board, August 6, 2004.

The second strategy is a Feebate proposal in which fees on the purchase of high GHG emitting vehicles would be returned as rebates to buyers of low GHG emitting vehicles. The fee schedule would need to be designed to obtain cumulative emission reductions equivalent to those that would have been achieved under the Pavley regulations.

It is anticipated that there will be other benefits associated with Pavley I and the proposed Pavley II measures, such as a reduction in criteria pollutants. The regulation will reduce “upstream” smog-forming emissions from refining, marketing, and distribution of fuel. This will result in reductions of hydrocarbons and oxides of nitrogen by approximately 6 tons per day in 2020 and 10 tons per day in 2030<sup>9</sup>.

In addition to Pavley I, ARB proposes to further strengthen the vehicle tailpipe emission standards beginning with the 2017 model year. The new standards will follow up on the existing standards that reach maximum stringency in 2016. The technologies that might be employed include highly efficient hybrid vehicles, use of lightweight materials to reduce vehicle mass, and reductions in air conditioning-related emissions through the use of low-GWP refrigerants or other approaches.

### Appendix C Transportation-Preliminary Recommendations

Table 3

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Pavley (AB 1493)	31.7	-9,999	ARB	2004/2009-2016*
Pavley II – Light-Duty Vehicle GHG Standards		-1,048	ARB	2010/2017

\* This regulation has already been adopted. Implementation of the regulation is pending the outcome of the legal challenge to the waiver denial.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **(T-3) Vehicle Efficiency Measures**

Several measures would further reduce tailpipe GHG emissions by increasing vehicle efficiency. These measures include: ensuring proper tire inflation and adopting a low rolling resistance tire standard, use of low friction engine oils, and solar-reflective automotive paint and window glazing. ARB identified the tire inflation measure as a Discrete Early Action in 2007, which means a regulation to implement the measure, must be enforceable starting in 2010.

<sup>9</sup> *Ibid.* August 6, 2004.

### ***Tires***

A properly inflated tire helps to reduce fuel GHG emissions by reducing tire rolling resistance. Low rolling resistance tires for passenger and light duty vehicles can result in a 1 to 2 percent reduction in GHGs. The tire inflation and tire program would affect vehicle service facilities such as dealerships, maintenance garages, oil change facilities, tire centers, and smog check facilities. For the tire inflation program, it is clear that not all vehicles are serviced at regular intervals and that many individuals maintain or service their own vehicles, therefore, public education about proper tire inflation is necessary. For the tire tread program, a two-phased approach is needed, beginning with data gathering and education, followed by the development and adoption of tire rolling resistance standards.

### ***Low Friction Engine Oils***

Engine oil formulations can also impact a vehicle's GHG emissions, because the more easily the internal parts of the engine move, the more efficiently the engine will run. This, in turn, reduces the engine load and fuel used. Requiring passenger cars to use low friction engine oils results in 2 percent GHG reduction. Entities that could be affected by the low friction engine oils measure, depending on the point of regulation, include lube oil manufacturers, automobile manufacturers, and auto-repair shops.

### ***Solar-Reflective Automotive Paint and Window Glazing***

The use of solar-reflective automotive paint and window glazing would reduce the solar heat gain in a vehicle parked in the sun. Solar-reflective automotive paints are formulated with pigments that have low absorption (high reflectance) of sunlight. The more solar energy is reflected from a vehicle, the less the vehicle's interior will heat up when it is parked in the sun. A cooler interior would require less air conditioner use, which improves vehicle efficiency. Also, because the trend over time has been towards increased glass in vehicles, this measure would likely include a requirement that window glazing also meets certain solar reflectivity requirements. The solar heat gain reductions that can be accomplished with reflective glazing are even more substantial than those that can be obtained with solar-reflective automotive paints. The affected entities for this measure would be the vehicle manufacturers, paint vendors and manufacturers, and window/window film suppliers.

Appendix C Transportation-Preliminary Recommendations  
Table 4

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Tire Pressure Program*	0.82	-629	ARB	2009/2010
Tire Tread Standard	0.3	-123	CEC	2009-2010?
Low Friction Engine Oils	2.8	-434	ARB	2012/2014
Solar-Reflective Automotive Paint and Window Glazing	0.89	-5	ARB	2009/2012
<b>Total:</b>	4.8			

\*Discrete Early Action, to be enforced beginning on January 1, 2010.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## B. FUELS

### ***(T-2) Low Carbon Fuel Standard—Discrete Early Action***

In January 2007, Governor Schwarzenegger issued an Executive Order (S-01-07) establishing a Low Carbon Fuel Standard (LCFS). ARB approved the LCFS as a discrete early action measure and is set to adopt the regulation at the end of 2008, with implementation beginning in 2010. With close to 16 billion gallons of gasoline and approximately 4 billion gallons of diesel sold per year, sales of petroleum-based fuels make up approximately 96 percent of all transportation fuel sold in California. The LCFS is a key part of the State's strategy to reduce GHG emissions from the transportation sector and is being developed to reduce the carbon intensity of the State's transportation fuels by at least 10 percent by 2020.

The LCFS would require fuel providers<sup>10</sup> in California to ensure that the mix of fuel they sell into the California market meets, on average, a declining standard for GHG emissions measured in carbon dioxide equivalent grams per energy unit<sup>11</sup> of fuel sold. Fuels used for both on-road and off-road consumption would be covered. However, the LCFS would not apply to certain aviation and marine fuels that ARB lacks the authority to regulate.

<sup>10</sup> The LCFS would apply to all transportation fuel providers, including: refiners, blenders, producers or importers of transportation fuels in California and applies to providers of gasoline, diesel, natural gas, LPG (propane), electricity, hydrogen, ethanol, biodiesel and other mixed blends.

<sup>11</sup> Units expressed are grams of CO<sub>2</sub> equivalent per mega joule (gCO<sub>2</sub>E/MJ).

Transportation fuels would be evaluated and assigned carbon intensity values measured on a full-fuel cycle basis. This full-fuel cycle assessment would include the direct emissions from resource extraction (or production), transportation, refining/distillation and distribution. In addition, indirect land use GHG emissions would also be calculated and assigned where appropriate. For example, GHG impacts would be estimated from changes in land use patterns (i.e., converting forest lands to farms in South America).

Reducing the aggregate carbon intensity of fuels may be achieved through market-based methods whereby providers exceeding the required performance standard would receive credits that may be applied to future obligations or traded with providers not meeting the LCFS. Declining carbon intensity standards would be determined separately for gasoline and diesel.

It is currently proposed that regulated parties (those companies under the LCFS) may meet the standard by various means, including: 1) providing only fuels that meet the standard; 2) providing a mix of higher and lower carbon fuels that on average meet the standard; 3) using previously banked credits in an amount that equals the credit deficit; and 4) acquiring credits from other parties who earned credits by exceeding the standard such that the amount of credits acquired equals the credit deficit. For example, a producer may choose to meet the LCFS by a combination of selling low carbon fuels (e.g., ethanol derived from waste resources), and by buying credits from other LCFS regulated parties.

Utilizing market-based mechanisms would allow fuel providers flexibility to choose how they reduce emissions and realize GHG reductions at the lowest cost and in the most consumer-responsive manner. For example, providers could purchase and blend more low-carbon ethanol into gasoline products, purchase credits from electric utilities supplying low-carbon electrons to electric passenger vehicles, diversify into low-carbon hydrogen as a product and other new strategies yet to be developed.

The LCFS should result in several co-benefits, including bringing about meaningful changes in the fuels market by giving low carbon fuels a market edge over high carbon fuels. The LCFS should spark research in alternatives to petroleum-based fuels, leading to GHG emission reductions over the long term. This may provide important benefits as the state diversifies its fuel mix and becomes less dependent on petroleum.

ARB is performing a complete environmental analysis of LCFS during the regulatory process. In addition, ARB is evaluating potential localized impacts associated with the LCFS, as well as, various sustainability issues. Fuels, such as natural gas, liquefied petroleum gas (LPG), electricity, and hydrogen, would contribute to the LCFS by displacing some gasoline and diesel fuel. To the extent that such displacement occurs, vehicles operated with these fuels are expected to have lower criteria and toxic emissions.

There will be additional costs associated with the development of new alternative fuels such as the production of ethanol from cellulosic feedstock or the production of biodiesel or renewable diesel from various biomass-related feedstocks. Moreover, there will be

added costs associated with infrastructure needs. However, the costs of producing these fuels, given the current cost of gasoline and diesel production, are expected to be highly competitive. Therefore, ARB estimates that there will be no net difference in the costs of producing fuels to meet the LCFS versus the cost of producing gasoline and diesel.

The LCFS is scheduled to be presented to the Board in the December 2008 timeframe with full implementation starting 2010.

**Appendix C Transportation-Preliminary Recommendations**  
**Table 5**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/Implementation Timeframe
Low Carbon Fuel Standard (Discrete Early Action)	16.5	0	ARB	2008/2010

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **C. GOODS MOVEMENT**

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In October 2007, ARB approved three early action measures that affected goods movement activities. One of these, ship electrification at ports, was a discrete early action and the other, Port Drayage Truck rule, was an early action measure. The Board adopted these two measures in December 2007. The third, Vessel Speed Reduction, is currently under development. These three, and several new measures, being proposed for consideration in the Scoping Plan are described below<sup>12</sup>.

### **(T-4) Ship Electrification at Ports—Discrete Early Action**

In December 2007, ARB adopted the shore power regulation, a Discrete Early Action measure (enforceable starting in 2010). This regulation requires most container, passenger, and refrigerated cargo ships to shut off their auxiliary engines while at dock and receive power from the electrical grid, or reduce their emissions by a similar amount via the implementation of other technologies.

<sup>12</sup> For the early action measures, both the Port Drayage Truck measure and the Vessel Speed Reduction measure are incorporated into measure T-10, while the Ship Electrification at Ports is measure T-9.

### **(T-5) Goods Movement Efficiency Measures**

There are many opportunities to reduce GHG emissions from goods movement by improving the overall efficiency of how goods are moved in and around California. Several new measures are proposed for consideration that will reduce GHG emissions from goods movement activities. These measures, which are being combined under measure T-10, are briefly described below. Overall, the emission reduction goal for measure T-10 is to achieve a combined 3.5 MMTCO<sub>2</sub>E reduction in GHG emissions by 2020.

#### **Goods Movement System-Wide Efficiency Improvements**

Under this proposed measure, California ports, railroad operators, shipping companies, terminal operators, ship owners/operators, importers, exporters, trucking companies serving ports and rail operation, government agencies, and the public would participate in developing and implementing programs to achieve system-wide reductions in GHG emissions from goods movement activities.

There are two components to the measure. One that focuses locally on California's four key goods movement corridors with particular emphasis on ports and intermodal rail operation and that would achieve improvements in efficiency prior to 2020. The second component focuses more globally and further into the future. This component would begin the process for identifying how to move from the current systems to a low carbon sustainable goods movement system and evaluating opportunities to reduce GHG from the overall goods movement system supply chain.

Key elements of the first component would be to:

- Estimate emission and key contributors to the emissions;
- Develop trade corridor emission reduction plans;
- Assign emission reduction goals to the key contributors with particular emphasis on ports and intermodal rail operations;
- Identify and develop approaches to achieve the emission reduction goals; and
- Monitoring implementation of the emission reductions.

For the longer-term more global aspects of the measure we propose to establish a Goods Movement Vision 2050 taskforce that would be charged with developing the steps needed to move toward a low-carbon, sustainable goods movement network in California by 2050. As part of this element, the taskforce would identify:

- Private-public partnerships that foster efficient logistics systems and goods movement networks;
- Public policies that support and promote low-carbon goods movement networks;
- Consumer choices that encourage efficient transport of goods to and through California; and
- Programs to foster and implement low-carbon innovations.

### ***Ships***

Ocean-going vessel speed reduction (VSR) is an early action measure primarily designed to reduce NO<sub>x</sub> emissions, but also provides reductions in diesel PM emissions, SO<sub>x</sub> emissions, and CO<sub>2</sub> emissions resulting from reduced fuel consumption. A voluntary VSR program is currently in place at the Ports of Los Angeles and Long Beach. For this measure, ARB would conduct a technical assessment of the impacts associated with VSR for ocean-going vessels. As part of the technical assessment, ARB would evaluate emission reduction benefits of a VSR measure in and out of California ports and along the California coast within 24 nautical miles (nm), and 40 nm. Both voluntary and regulatory approaches may be evaluated.

Another ship measure being proposed is the clean ship (or green ship) measure. Under this measure, the concept is to reduce fuel consumption and associated CO<sub>2</sub> emissions through a variety of technologies and strategies including hull and propeller design in new ships, air cavity system to reduce hull resistance, advanced hull and propeller coatings and maintenance programs, advanced engine design optimized for efficiency, advanced heat recovery, operational controls, and wind power assistive devices.

### ***Port Trucks***

In December 2007, the ARB approved a regulation to reduce GHGs, diesel PM, and NO<sub>x</sub> emissions from drayage trucks operating at California's ports and rail yards through retrofits and turnover of pre-1994 trucks. This early action measure will be implemented in two phases. The first phase requires all pre-1994 model year drayage trucks to be replaced or retired with newer model year trucks. The second phase requires all engines to meet or exceed the 2007 California and federal engine emission standards by December 31, 2013.

### ***Commercial Harbor Craft***

ARB proposes development of an educational program to help commercial harbor craft owners and operators reduce inefficiencies in the operation of commercial harbor craft by utilizing maintenance practices and operational improvements would reduce GHG emissions. Examples of practices that would reduce GHG emissions include: vessel speed reduction, regular engine maintenance, improved hull surface finish (smoothness), reduced hull fouling (seaweed and barnacles), use of navigational technologies (GPS, electronic charts, etc.), and propeller design and maintenance.

### ***Cargo Handling Equipment***

Cargo handling equipment includes diesel-fueled vehicles operating at a port or intermodal rail yard that are used to move cargo or are used for scheduled maintenance or repair activities. ARB would investigate and potentially develop a measure to restrict unnecessary idling, which would result in reduced fuel usage, fuel cost savings, and environmental/health benefits. A reduction in fuel consumption should result in greenhouse gas emission reductions, as well as reductions of criteria pollutants and toxic air contaminants.

**Transport Refrigeration Units**

Transport refrigeration units (TRUs) are refrigeration systems powered by integral internal combustion engines designed to control the environment of temperature sensitive products that are transported in trucks, trailers, shipping containers, and railcars. In 2004, the TRU Airborne Toxic Control Measure (ATCM) was adopted to reduce diesel particulate matter (PM) emissions from TRU engines (ARB staff is currently implementing this ATCM). A new measure is being proposed for TRUs that would go beyond the current ATCM and would be designed to limit the use of internal-combustion engine-powered TRUs on trucks, trailers, shipping containers, and railcars from being used for extended cold storage at California distribution centers, grocery stores, and elsewhere.

Another strategy proposed for TRUs is the development of energy efficiency guidelines for refrigerated trucks and trailers. There are many possible energy efficiency improvements that translate into fuel savings and GHG emission reductions. To help educate the industry about these efficiency improvements, a best practices guidance document specific to perishable goods transport would be developed.

Overall, we expect that, in addition to GHG reductions, these two strategies would reduce diesel particulate matter (PM), NOx, SOx, and fuel consumption. Reductions of these pollutants support the Diesel Risk Reduction Plan and the Goods Movement Emission Reduction Plan. In addition, many of these reductions will benefit communities impacted by air pollution from goods movement.

Leakage of GHG emissions could occur if containers from China go to other ports on the west coast and then come back, by rail or truck, to California or other destinations outside of California.

Table 7 contains a summary of the potential emission reductions and estimated costs from measures T-9 and T-10. ARB is not able to provide a net cost estimate at this time given the wide range of potential efficiency improvement measure and strategies. As we develop each measure, those strategies that prove to be the most cost effective will be pursued. ARB expect that implementation of these measures will significantly reduce the amount of fuel used to move goods. Given that fuel costs are continuing to rise, it is anticipated that, in most cases, the fuel savings will more than offset any capital costs.

**Appendix C Transportation-Preliminary Recommendations**

**Table 6**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Ship Electrification at Ports (Discrete Early Action)*	0.2	0**	ARB	2007/2010
Goods Movement Efficiency Measures <ul style="list-style-type: none"> <li>• Goods Movement System-Wide</li> </ul>	3.5	-1,240	ARB	2009-2011

Efficiency Improvements <ul style="list-style-type: none"> <li>• VSR</li> <li>• Clean Ships</li> <li>• Port Drayage Trucks</li> <li>• Commercial Harbor Craft Maintenance and Design Efficiency</li> <li>• Cargo Handling Equipment Anti-Idling</li> <li>• Transport Refrigeration Units Cold Storage Prohibition and Energy Efficiency</li> </ul>				
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\*This measure has already been adopted by ARB.

\*\*Costs of this measure are the result of other programs and are not attributed to the AB 32 GHG reduction program

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **D. MEDIUM- AND HEAVY-DUTY VEHICLES**

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### ***(T-6) Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)—Discrete Early Action***

This measure would require existing trucks/trailers to be retrofitted with the best available technology and/or ARB approved technology. This measure has been identified as a Discrete Early Action, which means it must be enforceable starting in 2010. Technologies that reduce GHG emissions and improve the fuel efficiency of trucks may include devices that reduce aerodynamic drag and rolling resistance. The requirements would apply to California and out-of-state registered trucks that travel to California. The cost of these retrofits would be recovered over the life of the vehicle through reduced fuel use. This measure would require in-use trucks and trailers to comply through a phase-in schedule starting in 2010 and achieve 100 percent compliance by 2014. Additionally, new 2011 and later tractors and trailers that are sold in or service California would need to be certified for aerodynamic efficiency requirements. The 2020 estimated GHG reductions could be up to 15 MMTCO<sub>2</sub>E nationwide, of which about 1.4 MMTCO<sub>2</sub>E or 9 percent would occur within California. Work is currently underway to bring proposed regulations to the Board in the fall of 2008.

**(T-7) Medium- and Heavy-Duty Vehicle Hybridization**

Hybrid electric technology offers the potential to significantly reduce GHG emissions and improve fuel efficiency. Hybrid technology provides the greatest benefit when used in vocational applications that have significant urban, stop-and-go driving, idling, and power take-off operations in their duty cycle. Such applications include parcel delivery trucks and vans, utility trucks, garbage trucks, transit buses, and other vocational work trucks. Entities that may be affected by this measure include owners and operators of parcel delivery trucks and vans, utility trucks, garbage trucks, transit buses, and other vocational work trucks. The implementation approach for this measure is to adopt a regulation and/or incentive program that reduces the GHG emissions of these types of new trucks sold in California, beginning in 2015.

**(T-8) Heavy-Duty Engine Efficiency**

Engine efficiency improvements may involve advanced combustion strategies (mixed mode combustion, improved injection systems, combustion chamber design, variable valve actuation, etc.), friction reduction (via improved piston and ring design, surface treatment, and advanced lubricants), waste heat recovery (advanced turbocharging, mechanical/electrical turbocompounding, thermoelectrics, bottoming cycle, etc.) and electrification of accessories (water pump, heating/air conditioning, oil pump, etc.). Many of these technologies are still in the research and development phase and may become ready in the time frame between 2012 and 2017. Other technologies, such as mechanical turbocompounding have recently been introduced by some engine manufacturers. Overall, these technologies have the potential to increase engine efficiency up to 18 percent. The cost of such technologies is currently unknown.

There may be some potential effects on small businesses for upfront capital expenditures, but the costs would be recovered through improved fuel economy over the useful life of the tractor truck. An evaluation may be conducted during the normal regulatory process to determine whether a financial assistance program would be needed to help small businesses comply with the requirements.

Improved fuel economy is expected to result in reduced emissions of criteria pollutants such as NOx.

**Appendix C Transportation-Preliminary Recommendations**

**Table 7**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)***(Discrete Early Action)	1.4‡	640	ARB	2008/Phased-In Schedule for large fleets: 20% by end of 2010; 40% by end of 2011; 65% by end of 2012; 100% by end of 2013

Medium- and Heavy-Duty Vehicle Hybridization	0.5	-85	ARB	2011/2015
Heavy-Duty Engine Efficiency	0.6	-187	ARB	2015/2017?

\*This measure would result in 13.6 MMTCO<sub>2</sub>E outside of California that ARB is not accounted for in this plan.

\*\*This measure would result in 13.6 MMTCO<sub>2</sub>E outside of California that ARB is not accounted for in this plan. In addition, while the net annualized cost of this measure accounts for the full cost of the equipment, only the fuel savings realized when the vehicle is operating in the State are accounted for as a benefit in the calculation. Analysis of the similar U.S. EPA SmartWay program indicates fuel savings can pay for the equipment within a few years.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **E. RAIL**

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### ***(T-10) High Speed Rail***

This measure supports implementation of plans to construct and operate a High Speed Rail (HSR) between Northern and Southern California. As planned, the HSR is a 700 mile long high speed rail system capable of speeds in excess of 200 miles per hour on dedicated, fully-grade separated tracks with state-of-the-art safety, signaling and automated rail control systems. The system would serve the major metropolitan centers of California in 2030 and is projected to displace between 86 and 117 million riders from other travel modes in 2030. For Phase 1 of the HSR, between San Francisco and Anaheim, 2020 is projected to be the first year of service, with 40 percent of the projected 2030 ridership levels.

Development of HSR presents a significant opportunity to reduce greenhouse gas emissions by offering the state more GHG efficient travel options and alternatives to business as usual.

HSR implementation is dependent on voter approval, and may be placed on the ballot as early as November 2008. If approved, construction of HSR is anticipated to begin in 2010, with full implementation anticipated in 2030.

Based on best available data, construction costs of the HSR system are currently estimated to be \$40 billion, and by 2030, the system is projected to generate nearly \$900 million in revenues and return a surplus to the state of more than \$300 million. Neither

the costs of, nor the revenues from the High Speed Rail measure are attributable to AB 32 implementation.

In order to ensure GHG emissions benefits from HSR, it is imperative that supplementary land use strategies are implemented. These strategies should ensure that growth around the rail is accommodated by GHG efficient land use patterns. There are a number of different approaches to accomplish this that would need to be further analyzed. One example would be to create an interregional transportation and land use body that would identify ‘smart corridor’ development areas around the rail system for preferential funding and permitting incentives.

**Appendix C Transportation-Preliminary Recommendations**  
**Table 8**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>	<b>Adoption/ Implementation Timeframe</b>
High Speed Rail	1*	0**	TBD	Pending Voter Approval

\*Estimates are based on the benefits of displacing air passengers and motor vehicle passengers minus the energy to operate HSR.

\*\*Costs of this measure are the result of other programs and are not attributed to the AB 32 GHG reduction program

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **Other Measures Under Evaluation**

### **Feebates**

A Feebate regulation would combine a rebate program for low emitting vehicles with a fee program for high emitting vehicles. A vehicle would be determined to be low or high emitting in relation to a GHG emission benchmark determined by the State to be appropriate for vehicles. The GHG emissions benchmark could take into account criteria beyond GHG emissions. Criteria such as gross vehicle weight (GVW), size of vehicle, or seating capacity could all factor into the calculation of a GHG emissions standard. Further, there could be multiple emissions benchmarks to account for different vehicle classes. The magnitude of the fee or rebate assigned to a vehicle would be determined by the difference between the GHG emissions of the vehicle and the applicable GHG emissions benchmark. In other words, a vehicle that is low emitting, relative to the GHG emissions benchmark, would receive a rebate, making it more affordable, and a vehicle which is high emitting, relative to the GHG emissions benchmark, would be charged a fee making it more expensive. The program could include a limit on the maximum fee or

rebate assigned to any vehicle. The schedule of fees and rebates and the maximum fee or rebate will be determined through the public process.

The Feebate program would advance the production and adoption of low-emission vehicles and cleaner technologies. Feebates would complement existing emission regulations on new vehicles by making low-emission vehicles more affordable. Vehicle manufacturers would include cleaner technologies in their new fleets to take advantage of the rebates offered to low-emission vehicles. At the same time, the rebates would make low-emission vehicles more attractive to new vehicle buyers. The majority of emissions benefits would stem from improvements in the vehicles themselves with minimal impacts on the range or volume of vehicles available for purchase.

The Feebate program would have an immediate and cumulative effect on GHG emissions from new vehicles. Both GHG and criteria pollutant benefits would be expected as cleaner technologies enter the passenger vehicle and truck fleet. As the existing vehicle stock turns over and auto manufacturers respond to the Feebate program by marketing cleaner and more efficient technologies, the GHG and criteria pollutant reductions would grow.

The Feebate program would be self-financing, with a small portion of the revenue generated from the program going to its administration. From year to year the program may generate a net loss due to a greater than expected demand for rebated vehicles or generate a net surplus due to a greater than expected demand for vehicles that carry a fee. Over the life of the program, ARB would adjust the fee and rebate schedules by modifying the GHG emissions benchmark to compensate the program for losses or surpluses generated. However, the level of the emissions benchmark will not determine the total emission reductions as much as the fee (or rebate) for each additional gram of GHG emitted (or avoided) per mile.

Using light-duty vehicle GHG emissions data from ARB's Pavley Regulation, ARB has estimated that a fee and rebate schedule of approximately 15-20 dollars per gram of CO<sub>2</sub> emitted per mile could generate reductions of up to 4 MMTCO<sub>2</sub>E in 2020, in addition to reductions attributable to the Pavley regulations. The current fleet wide average of CO<sub>2</sub>E emissions from vehicles is 419 grams of CO<sub>2</sub>E per mile.

Including medium-duty vehicles (8,500-10,000 lbs GVW) in the Feebate program which are currently excluded by Pavley could achieve additional reductions of about 1-3 MMTCO<sub>2</sub>E in 2020. Staff is currently reviewing the concept of including medium duty vehicles and does not propose it as a measure at this time.

A Feebate program could also result in additional reductions prior to 2020 by creating an incentive for manufacturers to improve vehicles beyond what would be required by Pavley. The expected reduction level would vary depending on specific design elements incorporated into the program as well as the schedule for anticipated tightening of vehicle tailpipe standards. Additional resources will be needed to quantify the effects of a Feebate program more precisely.

If California were to be ultimately prevented from implementing the Pavley regulations a much more aggressive Feebate schedule could be implemented to achieve the cumulative reductions that would have occurred under the combination of a Feebate program and the Pavley regulations. In 2020, the stronger Feebate program advanced in the absence of the Pavley regulation would translate to equivalent Pavley reductions of 31.7 MMTCO<sub>2</sub>E from the Feebate program.

**Appendix C-Transportation Other Measures Under Evaluation**  
**Table 9**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Feebates for light duty vehicles (in addition to Pavley)	4	-1,015	ARB
Feebates for medium duty vehicles (8,500-10,000 lbs GVW)*	1-3	TBD	ARB
Feebates (in lieu of Pavley)	31.7	TBD	ARB

\*This concept is currently under evaluation. It is not a proposed measure at this time.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **3. LOCAL GOVERNMENT ACTIONS AND REGIONAL TARGETS**

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This section includes the following measures:

#### **Preliminary Recommendations**

#### **Local Government Actions and Regional Targets (T-9)**

#### **Measures Under Evaluation**

- **Congestion Pricing**
- **Pay-As-You-Drive Insurance Premiums**
- **Indirect Source Rules for New Development**
- **Programs to Reduce Vehicle Trips**

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

### **Overview**

Regional planning agencies and local governments will be essential partners in achieving California's greenhouse gas goals. Many local governments around the state are providing leadership by developing local climate action plans for both municipal and community-wide emissions. Several regional agencies across the state, including councils of governments, metropolitan planning organizations and regional transportation planning agencies, are already participating in blueprint planning efforts that balance regional growth needs while providing affordable housing, resource and habitat protection and provide multiple mobility options while reducing reliance on vehicle travel.

Using these leading efforts as a model, the preliminary recommendation includes a measure calling for local government actions and regional targets. Local governments are encouraged to develop climate action plans and to set 2020 targets to reduce greenhouse gas emission. ARB, along with relevant State agencies, will work with regional and local governments to develop regional targets to reduce transportation-related greenhouse emissions. In addition, four other supporting measures to reduce greenhouse gases from passenger vehicles are under evaluation.

These measures will provide multiple benefits to Californians beyond greenhouse gas reduction. They will improve their quality of life by increasing access to a variety of mobility options such as walking, biking and transit, and will provide a diversity of housing options focused on proximity to jobs, recreation, and services. Other important considerations include agricultural, open space and habitat preservation, improved water quality, positive health effects, and the reduction of smog forming pollutants.

## Background

### Local Government

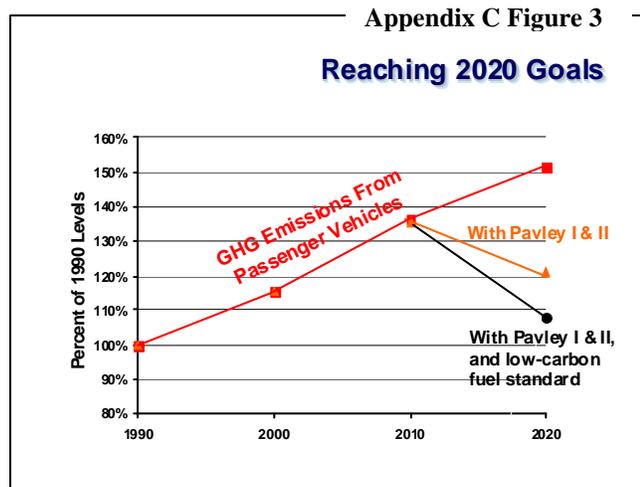
Regional and local governments have primary authority to plan, approve and permit how and where land is developed, how the transportation system is built, and how localities operate on a day-to-day basis. They also adopt planning documents that guide how they will grow and accommodate the changing needs of their jurisdictions. Beyond local governments' influence over community planning and vehicle use, they also have direct control over emissions resulting from municipal operations, such as energy use in government buildings and facilities, vehicle fleets, water treatment and landfill operations, parking, as well as other sources.

Many local governments are already taking action to reduce greenhouse emissions resulting from these activities, providing needed leadership and local economic benefits. These local actions have taken the form of building ordinances and codes, Climate Action Plans, green building standards, climate friendly purchasing practices, and green fleets, among others. Future emissions reduction strategies should support and build upon these activities

### Transportation Emissions

The number of miles Californians drive and the carbon content and amount of fuel used in their vehicles is responsible for a little over one third of GHG emitted in the state. Increasingly, Californians have been driving greater distances in vehicles that burn more fuel. Based on this trend, future business-as-usual projections show a significant increase in the amount of greenhouse gas emissions from vehicle travel – about 15 percent from 2010-2020 and almost 50 percent from 2010 to 2040. In order to reduce statewide GHG, strategies need to be developed that increase mobility without increasing the amount of miles driven or time spent in traffic. Most of the gains made by introducing cleaner vehicles and fuels will be eroded unless more efficient ways to get from place to place are implemented.

The chart to the right shows passenger vehicle GHG emissions rising steadily due mainly to the growth in vehicle miles traveled (VMT). Vehicle technology gains due to California Clean Car regulations (AB 1493, Pavley I & II) would decrease emissions significantly. A combination of the AB 1493 regulations, and a low-carbon fuel standard would reduce emissions even more, but not enough to reach 1990 levels if current trends in VMT continue



*Integrated Land Use and Transportation Strategies*

This increase in the amount Californians drive is caused by many factors. A large body of research over the last two decades identifies that many of these factors, including the increasing distances between jobs, housing, schools, services and amenities; the lack of viable transportation alternatives to reach these destinations, the amount of time spent in traffic and the number of vehicles that only carry one person could be addressed through integrated land use and transportation strategies, such as location-efficient development, transit, biking and walking infrastructure, pricing signals and transportation conservation.

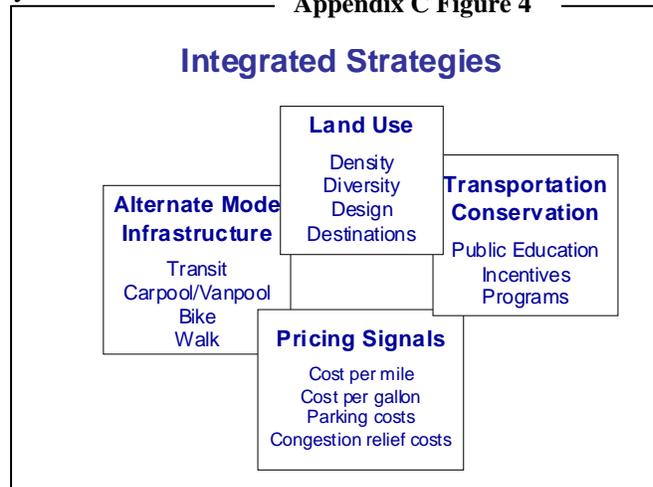
Land use patterns strongly influence driving behavior. Often referred to as the 4D's of land use, using less open space to house more people (density) closer to more places (destinations) and jobs (diversity), along with buildings and street patterns conducive to transit use, biking and walking (design), provide an optimal mix of land uses to support mobility with fewer driving trips. When land use patterns support alternate modes of travel, the cost-effectiveness of transit, carpool, biking and walking infrastructure improves and the two work together to increase transportation choices and reduce vehicle trips.

The infrastructure necessary for vehicles, the cost of maintaining that infrastructure, and the secondary impacts on air, water and environmental quality are very costly. Sending market-based price signals that reflect the true cost of driving can make the transportation system more efficient, e.g., having drivers pay the market rate of parking, paying to drive on congested routes, and converting the cost of vehicle insurance to a variable cost. Public education that helps individuals develop strategies to reduce how much time they spend driving by themselves, like telecommuting, employer carpooling coordination and employee transit pass subsidies can also help reduce GHG.

Transportation and land use modeling studies have been conducted to estimate the effect of land use, and alternative transit and pricing strategies on VMT and GHG emissions. Current modeling scenarios indicate that implementation of land use and alternative transit strategies alone can result in at least a two percent reduction in overall VMT and GHG emissions from base case levels in 2020. If pricing strategies are also implemented, overall VMT and GHG emission can be reduced further. Even larger reductions are expected to accrue in the 2030 to 2050 timeframe with implementation of land use and transit strategies. Modeling results show that reductions in the range of up to 25 percent in VMT and GHG emissions from 2050 base case levels are possible.<sup>13</sup>

<sup>13</sup> These are preliminary estimates based on ARB staff's literature search. The estimates may change as a result of further analysis.

Appendix C Figure 4



## Preliminary Recommendations

### ***Local Government Actions and Regional Targets***

#### **Local Government Actions**

Many California local governments have already adopted climate action plans, committing to ongoing efforts to tackle the causes of global warming. The areas of influence and authority for climate action by local governments typically include:

- *Community Energy.* Local governments can directly influence the energy used by their buildings, equipment, and infrastructure. In addition, many cities and counties can influence the carbon content of energy provided to their community through municipal utility operations, as well as the amount of energy used by the community businesses and residents through building codes, conservation programs and other mechanisms.
- *Community Waste and Recycling.* Local governments can directly influence the waste and recycling activities in their municipal buildings. Local agencies can also change the carbon footprint of their jurisdiction's waste and recycling operations through collection system adjustments, as well as through promotion of waste reduction and recycling to community businesses and residents.
- *Community Water and Wastewater Systems.* Local governments can work to reduce water use in municipal operations. They can reduce energy use of water, irrigation, and waste water systems operated by their municipal agencies, by upgrading or retrofitting pump systems, and also through community-wide water conservation and reclamation program efforts.
- *Community Transportation.* Local governments can increase the carbon efficiency of vehicles in their fleets. They can directly influence the local transportation planning processes to increase the use of low carbon travel such as transit, carpooling, biking, and walking. They can also partner with regional planning agencies to create a sustainable vision for the future that accommodates population growth in a carbon efficient way.
- *Community Design.* Local governments have the ability to directly influence both the siting and design of new residential and commercial developments in a way that reduces GHG associated with energy, water, waste, and vehicle travel.

Although not quantified at this time, actions taken by local government are expected to provide significant greenhouse gas reductions that ARB will track and account for as the Scoping Plan is implemented. ARB, along with relevant State agencies, will work with California Climate Action Registry, ICLEI-Local Governments for Sustainability, Local

Government Commission, and the Institute for Local Government’s “California Climate Action Network,” to develop measurement and tracking protocols, planning tools and best practices to assist local governments in planning for, quantifying and reporting greenhouse gas emissions reductions. Using these tools, ARB encourages local governments to set municipal and community-wide 2020 greenhouse gas reduction goals and adopt measures and best practices to meet those goals. ARB will work with local governments to reconcile local level accounting with state and regional emissions tracking as this Plan is implemented.

### **Regional Transportation-Related Greenhouse Gas Targets**

Transportation emissions are a function of vehicle technology, the carbon content of fuel, and how much the vehicles are driven. Comprehensive planning and project implementation at the regional and local level can provide people multiple mobility options and choice while minimizing greenhouse gases.

ARB proposes that the State work with regional and local government to develop regional targets for transportation-related greenhouse gas emissions in a process that considers the projected benefits of vehicle and fuel changes and each region’s potential for such reductions. The targets will consider appropriate timeframes for implementation and will balance all of the needs of the region including population growth (using per capita metrics, for example), housing, jobs, recreation, and resource protection.

The measure is based on current modeling showing how land use strategies and enhanced transit in major urban areas could provide greenhouse gas reductions of at least 2 percent over business as usual in 2020, double the benefits in 2030, and continued benefit increases through 2050.

The measure will focus on implementation of regional plans that meet performance-based regional targets. ARB proposes that regions use a blueprint planning process to map out their preferred land use and transportation scenarios that meet the regional targets and their other regional needs. Subsequent alignment of regional transportation plans (and transportation funding) and local general plans with the blueprints is key to reaching the regional targets. Actions to reach targets would not be prescribed to the regions. Target-based performance indicators would be established to measure progress. (Note: The Addendum to the 2007 Regional Transportation Plan Guidelines addressing greenhouse gases, as adopted by the California Transportation Commission in May 2008, includes recommendations for modeling, planning and strategies necessary to set and meet regional targets.)

**Appendix C: Local Government Actions and  
Regional Targets—Preliminary Recommendations**  
**Table 10**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Regional GHG Targets	≥2 MMT	-621 (aggregated)	Local Governments / ARB / Regional Planning Agencies	Local actions have begun already in some areas  Set targets by January 1, 2010
Local Government Actions	Not quantified at this time	Not quantified at this time	Local Government	Local Government tools and protocols by January 1, 2010

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

State, regional, and local agencies will work together to create a supporting foundation of policies, programs, incentives, and guidance to assist local actions and to ensure local accountability to help meet regional targets. This must include the following:

*Exercise State Leadership.* Promote low-impact development and reduce greenhouse gas emissions across all levels of government through the State’s building, operation, and planning efforts. The State will work to implement the State’s planning priorities as stated in AB 857 (Wiggins) Infrastructure Planning: Priorities and Funding (Chapter 1016, Statutes of 2002). The State will use the Strategic Growth Council as a coordination mechanism for meeting greenhouse gas reduction goals. The State will provide technical, fiscal, and regulatory priority to projects and developments consistent with regional blueprints that meet established targets.

*Pursue Funding Sources and Allocate Effectively.* Align existing funding sources and help secure new funding to implement blueprints at the local level, support local climate change planning and projects, and incentivize the desired high-quality, low-impact projects. State agencies will allocate infrastructure bonds to best promote efficiency, sustainability, and California’s environmental and economic goals. All levels of government will include greenhouse gas considerations in their funding decisions. Additional funding for enhanced transit service combined with incentives for land use development that provides a better market for transit is key to implementing blueprints.

*Improve Measurement through Partnerships.* Develop local government quantification protocols, improve transportation demand estimation tools, and develop better land use and transportation models that reflect the benefits of high-quality, low-impact development. The State will work with regions and local

governments to identify existing models and tools for planning and progress measurement that better meet local and regional needs.

*Promote High-Quality, Low-Impact (Resource-Efficient) Communities.* Establish a variety of mechanisms to recognize and support the building of livable, innovative projects and communities with low-carbon footprints to provide prototypes for future development. State, regional, and local governments will pursue supporting mechanisms including regulatory actions, targeted incentives, and targeted funding.

*Identify Funding Sources for Local Level GHG Reduction Strategies.* Local governments need financial resources to update their general plans and zoning codes and to develop strategies to comprehensively reduce municipal and community GHG. CARB will pursue and investigate strategies to provide stable funding for sustainable local planning and zoning updates. The State will work with local governments to identify and provide guidance on best practices to reduce GHG from new and existing development.

*Adopt Proven Measures.* Pursue proven emission reduction strategies, such as indirect source rules that mitigate high carbon footprint development and pricing measures that more accurately reflect the cost of driving and provide people with more transportation choices. All levels of government will adopt and implement feasible strategies, placing a high priority on measures with public health co-benefits.

*Amend CEQA Guidelines to Account for Greenhouse Gas Emissions.* Provide state guidance for determining significance and mitigating the GHG emissions of new projects. The Office of Planning and Research and the Resources Agency are developing proposed amendments to the CEQA Guidelines to provide guidance on how to address GHG in CEQA documents. As required by Senate Bill 97 (Chapter 185, statutes of 2007) the amended CEQA Guidelines will be adopted by January 1, 2010. These guidelines will support projects that lower the carbon footprint of new development, and encourage programmatic mitigation strategies that may include reliance on adopted regional blueprint plans, Climate Action Plans, and general plans that meet regional and local GHG targets and that have also undergone CEQA review.

*Conduct Outreach and Engage the Public.* Secure public support for the actions necessary to reduce greenhouse gas emissions from land use and transportation, and provide outreach and public education programs necessary to promote individual actions that help reduce greenhouse gas emissions. All levels of government, the business and development community, and the environmental and public health communities will work together to provide information on models/protocols, training, best practices, and funding sources for these outreach programs. The State will support and coordinate public engagement processes, including supporting public outreach efforts as integral elements in local and regional comprehensive planning efforts.

The timeline for the establishment of performance-based targets and creation of the supporting policies and strategies would run parallel. Setting of targets would be completed by January 1, 2010, while the creation of supporting policies and strategies would continue beyond that timeframe.

## **Other Measures Under Evaluation**

The Land Use Subgroup of the Climate Action Team (LUSCAT) and the Economic and Technology Advancement Advisory Committee (ETAAC), in their reports to ARB, suggested additional measures to reduce VMT and greenhouse gas emissions from passenger vehicles. These measures would support the implementation of regional transportation-related targets.

- Congestion Pricing
- Pay-As-You-Drive Insurance Premiums
- Indirect Source Rules for New Development
- Programs to Reduce Vehicle Trips

### *Congestion Pricing and Pay-As-You-Drive Insurance Premiums*

Research has shown that sending market signals that reflect the cost of driving can reduce emissions by making the transportation system more efficient and providing people with the choice of driving less to pay less or paying a little more to save time. This proposed strategy incorporates pricing incentives recommended by both ETAAC and LUSCAT: congestion pricing and Pay-As-You-Drive (PAYD) insurance premiums.

In a congestion pricing program, vehicles are charged a price, or toll, for traveling during peak hours on congested routes. Drivers who continue to travel on these routes during peak periods would pay more, but experience a faster, easier trip. Others would defer trips to off-peak hours, shift travel to less congested roadways, or switch to transit, carpools, or vanpools. Greenhouse gas emission reductions would come directly from the relief of severely congested traffic, some reduction in vehicle travel, and from the investment of funds in transit infrastructure that would provide additional transportation options during congested hours.

Regional planning agencies, as they are confronted with the need to grow even more densely, have expressed the need to manage travel demand and raise funds for needed transit investment through congestion pricing strategies. However, regional planning authorities need legal authority from the State to implement these pricing measures.

Pay-As-You-Drive (PAYD) insurance premiums are set based on driving record and other traditional risk factors, but are broken down into per-mile charges. Motorists would have the opportunity to lower their insurance costs by driving less. Some would. So PAYD insurance offered to a large percentage of California drivers would have the potential to significantly reduce vehicle miles traveled and GHG emissions.

PAYD insurance is currently being offered by insurance companies in Britain, the Netherlands, Israel, and South Africa, and has been piloted in some U.S. states, including Oregon, Texas, and Minnesota. ETAAC estimates that PAYD insurance could be implemented in California quickly by legislative and regulatory actions that allow insurance companies to implement these programs. The California Department of Insurance intends to adopt regulations with the goal of making PAYD insurance widely available in California and to encourage participation.

#### *Indirect Source Rules for New Development*

Household transportation surveys and modeling reveal that low-density development far away from employment centers and other destinations has a very high transportation carbon footprint. To help regions meet their GHG targets, regulatory mechanisms to mitigate for these types of high-GHG developments might need to be implemented. One mechanism recommended by LUSCAT is an indirect source rule, in which a new development meets a greenhouse gas threshold through GHG-efficient project design or other mitigation measures. The San Joaquin Valley Air Pollution Control District has adopted an indirect source rule for mitigation of particulate matter pollution from new development. Similar rules could be adopted for greenhouse gas mitigation purposes.

#### *Public Education and Programs to Reduce Vehicle Trips*

Land use measures mainly focus on new development. Only about one percent of total dwelling units per year are comprised of new development, so it takes a long time for land use strategies to accumulate into a significant benefit. Therefore it is important that VMT-related reductions from existing households are also pursued, especially in the short-term (2010-2020). Both work trips and non-work trips should be considered.

Strategies to mitigate the impact of employee commute trips could include mandatory employer programs like Rule 2202 in the South Coast Air Quality Management District rule that requires employers to mitigate emissions due to employee commute trips, or voluntary programs coordinated by regional or local agencies that quantify results and promote the most cost-effective trip reduction strategies.

Large-scale public education programs in California have been very successful at reducing energy use and waste. Reducing driving trips by one round trip per week would reduce the average driver's trip-making by five percent. The State should explore the possibility of engaging the public to reduce their transportation footprint by making some small adjustments (like combining trips) that could yield big results. Developing primary school climate change curriculum that includes transportation conservation would help raise a generation with a smaller footprint.

#### **Costs**

Overall, changes in this sector are anticipated to result in long term cost savings for all levels of government. While some savings may accrue in the 2020 timeframe, current research and practice indicates that much greater cost savings from smarter growth strategies and reduced vehicle travel are likely to accrue in the 2050 timeframe, and most significantly from avoided capital cost expenditures. Recent scenario planning work

reveals order of magnitude figures for cost savings on state and region wide bases. At the regional level, the Sacramento region’s Blueprint planning process has projected that implementation of their compact regional growth plan will yield a savings of about 12% (\$1.8 billion) in transportation system capital spending from a business as usual scenario in 2050 (SACOG Blueprint 2004). In 2000, the statewide Envision Utah scenario planning process estimated that implementation of a statewide compact growth plan would yield a potential 17% (\$4.5 billion) infrastructure cost savings from business as usual development (Ewing et al. 2007, Envision Utah 2000).

Total cost of emissions reductions for the recommended measures will ultimately depend on the selection of strategies to be implemented. Recognizing that resource allocation is often a balancing act, local, regional, and state agencies will need to work together to identify, leverage, and use existing funds, resources, and tools to advance GHG efficient land use and transportation efforts, with special attention towards investments that also help forward other economic, health, social, and environmental goals.

**Appendix C: Appendix C: Local Government Actions and  
Regional Targets—Other Measures Under Consideration**  
Table 11

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency
Congestion Pricing	Up to 1 MMT	Long-term savings.*	State Legislature/Regional Planning Agencies/Local Government
PAYD Insurance Premiums	Up to 1 MMT	Long-term savings*	Dept of Insurance
Indirect Source Rules for New Development	Up to 1 MMT	Long-term savings*	Local Air Districts/ARB
Programs to Reduce Vehicle Trips	Up to 1 MMT	Long-term savings*	State, Regional, and Local Agencies

\* An estimated aggregated \$621 million in savings, based on \$100/metric ton, and fuel savings

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **Other State Agencies' Supporting Measures**

The Land Use Subgroup of the Climate Action Team (LUSCAT) April 2008 submittal to ARB included actions that State agencies have committed to implementing that will help create the supporting foundation for actions by local and regional agencies. The Department of Housing and Community Development, the State Water Resources Control Board, the California Energy Commission, the California Department of Transportation, the Department of Conservation, and the Governor's Office of Planning and Research all submitted strategies to LUSCAT. No greenhouse gas emission reduction estimates were included in most actions; however, in aggregate they may result in substantial assistance for the local actions necessary to reach regional targets.

### **Technical Assistance**

*Housing Element Technical Assistance.* The State Department of Housing and Community Development will update technical assistance and outreach efforts to include climate change considerations for housing elements.

*Energy-Aware Planning Guide Update.* The California Energy Commission will update the existing Energy Aware Guide to provide policy and technical assistance to regional and local governments.

*GHG Mobile Source Technical Guidance.* The California Department of Transportation will set up a framework that ensures that GHG emissions from mobile sources are addressed in the transportation plans and projects. The framework would include development of appropriate mitigation measures, technical guidance and modeling tools, and incorporate analysis of economic and environmental benefits associated with energy efficiency measures and emission reduction strategies into the State Transportation Plan and subsequent Action Plan.

*2010 State Transportation Improvement Program (STIP) Guidelines.* The California Transportation Commission will update the STIP Guidelines to describe policy, standards, criteria and procedures for the development, adoption and implementation of the STIP. Potential strategy metrics include the number of projects that promote pedestrian, bicycle, transit and rail access.

*Staff Training and Public Education.* The California Department of Transportation will include the subject of climate change and GHG emissions in the Department's training program, enhance outreach efforts, maintain a website and convene educational forums.

### **State Guidelines**

*Regional Transportation Plan (RTP) Guidelines Update.* The California Transportation Commission and California Department of Transportation will update the RTP Guidelines to incorporate meeting AB 32 GHG emission reduction targets and to enhance the use of regional blueprint plans.

*GHG in CEQA Guidelines.* The Governor's Office of Planning and Research will develop CEQA guidelines for mitigation of GHG emissions. Per SB 97, the guidelines must be submitted to the Resources Agency by July 1, 2009 and the Resources Agency shall adopt the guidelines by January 1, 2010.

*Watershed-Friendly Landscape Guidelines.* The California Integrated Waste Management Board is developing a set of landscape guidelines for use throughout the State. A well-designed and maintained landscape can cost less to maintain in the long run by consuming fewer resources. Although the primary objective is to protect watersheds through the use of sustainable landscaping practices, a secondary motivation is the reduction or avoidance of GHG. These guidelines will be consistent with the provisions of AB 1881, signed by the Governor September 28, 2006. This legislation requires the California Department of Water Resources (DWR) to update the State Model Water Efficient Landscape Ordinance, based on recommendations set forth in the Landscape Task Force report, by January 1, 2009.

### **Funding, Incentives and Grants**

*Affordable Housing Finance Incentives.* State Department of Housing and Community Development will promote emission reductions and energy conservation in HCD administered funding programs.

*Climate Change Criteria for State Water Resources Control Board Grants.* The State Water Resources Control Board will incorporate climate change criteria in the new grant programs under the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84) – Clean Beaches, Storm Water, and Agricultural Water Quality grant programs.

### **Updated and New Programs or Policies**

*Complete Streets.* The California Department of Transportation will provide improved safety and convenient access to all users of streets, roads and highways. Implementation of greening policies (street trees and green landscaping) are essential components to this measure. Other components include the use of alternate paving, retrofit of existing signals and crosswalks with improved technologies, inclusions of Complete Streets policies and strategies in General Plans, among other infrastructural improvements.

*Smart Mobility Framework.* This framework, under development by Caltrans with funding from USEPA and FHWA, will provide a tool to help implement multimodal transportation and smart growth land use strategies in California.

*Reverse Perverse Incentives to Develop Agricultural Lands.* The Department of Conservation will determine whether state and federal tax law encourages the conversion of agricultural lands to urban or other uses.

*Working Lands Protocol Pilot Program.* The Department of Conservation proposes a strategy to develop a model planning program to guide local land use decision makers in valuing ecosystem services on land.

*Transfer of Development Rights.* The Department of Conservation proposes to allow an individual with a zoning or other planning right to develop residences, to sell that development right to another person, gaining the seller income and allowing an increase of residential density for the buyer. This could be used as a method to support other (Blueprint) planning goals and objectives.

*Subsurface Cleanup Technology.* The State Water Resources Control Board may, upon approval, set up a strategy to require the lifecycle of GHG emissions to be calculated for contaminant removal technologies. Emissions calculations would be considered when evaluating the preferred technology for a given cleanup site. Periodic cleanup reports would be required to include actual GHG emission data, based on hours of operation, utility bills or other readily available information.

## **4. ELECTRICITY AND NATURAL GAS**

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This section includes the following measures:

### **Preliminary Recommendations**

**California Cap-and-Trade Program Linked to the Western Climate Initiative**

**(E-1 and CR-1) Energy Efficiency and Conservation**

**(CR-2) Solar Water Heating**

**(E-4) Million Solar Roofs**

**(E-3) Increasing Combined Heat and Power**

**(E-2) Renewables Portfolio Standard**

### **Measures under Evaluation**

**Additional Energy Efficiency and Conservation**

**Expanded Solar Water Heating**

**Expanded Million Solar Roofs**

**Coal Emission Reduction Standard**

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

## **Overview**

The California economy, and indeed the well-being of all of California's citizens, depends on an adequate, reasonably-priced, and environmentally-sound supply of energy. Yet, uncontrolled fossil-fuel combustion produces greenhouse gases (GHGs), the primary contributor to climate change. California's challenge, like that of the rest of the world, is to maintain a growing economy while decreasing energy-related contributions to GHG emissions. Two overarching strategies for obtaining GHG reductions from the electricity and natural gas sectors are demand-side strategies that reduce energy use, and supply-side strategies that limit GHG emissions associated with electricity generation.

California has a long history of pursuing demand-side management, energy efficiency in particular, as a cost-effective means of reducing California's energy needs and forestalling the need for additional power plants. Looking ahead, energy efficiency will be California's most effective tool for achieving GHG reductions in the electricity and natural gas sectors. California must enhance existing efficiency programs and institute new policies and programs to achieve unprecedented levels of energy savings.

Supply-side strategies complement demand-side strategies by reducing the emissions associated with electricity generation. California has made commitments to renewable energy and will continue to push the electric utilities and other electric service providers (ESPs) to meet an increasing portion of their energy resource portfolio with renewable generation. Emission reductions will also come from increased use of other forms of distributed generation such as fuel cells, solar photovoltaics, and combined heat and power systems. Finally, there are

measures that could specifically target high-emitting sources of energy, such as coal, by putting limitations on the emissions associated with electricity that retail providers purchase and/or deliver to California consumers.

### **Background**

This section of the Draft Scoping Plan addresses emissions associated with electricity production and natural gas consumption in residential and commercial applications. Emissions due to the extraction, refining, and transportation of fuels, as well as industrial uses of electricity and natural gas, are addressed in the Industrial Sector. Combined Heat and Power (CHP) is addressed in both places but the GHG reductions are attributed to the Electricity Sector.

Electricity generation from central power plants and distributed sources such as CHP systems was responsible for approximately one quarter of all greenhouse gas emissions in California in 2004, or about 120 MMTCO<sub>2</sub>E. This makes electricity production second only to transportation in terms of its contribution to California's carbon footprint. Natural gas consumption in residential and commercial buildings accounted for about nine percent of GHG emissions, and the emissions attributable to the heat output for CHP systems are an additional 1.5 percent.

### **Electricity Overview**

California's energy ownership and delivery structure is complex and involves many different players. Five major utilities provide about 80 percent of the electricity currently consumed in California. These utilities are: Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric; Los Angeles Department of Water and Power, and Sacramento Municipal Utility District. About 70 other entities provide the remaining 20 percent. These include Energy Service Providers (ESPs), small and multi-jurisdictional investor-owned utilities, small publicly-owned utilities, irrigation and water districts, rural cooperatives, Native American utilities, and the California Department of Water Resources. This electricity is delivered via a network of transmission and distribution lines that connect California to the other western states. Distribution systems transfer high-voltage power from the transmission grid through substations, where the voltage is reduced. From the substation, distribution lines deliver power to customers.

California's electricity supply is quite diverse, with electricity coming from fossil fuels; renewable resources such as small hydroelectric, wind, solar, biomass, and geothermal; distributed sources such as CHP and solar photovoltaic systems; large hydroelectric sources such as Shasta and Bonneville Dams; and nuclear facilities. This resource mix has changed over the years. In the late 1970s, petroleum was the fuel source for over half of the state's electricity. Today, cleaner-burning natural gas produces between 40 and 45 percent of the state's electricity, and renewable resources account for about 12 percent. The fuel diversity present in this electricity mix helps to insulate California's economy from price shocks and supply disruptions, increases the reliability of the electricity system, and provides multiple environmental benefits.

The exact makeup of California's electricity supply varies from year to year primarily as a result of two factors: the variability of hydroelectric resources, and increasing amounts of renewable energy resources over time. The availability of energy from hydroelectric resources varies significantly depending upon precipitation patterns in California and the Pacific Northwest. A year in which there is below average rainfall or snowpack means that less electricity is produced from hydro-electric resources, and other resources (usually natural gas) must pick up the difference.

Over the last three decades, the state has built one of the largest and most diverse renewable generation portfolios in the world. As California meets its Renewables Portfolio Standard, renewables displace fossil fuels in the overall mix. It should be noted, however, that conventional resources – natural gas, nuclear, coal and large hydroelectric – will continue to be the mainstay of the state's resource mix for the 2020 timeframe. Even when California reaches its 33 percent renewable energy target, two-thirds of the state's electricity will still come from conventional sources.

Between two-thirds and three-quarters of electricity consumed in California is generated in-state, with the rest being imported from other western states. A disproportionate share of California's electricity-related GHG emissions can be attributed to these imports. While imported electricity accounts for 25 to 30 percent of total electricity consumed in-state, out-of-state power plants contribute more than half of the GHG emissions associated with California's electricity consumption. This is because California's imports are dominated by coal-generated electricity.

Power plant emissions of criteria pollutants and toxics are strictly regulated in California. Fossil fuel-based electricity generation emits ozone precursors (VOC and NO<sub>x</sub>) and particulate matter, both of which are serious public health concerns in our urban nonattainment areas. State Implementation Plan control measures will continue to reduce power plant-related emissions of criteria pollutants, and ARB's existing toxics program will continue to focus on emissions of toxic air contaminants. Further reductions in statewide emissions of these pollutants are expected as California's electricity mix shifts to increased percentages of renewable resources.

Several agencies regulate or oversee various parts of the industry. The California Public Utilities Commission (CPUC) has authority to regulate investor owned utilities (IOUs), community choice aggregators (CCAs), and ESPs. The publicly owned utilities (POUs) are largely self-governed, but recent legislation gives the CEC authority to track their energy efficiency programs and renewable energy purchases, and to regulate long-term POU energy contracts and investments. ARB and local air districts provide air regulation over in-state generation facilities, and the CEC has permitting authority over large thermal power plants.

### **Natural Gas Overview**

The largest use of natural gas is as fuel for electrical generation, which is responsible for nearly half of all natural gas consumed in the state. Residential customers use another 22 percent of the natural gas and of that amount, 88 percent is used for space and water heating. The remainder is used for commercial and industrial purposes. Commercial and industrial uses generally include boilers, heaters, and gas turbines (such as those used for CHP).

In 2006, California produced 13.5 percent of its own natural gas, with the remaining 86.5 percent coming from the southwest, Canada, and the Rocky Mountain region by pipeline. Once the gas arrives in California, 98 percent of it is distributed by the state's three major gas utilities – SDG&E, Southern California Gas Company, and PG&E. These utilities pipe natural gas to industrial, commercial, and residential customers.

California's natural gas demand growth is expected to be slower than the rest of the nation's, due largely to the state's energy efficiency programs and the use of renewable energy for electricity

generation. Nevertheless, under a business-as-usual scenario, the demand for natural gas is projected to steadily increase.

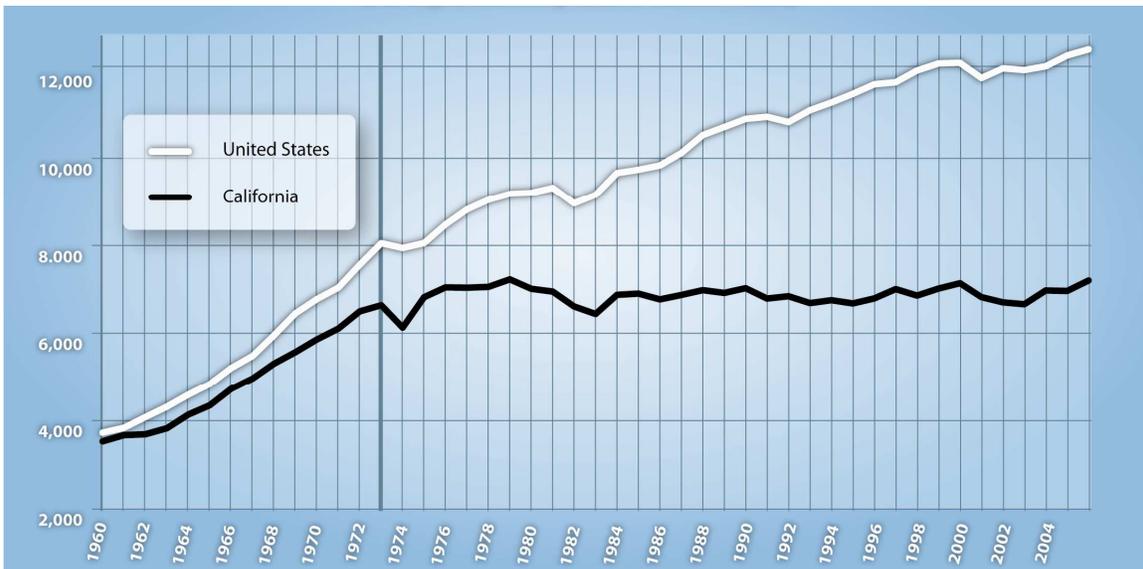
This section of the Draft Scoping Plan addresses GHG emissions related to commercial and residential use of natural gas for space heating, cooking, hot water (otherwise known as the “commercial / residential sector”), electricity generation, and CHP. Combined Heat and Power (CHP) is also addressed in the Industrial Sector but the GHG reductions are attributed to the Electricity Sector.

### Energy Efficiency and Conservation

Energy efficiency is the cornerstone of California's energy strategy and is the state’s highest priority energy resource. For more than three decades, California has led the nation with aggressive building and appliance standards and utility energy efficiency programs. These combined efforts are saving more than 40,000 GWh of electricity annually<sup>14</sup> – enough to power almost six million California homes. In part due to these successful policies, California uses less electricity per person than any other state in the nation. While per capita electricity consumption in the United States increased by nearly 50 percent over the past 30 years, California's per capita electricity use remained virtually flat as illustrated in Appendix C Figure 6. Except for its use in generating electricity, natural gas consumption has also decreased on a per capita basis as building and appliance codes reduced the amount of natural gas needed to heat water, homes, and offices. California has only begun to tap its potential energy efficiency resources and can continue to achieve significant energy savings through intelligent investments energy efficiency technologies, standards, and programs.

Conservation is a strategy that further reduces energy demand. Energy efficiency and conservation both have the effect of reducing the need for energy generation and fuel use. Whereas energy efficiency is accomplished through better technology, conservation refers to changes in behavior. Buying a more efficient light bulb is an example of energy efficiency; turning it off as you leave the room is an example of conservation. During the electricity crisis of 2001, California consumers responded to the Flex Your Power campaign with impressive levels of conservation, proving that conservation is a viable strategy for reducing energy use.

**Appendix C Figure 5**  
**Per Capita Electricity Sales in Kilowatt Hours – California versus the United States**



Source: California Energy Commission

## **Challenges to Meeting Future Demand**

### ***Population Growth and Energy Consumption Trends***

Unless efficiency programs are greatly expanded, population growth and changes in consumer behavior are expected to exceed the ability of current standards and utility programs to hold down energy consumption. Between now and 2020, the State's population is expected to grow to 44 million, or about 1.4 percent annually. The Southland's Inland Empire, and the Sacramento and San Joaquin Valleys are experiencing the highest rates of growth. The warmer and longer summers in these areas translate to more air conditioning use, especially during peak periods that coincide with the hottest time of the day. Further, if past trends continue, consumers will purchase increasingly larger homes and appliances as well as a growing number of electronics and gadgets. These trends, taken together, will cause per capita energy consumption to increase unless they are countered with much more aggressive energy efficiency measures.

### ***Electrification of Transportation***

A second challenge for this sector is likely to come from transportation fuel switching – switching from gasoline and diesel to electricity. Examples are port electrification, plug-in vehicles, and the production of hydrogen (via electrolysis) for vehicles powered by fuel cells or internal combustion engines. As the transportation sector increasingly looks to alternative fuels in an effort to reduce GHG emissions, electricity consumption is expected to increase commensurately.

### ***Climate Change Effects***

Another significant challenge in the energy sector may be climate change itself. Increasing average temperatures and incidences of heat waves – a result of climate change – has the potential to increase the demand for space cooling. Given the current infrastructure in place, this could force our less efficient plants to run more often to meet demand. During the summer months, California also imports energy generated by hydropower from the Northwest to meet peak demand. Decreasing snowpack within California and throughout the west is likely to reduce the availability of this clean and relatively inexpensive hydropower source, further exacerbating the problem. In addition, a large number of power plants in California are located along the coast. The potential for sea level rise associated with climate change could have detrimental effects on the operation of those plants. In effect, climate change events could impede California's ability to reduce emissions from the energy sectors.

## **GHG Reduction Strategies for 2020**

Slowing global warming requires meeting energy needs with zero- or low-carbon energy sources. Two overarching strategies for obtaining GHG reductions from the energy sector are demand-side strategies that reduce energy use, and supply-side strategies that limit the emissions associated with electricity generation.

Reducing energy demand through energy efficiency and conservation will continue to be California's most cost-effective tool for achieving GHG reductions in the energy sector. While California's past achievements in energy efficiency are impressive, we need to do much more in order to meet the AB 32 greenhouse gas targets. California must take actions that reduce per capita energy demand *significantly faster* than the rate of population growth. Among other

things, this will require dramatic improvements in how we build our homes and the appliances we use. Because of the urgent need to reduce as much energy as possible, California must additionally put renewed emphasis on motivating consumers to conserve by using energy wisely.

Emission reductions will also come from the supply side, through increased use of renewable energy and other forms of clean, distributed generation, and through measures that limit the use of electricity generated from high GHG sources. Existing programs and policies already lay the groundwork for renewable energy in California. The enhanced Renewables Portfolio Standard (RPS) recommended in the Draft Scoping Plan will require IOUs, ESPs, and CCAs to meet 33 percent of their electricity sales with qualifying renewable power, such as from wind or geothermal resources. Additional savings will come from California incentive programs for rooftop solar photovoltaic and solar water heater systems. By tapping into these existing policies and programs, increasing targets, and addressing key infrastructure barriers, California will achieve significant GHG reductions.

Other GHG savings can be achieved by removing financial barriers and setting targets for combined heat and power and other forms of clean, distributed generation. Finally, there are measures that could specifically target high-emitting sources of energy such as coal, by putting limitations on the emissions associated with electricity that retail providers purchase and/or deliver to California consumers.

### **GHG Reduction Strategies for 2050**

Looking beyond 2020, research and deployment of new technologies will play an essential role in delivering the technologies needed to change the way we generate and use energy. The Economic and Technology Advancement Advisory Committee recognized the importance of pursuing technologies that are transformative in nature.<sup>15</sup> Two of the technologies that they highlighted are "smart grids" and carbon capture and sequestration:

- **Smart Grids.** Today's power grid was designed primarily to transmit electricity from central generation source to the point of consumption. A "smart" and interactive grid and communication infrastructure would allow the two-way flow of energy and data needed for widespread deployment of distributed renewable generation resources, plug-in hybrids or electric vehicles, and end-use efficiency devices.<sup>16</sup> Smart grids can accommodate increasing amounts of distributed generation resources located near points of consumption, which reduce overall electricity system losses and corresponding GHG emissions. Such a system would allow distributed generation to become mainstream, and would support the use of plug-in electric vehicles as an energy storage device by charging at night and supplying electricity to the grid during peak hours. The two-way flow of energy and data would also allow customers to respond to price signals, and give consumers the ability to lower their electricity bills by reducing demand during peak times. Improved demand response capabilities would in turn allow grid operators more

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<sup>15</sup> <http://www.arb.ca.gov/cc/etaac/ETAACFinalReport2-11-08.pdf>

<sup>16</sup> The demand side actions would be accomplished through efficiency, conservation, and fuel substitution strategies discussed elsewhere in this document.

flexibility in responding to fluctuations on the generation side, which can help alleviate the current difficulties with integrating intermittent resources such as wind.

- **Carbon capture and storage (CCS).** CCS is any process that “captures” CO<sub>2</sub> emissions and stores or sequesters them away from the atmosphere. Geologic sequestration involves using gas separation technologies to capture CO<sub>2</sub> from large point sources, such as power plants, cement factories, or refineries, and injecting it deep underground. While the likely rate of deployment of CCS may not yield substantial reductions before 2020, CCS within California and the Western Electricity Coordinating Council (WECC) region has the potential to play a significant role in helping to achieve the GHG goals for 2050.

To reduce emissions to the level needed by 2050, California needs to promote innovation that produces significant improvement in technology and infrastructure. Furthermore, we must ensure that the policies and technologies deployed over the next few years do not detract from the implementation of even more promising technologies that emerge in the future.

### **Economic Benefits**

California can serve as a model for the nation by demonstrating that dramatic greenhouse gas reductions through energy measures are not only possible, but economically beneficial. Investments in energy efficiency are often highly cost-effective, and many consumers and businesses will find that it is possible to lessen their carbon footprint while simultaneously saving money. Other economic benefits will be gained as new energy technologies are developed to meet the climate change challenge. Investments in energy efficiency and clean energy technologies have been shown to provide numerous benefits on an economy-wide scale, by reducing the need for energy imports, cutting emissions and associated health-related costs, and creating high-paying jobs. As an added benefit of being a leader in clean energy technologies, many California companies will find that their technology innovations can be exported to other states and nations, creating additional jobs and other economic benefits that will ripple through the economy. Thus, there is no need to choose between the environment and the economy. We can create more jobs, reduce societal costs, *and* protect the environment by adopting policies that enhance energy efficiency and clean energy technologies.

### **Overlap with Other Sectors**

The energy sector overlaps and intersects with many of the other GHG sectors discussed in the Draft Scoping Plan. Because buildings use almost 70 percent of all electricity consumed in the state, green building measures hold promise for additional demand side energy reductions. Measures addressed in the Green Buildings and Local Government sections of the Draft Scoping Plan therefore have significant implications for the electricity and natural gas sectors. Transportation is another area of significant crossover. Electricity and natural gas represent two alternative fuels for the transportation sector that are less GHG-intensive than gasoline or diesel, but shift emissions to the electricity and natural gas sectors. The Forest and Agricultural, and Recycling and Waste Sectors also offer GHG reduction measures that affect the Energy Sector. Biomass from forests or agricultural waste can be used as fuel for electricity production. Similarly, electricity can also be generated from landfill gas. In some cases, methane can be captured for direct injection into natural gas pipelines. The Water Sector is important as well. The pumping, treatment, and conveyance of water to consumers in California are extremely energy intensive activities. The State Water Project alone is the single largest electricity

consumer in the state. Measures that increase the efficiency with which we use water will reduce the energy required to transport and treat water.

## **GHG Reduction Measures**

This section includes both “Preliminary Recommendations” and “Measures under Evaluation.” Unlike other sectors, the electricity and commercial/residential sectors feature “Measures under Evaluation” that are simply more aggressive versions of the “Preliminary Recommendations.”

### **Cap-and-Trade Program**

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver GHG reductions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner states and provinces to create this regional market.

The WCI, consistent with the recommendations in the draft decision from the CPUC and CEC Joint Agency Decision, /Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors/, March 2008, Publication #CEC-100-2008-002-F, proposes to include the electric sector in the cap-and-trade program. As required under AB 32, California is examining the First Jurisdictional Deliverer as the point of regulation for the electric sector, ensuring that California and the WCI Partners cover emissions from electricity generated in the Partner jurisdictions as well as emissions from electricity imported into the jurisdictions.

The WCI also proposes that emissions from residential, commercial, and industrial natural gas users be included in the cap-and-trade program. Large users of natural gas would have a direct regulatory obligation under the program based on their facility emissions. WCI recommends that for small users (such as residential and commercial natural gas customers), the emissions be phased into the program, with the point of regulation being the natural gas local distribution companies (LDCs). These LDCs would have the compliance obligation under the cap-and-trade program.

By setting a limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will complement other regulatory measures for electricity and natural gas and achieve additional reductions in greenhouse gases within this sector.

### **(E-1 and CR-1) Energy Efficiency and Conservation**

Energy efficiency is first in California’s adopted “loading order” as expressed in the State’s Energy Action Plan, first adopted by the CPUC and CEC in 2003, and represents a critical strategy for reducing this sector’s GHG emissions. In order to meet our climate change goals, California must pursue advanced levels of energy efficiency that will require novel approaches. Beyond more aggressive building and appliance standards and new utility programs, making significant reductions in GHG emissions will take fresh approaches to how we design, build, and retrofit buildings. Additional GHG reductions can be achieved through efforts that promote consumer awareness of energy costs and energy waste.

Preliminary recommendations are that California institute statewide energy efficiency targets of 32,000 GWh (E-1) and 800 million therms (CR-1) in energy demand reductions relative to

business as usual projections for the year 2020. Under evaluation is the option of raising these targets to 40,000 GWh and 1 billion therms in savings relative to business as usual projections for the year 2020. Discussed below are current efficiency programs and new approaches that may be necessary to meet the recommended efficiency targets. The specific efficiency programs or strategies are yet to be developed; however, meeting the minimum targets would likely require implementation of most of the energy efficiency strategies discussed below. In order to reach the higher efficiency targets under evaluation, California would need to pursue these strategies even more aggressively.

### **Building and Appliance Standards**

Under California's Public Resources Code, the CEC is authorized to adopt and update Building Energy Efficiency Standards and Appliance Efficiency Regulations. These building and appliance standards are one of the most effective tools for achieving energy efficiency. Each successive version of the building and appliance standards requires new technologies and tighter performance standards, thereby generating new energy savings. By increasing the efficiency of buildings and appliances, the standards also help consumers and businesses save money.

The building standards include both prescriptive and performance standards for new construction, and alterations and additions to existing buildings. Alterations, especially to existing commercial buildings, are responsible for a significant part of the energy savings gained from the building standards. The CEC updates the standards at its discretion but typically on a three year cycle. The most recent update occurred in 2008, and several update cycles are expected to occur between now and 2020.

California's appliance standards improve the operation and efficiency of refrigerators, freezers, air conditioners, and other appliances. The Appliance Efficiency Regulations include standards for both federally-regulated appliances and non-federally-regulated appliances. The standards apply to appliances sold or offered for sale in California, with a few exceptions. As with the building standards, the CEC updates the appliance standards at its discretion. The CEC adopted the most recent appliance standards in 2007 and expects to go through several more update cycles between now and 2020.

By law, the building and appliance standards must be cost effective, when taken in their entirety and amortized over the economic life of the structure and/or appliance. The CEC includes an estimate of "avoided costs" as part of this life cycle cost analysis. Future iterations of the standards will incorporate updated fuel prices and a "carbon adder" in the calculation of avoided costs. Thus, future standards are expected to include a more accurate representation of the types of measures that are truly cost effective in today's world.

All of the technologies utilized to implement these energy efficiency standards are considered "off the shelf" in that they are readily available in the marketplace. As part of the process of updating the standards, the CEC evaluates new and emerging technology for possible inclusion in the next iteration. For the building standards, the CEC administers an ongoing "compliance option" process that evaluates what compliance credit should be approved for new technologies. Once a compliance option has been in existence for a period of time, the CEC considers whether it should be added to the standards. In that way, the compliance option offers a testing ground for new technologies and a pathway to becoming part of the standards. The CEC's Buildings and Appliances Office also works with the Public Interest Energy Research (PIER) program and

the utility programs to identify promising new technologies for possible inclusion in the standards.

Recent policies have placed priority on and established specific goals for updates to the standards:

- **The California Green Building Initiative** (Executive Order S-20-04) calls for a 20 percent improvement in the nonresidential building standards by 2015.
- **The West Coast Governors' Global Warming Initiative** established joint commitments for the States of Washington, Oregon, and California to improve their building energy codes (both residential and nonresidential) by 15 percent by 2015.
- **The Energy Action Plan and the Integrated Energy Policy Report** call for ongoing updates to the standards that meet energy efficiency goals, address demand response, and promote the combination of solar photovoltaics and high energy efficiency buildings.
- **Zero Net Energy goals** have been established by the CPUC and CEC for all new residential and commercial construction, meaning that the energy generated on-site completely offsets the energy consumed within the building over the course of a year. Significant changes to the building and appliance standards will be required if California is to meet these targets on a statewide basis.
- **Assembly Bill 662** (Ruskin, Chapter 531, statutes of 2007) gives the CEC authority to regulate water efficiency. This legislation allows the CEC to develop efficiency standards that apply to both indoor and outdoor water use.
- **Assembly Bill 1109** (Huffman, Chapter 534, statutes of 2007) requires the CEC to adopt minimum energy efficiency standards for general purpose lighting, to reduce electricity consumption 50 percent for indoor residential lighting and 25 percent for indoor commercial lighting.

In addition to these mandates, the CEC is expanding appliance standards to cover consumer electronics, a growing source of energy demand that has not previously been addressed by the standards.

### **Utility Energy Efficiency Programs**

California's electric and gas utilities all offer, to various degrees, programs designed to reduce the gas and electric demand of the residential, commercial, and industrial customers they serve. Many of the programs use a combination of education and financial incentives to help consumers save energy.

#### ***IOU Programs***

The Investor Owned Utility (IOU) programs were initially funded exclusively through electric Public Goods Charge and natural gas Demand Side Management charge on customers' bills, capped at \$228 million per year for electricity and gas, respectively. As of 2006-08, the efficiency budgets were greatly expanded, with more than half of the funding for efficiency coming from the utilities procurement budgets (funds used to contract for energy supplies), based upon cost effectiveness tests. These energy efficiency programs typically include discounts or rebates for the purchase or installation of efficient appliances, custom projects for large commercial and industrial processes, consumer awareness campaigns, energy audits, and other demand-side management efforts. The CPUC approves each utility's plan for efficiency

programs every three years, which the utility implements with CPUC oversight. A number of programs are also coordinated on a statewide basis.

During the course of planning for energy efficiency programs the CPUC and IOUs establish a level of energy efficiency that is termed “economic potential.” This level of efficiency potential is considered a theoretical maximum savings for which the value of the energy saved exceeds the total societal cost. This level of savings is unattainable because of market barriers and consumer preferences.

Annual savings targets for IOU energy efficiency programs that run through the year 2013 – the current planning cycle – are designed to capture approximately 70 percent of the economic potential identified for that period. The adopted portfolio plans for 2006-2008 reflect a mix of proven program designs and implementation strategies in combination with approaches to solicit new, innovative designs and savings technologies to enhance overall portfolio performance, both in the short- and long-term.

The CPUC recently adopted a “risk-reward mechanism” to bolster incentives towards achieving these targets. Under the new framework, IOUs earn an increased return on energy efficiency investments if they achieve at least 85 percent of their efficiency target, or face economic penalties if they achieve less than 65 percent of the target.

In addition, California’s IOUs are currently preparing a statewide 2009-2020 Strategic Plan for Energy Efficiency and Demand Side Management that will be reviewed and adopted by the CPUC in late 2008. The plan outlines key strategies and actions by IOUs, California agencies, businesses, research institutes and other entities necessary to achieve energy efficiency savings goals for 2020 that surpass the aggressive targets adopted by the CPUC in 2004 and 2007. The targets adopted by the CPUC, and supported by the CEC, are as follows:

1. By 2020, all new residential buildings will be zero net energy<sup>17</sup>; and
2. By 2030, all new commercial buildings will be zero net energy.

An additional goal is to transform California’s Heating, Ventilation, and Air Conditioning (HVAC) practices, technologies, and industry such that HVAC systems installed in California are optimized to California’s climate, properly sized, highly energy efficient, and effective at reducing peak demand for electricity.

To achieve these goals, existing IOU programs will be increasingly coordinated with other state programs, such as building and appliance codes and standards programs, emerging technology programs, local government programs, and clean energy workforce development and training efforts. New programs likely will be expanded or developed, such as benchmarking building energy use and rating and labeling buildings, certifying industrial facilities for their energy management practices, local or state mandatory retrofit or retro-commissioning programs, and improved low or no-cost financing for energy efficiency improvements. Additionally, clean energy marketing and education programs will be linked with other statewide programs and ongoing AB 32 implementation activities.

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<sup>17</sup> The CPUC has defined “Zero Net Energy” as the implementation of a combination of building energy efficiency design features and on-site clean distributed generation that result in no net purchases from the electricity or gas grid, at the level of a single “project” seeking development entitlements and building code permits.

### **POU programs**

There are important differences between IOUs and POU (and among POU) that effect their ability to fund and affect energy efficiency within their territories. POU account for 25 percent of the electricity provided in California, but only 5 percent of the utility efficiency savings total. This is primarily because up until the last decade, POU were not required to invest in energy efficiency, the result being that most POU have relatively little experience in this area. Also, some POU are very small and simply do not have the staff to implement efficiency programs. The two largest POU in the state – SMUD and the LADWP – have had energy efficiency programs and account for about 60 percent of the POU savings (roughly equal to their share of the POU market).<sup>18</sup>

AB 1890 (Brulte, Chapter 854, Statutes of 1996) required the POU to implement a non-bypassable surcharge to fund public benefit programs, with total funding percentages set at a level similar to those of the IOUs. Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) obligates the CEC to develop statewide estimates of energy efficiency and demand reduction potential, and to establish energy savings targets for the POU. The CEC is required by law to report POU program investments and savings to the Legislature and the POU governing boards, but AB 2021 does not mandate the POU to meet their energy savings targets. Further, no statutory requirements currently exist for ESPs or CCAs to invest in energy efficiency for their customers, though their customers fund a portion of the IOU energy efficiency programs through their distribution charges and are currently eligible to participate in IOU-administered energy efficiency programs.

The CPUC and CEC have recommended that ARB adopt mandatory minimum levels of cost effective energy efficiency savings for POU, consistent with the programs and goals adopted by the CPUC for IOUs.<sup>19</sup> ARB supports the establishment of mandatory levels of energy efficiency for POU.

### **Utility Energy Efficiency Programs Overall**

While achieving energy efficiency savings exceeding current levels is possible, capturing such savings by way of voluntary incentive programs of the sort typically run by utilities will become difficult over time, as achievement of existing goals themselves will require unprecedented rates of program success. Increasingly, additional energy efficiency will necessitate more stringent codes and standards and innovative means of delivery.

Much of the current technology utilized to implement utility efficiency programs such as compact fluorescent light bulbs and efficient refrigeration are considered “off the shelf,” meaning they are readily available in the marketplace. However, these technologies often require incentives to be price-competitive with older less efficient technologies. Upstream incentives or rebates are designed to promote market adoption, acceptance and, ultimately, market transformation. As market penetration is achieved, incentives for some technologies can be reduced or dropped completely. This “market transformation” is best maintained by

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<sup>18</sup> California Municipal Utilities Association, December 2006, *Energy Efficiency in California’s Public Power Sector: A Status Report*.

<sup>19</sup> CPUC and CEC Joint Agency Decision, March 2008, *Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*, CEC-100-2008-002-F

incorporating the high efficiency technologies into mandatory building codes and appliance standards. In addition, many larger business and institutional customers use IOU energy efficiency incentive funds to implement custom on-site measures such as installation of efficient boilers, HVAC systems, and overall energy management tools. Without incentive funds, many of these types of installations would not be deemed cost-effective by customers in the near term, even though the payback may occur in as little as three to seven years.

### **New Approaches for Advancing Energy Efficiency and Conservation**

Achieving new levels of energy efficiency would require novel approaches that go beyond building and appliance standards and beyond utility efficiency programs. The new paradigm needed for efficiency program implementation would include unparalleled statewide activities that leverage past successes. It would require increased efforts, additional resources, commitments, and new levels of collaboration between key agencies such as the Building Standards Commission, the Department of Housing and Community Development, the CEC, the CPUC, and utilities. Below are some strategies that California would need to pursue if we are to capture maximum levels of energy efficiency.

### **Implementing Recent Legislation and Energy Policies**

- The 2007 *Guidelines for California's Solar Electric Incentives Programs*<sup>20</sup> includes an eligibility criteria requirement for existing commercial buildings to receive an energy benchmark when a solar electric (PV) system will be installed. The intent of this requirement is for all cost-effective energy efficiency options to be considered before an investment in renewable energy is made. Understanding how a building's energy use compares to its peers is an important first step to identifying appropriate efficiency improvements.
- AB 1103 (Saldana, Chapter 533, Statutes of 2007) requires energy use benchmarking and disclosure by all commercial building owners to prospective buyers, lessees, or lenders starting January 1, 2010. The intent of this legislation is to include energy performance in the building's valuation at the time of a financial transaction. This could create a regional market for efficient buildings by including energy performance in the disclosures used to comparatively rate real estate property.
- As described above, new legislation requires the CEC to address lighting efficiency through its standards to achieve a 50 percent reduction in general lighting usage in residences and a 25 percent reduction in general lighting in commercial buildings by 2018. Other legislation gives the CEC authority to regulate water efficiency. Broadening the standards to include water efficiency, and addressing lighting with specific targets in mind, would achieve savings in areas that are relatively untapped.

### **Programs and Requirements for Existing Buildings**

Because most of California's older buildings were built to lesser or non-existent building efficiency standards, improving the energy efficiency of existing residential and commercial buildings in California could produce substantial GHG benefits. This could be accomplished through a combination of aggressive utility offerings, incentives, the establishment and

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<sup>20</sup> California Energy Commission, December 2007, *Guidelines for California's Solar Electric Incentives Programs*, CEC-300-2007-012-CMF

mandatory disclosure of environmental performance ratings for buildings, and time-of-sale environmental performance requirements. See the Green Building section for more details on measures for existing buildings.

### ***Tapping into Emerging Technologies***

The CEC's PIER program and the IOU Codes and Standards programs promote research, development and demonstration of new and emerging energy savings technologies. To achieve increased savings, emerging technologies would need to be more rapidly brought into utility incentive programs, and into voluntary and then mandatory standards.

### ***Broadening the Appliance Standards***

Many consumer products that are not currently subject to California energy efficiency requirements offer significant potential for efficiency improvements. Future appliance standards should address the energy consumption of electronic devices that enjoy widespread use and/or that offer significant potential for efficiency improvements, such as flat screen TVs, computers, and portable electronics that with rechargeable batteries. These new "appliances" represent a significant (estimated at 15 percent) and growing portion of the overall energy use within a home. As an example, future standards for plasma and LCD TVs could save approximately 6,500 GWh per year.

### ***Zero Net Energy Buildings***

There are several concepts that must become standard practice in order to reach the targets set for ZNE buildings.

- **Stretch goals**

In the 2007 Integrated Energy Policy Report, the CEC recommends increasing new building standards in support of the ZNE targets for new homes (2020) and new commercial buildings (2030) established by the CPUC. The CEC plans to meet this goal by providing options to builders in the forms of "tiers." The first tier will be the traditional mandatory standard that increases in stringency with every code cycle. Additional tiers will be voluntary and represent a "reach" or "stretch" goal for advanced levels of energy efficiency. Establishing these "beyond code" options for new buildings provides a mechanism for testing new building efficiency strategies, and it is the testing of these new strategies that provides a pathway to the betterment of subsequent minimum codes.

In order to quickly advance building practices such that zero energy homes become mainstream by 2020, California would need to establish programs and targets that encourage builders to exceed minimum codes, as this will be the proving ground for new building technologies and strategies. There are several specific measures in the Green Buildings section that would require local jurisdictions to meet "beyond code" targets.

- **Integrated Design**

Integrated design is a comprehensive strategy for delivering energy-efficient, high performance buildings at little or no additional cost. The approach brings all relevant players (architects, engineers, construction professionals) together at the start of the project, to analyze and optimize building performance and cost from the earliest design

stages. As simple and obvious as it sounds, integrated design is not the norm. Making this process the norm would require guidelines and training for both practicing professionals and emerging design professionals in architectural and engineering schools.

- **Passive Solar Design**

Another strategy that supports ZNE buildings is passive solar design. With our current understanding of building systems, it is possible to design most buildings (particularly residential buildings) such that the energy required for heating and cooling is minimal. Orienting buildings to face south allows the sun to provide free heating in the wintertime, while window overhangs, strategically placed landscaping, and minimizing windows along the west side prevent overheating in the summertime. Exposing or adding thermal mass to the building allows it to “store” energy in its walls and floors, thus enabling the temperature inside to remain at a comfortable level for most of the day. Using simple, time-honored passive solar design strategies, buildings can be made to require much less energy than they do today. Some of these design principles will be captured in the new building standards, but there is a gap in the knowledge base. In order to ensure that building designers understand these concepts, it may be necessary to require passive solar design as part of architectural programs, exams, and ongoing professional education credits.

### ***Energy Efficiency Financing***

As discussed below in the Green Building section, it is crucial that aggressive energy efficiency measures be accompanied by better financing alternatives. While energy efficiency is typically cost effective over the life of a building, building owners cannot always manage the up-front cost of these investments. For new or resale homes, a small number of lenders already offer “energy efficient mortgages” that allow the buyer to qualify for a larger loan if the home is energy efficient. In order for such offerings to become standard, lenders and appraisers alike could be required to factor the energy saving features of a home into their estimates of the home value and monthly utility bill outlay. In an energy efficient home, the utility bills will be much lower, and these bill reductions can more-than-offset the increase in mortgage payments. For homes undergoing an energy efficient retrofit, creative funding strategies like on-bill financing (offered by utilities or a third party) allow the building owner to implement improvements without having to front the initial investment. As with the energy efficient mortgage, these financing mechanisms would allow the homeowner to pay off the investment with utility bill savings over time.

### ***Energy Use Awareness for Increased Conservation***

Because informed consumers make better energy decisions, efforts to help consumers make the connection between their actions, their utility bills, and their environment play an important role in achieving California’s energy reduction targets. Building upon the past successful efforts of the Flex Your Power campaign, the CPUC has authorized a statewide energy awareness campaign to motivate consumers to conserve energy and to invest in energy efficiency.<sup>21</sup>

Even more powerful than education campaigns, however, is energy-use feedback provided to consumers via in-home displays. Providing feedback on how daily activities in the house translate to energy costs is a simple concept that empowers consumers to take control of their

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<sup>21</sup> CPUC Decision 07-10-032, October 18, 2007, p. 57.

utility bills. These devices relay information about energy consumption and energy costs to the consumer on a real-time basis and have been shown to induce conservation. An Emerging Technologies Report prepared for the American Council for an Energy Efficient Economy surveyed the results from roughly 20 studies on energy use feedback over the past 35 years and found energy savings ranging from four percent and 15 percent.<sup>22</sup> The authors chose five percent as a reasonably reliable and conservative estimate of expected energy savings from the use of energy displays, based on a 2004–2005 controlled pilot study by Hydro One in Canada.<sup>23</sup> Based on this research, it is reasonable to assume that the installation of energy use displays could cause consumers to reduce their energy use by five percent on average. This response would be above and beyond the typical consumer response to energy price.

Energy use monitors have three basic components: a sensor that collects energy use data from the meter or circuit panel, a wall or desk-mounted display, and a means of communication between the two. After collecting demand data from the meter, the devices can display both instantaneous power usage and cumulative energy usage over selected time periods; in some cases, the device can also provide projected energy use and cost estimates and even show other home diagnostic data such as temperature, humidity, and estimated greenhouse gas emissions.<sup>24</sup>

California could require that all new homes come equipped with an energy use display that provides real-time feedback to occupants on whole-house electricity consumption, electricity production (for homes with rooftop solar installations), and if possible, natural gas and water use. For existing homes, these devices should be required for installation at time-of-sale or upon installation of a new HVAC system.

While there are home energy-use displays currently on the market, the technology is still relatively new and can be improved in terms of ease of installation, ease-of-use, and integration with other home systems such as thermostats, gas use, and possibly water use as well. California could set performance standards for these technologies and work with manufacturers to develop, test, and demonstrate display systems for use in a wide variety of homes (i.e. homes that may have different metering infrastructure).

### **Benefits and Costs**

California has and continues to pursue energy efficiency for a variety of energy and environmental reasons, including:

- Reducing energy supply costs and lowering bills for customers,
- Reducing peak energy demand,
- Maintaining reliable energy services and reducing price volatility, and
- Achieving other environmental objectives such as reducing local air pollution and other environmental impacts of electricity generation.

Investments in energy efficiency also provide numerous benefits on an economy-wide scale, by reducing the need for energy imports, cutting emissions and the associated health-related costs,

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<sup>22</sup> [http://www.aceee.org/emertech/2006\\_EnergyDisplays.pdf](http://www.aceee.org/emertech/2006_EnergyDisplays.pdf)

<sup>23</sup> In the Hydro One pilot project, the utility provided no energy savings guidance and still achieved aggregate savings of 5% in base-load electricity that persisted over the 18-month test period.

<sup>24</sup> [http://www.aceee.org/emertech/2006\\_EnergyDisplays.pdf](http://www.aceee.org/emertech/2006_EnergyDisplays.pdf)

and creating high-paying jobs. Based on past experiences, each dollar spent on energy efficiency in California provides about two dollars in net benefits.<sup>25</sup>

End-use efficiency investments inherently result in reduced electricity generation and therefore provide both environmental justice and public health benefits. Utility energy efficiency programs are designed to provide a fair distribution of funds among residential and nonresidential customers, while maximizing energy savings. In addition, there are targeted programs overseen by the Low-Income Oversight Board that provide energy efficiency services specifically for low-income households.

The potential costs and emissions reductions from meeting the recommended targets and the expanded targets under evaluation are summarized in the table below. For purposes of this analysis, ARB assumed a 7.8 percent avoided line loss for electricity saved.

**Appendix C: Electricity and Natural Gas-Preliminary Recommendations and Measures under Evaluation**

**Table 12**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/Implementation Timeframe
<b>Preliminary Recommendations</b>				
E-1: Energy Efficiency and Conservation (Electricity)	15.2	-3,116	CPUC & CEC	Ongoing
CR-1: Energy Efficiency and Conservation (Natural Gas)	4.2	-220	CPUC & CEC	Ongoing
<b>Measures under Evaluation</b>				
Additional Electricity Energy Efficiency	Additional 3.8	-553	CPUC & CEC	N/A
Additional Natural Gas Energy Efficiency	Additional 1.0	-146	CPUC & CEC	N/A

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **(CR-2) Solar Water Heating**

Solar water heating systems represent what is likely the largest untapped potential for natural gas savings in California. If implemented statewide, solar water heating could save California an estimated 1.2 billion therms of natural gas per year,<sup>26</sup> the equivalent of 22 percent of all residential gas use and representing an estimated 6.2 MMTCO<sub>2</sub>E in emission reductions.

ARB's preliminary recommendations are to fully implement the goal of 200,000 solar water systems as directed in Assembly Bill 1470. Under evaluation is a measure that would

<sup>25</sup> California Environmental Protection Agency, 2006, *Climate Action Team Report to Governor Schwarzenegger and the Legislature*

<sup>26</sup> Kema-Xenergy study, 2003

significantly expand the program to reach 750,000 existing homes and businesses, and require that 75 percent of all new homes in the state be equipped with solar water systems by 2020.

A solar water heating system uses the sun to heat water. It commonly consists of two parts: a roof-mounted solar collector to heat the water, and a storage tank. Typically, a residential solar water heating system augments rather than replaces the conventional water heating system, but in doing so cuts the need for conventional water heating by about two-thirds.

In 2007, the Solar Hot Water and Efficiency Act of 2007 (SHWEA)<sup>27</sup> authorized a ten year, \$250 million incentive program for solar water heaters with a goal of promoting the installation of 200,000 solar water systems in California by 2017. The CPUC is currently running a pilot program to evaluate the potential impacts on equipment prices, demand, and overall cost-effectiveness of a solar hot water heating incentive program.<sup>28</sup> If the pilot program proves to be cost effective, the SHWEA requires that the CPUC design and implement a statewide incentive program. Funding would be established through a consumption-based surcharge on gas customers. The SHWEA requires that at least 10 percent of collected funds be allocated for low-income and affordable housing projects, and exempts low-income customers from the surcharge. Assuming an average of 130 therms per year saved for each installation, the SHWEA would save Californians 26 million therms per year. While significant, the program target is set at less than two percent of the total potential for solar water heating in California.

Capturing the remaining market for solar water heating systems could greatly reduce GHG emissions. California could expand the SHWEA program and establish targets for new construction, with an overall target of 1.75 million solar water heating system installations by 2020. This would capture just under 10 percent of estimated market potential for solar water heating. The target of 1.75 million installations would come from a combination of a SHWEA-type program for existing homes, and mandates for new homes.

Targeting new buildings offers perhaps the easiest path to increasing our use of solar water heating because: 1) the cost per installation is much lower for new buildings; 2) a builder can integrate the technology into an entire development at one time; and 3) the cost is amortized over the life of the loan, and monthly payments can be fully offset by utility bills savings. In support of California's new target of zero energy homes as standard by 2020, California could phase in a mandate for solar water heating in all new homes. Beginning with a solar water heating mandate for five percent of all new homes in 2010 and ramping up to 75 percent of new homes by 2020, California could see over one million installations of solar water heating in this same time period.

Targeting existing buildings is more of a challenge because the systems are almost twice as expensive to install in a retrofit application, requiring the building owner to invest in a technology with a longer payback. Overcoming these barriers will require a combination of financial incentives, on-bill or other financing options, and education/outreach. For this measure, the target would be 750,000 solar water heating systems by 2020. While hot water

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<sup>27</sup> Assembly Bill 1470 (Huffman, Chapter 536, Statutes of 2007)

<sup>28</sup> The California Center for Sustainable Energy (formerly called the San Diego Regional Energy Center) is administering the pilot solar water heating program.

needs are more limited in non-residential applications, opportunities do exist for installing solar water heating systems in commercial, industrial and government buildings.

### Greenhouse Gas Reductions

For purpose of this analysis, ARB staff used a capital cost of \$6,500 and \$3,000 per system for existing homes and new homes, respectively, and technology cost reduction factor of two percent per year. These figures and the assumed gas savings of 130 therms per year per system were based on preliminary estimates from the California Center for Sustainable Energy pilot project in southern California. Capital costs were annualized assuming a 20-year system lifespan. Note that the AB 1470 program is already funded and is not linked to the AB 32 effort. Therefore, the cost of GHG reductions for the AB 1470 program is assumed to be zero.

#### Appendix C: Electricity and Natural Gas-Preliminary Recommendations and Measures under Evaluation

Table 13

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> e	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
<b>Preliminary Recommendations</b>				
CR-2 - Solar Water Heating: AB 1470 target: 200,000 units installed by 2017	0.1	292	CPUC	2010-2017
<b>Measures under Evaluation</b>				
Expanded Solar Water Heating: 1.75 million units installed by 2020	Additional 1	292	CPUC	N/A

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### (E-4) Million Solar Roofs Program

As part of Governor Arnold Schwarzenegger's Million Solar Roofs Program, California has set a goal to install 3,000 megawatts of new, solar capacity by 2017 - moving the state toward a cleaner energy future and helping lower the cost of solar systems for consumers. The Million Solar Roofs Program is a ratepayer-financed incentive program aimed at transforming the market for rooftop solar systems by driving down costs over time. Created under Senate Bill 1 (Murray, Chapter 132, Statutes of 2006), Million Solar Roofs builds on previous ratepayer-funded programs<sup>29</sup> and provides up to \$3.3 billion in financial incentives that decline over time. The current program, with its target of 3,000 MW, is a Preliminary Recommendation and is referred to as Measure E-4. A Measure under Evaluation would set an expanded target for 2020 of 5,000 MW of installed capacity.

<sup>29</sup> Renewable energy incentive programs that preceded CSI include the CEC's Emerging Renewables Program and the California Public Utilities Commission's Self Generation Incentive Program. These programs no longer include solar, but still provide incentives for wind energy and fuel cells. A number of publicly owned utilities also have administered solar programs.

Solar-generated electricity produces no emissions and requires very little maintenance. Yet, for many applications, the technology is not yet cost competitive with electricity from conventional sources. Meeting California's solar targets therefore requires incentives, at least until new technologies and steady market demand bring about cost reductions.

The Million Solar Roofs Program has three distinct program components, each with a portion of the statewide budget and solar installation goals:

- The California Public Utility Commission's \$2.17 billion portion of the program, known as the California Solar Initiative,<sup>30</sup> directs incentives to customers in investor-owned utility territories (about 75-80 percent of the state's electricity use) for existing residential and new and existing non residential buildings. The goals for this program component are: 1,750 MW of installed capacity from the mainstream incentive program and 190 MW from the forthcoming low-income resident incentive program.
- The CEC provides incentives for solar in new home construction through its New Solar Homes Partnership (NSHP). The NSHP also is limited to investor-owned utility customers and is authorized to use up to \$400 million over the program term with a goal of installing 400 MW of solar on new homes.
- The publicly owned utilities (POUs) component requires each municipal utility to offer an equivalent incentive program, an aggregate commitment of \$784 million over the duration of the program, toward a goal of installing 660 MW of solar.

As directed by SB 1, the CEC recently established eligibility criteria, conditions for incentives, and rating standards for solar energy system incentive programs. Per the new guidelines, obtaining the incentives requires that building owners or developers meet certain efficiency requirements: specifically, that new construction projects meet energy efficiency levels that exceed the state's Title 24 Building Energy Efficiency Standards, and that existing building owners conduct an energy audit. By requiring greater energy efficiency for projects that seek solar incentives, the state is able to reduce both electricity and natural gas needs and their associated GHG emissions. Thus, the program can help to achieve ARB's recommended efficiency targets.

Progress towards the 2017 target is promising, though the net metering cap could pose a challenge. Under California's net metering law, participants are credited for any excess electricity generated during the day, and are allowed to draw down that credit at night or any time when the on-site electrical load exceeds what the system produces. The amount of generation eligible for net metering is subject to a statewide cap. The net metering cap must eventually be increased<sup>31</sup> in order for additional solar systems to receive this attractive rate tariff. Compensation for surplus generation is critical both for meeting the program goals and for supporting zero energy buildings.<sup>32</sup>

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<sup>30</sup> "California Solar Initiative" is also used to describe the entire program – including the portions managed by the CEC and the publicly owned utilities. To avoid possible confusion with the CPUC's program, however, ARB is using "Million Solar Roofs" when referencing the program in its entirety.

<sup>31</sup> Senate Bill 1 raised the net metering cap from .5 percent to 2.5 percent of peak demand. However, it is anticipated that this cap will support only half the state's solar goal and needs to be raised again before the state reaches the 3,000 MW solar capacity goal.

<sup>32</sup> Most buildings use electricity and natural gas. To be "zero net energy," buildings will have to balance gas use by producing surplus electricity, except for those few buildings, like all-electric buildings with heat pumps or dairy facilities, able to supply their own space and water heating needs.

**Benefits and Costs**

The installation of solar electric technologies and the requisite energy efficiency measures will result in savings to customers via lower energy bills. Further, the solar industry provides in-state jobs to solar manufacturers, retailers and installers.

To realize greater energy efficiency benefits, the CEC could require more advanced levels of energy efficiency as a condition for solar incentives. It should be noted that more rigorous energy efficiency requirements are not widely supported by the solar industry due to fears of that aggressive energy efficiency rules would hurt solar sales.

The estimated costs and potential GHG reductions from the solar elements of the Million Solar Roofs program and the expanded Measure under Evaluation are shown below. Both assume a 17 percent capacity factor for solar photovoltaics, and a 7.8 percent avoided line loss for each kWh saved. (This estimate does not include the potential emissions reductions as a result of the new efficiency requirements associated with the program. Because program participants generally receive energy efficiency rebates from the utility company in addition the rebate for solar, the GHG reductions due to energy efficiency improvements are shown under the Energy Efficiency measure described elsewhere in this section.) Cost calculations assume an installed cost of \$8.40 per watt in 2010, declining to \$6.46 per watt in 2020 at a rate of two percent per year. Capital costs were annualized assuming a 20-year system lifespan. Note that the program authorized by SB 1 is already funded and is not linked to the AB 32 effort. Therefore, the cost of GHG reductions for meeting the 3,000 MW target is assumed to be zero.

**Appendix C: Electricity and Natural Gas-Preliminary Recommendations and Measures under Evaluation**

**Table 14**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/Implementation Timeframe
Preliminary Recommendations				
E-4 – Million Solar Roofs: 3,000 MW by 2017	2.0	0**	CPUC/CEC	Current program
Measures under Evaluation				
Expanded Million Solar Roofs: 5,000 MW by 2020	Additional 1.3	1,009	CPUC/CEC	2017-2020

\*Excluding the cost of net metering credits

\*\*Costs of this measure are the result of other programs and are not attributed to the AB 32 GHG reduction program

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **(E-2) Increasing Combined Heat and Power**

This Preliminary Recommendation sets a target of an additional 4,000 MW of installed CHP capacity by 2020, enough to displace approximately 30,000 GWh of demand from other power generation sources.<sup>33</sup>

CHP systems, also referred to as cogeneration, generate electricity and useful thermal energy in an integrated system. Combustion-based power plants do not convert all of their available energy into electricity and typically lose more than half as excess heat. By producing both heat and electricity, CHP systems use more of the energy contained in fuel, thereby increasing efficiencies and reducing GHG emissions. The widespread development of CHP systems would help displace the need to develop new or expand existing power plants. This should produce statewide and regional benefits.

CHP systems are generally used in distributed generation applications located at or near electrical and thermal loads. The electricity generated from a CHP system can be either consumed on site or delivered to the grid; the useful thermal energy can be exported to neighboring facilities but is typically consumed on site. By simultaneously reducing fuel requirements for on-site process heaters and electricity generation, CHP systems can be an extremely fuel-efficient and cost-effective form of distributed generation. Some CHP units can be fueled with renewable resources, and those fueled by natural gas generally use less fuel to provide both heat and power than would be used to provide these two services separately.

CHP is used in many different applications. Small units less than 1 MW in size are often installed in places like nursing homes, schools, and laundries. Larger units ranging in size from 5 to 10 MW usually require host sites that have continuous thermal energy needs. Food processors, large data centers and transportation facilities are examples of applications for CHP projects in this size range. CHP projects in the 10 MW to 60 MW range are found in facilities that operate continuously and are sometimes connected at the transmission level, such as chemical plants or oil refineries. Very large units, which can range in excess of 100 MW, feed substantial amounts of power onto the grid for use by other customers as well as serving the thermal and electric needs of the host site.

California has supported CHP for many years, but market barriers stand in the way of CHP reaching its full market potential. A 2005 draft report prepared for the California Energy Commission by the Electric Power Research Institute (EPRI)<sup>34</sup> examined these barriers and their effects upon the market for CHP. EPRI developed estimates of current CHP capacity in the state, estimated technical and economic market potential, and analyzed the costs and benefits of various incentive options to promote development of the CHP market opportunity. Using different forecasts of technology costs, natural gas and electricity prices, and program design, EPRI predicted a potential market for CHP of between 1,966 MW and 7,300 MW over the period 2002-2020.<sup>35</sup> The 7,300 MW modeled under EPRI's "high deployment scenario" represents an increment of more than 5,000 MW above the base case. EPRI concluded that

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<sup>33</sup> Accounting for avoided transmission line losses of seven percent, this amount of CHP would actually displace 32,000 GWh from the grid.

<sup>34</sup> California Energy Commission, Draft Consultant Report, Assessment of California CHP Market and Policy Options for Increased Penetration. Prepared by Electric Power Research Institute. April 2005.

reaching this level of CHP deployment would require fully addressing the export barriers, utility-provided incentive payments, technological advances, the addition of a T&D (transmission and distribution) support payment, and a CO<sub>2</sub> reduction payment. Under their “moderate” scenario, which considered more modest changes in policy and incentives, EPRI predicted a CHP market potential as high as 4,400 MW. It is this estimate that forms the basis for the proposed GHG reduction measure.

Efforts to increase the deployment of CHP may require a multi-pronged approach that includes addressing significant market barriers, incentives where appropriate, and potential mandates.

### **Small CHP**

The Waste Heat and Carbon Emissions Reduction Act<sup>36</sup> requires the CPUC and CEC to evaluate new rules and programs for small CHP systems (up to 20 MW in size). Specifically, the Act directs the CPUC to establish a feed-in tariff – a pre-negotiated price that utilities would pay for excess electricity that is fed into the grid. Under the Act, the CPUC may require the state’s IOUs to purchase specified amounts of excess electricity from CHP customers that comply with specified sizing, energy efficiency, and air pollution control requirements. The statute also authorizes the state’s POUs to purchase excess electricity from CHP systems at a rate determined by their governing boards. The Act furthermore requires the CPUC to evaluate a pay-as-you-save pilot program that would provide up-front financing to nonprofit organizations for the development of up to 100 MW of power.

Because the statute does not specifically mandate the CPUC to require participation of the state’s IOUs, or require the state’s POUs to create specific programs for their customers, the Act’s potential to encourage the development of small CHP systems (under 20 MW) CHP is currently unknown. This legislation represents a step toward opening the wholesale market for smaller CHP projects. However, because the statute does not compel the CPUC impose requirements on the state’s IOUs, or require the state’s POUs to create specific programs for their customers, it stops short of providing small CHP operators with the guaranteed access to wholesale markets recommended in the CEC’s *Integrated Energy Policy Report*<sup>37</sup>. In order to ensure that the target level of CHP is achieved by 2020, it may be necessary to require utilities to buy back excess power. Another option would be for the state to mandate CHP for certain types of new or existing industrial, commercial and institutional facilities.

### **Medium and Large CHP**

The majority of energy and GHG savings in the future may come from larger CHP systems. As with smaller CHP systems, the key difficulty faced by larger CHP owners is the inability to sell excess electricity to the grid. Sizing CHP systems to operate efficiently often results in the generation of excess electricity. Without a market for this power, many CHP systems may not provide adequate economic return.

Specific actions that have been identified as necessary to create a viable market for CHP system power include:

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<sup>36</sup> AB 1613 (Blakeslee, Chapter 713, Statutes of 2007)

<sup>37</sup> California Energy Commission, 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF

- Creating utility portfolio standards for CHP power;
- Encouraging power export so CHP systems are optimally sized for onsite heat loads and large enough to provide T&D capacity to utilities; and
- Developing guaranteed rate structures and market access for CHP power that appropriately value the electrical system and environmental benefits of CHP power<sup>38</sup>

The CPUC intends to open a rulemaking focusing exclusively on CHP this year. During this proceeding, the CPUC is expected to explore regulatory issues that directly affect the development of ultra-clean CHP, and to make decisions regarding how to facilitate the development of efficient and environmentally beneficial CHP. This will require discussions about how CHP generators can participate in a generation market that requires scheduling hour-by-hour exports with the CAISO. Meanwhile, the CEC will continue its efforts to support the development of an active CHP market through research and policy-setting activities.

While CHP systems use fuel more efficiently than centralized power plants, they have the effect of increasing fuel use on-site. The potential emissions from CHP systems varies significantly depending upon the system size and type of technology used,<sup>39</sup> but the increase in fuel use generally causes increased emissions of CO<sub>2</sub> on-site. Potential local adverse effects need to be prevented or mitigated through the existing air permitting process.

### **Benefits and Costs**

In addition to the energy cost savings and carbon emission reduction benefits, the development and use of well-designed additional CHP systems in California offer other environmental and power generation/distribution benefits. Reliable baseload or load-following CHP can:

- Provide an alternative to new central station fossil-fuel generation and reduces the need for new transmission and distribution infrastructure.
- Improves the efficiency, reliability and security of the State's electricity system and reduces losses during peak hours.
- Provide valuable protection against supply outages and brownouts, especially at oil refineries.
- Provide more efficient fuel use, reduced energy costs and the most efficient and cost-effective form of distributed power generation.
- Effectively reduce transmission and distribution congestion.
- By offsetting more expensive peak electricity, provide potential cost savings to the host site.

For purposes of estimating GHG reductions, ARB staff estimated the electric generation potential from CHP (or the amount of electricity offset from the grid, based on an assumed 85 percent capacity factor), the total amount of fuel consumed onsite, and the amount of waste heat generated for useful thermal purposes (which was then used to calculate the amount of fuel not

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<sup>38</sup> California Energy Commission, 2007, *Distributed Generation and Cogeneration Policy Roadmap for California*, CEC-500-2007-021

<sup>39</sup> Molten carbonate fuel cells, for example, convert chemical energy directly into electricity while producing very little pollution. (Kaarsberg, 2001)

consumed to produce that amount of thermal energy). Emission gains and reductions were calculated for each of these elements and the net emission reductions are shown in the table below. Capital costs were annualized assuming a 30-year system lifespan and operating costs were estimated based on fuel inputs.

**Appendix C: Electricity and Natural Gas - Preliminary Recommendations**  
**Table 15**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
E-2: Increasing Combined Heat and Power Use by 32,000 GWh	6.8	-1,311	CPUC & CEC	2009-2020

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **(E-3) Renewables Portfolio Standard**

The California Energy Commission (CEC) estimates that about 12 percent of California's retail electric load is currently met with renewable resources, including wind, solar, geothermal, small hydroelectric, biomass, and biogas. California's Renewables Portfolio Standard (RPS), which was originally established under Senate Bill 1078 (Sher, Chapter 516, Statutes of 2002), requires IOUs, CCAs, and ESPs to increase the percentage of renewable resources in their retail portfolios. While the original legislation gave IOUs until 2017 to meet a 20 percent RPS, Senate Bill 107 (Simitian, Chapter 464, Statutes of 2006) moved up the deadline to 2010.

A more aggressive RPS goal of 33 percent by 2020 has been proposed by Governor Schwarzenegger but is not yet codified into statute. In 2005, The CEC and the CPUC committed in the Energy Action Plan II to "evaluate and develop implementation paths for achieving renewable resource goals beyond 2010, including 33 percent renewables by 2020, in light of cost-benefit and risk analysis, for all load serving entities."<sup>40</sup> Given the importance of renewables to the success of AB 32, an appropriate target for 2020 should be set that is realistic yet pushes California's renewable energy use forward as far as possible. Based on Governor Schwarzenegger's call for a statewide 33 percent RPS, ARB is including the 33 percent RPS as a Preliminary Recommendation.

Unlike the IOUs, the POUs are not currently obligated to meet the RPS requirement but are encouraged to follow the same path. The governing boards of the state's three largest POUs, the Los Angeles Department of Water and Power (LADWP), the Sacramento Municipal Utility District (SMUD), and the Imperial Irrigation District (IID), have adopted policies to achieve 20 percent renewables by 2010 or 2011. LADWP and IID have established targets of 35 and 30 percent, respectively, by 2020. In the *Interim Decision on Basic Greenhouse Gas Regulatory*

<sup>40</sup> CPUC and CEC, 2005, *Energy Action Plan II*, p. 6

*Framework for Electricity and Natural Gas Sectors*,<sup>41</sup> the CPUC and CEC recommended that ARB require the POUs to meet a 20 percent RPS by 2017. This measure would be designed to require that POUs meet an equivalent standard as is required of the IOUs or to achieve GHG reductions of an equivalent amount through other measures.

Reaching a target of 33 percent will require that California quickly address challenges such as program complexity, permitting difficulties, and transmission and distribution issues. Multiple government agencies must work together to overcome these project development barriers.

The Renewable Energy Transmission Initiative (RETI) is one such effort. RETI is a multi-agency initiative to identify competitive renewable energy zones and streamline approval of transmission infrastructure to access those zones. RETI will identify the transmission projects needed to access renewable power resource areas, facilitate transmission corridor designation and streamline the siting and permitting process. The state strongly supports this effort to streamline transmission planning and help bring new renewable projects online.

In addition to transmission planning, the state must consider grid reliability and grid integration issues associated with intermittent renewable resources (such as solar and wind). Flexible fossil resources (such as plants that supply power at peak times), dispatchable demand response, and storage will be needed to provide system ramping and regulation for increasing penetrations of intermittent renewable resources. The California Independent System Operator (CAISO) has not yet studied the operating needs or costs of integrating 33 percent renewable energy, but has stated the costs could increase as more renewable energy is integrated into the grid. CAISO support and analysis of increasing renewals and their impact on the transmission system is vitally needed.

### **Benefits and Costs**

Expanding the state's RPS goals will accelerate achievement of longer term (post 2020) GHG reduction goals, enhance fuel diversity, reduce reliance on fossil fuels, and reduce criteria pollutants. An RPS will also stimulate economic activity by providing opportunities for California companies that develop, produce, install, or operate renewable equipment. Studies have shown that the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered (i.e., per average megawatt).<sup>42</sup>

Further study is needed to determine which renewable technologies and fuel sources (e.g., solar, biomass, etc.) provide the greatest GHG benefits. This can help direct future RPS policy decisions that optimize for maximum GHG reductions.

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<sup>41</sup> CPUC and CEC Joint Agency Decision, March, 2008, *Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*, CEC-100-2008-002-CMF

<sup>42</sup> Renewable and Appropriate Energy Laboratory, 2004, *Putting Renewables to Work: How Many Jobs can the Clean Energy Industry Generate*.

**Appendix C: Electricity and Natural Gas - Preliminary Recommendations****Table 16**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>	<b>Adoption/ Implementation Timeframe</b>
E-3: Renewables Portfolio Standards (33% by 2020 for IOUs & POU's)	21.2	1,556	CEC/ CPUC	2020

\*Note: The cost associated with this measure only reflect the incremental costs to achieve 33% RPS above the existing 20% RPS.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## Other Measures Under Evaluation

### **Coal Emission Reduction Standard**

This Measure under evaluation would require that California's electric service providers, and other entities using coal for electricity production, reduce the CO<sub>2</sub> emissions associated with their current coal-based electricity sales. If implemented, this measure would require that 40 percent of the coal-based emissions be eliminated or offset by 2020. This measure would complement the Emission Performance Standard (described below) by requiring electric service providers to divest or otherwise mitigate portions of existing investments in coal-based generation.

Current estimates are that 32,000GWh of electricity consumed annually in California comes from coal-based generation, with approximately 87 percent of this amount imported from out-of-state facilities.<sup>43</sup> Most of the coal-fired electricity consumed in California can be traced from the supplier back to the source because it is either claimed as specific purchases<sup>44</sup> or represents ownership shares in the power plant itself.

This GHG reduction measure, if implemented, would require electric retail providers and other applicable entities to reduce the CO<sub>2</sub> emissions associated with their current coal-based power purchases or ownership shares beginning in 2013; ultimately achieving a 40 percent reduction in coal-based CO<sub>2</sub> emissions by 2020. The required emission reduction would be the difference between existing coal-based generation and the emissions of a highly efficient baseload natural gas fueled plant. These entities could also be required to eliminate or offset 100 percent of GHG emissions from any new sources of coal-based generation added to their portfolios. Reductions

<sup>43</sup> California Energy Commission, 2008, *2007 Net System Power Report*, CEC-200-2008-002-CMF.

<sup>44</sup> This measure targets "specific purchases" of coal-based power. Specific purchases are defined by law as "electricity transactions which are traceable to *specific generation sources* by an auditable contract trail or equivalent, such as a tradable commodity system, that provides commercial verification that the electricity source claimed has been sold once and only once to a retail consumer [emphasis added]." Specific purchases also include generation obtained from a utility's own power plants. (Chapter 796, Statutes of 1997, Article 14, PUC, §398.2 (b))

in CO<sub>2</sub> emissions from coal-based generation could be achieved by a variety of means, including:

- foregoing a portion of generation available from current coal contracts,
- cancelling or renegotiating current contracts,
- implementing carbon capture and sequestration, and/or
- acquiring offsets, to the extent allowed under other state emission regulations.

This measure would complement the Emissions Performance Standard (EPS), an existing law<sup>45</sup> that precludes California's electric service providers from making investments in baseload electricity generation that emits more carbon dioxide than a combined cycle gas turbine (CCGT). The EPS thus prohibits the procurement of baseload energy from coal-fired power plants (unless they sequester CO<sub>2</sub>) and other higher-emitting power plants. In doing so, the EPS has significant potential to limit further development of high carbon-content power generating facilities. During its rulemaking proceedings for the proposed EPS, the CPUC noted that the measure had helped prevent the development of 30 coal-fired power plants that had been proposed to serve California's electricity market. This measure's ability to influence the power-development market in the western U.S. will likely curtail development of other high carbon- or high GHG-emitting facilities in the future.

By reducing California purchases of coal-based power, this measure could free up existing coal plants to sell power to other states within the Western Electricity Coordinating Council (WECC) territory. This would result in a type of "leakage" – emissions formally assigned to California related generation could simply be transferred to other states. In the absence of similar regulations on all service providers within the WECC, the potential for leakage is very high, especially if this measure is met by transferring the produced power to out-of-state service providers or marketers rather than curtailing generation altogether. This issue would need to be addressed in detail during the regulatory development process.

### **Benefits and Costs**

To the extent that this measure reduced coal-based generation throughout the WECC, it would provide significant environmental benefits and reduce negative impacts to disadvantaged communities. Coal-generating facilities emit high levels of criteria pollutants; therefore, reducing coal-fired generation would provide environmental benefits at the local and regional level in the form of reduced emissions of sulfur, mercury, and particulates, and lower acid rain impacts.

Coal-based power plants also use extensive amounts of cooling water and plants located in the Southwestern U.S. have had negative impacts on limited water supplies. Thus, the measure could help relieve demand on limited water supplies in certain regions.

The emissions reduction goal for coal-based power could include phased annual reduction goals as illustrated in the table below. To calculate the CO<sub>2</sub> reduction potential for this measure, staff assumed that coal-based generation would be replaced with combined cycle natural gas generation.

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<sup>45</sup> CCR §§2900-13 and PUC §§340-341

The percentage and amount of CO<sub>2</sub> reductions targeted for each of these years is shown in the tables below:

**Appendix C: Illustration of Potential Emission Reductions**  
**Table 17**

Year	Annual CO <sub>2</sub> Emission Reduction*	Equivalent GWh Displaced	Annual Reduction Goals (MMTCO <sub>2</sub> E)
2013	5%	1,600	1.1
2014	10%	3,200	2.1
2015	15%	4,800	3.2
2016	20%	6,400	4.3
2017	25%	8,000	5.3
2018	30%	9,600	6.4
2019	35%	11,200	7.5
2020	40%	12,800	8.5

\* This represents the percent reduction from 2007 emissions based on the 2007 estimates for coal power

The calculations for both costs and GHG reductions assume that coal-fired generation would be replaced with generation from a CCGT. The costs considered in this analysis are based on the difference in price between a kWh of coal-fired generation versus that from a CCGT. The low end of the cost range assumes only the difference in price between the two sources. The high end of the range assumes that the retail provider must pay for electricity purchased (based on CCGT prices) *and* electricity not used (based on coal prices). This represents the case in which the supplier is not able to modify existing contracts and must continue to pay the plant operator even if the electricity is not generated. Thus, the high estimate is likely to be the maximum cost necessary to comply with this measure. Potential costs associated with canceling existing contracts, acquiring offsets, or financing carbon sequestration are not explicitly included; however, it is reasonable to assume that the retail provider would only invest in these options if the cost of doing so was less than the high end costs provided below.

**Appendix C: Electricity and Natural Gas - Measures under Evaluation**  
**Table 18**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency
Coal Emission Reduction Standard	Up to 8	850	N/A

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **5. WATER**

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**This section includes the following measures:**

### **Preliminary Recommendations**

- (W-1) Water Use Efficiency**
- (W-2) Water Recycling**
- (W-3) Water System Energy Efficiency**
- (W-4) Reuse Urban Runoff**
- (W-5) Increase Renewable Energy Production**
- (W-6) Public Goods Charge for Water**

ARB worked closely with the CAT to develop this Plan. Input from the CAT was then compiled, evaluated and analyzed by ARB staff. Many of the measures included in the Preliminary Recommendations and Measures Under Consideration are the direct input from the CAT for this sector.

### **Overview**

The Water sector plays a critical role in California and cuts across almost all other sectors. Approximately 19 percent of electricity and 30 percent of non-power plant natural gas consumed in California are used by the Water sector to grow crops, to supply development, to drive industry, and to produce energy. On top of these many, often competing needs, water is also needed to maintain a healthy environment. Global warming will likely make it even more difficult for California to meet all of these needs. The greenhouse gas reduction measures proposed for the Water sector are largely measures to develop additional supply reliability to meet the growing demands of these multiple, competing needs for water in California. Nevertheless, these measures can have many co-benefits including reducing greenhouse gas emissions below what would otherwise be the case.

Six GHG emission reduction strategies are proposed for the Water sector:

- 1) Water Use Efficiency
- 2) Water Recycling
- 3) Water System Energy Efficiency
- 4) Reuse Urban Runoff, and
- 5) Increase Renewable Energy Production.
- 6) Public Goods Charge for Water

The first and second measures are primarily water supply measures. While efficiency and recycling have many benefits to the sector, the greenhouse gas emission reductions from these measures are accounted for in reduced energy requirements. ARB is currently evaluating methods to distinguish the Water sector emissions and/or reductions from those in the Electricity sector.

The Water System Energy Efficiency measure sets a target of 20 percent improvement in system efficiency for the Water sector resulting in approximately 4,400 GWh of additional electricity savings annually, resulting in a 2 MMTCO<sub>2</sub>E GHG emission reduction.

Reusing urban runoff has the potential to achieve energy and emission reductions by reducing the need for new water supply. The emission reductions from reusing urban runoff are already captured in reduced per capita electricity use and accounted for in the Electricity sector. Again, ARB is working to quantify Water-specific emissions and reductions.

The purpose of the fifth measure, Increase Renewable Energy Production, is to take advantage of the State's water system-related opportunities to generate additional renewable electricity. Examples of renewable energy existing within water systems include in-conduit hydroelectric, solar, wind, and gases emitted from decomposing organic wastes. The CEC's PIER program estimates statewide generation potential from currently undeveloped in-conduit hydroelectric and wastewater treatment renewable energy resources at a total of 2,100 GWh/yr, or 0.9 MMTCO<sub>2</sub>E of GHG reductions.

The State will also establish a Public Goods Charge for water to fund investments in water efficiency that will lead to reductions in greenhouse gases. As noted by the Economic and Technology Advancement Advisory Committee, a public goods charge on water can be collected on water bills and then used to fund end-use water efficiency improvements, system-wide efficiency projects and water recycling. Depending on how the fee schedule is developed, a public goods charge could generate \$100 million to \$500 million annually to invest in further efficiency improvements. These actions would also have the co-benefit of improving water quality and water supply reliability.

The agencies involved in the water sector are working to develop a consistent policy thread for the Water sector to achieve greenhouse gas benefits while meeting the many other demands placed on this sector. The Governor is promoting a comprehensive water proposal which will provide additional opportunity for the water sector to contribute to the goal of reducing the State's emissions. For example, DWR is currently working with the United States Geological Survey on a Sacramento-San Joaquin Delta peat growing project and a Delta rice project, both of which have the potential co-benefit of carbon sequestration.

## **Preliminary Recommendations**

### ***W-1: Water Use Efficiency***

Using water more efficiently is one of the key ways to provide water for a growing California. The Governor directed State agencies to develop and implement a plan to achieve a 20 percent reduction in per capita urban water use by 2020. This directive builds on the California Water Plan Update 2005, which identified water use efficiency as a "foundational action" for California water management. California will achieve 1.76 MAF of urban water use efficiency by 2020 to meet the Governor's call.

To implement this 20 percent by 2020 goal, DWR is collaborating with CEC, PUC, SWRCB, and the Department of Public Health (DPH) to develop and implement various strategies and measures to increase water use efficiency and thereby reduce greenhouse gas emissions relative to more energy intensive sources of new supply. This initiative will need to utilize the many Integrated Regional Water Management planning efforts currently underway throughout California. During 2008, the five-agency group will prepare a statewide water use efficiency

measure for the Public Review Draft of the California Water Plan Update 2009 and identify additional opportunities to reduce greenhouse gas emissions from the entire water sector.

Measures for achieving the directed water conservation target include:

- Best Management Practices
- Appliance Efficiency Standards
- Landscape Water Conservation
- Analytical Tools
- Regulatory Actions

**Appendix C: Water-Preliminary Recommendations**

**Table 19**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Water Use Efficiency	1.4	TBD	DWR, CEC	Ongoing

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

**W-2: Water Recycling**

Water recycling can reduce energy use and thereby reduce GHG emissions by providing local water more efficiently than importing new water from nonlocal sources. This measure proposes that National Pollution Discharge Elimination System permits be amended to require preparation and implementation of water recycling plans at wastewater treatment plants in communities that rely on imported water supplies and communities where water recycling would otherwise require less energy than current water supplies.

Modern treatment facilities are capable of producing wastewater that is suitable for recycling. The DWR publication *Water Recycling 2030: Recommendations of California’s Recycled Water Task Force* reports that approximately 10 percent of municipal wastewater in California is being recycled, but as much as 23 percent of the municipal wastewater flow could be recycled. This measure targets the 23 percent recycling goal by 2030. Finding suitable markets and funding treatment and distribution system costs are challenges to increasing the use of recycled water.

Substantial energy savings could be realized if recycled wastewater was used to replace potable water in appropriate applications such as irrigation. The amount of energy required to import or recycle water varies widely throughout the State. The CEC has reported that water supply and conveyance of water from northern to southern California consumes an estimated 3.2 MWh per AF. In sharp contrast, the estimated energy needed to recycle wastewater is approximately 0.7 MWh per AF. As a result, the potential energy savings that could be realized through water recycling is estimated as 2.5 MWh per AF for southern California communities that import water.

**Appendix C: Water-Preliminary Recommendations**  
**Table 20**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Water Recycling	0.3	TBD	SWRCB	Ongoing

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **W-3: Water System Energy Efficiency**

To meet the needs of Californians, the State’s water systems include natural and man-made facilities for the capture, storage, conveyance, treatment, distribution and re-use of water, requiring energy at nearly every step. Consistent with the recommendations of the California Water Plan Update 2005 and the 2005 Integrated Energy Policy Report, this measure seeks to reduce the magnitude<sup>46</sup> and intensity<sup>47</sup> of energy use in California’s water systems through further implementation of energy efficiency measures.

Setting a target of a 20 percent reduction from 2006 levels would yield a savings of 4,400 GWh per year. A reduction in electricity consumption would in turn reduce the greenhouse emission associated with this amount of electricity generation. An assessment of actual potential is needed to determine if such target is reasonable.

Two mechanisms are proposed to assess the potential of increasing pumping efficiency in the water sector: 1) construct tools and protocols to evaluate, measure, and verify the energy impacts of water system and end use efficiency activities and programs, and 2) conduct research and demonstration projects that explore ways to reduce the energy intensity of the water use cycle and better manage the energy demand of the water system. To accurately assess the potential greenhouse gas emission reductions that are possible various tools are needed to evaluate, measure, and verify the amount of energy that could be saved at various stages upstream and downstream of the activity or effort. Use of these tools will assist in program implementation and help with evaluation of program effectiveness. These tools can also help water agencies and regional boards determine the most effective measures to implement as part of their water management strategies under existing requirements. These tools will be beneficial to ensuring the cost-effectiveness of projects and governmental accountability. Research is also needed to deploy advanced technologies in the water system to lower energy intensity; examine opportunities to shift loads off peak; integrate into the grid intermittent renewable generation

<sup>46</sup> Total energy consumed by a particular segment of the water use cycle. Peak demand is usually measured in megawatts and annual consumption in kilowatt-hours or megawatt hours.

<sup>47</sup> Total energy consumed per unit of water to perform a water management-related action, such as desalting, conveyance, etc... This demand is usually measured in kilowatt-hours per million gallons.

from water systems; refine understanding of the interaction of water and energy within the State; and identify new and innovative technologies and measures for mutually achieving energy and water efficiency savings.

**Appendix C: Water-Preliminary Recommendations**  
**Table 21**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/Implementation Timeframe
Water System Energy Efficiency	2	TBD	DWR, PUC, SWRCB, CEC	Ongoing

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **W-4: Reuse Urban Runoff**

Although urban water reuse may have the potential to achieve energy and emission reductions by reducing the use of new water, information is not available at this time to accurately quantify the volume of water that could be captured and reused, or the energy savings that could be realized. A pilot methodology is being evaluated and accordingly results are considered preliminary at this time.

A reduction of GHG emissions may be realized by replacing energy-intensive water supplies with sources that require less energy. This measure would increase local surface and groundwater supplies by:

- 1) adopting stormwater management strategies, such as Low Impact Development (LID), to increase infiltration or storage in urban areas,
- 2) increasing regional stormwater capture and infiltration, and
- 3) constructing neighborhood facilities to locally capture and reuse dry weather flows.

Development of impervious surfaces and the reliance on traditional storm drain systems have reduced stormwater infiltration in urban areas. Traditional storm drain systems are designed to capture and convey water away from developed areas as swiftly as possible, typically discharging to streams or water bodies. Nontraditional stormwater management strategies emphasize the use of vegetated channels and natural landscapes to intercept runoff, slowing the discharge rate, increasing infiltration, and ultimately reducing discharge volume. LID is probably the most recognized approach, but the basic components are shared by other land use and planning techniques. This measure would require capture and infiltration or storage of stormwater to increase local water supplies. Examples of some LID techniques include simple actions such as the addition of rain barrels and the disconnection of downspouts from storm drains to the installation of underground cisterns, construction of surface storage basins, or adoption of water-saving street designs. A methodology is being evaluated to estimate the volume of water that could be obtained through urban stormwater capture, infiltration and/or storage. Applying this preliminary methodology to the urbanized area of southern California

yielded estimates of 270,000–333,000 acre-feet of stormwater per year that could be obtained from new and redevelopment residential and commercial projects. Further investigation is warranted to validate these estimates.

In addition, this CAT measure promotes development of regional infiltration facilities and neighborhood facilities to augment local water supplies. In the urban environment, water is available from a multitude of sources on a year-round basis. Sources of urban water include stormwater discharge, but also water that becomes available from various urban activities like landscape irrigation, leaking pipes, washing cars, etc. Small neighborhood facilities could capture this water for local use.

**Appendix C: Water-Preliminary Recommendations**  
**Table 22**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E†	Net Annualized Cost (\$ Millions)	Proposed Lead Agency	Adoption/Implementation Timeframe
Reuse Urban Runoff	0.2	TBD	SWRCB	TBD

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### ***W-5: Increase Renewable Energy Production from Water***

The purpose of this measure is to identify and implement specific projects that take advantage of the State’s water system-related opportunities to generate renewable electricity. Examples of renewable energy existing within water and wastewater systems include water moving through conduits, sunlight, wind, and gases emitted from decomposing organic wastes. The CEC’s PIER program estimates statewide generation potential from currently undeveloped in-conduit hydroelectric and wastewater treatment renewable energy resources at a total of 2,100 GWh per year. Further development of renewable generation from solar and wind resources at water system sites would add to this total. Renewable energy generation at water and wastewater facilities will reduce greenhouse gas emissions by reducing the need for the facilities to consume electricity derived from fossil fuels. In addition to greenhouse gas emission reductions, benefits of projects developed under this measure may also include better management of on-site electricity load at water system sites, mitigation of electricity price volatility, contribution to meeting renewable energy standards, and capture and use of gases from wastewater in an environmentally-preferred manner.

Implementation of this measure will involve several mechanisms. DWR is currently evaluating opportunities to increase the use of renewable energy for the State Water Project as a means to reduce the carbon footprint of the project. Local agencies are encouraged to develop their own cost-effective projects. The use of existing financial incentives is also encouraged. Another mechanism is to assess economic potential to better target future incentives and research technologies to lower costs and improve performance.

**Appendix C: Water-Preliminary Recommendations**  
**Table 23**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>	<b>Adoption/Implementation Timeframe</b>
Increase Renewable Energy Production	0.9	TBD	CEC, PUC	2020

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **W-6: Public Goods Charge for Water**

A public goods charge applied to water will raise funds for reducing GHG emissions resulting from capturing, storing, conveying, treating and disposing of water. These funds would provide a stable and sustained source of revenue to further develop water use efficiency, water recycling, pumping and treatment efficiency, reuse of urban runoff, and increase renewable energy production from California’s water system. These actions would also have the co-benefit of improving water quality and water supply reliability. Depending on how the water fee schedule would be developed, approximately \$100 million to \$500 million could be raised per year with fees of about \$10 to \$50 per connection per year or \$0.83 to \$4.17 per month. There would be no assessment for low-income customers (customers on lifeline billing).

This measure would be implemented via regulation. The regulation will be presented to the Board in the 2010-2011 timeframe and will be in effect in 2012-2013. The charge would be applied to each water connection, be collected by each retail water provider in the State, and include all uses of water. The funds raised by this measure would be distributed among local, regional, and statewide planning efforts to reduce water-related GHG emissions. As part of implementation, ARB would develop protocols for monitoring, tracking, and reporting performance to ensure that GHG reductions are real, permanent, quantifiable, verifiable, and enforceable.

This public goods charge would be a flat rate per connection i.e. not based on the quantity of water use and therefore not likely to directly reduce water use or the associated emissions. Nevertheless, the funds could be invested in water use efficiency, water recycling, pumping and treatment efficiency, reuse of urban runoff, and increase renewable energy production, thereby achieving both GHG and criteria pollutant benefits.

**Appendix C: Water-Preliminary Recommendations**  
**Table 24**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>	<b>Adoption/Implementation Timeframe</b>
Public Goods Charge for Water	TBD	TBD		2020

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **6. GREEN BUILDINGS**

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**This section includes the following measures:**

### **Other Measures Under Evaluation**

**Greening New and Existing State Buildings**

**Greening Public Schools**

**Greening New Residential and Commercial Construction**

**Greening Existing Homes and Commercial Buildings**

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

### **Overview**

The design, construction, renovation, maintenance and operation of buildings have enormous implications for California's carbon footprint. Just the electricity, natural gas, and water used in buildings accounts for almost one quarter of all California emissions. Construction, demolition, and operation of buildings also produce considerable amounts of waste, from which there are associated GHG emissions. Finally, the choice of where buildings are built and how they are integrated within communities affects transportation patterns and infrastructure needs, which can result in significant GHG impacts.

“Green buildings” are designed, built, renovated, operated, and maintained using a holistic approach that creates and ensures a healthy and comfortable environment while maximizing energy and resource efficiency. Factors that are considered when designing a green building include: site selection and development, water and energy use, environmentally preferable products and materials, waste management, and indoor air quality. As such, green buildings are a vital tool for meeting the objectives of AB 32 because they provide a mechanism for reducing GHG emissions from multiple sectors – principally energy, water, waste, and transportation.

Employing a whole-building design approach can create synergies that result in multiple benefits at little or no cost, allowing for efficiencies that would never be possible on an incremental basis. Tightening up a building and employing good passive solar design, for example, can dramatically reduce the building's heating and air conditioning requirements. The cost savings can then be spent on other green building features, such as sustainable materials, photovoltaics, more-efficient appliances, or a grey-water system for the building.

While green building strategies are most easily integrated into new buildings, existing building stock offers the greatest potential for gains in energy and water efficiency. California has made impressive strides in improving energy standards for new construction; however, many buildings were built before energy standards were required for new construction. As a consequence, existing buildings account for the majority of the potential for GHG reductions. Even buildings less than ten years old offer a significant opportunity for improved performance with the implementation of technically feasible and economically justifiable technologies and practices.

### **GHG Reduction Strategies**

California can reduce the carbon footprint of the built environment by adopting comprehensive policies that address energy and water consumption, land use, waste management, and other critical components of designing, constructing, maintaining, operating, and renovating both new and existing buildings. While there are many environmental benefits from green buildings, 90 percent of the GHG benefits derive from the energy component (energy efficiency, solar, and other clean on site generation), which overlap with electricity and natural gas sector strategies. Capturing the full GHG reduction potential from buildings will require a statewide green building effort, consisting of both mandatory and voluntary actions that are supported by incentives and education. These actions will ensure that buildings are designed, constructed, operated, maintained, renovated and deconstructed in a sustainable way.

There are many green building rating systems available to evaluate and rate the energy efficiency and environmental performance of buildings. The following are three of the more well-recognized rating systems:

- Leadership in Energy and Environmental Design (LEED) – a nationally accepted green rating system that addresses new construction, existing commercial, residential, and retail buildings as well as schools and neighborhoods.
- The Collaborative for High Performance Schools (CHPS) – a rating system that offers green building certification geared towards California schools.
- GreenPoint Rated – a rating system that provides green building certification for California homes.

These rating systems provide a metric against which we can compare the environmental performance of one building against another. They also provide a means by which to challenge the building community to design better buildings. Setting the bar higher and higher (e.g., going from LEED “Silver” to LEED “Gold”) will result in buildings that perform better and consume less resources, thereby reducing GHG emissions.

There are existing State policies that will reduce the GHG emissions associated with buildings. Three of these policies are highlighted below.

1. The Green Building Initiative, known as the Executive Order (EO) S-20-04, requires that the State commit to aggressive action to reduce State building electricity purchases from the grid by retrofitting, building and operating the most energy and resource efficient buildings, and by taking all cost-effective measures described in the Green Building Action Plan for facilities owned, funded or leased by the State and to encourage cities, counties and schools to do the same. Specifically, the EO requires that state agencies, departments, and other entities under the direct executive authority of the Governor cooperate in taking measures to reduce grid-based energy purchases for state-owned buildings by 20 percent by 2015, through cost-effective efficiency measures and distributed generation technologies. These measures include:
  - Designing, constructing and operating all new and renovated state-owned facilities paid for with state funds as "LEED Silver" or higher certified buildings;
  - Identifying the most appropriate financing and project delivery mechanisms to achieve these goals;

- Seeking out office space leases in buildings with a U.S. EPA Energy Star rating; and
- Purchasing or operating Energy Star electrical equipment whenever cost-effective.

The EO also references the Green Building Action Plan, which commits the State to benchmarking, retro-commissioning, and certifying existing Executive Branch facilities over 50,000 square feet in size as LEED for Existing Buildings (LEED-EB) by 2015.

The EO further requires the Division of the State Architect to adopt guidelines to enable and encourage schools built with state funds to be resource and energy efficient.

2. The California Building Standards Commission (CBSC) and the Department of Housing and Community Development (HCD) are currently developing a California Green Building Code (Green Building Code). Though the initial version will be a voluntary code, a mandatory Green Building Code will go into effect in 2010. This mandatory code will institute minimum environmental performance standards for all building types and establish a new "floor" for California building practices. The Green Building Code will reference other building standards contained in Title 24 and establish new performance standards for commissioning, water efficiency, solid waste management, and indoor air quality.
3. The California Public Utilities Commission has established "zero net energy" (ZNE) goals for new construction in California. By 2020, the goal is that all new homes will be ZNE. For commercial buildings, the target date is 2030.

There are additional opportunities for reducing the carbon footprint of California's built environment. Capturing further GHG reductions from California buildings will require measures that go beyond the Green Building Code and the requirements of the EO. Green building strategies could target new and existing buildings as follows:

- New buildings. The State of California could lead by example, by requiring that all new state buildings meet LEED Gold standards and exceed energy codes such that by 2025, all new state buildings will be ZNE. New schools would be required to meet CHPS standards and by 2020, all new schools would be zero net energy schools. For private buildings, California would set statewide targets for buildings to go beyond the code, thus challenging communities to build to higher performance levels. As codes and standards push new construction toward a standard of ZNE, efforts for going "beyond code" would focus on non-energy areas of improvement, such as water, embodied energy of building materials, and solid waste.
- Existing buildings. Leading the way, California could accelerate efforts to benchmark and retrofit all state buildings. Furthermore, the standard for existing state buildings could be raised from LEED-EB certified to LEED-EB Silver. School modernization funds could be tied to meeting CHPS standards. Schools not ready for a complete modernization could be required to undergo energy and water testing and benchmarking, and to undertake all measures with up to a ten-year payback. For commercial and residential buildings, California could develop a standardized environmental performance testing and rating system based on the California Energy Commission's Home Energy Rating System (HERS). Utilities could establish aggressive whole-building testing,

rating, and retrofit programs for residential and commercial buildings. Buildings that have not taken advantage of these programs could be required to do so at time-of-sale.

Because it is sometimes difficult for consumers to take the long view, aggressive green building measures could be accompanied by a comprehensive set of funding mechanisms, resources, and education. Creative funding strategies, like on-bill financing or energy efficiency services arrangements, allow the building owner to implement improvements without having to provide up front capital. With such mechanisms available, the owner could afford to invest in more energy or water efficient technologies because the loan payments would be offset by utility bill savings over time. Other financial incentives such as grants, loans, tax credits, and rebates, would encourage greater numbers of builders, contractors, owners, buyers and sellers of real property to invest in green buildings. Non-financial incentives could include expedited permitting, priority plan review, green building technical assistance and recognition programs. Architects, builders, and homeowners often lack the time and resources to research green building design options, and applying for incentives can often be burdensome. Creating a “one stop shop” for information, resources, and incentives could make the process easier and faster for architects, builders, and homeowners. Improving access to technical information and implementing recognition programs could encourage market transformation through raising awareness and knowledge of green building practices and benefits.

Similarly, better financing mechanisms could be put in place for retrofits to state buildings and schools. These issues are discussed in more detail in the appropriate measure description.

### **Cost and benefits**

For both new and existing buildings, green building strategies should be viewed not as a cost, but an *investment* that produces both monetary savings and other benefits over time. Correspondingly, the “opportunity cost” of not implementing energy efficiencies could be taken into account, as could the opportunity cost of unknown energy price volatility in future markets. This concept is reflected in the discussion below.

### **Costs**

With upfront planning, new green buildings can be constructed at little or no additional cost.<sup>48</sup> The key is to incorporate green building strategies not as an afterthought, but as integral to the design process.

For existing buildings, the costs of retrofits vary significantly depending upon the aggressiveness of the options pursued. Diagnostic evaluation and audits of existing buildings can identify opportunities for optimizing existing building systems for immediate savings at very low cost. Addressing leaks, for example, can be highly cost effective. In one study, retro-commissioning of existing buildings was found to yield whole-building energy savings of 15 percent and payback times of 0.7 years.<sup>49</sup>

Comprehensive building infrastructure upgrades and the installation of clean on-site generation, on the other hand, can require substantial investments and longer-term paybacks.

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<sup>48</sup> Matthiessen, “The Cost of Green Revisited,” Davis Langdon, July 2007.

[www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited/](http://www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited/)

<sup>49</sup> <http://eetd.lbl.gov/emills/PUBS/Cx-Costs-Benefits.html>

### **Benefits**

Green buildings, by design, reduce water, energy, and waste-streams, all of which translate into a reduced carbon footprint. Green building strategies also contribute to improved water quality, improved air quality, and reduced impacts on community infrastructure. According to the US Green Building Council, a LEED Certified building saves 30-50 percent of water use (more than 1 million gallons of water savings per year); uses 32 percent less electricity, 26 percent less natural gas, and 36 percent less total energy.<sup>50</sup>

Green buildings further provide numerous health benefits, primarily through improved indoor air quality, thermal comfort, and lighting environments. Several case studies have demonstrated that these attributes of green buildings translate to measurable benefits. In schools, for example, integrating daylighting with other aspects of indoor environmental quality has been shown to considerably improve student performance. Heschong Mahone Group conducted a series of studies of schools and daylighting, including one in 1999 that found significant correlations between academic progress and daylighting. Students with the most daylighting in their classrooms progressed 20 percent faster on math tests and 26 percent faster on reading tests in one year, compared to students in classrooms with little or no daylight.<sup>51</sup>

These benefits for building occupants translate to economic benefits for the building owner as well. According to one study, buildings that earn LEED or Energy Star certifications have higher occupancy rates and lease for more dollars per square foot than their peers.<sup>52</sup> In another study, Heschong Mahone Group evaluated chain stores with and without skylights, and found that skylight systems increased retail sales by as much as 40 percent.<sup>53</sup>

The most quantifiable benefit, however, arises from reduced operating costs. Cost savings from energy and water efficient equipment and fixtures are well documented and can exceed 30-40 percent and 20-30 percent respectively. Overall, most green building strategies more than pay for themselves over the life of the building, meaning that green buildings essentially provide GHG reductions at no additional cost.

Accounting only for potential GHG savings that arise from reductions in energy and water use and from the recycling of construction debris, preliminary estimates are that green building measures can reduce California GHG emissions by approximately 28.5 MMTCO<sub>2</sub>E in the year 2020.<sup>54</sup> Of this, 25.5 MMTCO<sub>2</sub>E comes from energy savings, and the additional GHG savings come from reductions in water and solid waste. For purposes of the Draft Scoping Plan, we are considering green buildings to be a mechanism that enables GHG reductions in other sectors. For example, green building strategies are what make it possible to reach the targets set for electricity and natural gas reductions. In order to avoid double counting, the ARB is not counting any of the green building measures as “additional” GHG reductions, but this may change as ARB staff gains a better understanding of the interactions between the sectors.

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<sup>50</sup> [www.usgbc.org/DisplayPage.aspx?CMSPageID=77#usgbc\\_publications](http://www.usgbc.org/DisplayPage.aspx?CMSPageID=77#usgbc_publications)

<sup>51</sup> <http://www.h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm>

<sup>52</sup> CoStar Group, Inc., “Commercial Real Estate and the Environment,” March 2008.

<sup>53</sup> <http://www.h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm>

<sup>54</sup> Initial estimates for GHG emission reduction potential for this sector are based on LEED “Certified” buildings, however many of the strategies recommend certification to “LEED Silver” or higher standards. Also, these estimates do not include savings from green operating procedures such as recycling. As a result, actual emission reductions could be greater than those estimated here.

## Other Measures Under Evaluation

### **Measure: Greening New and Existing State Buildings**

California would require that all State buildings exceed the current performance requirements outlined in the Governor's Green Building Executive Order S-20-04.

State government could lead by example, by designing, building, operating, and retrofitting state buildings such that they achieve maximum GHG emission reductions. The State owns and operates over 290 million ft<sup>2</sup> of occupied space representing a total of 13,429 existing buildings, with another 17.5 million ft<sup>2</sup> of newly constructed state buildings planned for completion by 2020.

The green building objectives outlined in EO S-20-04 are mandatory for Executive Branch agencies. Agencies not under direct executive authority of the Governor are encouraged to implement them as well, including state facilities under the control of the California universities, Administrative Office of the Courts and legislative branch.

California's new requirements would apply to all state-owned facilities and leases, including state facilities not covered in the current EO. In addition, California would implement new standards for new and existing state buildings that go beyond the requirements of the EO. California's new policy could be as follows:

1. All new and renovated state buildings larger than 10,000 square feet in size would be required to meet the following targets:
  - Beginning in 2010, all new buildings would be designed, constructed, and operated to the standards of LEED-NC "Gold"
  - Beginning in 2025, all new buildings would be ZNE (five years earlier than the statewide mandate for commercial buildings.) Until the ZNE target is reached, state buildings would exceed Title 24 energy codes by 20 percent.
2. All single occupancy leases undertaken by the State would be LEED certified buildings unless compelling market conditions make this impossible. Multiple tenant leases would be in LEED certified buildings where possible
3. All existing state buildings over 25,000 square feet in size would achieve LEED-EB Silver certification by 2020. Smaller buildings would be required to be operated and maintained at a level equivalent to LEED-EB but certification would not be required.

In order to meet the proposed requirements for existing buildings, a better funding mechanism is needed for identifying and evaluating potential energy improvement projects. This process, which can entail retro-commissioning studies, Investment-Grade Audits, and program administration costs, requires up-front money that can be difficult to obtain given current State operating procedures. One option would be to establish a Pooled Investment Fund to provide continuing funds for the up-front costs of energy projects in existing buildings, and the costs of administering the green building program. This fund could be continuously appropriated without regard to fiscal years so that program funding continuity can be maintained.

The GHG emission reduction potential from this measure is approximately 1.0 MMTCO<sub>2</sub>E.

## **Measure: Greening Public Schools**

### **New School Construction**

Beginning in 2010, California would require that all new schools be built to CHPS Standards. By 2020, all new schools would also be required to be “Zero Net energy”.

CDE estimates that 5,843 new classrooms per year are needed to accommodate the rising student population. The Governor’s Executive Order S-20-04 encourages that all schools built with state funds to be resource and energy efficient, but does not specify a standard.

CHPS offers a green building certification program especially designed for K-12 schools in California. A CHPS school is a school that achieves excellence in environmental efficiency and healthy building practices. Schools can self-certify through the free CHPS Designed Program, or seek third-party verification of their high performance school through the CHPS Verified program.

Meanwhile, the Division of State Architect in cooperation with the Office of Public School Construction has begun development of a “Grid Neutral by Design” schools program to encourage schools build with state funds to produce as much electricity as it uses over the course of a year.<sup>55</sup> Achieving this goal would require new innovative funding mechanisms to supplement existing school funding programs.

In addition, CHPS schools provide a healthy learning environment for California’s children and have been shown to improve learning performance.

### **Existing Schools**

All schools seeking modernization funds could be required to meet CHPS standards. Schools not going through a major renovation could be required, by 2020, to undergo energy and water testing and benchmarking, and to implement all efficiency measures with up to a ten year payback.

The State has more than 1,000 school districts educating more than six million students. The energy purchased to operate these schools cost California school districts over \$1 billion per year and generates more than two million tons of CO<sub>2</sub> emissions each year.<sup>56</sup>

Updating existing schools can be broken up into two categories: major modernizations and minor retrofits. Current law does not allow for existing schools to receive funding for major renovations until they are at least 20 years old for portable classrooms and 25 years old for permanent buildings. Bringing significant numbers of existing schools to CHPS standards would require a revision to existing requirements such that the Office of Public School Construction (OPSC) and State Allocation Board (SAB) are allowed to authorize modernization funding for

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<sup>55</sup> Grid Neutral schools are a variation on the ZNE concept

<sup>56</sup> Based on information from a study completed in September 2004 for the California Green Building Action Plan

schools less than 25 years old. Due to funding restrictions, it may be difficult to change the building age requirements for obtaining these funds. Therefore, relying on school modernization for GHG savings may have limited effect in the 2020 timeframe. Schools not undergoing a complete modernization could be required to make energy and water efficiency improvements as described below.

California could implement the following requirements:

- Funding for school modernization could be tied to meeting or exceeding CHPS standards for existing schools.<sup>57</sup> By changing these funding requirements, all public schools in California would eventually meet CHPS standards.
- By 2020, all schools could be required to undergo an environmental performance audit and benchmarking process to identify the best avenues for efficiency improvements. Schools could be required to improve energy and water efficiency by 25 percent unless the environmental performance audit shows little room for improvement.

According to the California Department of Education (CDE), there are a total of 9,674 public schools, and approximately 188 new schools are built each year. By implementing the measures for new and existing schools described above, California could reduce GHG emissions associated with K-12 schools by approximately 1.6 MMTCO<sub>2</sub>E in 2020.

### **Measure: Greening New Residential and Commercial Construction**

California would require all new construction to meet the California Green Building Standards Code. California would additionally work with local jurisdictions to set and meet targets for new homes and commercial buildings to exceed the code.

California is expected to experience significant population growth in the coming decades, much of which is expected to take place in the state's hot inland areas. Estimates are that more than two million homes and almost 1.3 billion square feet of commercial space will be constructed between 2010 and 2020. Meeting California's aggressive climate change goals will require that these new buildings be built as energy efficient as possible and with the least environmental footprint. Employing green building strategies would ensure that these new homes are energy efficient *and resource* efficient.

Adoption of a mandatory Green Building Code for residential construction is essential for improving the overall environmental performance of new homes. The California Building Standards Commission is currently conducting an annual building code adoption cycle that includes a new California Green Building Standards Code (CGBSC). Initially, the CGBSC will be voluntary. However, it is anticipated that the CGBSC will be adopted as a mandatory code by the end of 2010, which would be published in Title 24, Part 11 of the California Code of Regulations. The requirements contained within the new CGBSC would need to be well-aligned and supportive of existing green building standards to achieve any meaningful improvement beyond those already offered by the energy standards. California would place a high priority on ensuring that the new Green Building Code incorporates a full range of aggressive resource efficiency requirements.

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<sup>57</sup> It is anticipated that CHPS will be developing green building standards for existing schools by 2009

In addition, the State could set targets for a certain percentage of homes and commercial buildings to go beyond the code. In addition to establishing goals for ZNE homes and buildings, the CPUC established an interim goal that 50 percent of new homes achieve energy savings that meet the Tier II standards of the Energy Commission's New Solar Homes Program by 2011. The New Solar Homes Partnership Tier II Energy Efficiency Requirements are:

- 35 percent Total Energy Savings Compared to 2005 Title 24
- 40 percent Cooling Energy Savings Compared to 2005 Title 24
- Energy Star for Builder Provided Appliances
- Full Compliance with Title 24 Lighting Requirements

The State could adopt these targets and expand them to address other aspects of environmental performance. For new homes, the target could be that by 2011, 50 percent of all new homes to reduce their carbon footprint by an additional 35 percent beyond code. This means not only that energy performance would be increased by 35 percent, but also water efficiency. For commercial buildings, this target could be that by 2011, 25 percent of all new buildings go 25 percent beyond code. The state could work with local jurisdictions to set the specifics of these targets, including options for certification (e.g., CEC's Tier II standards, LEED, or GreenPoint Rated homes), incentives, reporting, and verification. As zero energy mandates are incorporated into the energy standards, these targets may need to be adjusted accordingly to account for a dwindling potential for improvements "beyond code."

If all new residential construction meets the new Green Building Code, and 50 percent of new homes go 35 percent beyond this code, California would reduce GHG emissions up to 5.4 MMTCO<sub>2</sub>E in the year 2020. New commercial buildings meeting the Green Building Code and 25 percent going beyond code would reduce GHG emissions by approximately another 3.5 MMTCO<sub>2</sub>E.

### ***Measure: Greening Existing Homes and Commercial Buildings***

California could require energy and water utilities to aggressively promote comprehensive environmental performance testing for homes and commercial buildings, and to offer financing mechanisms to support all cost-effective energy and water efficiency improvements. All homes and buildings that are not retrofit through this program could be required to undergo similar testing and environmental performance upgrades at time of sale.

California could establish a comprehensive environmental performance rating system for residential and commercial buildings. The purpose of such a system is to inform owners and prospective buyers how well a building "performs" in terms of energy and water efficiency, as well as its overall carbon footprint. Understanding how a building's performance compares to its peers (i.e. "benchmarking") is an important first step to identifying appropriate efficiency improvements. In order to obtain a rating, a home or commercial building would first need to undergo an environmental performance audit. For purpose of this discussion, an environmental performance audit includes preliminary energy and water audits, building performance testing, and benchmarking.<sup>58</sup>

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<sup>58</sup> For homes, this should be done by a Home Energy Rating System (HERS) provider

This measure could be implemented by requiring that utilities (potentially working with third party providers) offer environmental performance audits to all homeowners in their service territories, and to provide financing mechanisms for cost-effective energy and water efficiency improvements up to a specified limit (within regulatory guidelines for cost-effective use of ratepayer funds). The CEC and CPUC would be the likely entities to develop the details of this program, including setting aggressive targets for these utility-sponsored retrofits. If two percent of existing homes were targeted each year, almost three million homes could be retrofit by 2020.

For homes that have not gone through the environmental performance audit, this would become a requirement at the time of sale. Homes built more than 10 years prior and that fail to meet a minimum energy and environmental performance threshold would be required to implement appropriate cost-effective performance improvements. Once a home goes through this process, it would be exempt for a certain number of years. Similarly, this requirement could be waived for new homes. In order for this requirement to work, lenders must offer “energy and water efficient mortgages” that allow the buyer to qualify for a larger loan if the home is energy and water efficient. Lenders and appraisers alike must be required to factor the energy and water saving features of a home into their estimates of the home value and monthly utility bill outlay. In an energy efficient home, the utility bills would be much lower, and these bill reductions can more-than-offset the increase in mortgage payments.

Similarly, utilities and other third parties could also be required to offer a similar program for commercial building owners, promoting environmental performance testing and financial incentives for retro-commissioning. The retro-commissioning process includes conducting a diagnostic evaluation of the entire building to identify operational problems, making appropriate repairs, and optimizing controls and sequences to improve overall energy performance and indoor air quality. New legislation<sup>59</sup> already requires energy use benchmarking and disclosure by all commercial building owners to prospective buyers, lessees, or lenders starting January 1, 2010. A next step could be to require commercial buildings to implement cost-effective environmental performance upgrades at time of sale.

There are approximately 13 million existing homes in California and over seven billion ft<sup>2</sup> of commercial floor space. Meeting the goals set forth in these measures could reduce GHG emissions attributable to existing homes and commercial buildings by approximately 17.0 MMTCO<sub>2</sub>E.

**Appendix C Table 25  
Green Buildings Summary  
GHG Emission Reduction Potential**

Strategy	GHG Emission Reduction Potential (MMTCO <sub>2</sub> E)*
Existing State Building	0.9
New State Construction	0.06
Existing Public Schools	1.3
New School Construction	0.3
Existing Residential	9.7
New Residential Construction	5.4

<sup>59</sup> AB 1103 (2007)

Existing Commercial Buildings	7.3
New Commercial Construction	3.5
Total	28.5

\* In order to avoid double counting, the ARB is not counting the green building measures as “additional” GHG reductions, but this may change as ARB staff gains a better understanding of the interactions between the sectors.

## **7. INDUSTRY**

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**This section includes the following measures:**

### **Preliminary Recommendations**

**California Cap-and-Trade Program Linked to the Western Climate Initiative  
(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources**

### **Other Measures Under Evaluation**

**Carbon Intensity Standard for Cement Manufacturers**

**Carbon Intensity Standard for Concrete Batch Plants**

**Waste Reduction in Concrete Use**

**Refinery Energy Efficiency Process Improvement**

**Removal of Methane Exemption from Existing Refinery Regulations**

**Oil and Gas Extraction GHG Emission Reduction**

**GHG Leak Reduction from Oil and Gas Transmission**

**Industrial Boiler Efficiency**

**Stationary Internal Combustion Engine Electrification**

**Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials**

**Off-Road Equipment**

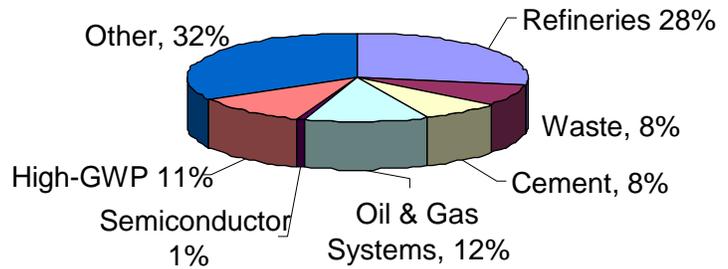
## **Overview**

The Industry sector in California covers a broad and diverse range of sources. The state, if it were a nation, would have one of the largest economies in the world; maintaining the economic health of California's business and industry while continuing to reduce criteria, toxic, and GHG emissions is vitally important. With over 100 MMTCO<sub>2</sub>E in emissions in 2004, these sources in these sectors account for approximately 20 percent of California's GHG emissions. As part of the draft of the Plan, measures to reduce GHG emissions from the following sectors are being evaluated: cement/concrete manufacturing, refineries, in-state production of oil and gas production and transmission, fuel use by general combustion processes—such as boilers and internal combustion engines (I.C. engines)—at commercial and industrial operations, and glass manufacturing, and off-road equipment.

The emission reduction strategies are as diverse as the sector itself, but focus on increasing energy efficiency, using more recycled material, reducing leaks, decreasing the carbon intensity of products, switching to alternative methods and optimizing processes, and capturing and destroying process emissions of GHGs. California cannot only implement these strategies, but can be an industry leader in creating new products and techniques to reduce emissions of GHGs.

The Industry sector consumes 27 percent of the natural gas used in the state. Reductions in GHGs from industrial processes will look toward alternative fuels, increased energy efficiency, process improvements, and technological advancements. Therefore, the diversity of the equipment and processes will play a key role in determining the best control technology to apply in various applications. The measures presented would affect most of the large industrial sources included in a cap and trade program. For further discussion of that program, please see the discussion in the Draft Scoping Plan and in previously in Appendix C.

**Appendix C Figure 6** **Industrial and Commercial**  
**(100 MMTCO<sub>2</sub>E)**



## **Preliminary Recommendations**

### ***Cap-and-Trade Program***

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver GHG reductions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner states and provinces to create this regional market.

The WCI proposes to include emissions from industrial facilities in the cap-and trade program. Both fuel consumption and process emissions are recommended for inclusion. Large emitters would have a direct regulatory obligation under the program based on their facility emissions. Those covered by the program would have flexibility in how best to meet their regulatory obligation to surrender emission allowances to cover their actual emissions in each compliance period. Consistent with the WCI draft recommendations, California's preliminary recommendation is to include all large industrial facilities within the cap-and-trade program, including cement plants, refineries, oil and gas production, and others.

To apply the cap-and-trade program effectively and comply with the requirements of AB 32, the potential for emissions "leakage" must be considered. While important for all sectors, the assessment of the risk of leakage for industrial facilities must particularly consider the potential for production to shift to outside of California or outside of WCI. California and the WCI Partners are examining these risks, and are working to identify approaches for mitigating leakage potential, thereby ensuring that production in California and the WCI Partner jurisdictions remains competitive and real emissions reductions are achieved.

By setting a limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will motivate GHG reduction from industrial facilities that are expected to be the most cost effective options available from these sources.

### ***(I-1) Energy Efficiency and Co-Benefits Audit for Large Industrial Sources***

This measure would apply to major industrial facilities with more than 0.5 MMTCO<sub>2</sub>E per year of emissions of greenhouse gases. In general, these facilities also have significant emissions of criteria air pollutants, toxic air pollutants, or both. Major facilities that have this level of emissions include larger power plants, refineries, and cement plants. The measure would be implemented through a regulation adopted by ARB.

In California, the 2004 emissions inventory shows that there are 54 major industrial with emissions greater than 0.5 MMTCO<sub>2</sub>E. The breakdown includes five major oil and gas facilities, two hydrogen plants, one minerals facility, 13 refineries, nine cement plants, 23 power plants, and one natural gas compressor station. The five oil and gas facilities are located in the western Kern County oil fields and are distributed sources but are each treated as a single stationary source; the other facilities are located at single sites throughout California. The emissions range from about 5 MMTCO<sub>2</sub>E to just over 0.5 MMTCO<sub>2</sub>E. The total emissions associated with these

facilities are about 77 MMTCO<sub>2</sub>E, which represents about 80 percent of the total emissions from the industrial sector.

Each facility would be required to conduct an audit of the energy efficiency of significant individual sources within the facility to determine the potential to reduce greenhouse gases, criteria air pollutants, and toxic air pollutants. The audit would include an assessment of the impacts of replacing or upgrading, older less efficient units such as boiler and heaters, or replacing the units with combined heat and power units. For example, the audit might identify specific sources within a facility that are old, inefficient, are cost-effective to control directly and have significant emissions of criteria air pollutants, toxic air pollutants, or both.

The analysis would identify the potential emissions reductions, the costs, the cost-effectiveness, the technical feasibility, and the potential to reduce air pollution impacts on local populations. Rulemaking will be initiated in 2010 and in effect by 2012. The Board and affected sources will use the results of the audit to determine if certain emission sources within a facility have cost-effective GHG reduction options that also provide significant reductions in other pollutants. Where this is the case, rule requirements, permit conditions, or other mechanisms would be considered to ensure the best combination of GHG and other pollutant reductions. The estimated one time cost for the measure is approximately \$13.5 million, based on an estimated average audit cost of \$250,000 per facility applicable to about 54 facilities.

**Appendix C: Industry-Preliminary Recommendations**

**Table 26**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>	<b>Adoption/ Implementation Timeframe</b>
Energy Efficiency and Co-Benefits Audits for Large Stationary Sources	TBD	TBD	ARB	2010/2012

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## Other Measures Under Evaluation

### A. CEMENT

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ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

With California's continuing growth comes an increase in demand for cement. Reducing GHG emissions from this sector needs to be done in a manner that minimizes the potential for both emissions and economic leakage and maintains a strong, competitive cement industry in California. In 2006, GHG emissions from the production of cement in California were 10.5 MMTCO<sub>2</sub>E. However, total emissions associated with cement used in the State, 40 percent of which is imported, were estimated to be 15.3 MMTCO<sub>2</sub>E.

The basic process of cement manufacturing is relatively simple: heat calcium carbonate (limestone) to approximately 3000 °F, thereby separating the limestone into equal parts of CO<sub>2</sub> and lime in a process known as calcination. At this high temperature, the lime is combined with clay, aluminum, and steel to make a golf ball sized product called "clinker." Grind the clinker to a fine powder and you have cement, the "glue" that holds rock, sand, and other aggregate together in concrete. Cement is shipped to concrete manufacturing facilities (batch plants) and other end users to make concrete.

Greenhouse gases are produced during two parts of this process. Burning fossil fuel, typically coal in most California plants, to reach the required temperature produces slightly less than half of the CO<sub>2</sub> emissions in this process. The rest of the CO<sub>2</sub> is generated from the calcination process. Approximately one ton of CO<sub>2</sub> is produced for each ton of cement manufactured.

California has 11 cement plants, owned by at least six companies, three of which—Cemex (Mexico), Heidelberg (Germany), and Mitsubishi (Japan)—are large multinational conglomerates. Other than the large cement companies, there is the multi-million dollar cement import business<sup>60</sup>. California imported approximately 40 percent of the cement used in the state in 2005. Cement is delivered to and from California's border states. Cement is imported from Canada, China, Thailand, Japan, and Mexico. Fly ash and slag are not produced in California, but are transported to California by rail from many places throughout the U.S. California's cement exports are relatively small, mostly from manufacturers in the Mojave Desert to Las Vegas. ARB has not quantified these exports.

To reduce the GHGs emitted from manufacturing cement, manufacturers can switch to alternative fuels and improve the energy efficiency of the manufacturing process. GHG emissions can also be reduced by using less cement per ton of concrete by partially replacing the cement with other materials that have cement-like properties. Adding these materials can improve the strength of the final product. These materials are known as "supplementary cementitious materials", or SCMs. The most common SCMs are fly ash, a byproduct of coal

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<sup>60</sup> See website at CNCA.org

combustion, and slag, a byproduct of steel manufacturing. Other materials may also act as suitable SCMs. In addition to these approaches, the GHG emissions can be reduced by reducing the amount of concrete that is unused or wasted. Finally, new technology, such as carbon capture and sequestration (CCS), may also reduce GHG emissions. The strategies developed within this sector could be used elsewhere to implement similar emission reduction strategies.

Based on how GHGs can be reduced in this sector, ARB has evaluated three potential approaches that could complement the inclusion of cement plants in the cap-and-trade program (see discussion above regarding the cap-and-trade program). The first approach being evaluated is targeted at the manufacturing of cement and would establish a carbon intensity factor (CIF) for cement, defined as the amount of CO<sub>2</sub> generated per ton of cement. The second approach is targeted at the use of cement at concrete batch plants. This approach is also based on a carbon intensity factor, defined as the amount of CO<sub>2</sub> generated per ton of cement and is achieved by either using very low carbon cement, blending SCMs into the concrete, or both. The third approach would focus on minimizing waste. Each of these measures is discussed further below.

Leakage has been a key consideration in developing the GHG emission reduction strategies in this sector. If GHG requirements were applied to California cement manufacturing facilities only, the cost of cement from those facilities would rise relative to imports, and imports could displace California productivity. Generally, California's cement manufacturing plants are more efficient than those that produce imported cement. California plants would decrease their GHGs produced, but increased imports would likely result in a net worldwide increase in GHG emissions. To minimize leakage, in-state and imported products need to be subject to the same standards.

Specifications for concrete are often based on the ingredients that go in to making the concrete rather than solely on the performance of the final product. The California Department of Transportation (CalTrans) plays a key role in setting these specifications for much of the concrete used in California. Current CalTrans specifications allow blending of up to 35 percent fly ash, 60 percent slag, and 2.5 percent limestone into the concrete mixture, depending upon the intended application. Municipalities in California typically base their concrete specifications on CalTrans specifications, the "Green Book", or the California Building Code. However, many municipalities do not use the most current specification. More closely following current specifications would allow municipalities to fully utilize SCMs.

One GHG emission reduction strategy previously suggested for further evaluation in the cement sector was the use of wafflemats—a device that is used to displace a volume of concrete used in a slab, therefore reducing the amount of concrete used. Initial evaluation of this strategy indicated that the reductions associated with this technology were less than anticipated, and that the application of the technology was limited. Further evaluation of this technology is not anticipated at this time.

### ***Carbon Intensity Standard for Cement Manufacturers***

In this approach, ARB staff is evaluating the feasibility of setting standards based on the average carbon intensity factors (CIF) for cement used in California. This standard would apply to imported cement as well as that manufactured in California. The CIF is defined as metric tons CO<sub>2</sub> emitted per metric ton of cement produced.

As discussed above, the CIF improvements at the cement production level are expected to be met through alternative fuels or energy efficiency measures. There is very little addition of SCMs that occur at the manufacturing plants today. Therefore, the focus would be to ensure that lower carbon fuels are produced by maximizing the use of alternative fuels and energy efficiency.

The average 2006 CIF for cement manufactured in California plants is 0.90 metric tons CO<sub>2</sub> per metric ton of cement. An estimated CIF value for the production of imported cement is 1.0 metric tons CO<sub>2</sub> per metric ton of cement. The majority of imported cement is transported by ship into California. Maritime emissions of 0.30 metric tons CO<sub>2</sub> per metric ton of cement would need to be added to the seaborne imported cement CIF to reflect these higher emissions. Thus, the estimated total 2006 CIF for imported cement is 1.15 metric tons CO<sub>2</sub> per metric ton of cement. Total cement amount used in California consists of cement manufactured in California and imported cement from overseas. As SCMs are added to cement to create blended cements, the cement produced at California is, in effect, stretched to provide greater quantities of usable product. As a result, there will likely be a decrease of imported cement as well as imported cement GHG emissions in California.

For example, establishing a maximum California and imported cement CIF standard of 0.80 metric tons CO<sub>2</sub> per metric ton cement would reduce GHG emissions from in-state production and imported cement by 1.8 MMTCO<sub>2</sub>E in 2020. Final carbon intensity values would need to be determined through the rule development process. The range of emission reductions is expected to be between 1.1 to 2.5 MMTCO<sub>2</sub>E for cement produced and imported in California.

It is expected that switching fuels from coal and increasing the energy efficiency of the manufacturing facility's equipment will be key in meeting a more stringent CIF requirement. The impacts on ozone forming pollutants, particulate matter and toxic air pollutants of any fuel switching would be evaluated as part of the rule development process.

ARB estimated the total capital costs for this measure to be about \$220 million, with a net annualized savings to be about \$4 million, due primarily to the improvements in energy efficiency and energy savings.

### ***Carbon Intensity Standard for Concrete Batch Plants***

Concrete batch plants mix the cement, sand, aggregate, and water to produce the concrete mixture. The batch plant receives raw materials from different vendors, which includes the cement. Cement accounts for about 15 percent of the final concrete blend.

In this approach, ARB is evaluating the feasibility of establishing a lower carbon intensity factor (CIF) for cement than that required at the cement manufacturing facility. The standard at the concrete batch plant could be met either by using cement with very low carbon intensity factors, by adding materials such as SCMs to replace cement in the concrete blend, or using a combination of both.

For example, the CIF for a batch plant could be set at 0.60 metric tons CO<sub>2</sub> of cement at the batch plant. In the example presented above, the average CIF for California and imported

cement that is delivered to the batch plant could be set at 0.80 metric tons CO<sub>2</sub> per metric ton of cement. In this example, the batch plant must then reduce the carbon intensity by 25 percent.

To meet the CIF, batch plants would need to either use cement produced to a very low CIF (i.e., less than 0.8), or would blend SCMs into the concrete mixture, further decreasing the CIF value of the cement even more. For example, if the cement that will be used to manufacture concrete is blended with 15 percent SCM, the CIF value of the cement is reduced by 15 percent. The lower the CIF value of the cement that the batch plant uses, the less blending of SCMs is required to meet the CIF standard. Therefore, the batch plant has flexibility in how it meets the CIF standard through the choice of cement used.

By basing the standard on an average CIF, the concrete batch plant would have the flexibility to provide high CIF cement concrete when needed by the customer. A second possible approach would define multiple classes of concrete based on the proportion of cement in each cubic yard of material. The approach would have less regulatory certainty but would provide more flexibility.

Requiring a CIF of 0.60 metric tons per metric ton of cement at the batch plant would reduce GHG emissions by 3.1 MMTCO<sub>2</sub>E. A reasonable range of emissions reductions for this category would be 2.5 to 3.5 MMTCO<sub>2</sub>E.

Currently, the cost of a ton of cement, which is on the order of \$100 per ton, is only slightly more expensive than a ton of SCM. Therefore, we have estimated that there would be no net costs or savings for this measure.

## **Waste Reduction in Concrete Use**

An additional approach that is under evaluation would reduce the GHG emissions from cement manufacturing by reducing concrete waste. Under this measure, ARB would set a minimum waste requirement or establish and emissions fees on unused returned concrete. It is estimated that approximately five to eight percent of the concrete that is made in California every year is returned to the plant as waste. Considering that California consumes about 16 million metric tons of cement each year, this correlates to approximately one MMTCO<sub>2</sub>E excess per year. Ways to decrease the amount of concrete wasted include: better estimating the total concrete needed for the job; using trucks that mix the concrete on-site; and using the returned or left over concrete at a job site (e.g. make sidewalks now that had been planned for a later concrete placement) or at a concrete batch plant (e.g. make concrete blocks).

**Appendix C: Industry-Other Measures Under Evaluation**  
**Table 27**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E<sup>61</sup></b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Carbon Intensity Standard for Cement Manufacturers	1.1 – 2.5	-3	ARB

<sup>61</sup> Potential 2020 GHG reductions may change due to additional information received by staff and continued evaluation of California's cement sector.

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E<sup>61</sup></b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Carbon Intensity Standard for Concrete Batch Plants	2.5 – 3.5	0	ARB
Waste Reduction in Concrete Use	0.5 – 1.0	-28	ARB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **B. REFINERIES**

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The GHG emissions from refineries in the state are estimated to be 35.2 MMTCO<sub>2</sub>E (2004), including emissions from hydrogen production. Increased energy efficiency would produce significant emission reductions in this sector. Establishing leak controls for methane would also result in GHG reductions.

California is the third largest refining state in the nation, with 21 refineries located primarily in the San Francisco and Los Angeles regions. These facilities produce approximately 80 million gallons of refined product per day.<sup>62</sup>

It is unlikely that refinery production will decrease in California over the next 12 years because of GHG reduction requirements. Due to the state's proximity to existing infrastructure (seaports, pipelines, etc.) and the developing Low Carbon Fuel Standard (LCFS)—which should hold both in-state and out-of-state producers to the same low carbon fuel standard—the demand for fuel products from California's refineries will not significantly change in the short term.

### ***Refinery Energy Efficiency Process Improvements***

Improving energy efficiency would reduce GHG emissions by reducing fossil fuel consumption across a number of refinery processes. The GHG sources that would be affected by this measure are process heaters, boilers, fluid catalytic crackers, hydrogen plants, and flares. Efficiency improvements would be realized by:

- Replacing the low efficiency boilers and heaters with new equipment;
- Installing fluid catalyst cracker (FCC) power recovery turbines;
- Optimizing carbon-on-regenerated-catalyst (CRC) ratio with a carbon monoxide boiler or incinerator;
- Replacing hydrogen plants with modern, more efficient plants; and
- Increasing gas recovery capacity for flares.

Refineries are complex, energy-integrated industrial sources. Their sizes, ages, and degrees of technical sophistication vary so the opportunities to increase the efficiency of any refinery are site-specific. However, based on available data, much older, less-efficient equipment is still in service in California's refineries today. For this analysis, staff estimated that 20 percent of existing boilers and process heaters could be replaced cost effectively with modern units. Furthermore, staff estimated that power recovery turbines might be installed at three FCCs and catalyst regeneration improvements realized at a couple more. Newer, more efficient hydrogen plants could replace older plants in several refineries, while increasing gas recovery from flare systems could be improved at nearly all of the refineries.

Until an energy survey can be conducted at the refineries, potential GHG emission reductions can only be approximated. Actual GHG reductions and fuel savings realized through these measures may be higher or lower.

Currently, these measures would be expected to reduce GHG emissions from California refineries by about six to 15 percent, resulting in reductions between 2.0 to 5.0 MMTCO<sub>2</sub>E per

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<sup>62</sup> California Energy Commission, 2008; From Web site: [www.energy.ca.gov/oil/refineries.html](http://www.energy.ca.gov/oil/refineries.html)

year. They could also generate reductions in criteria pollutants. These are significant improvements, given that, based on purchased energy (natural gas, electricity, and steam) per barrel of crude processed, California refineries are already more efficient, on average, than refineries located elsewhere in the United States.

The estimated total capital cost of these efficiency improvements would be approximately in the range of \$600 to 900 million. These costs are expected to be more than offset by energy cost savings, with a net annualized savings of about \$450 million. Significant construction costs and logistical planning challenges may reduce these savings.

### **Removal of Methane Exemption from Existing Refinery Regulations**

Under this measure, existing fugitive methane exemptions would be removed from the regulations applicable to equipment and sources employed in California's refineries. The local air pollution control authorities oversee and implement regulations which limit and monitor refinery fugitive emissions. Methane is currently exempted from local fugitive emissions regulations because it is not a volatile organic compound (VOC) that contributes to urban ozone levels. Storage tanks, wastewater treatment facilities, and process losses (leaks) are all sources of fugitive emissions which contain methane. Valves, pumps, compressors, pressure relief valves, flanges, connectors and other piping components are especially vulnerable to leakage. To implement this measure, ARB would work with the local air pollution control authorities to:

- Modify existing regulations to include in addition to VOCs, methane detection and leak repair as a regulatory requirement;
- Ensure that components that contain significant amounts of methane are included in fugitive emissions monitoring programs, and increase the fugitive methane monitoring frequency of all identified components; and
- Modify leak detection methodology and equipment requirements to detect methane, and where needed, require the installation of additional leak detection equipment.

The measure described herein is expected to reduce GHGs be between 0.01 and 0.05 MMTCO<sub>2</sub>E per year in 2020. This measure is expected to eliminate approximately 85 to 90 percent of fugitive methane emissions. Additional analysis is needed to more accurately quantify actual refinery methane emissions.

Based on data provided by the South Coast Air Quality Management District and the Bay Area Air Quality Management District, ARB estimates that the annual costs for implementation of this measure to be about \$5,000,000. When methane leaks are minimized, savings will occur, and the gas captured as a result of this measure will result in an energy savings valued at \$2,700,000. Implementation of these regulations will require close coordination with local air districts, but should not impact entities beyond the refining industry. This measure should have little or no impact on the price of refined end products.

The benefits and costs of the refinery-based GHG-reduction measures described in this section are summarized in the tables below.

**Appendix C: Industry-Other Measures Under Evaluation**  
**Table 28**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Refinery Energy Efficiency Process Improvement	2 to 5	-383	ARB
Removal of Methane Exemption from Existing Refinery Regulations	0.01 - 0.05	5	ARB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

These measures were selected based on a review of the available literature on current refinery technology and an analysis of existing refinery operations. Overall, the measures listed above are expected to generate the greatest GHG reductions for the least cost.

These measures were selected based on a review of the available literature on current refinery technology and an analysis of existing refinery operations. Generally, the measures listed above are expected to generate the greatest GHG reductions for the least cost.

## **C. OIL AND GAS PRODUCTION**

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California has a large oil and gas industry, which produced approximately 250 million barrels of crude oil and 325 billion cubic feet of natural gas in 2005. This production comes from California's more than 50,000 oil and 1,500 gas wells, including off-shore platforms. The majority of the oil wells are located in southern California, with most of the gas fields located in northern California.

An extensive network of pipelines within the state brings California crude from import terminals and onshore and offshore oil fields to refineries, and distributes finished fuels to more than 70 product terminals throughout the state. Pipelines are also part of the regional petroleum market. California refineries supply Nevada with almost 100 percent of its transportation fuels. Arizona gets more than 60 percent of its fuel from California, while Oregon depends on California's refiners for 25 to 35 percent of its fuel.

The industry is dominated by large, integrated oil companies. While small businesses comprise a large number of individual production wells, their share of total production is modest. There is some evidence that with the current high oil prices, more small producers are entering or reentering the market, resulting in increased emissions.

GHG emissions come from both combustion and fugitive sources. Two types of measures are being evaluated to reduce GHGs in this sector—one that addresses emissions from *Extraction and Processing* (removing oil and gas from the ground and processing them for transmission) and another that addresses emissions from *Transmission and Distribution* (transporting and distributing natural gas). The transmission measure would be based on strategies developed under the U.S. Environmental Protection Agency's Natural Gas STAR program, which specifically focuses on reducing fugitive emissions from this sector.

### **Oil and Gas Extraction GHG Emission Reduction**

This measure would address emissions from the extraction process of California's large oil and gas industry, including on and off-shore sources. Extraction-related GHG emissions come primarily from combustion (95 percent) and secondarily, from fugitive sources. Emissions include primarily CO<sub>2</sub>, with modest additional GHG emissions coming from methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). These emissions are produced mainly from the combustion of natural gas in generators, boilers, pumps and other related equipment. The measure would include: repowering, retrofitting, replacing or repairing existing equipment; installing new CHP; electrifying equipment; using monitoring equipment to detect leaks; and possibly employing CO<sub>2</sub> injection to enhance oil recovery.

Total emissions from oil and gas extraction are estimated to be 14.3 MMTCO<sub>2</sub>E in 2004 and 13.6 MMTCO<sub>2</sub>E in 2020. This relatively constant level of emissions follows the historical trend of statewide extraction rates. However, the increase in crude oil prices resulting in increased oil extraction may show that projected emissions are underestimated. If so, this measure would yield greater benefits.

The measure described here is expected to reduce GHGs by approximately 1.5 to 2.5 MMTCO<sub>2</sub>E per year, beginning in 2015 and continuing to 2020 and beyond. The combustion emission

reductions are based on the improved fuel efficiencies resulting from actions such as replacing small internal combustion engine pumps with electric motors and retrofitting or replacing boilers and steam generators. These emission reductions may be underestimated if an industry survey reveals that there are additional sources to upgrade or replace. In addition, the Energy Efficiency and Co-Benefits Audit measure (I-1) will provide additional information on the major oil fields in western Kern County. Given the uncertainty in the emissions and reductions, the potential reductions are given as a range.

ARB staff estimates that implementing this measure would result in significant cost savings due to the energy savings. Capital costs are estimated to total \$350 million, with net annualized costs savings of about \$170 million. Costs and benefits of CHP are accounted for under the CHP measure contained within the energy sector. Because these efforts are expected to be cost effective, implementation of this measure would not significantly impact the industry and would not on average raise the cost of production. Because of the cost savings, there is a potential for further reductions from this measure and these potential reductions will be evaluated as part of the ongoing evaluation of the sector.

### ***GHG Leak Reduction from Oil and Gas Transmission***

This measure addresses emissions from the transmission and distribution of natural gas throughout California. Statewide, there are approximately 12,000 miles of pipeline for natural gas. Transmission-related emissions come primarily from fugitive sources and secondarily from combustion sources. Emissions include primarily CH<sub>4</sub> and a smaller amount of CO<sub>2</sub>. Modest GHG emissions of N<sub>2</sub>O come from combustion. These emissions sources come from venting, accidental releases of GHGs, and leaks of flanges, valves and other fittings along pipelines. The combustion of natural gas in pipeline related equipment produces lesser amounts of GHG emissions.

This measure would include: replacing older equipment (flanges valves and fittings); substituting high bleed with low bleed pneumatic devices; installing vapor recovery devices; using emission monitoring equipment to detect leaks; installing more energy efficient equipment; switching to low carbon fuels to run the equipment; and improving practices for inspection and management. The measure would be based, to a large degree, upon the U.S. EPA's Natural Gas STAR program aimed at cost effective approaches to reducing methane emissions.

Total emissions from natural gas transmission are estimated to be 2.2 MMTCO<sub>2</sub>E in 2004 and 2.3 MMCO<sub>2</sub>ET in 2020. The measure described here is expected to reduce GHGs by approximately 0.5 to 1.5 MMTCO<sub>2</sub>E per year. Staff estimated the fugitive emission reductions by applying the natural gas savings from the U.S. EPA's Natural Gas STAR program actions described above to a number of such units in the current emissions inventory. These emission reductions may be underestimated if an industry survey reveals that there are additional sources of emissions. Given the uncertainty in the emissions and reductions, the potential reductions are given as a range.

ARB staff estimates capital costs to be about \$28 million, with annualized net savings of about \$15 million. Implementation of this measure would impact mainly the natural gas industry and would have little or no impact on the price of end products. Because of the cost savings, there is

a potential for further reductions from this measure and these potential reductions will be evaluated as part of the ongoing evaluation of the sector.

**Appendix C: Industry-Other Measures Under Evaluation**  
**Table 29**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Oil and Gas Extraction GHG Emission Reduction	1 to 3	-170	ARB
GHG Leak Reduction from Oil and Gas Transmission	0.5 to 1.5	-15	ARB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **D. GENERAL COMBUSTION**

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While this sector is spread throughout California, large concentrations of industrial and commercial sources are located in the most concentrated areas of population including the Bay Area and South Coast. Additionally, large agricultural and food processing industries are located in the San Joaquin Valley. The sector includes many industrial and commercial subcategories that have a significant impact on the economy of California, including industries that employ large numbers of Californians. The industries with the greatest GHG emissions include food products, pulp and paper, metal durables, chemicals and allied products, and rubber.

In terms of equipment, the General Combustion Sector GHG emission sources are primarily boilers and internal combustion engines (IC engines). These devices have been regulated by the State and local air districts for the control of ozone-forming pollutants. Most local air quality regulatory agencies in California have had boiler rules that limit ozone-forming pollutants since the early 1990s. The stringency of these rules is periodically increased requiring the retrofit or replacement of older boilers with more efficient models. More efficient boilers result in reduced fossil fuel combustion and achieve a concurrent reduction of GHG emissions.

ARB does not expect small business to be significantly affected by any measures in the General Combustion Sector as most of the GHG emissions in the sector are from large industrial and commercial sources. These GHG reduction measures would be for boilers and IC engines rated at or over 10 MMBtu per hour and 50 horsepower, respectively and this equipment is not typically owned by small business.

Additional emission reductions for boilers could be achieved through the use of advanced technologies such as fuel cell systems or “super boilers” which combine ultra-high fuel efficiency with ultra-low emissions. Additional reductions for IC engines could be obtained by taking advantage of technology which is expected to be commercially available in the future.

### ***Industrial Boiler Efficiency***

This sector encompasses greenhouse gas (GHG) emissions resulting from combustion of natural gas and diesel/fuel oil in boilers operated in an industrial or commercial setting. Nearly all boilers in the State use natural gas as a fuel. Currently these sources operate at an average efficiency of between 75-78 percent. By improving boiler efficiency, a source can reduce fossil fuel usage—thereby reducing GHG emissions. For boilers, the expected GHG emission reduction potential would be in the range of 0.5 to 1.5 MMTCO<sub>2</sub>E annual emission reductions by 2020 using commonly available techniques for improving thermal efficiency.

This measure would require one or more of the following: annual tuning of all boilers, the installation of an oxygen trim system, and/or a non-condensing economizer to maximize boiler efficiency. A source could also replace an existing boiler with a new one that is equipped with these systems. New boilers have more air/fuel ratio controls and generally operate in the range of 80-83 percent efficiency.

Boilers are often oversized for their steam or hot water demand and operate at a reduced rate much of the time. The efficiency of an existing boiler can be improved by retrofitting the boiler with an oxygen trim system including a variable frequency drive and parallel positioning. Actual

efficiency improvement will vary depending on the individual application. The estimated efficiency improvement averages approximately two percent. A regulation would require that sources be required to retrofit all boilers rated 10 MMBtu/hr or more with oxygen trim system.

Annual tuning of a boiler helps ensure that the oxygen trim system is calibrated, so that boiler efficiency can be optimized. Annual tuning of boilers is required by some local district rules. Staff proposes requiring tuning for all permitted boilers. The resultant efficiency improvement will vary depending on the initial condition of the boiler but should average an additional one to two percent.

A non-condensing economizer improves efficiency by recovering and utilizing heat to pre-heat boiler feed water that would otherwise be lost to the stack. The efficiency improvement from retrofitting a boiler with a non-condensing economizer would normally be in the range of four to five percent. Staff proposes that sources be required to retrofit boilers that are 50 MMBtu/hr or more with a non-condensing economizer.

A source could also replace an existing boiler with a new one that is equipped with these systems. New boilers and modified boilers could be required to have these systems.

The total capital costs for this measure are estimated to be about \$90 million, with net annualized savings of about \$127 million.

One advanced technology that could replace boilers and provide significant GHG emission reductions is fuel cells. Unlike a boiler system, the heat generated from a fuel cell is electrochemical, involving no combustion. There are existing incentives available for facilities in the State that incorporate fuel cell technology through the Self Generated Power Incentive Program as well as tax and other incentives. Typically, 40-50 percent of capital costs have been covered by incentives.

### ***Stationary Internal Combustion Engine Electrification***

The IC engine measure would affect owners and operators of engines in industrial and commercial operations rated at over 50 hp and used as primary power sources—also known as “prime” engines. This measure would not affect I.C. engines used for emergency power generation.

The IC engine measure would reduce GHG emissions from individual engines by around 33 percent for natural gas fired engines and about 40 percent for diesel fired engines through engine electrification requirements. This measure would have a GHG emission reduction potential of about 0.1 to 1.0 MMTCO<sub>2</sub>E per year, assuming that 33 percent of prime engines will be electrified by 2020. Additionally, this measure would provide reductions of ozone forming pollutants (NO<sub>x</sub>) and particulate matter.

This measure would include the replacement of IC engines with electric motors (electrification). Another advantage of electrification is that the direct emissions from the engines are zero. The electric motor replacing an engine must be powered from the grid. Therefore the GHG emissions are reduced to those of the electrical grid power used to replace the natural gas or

diesel used by the engine. Distributed generation sources may power electric motors with their own electrical power.

The total capital costs for this measure are estimated to be about \$51 million, with net annualized savings of about \$13 million.

**Appendix C: Industry-Other Measures Under Evaluation**  
**Table 30**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Industrial Boiler Efficiency	0.5 – 1.5	-127	ARB
Stationary Internal Combustion Engine Electrification	0.1 – 1.0	-13	ARB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **E. GLASS MANUFACTURING EFFICIENCY**

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Based on a preliminary analysis, there are five container glass manufacturing plants, four fiberglass manufacturing plants, four flat or float glass manufacturing plants and about four press and blown glass plants in California. The glass manufacturing plants discussed in this Plan are located in California, but the proposed strategies may impact plants that sell their products into California if an increase in recycle content is required. States with the largest number of major glass plants include Ohio, Pennsylvania, California, Texas, New York, Kentucky, and North Carolina.

Glass manufacturing companies in California varies in size and range from small privately held companies to large multinational corporations. California glass manufacturing companies employ approximately 18,000 people. Production and consumption for all four subsectors of the glass manufacturing industry are often concentrated near U.S. population centers due to the prohibitive shipping costs of both raw materials and products, and the heavy concentration of end-use customers. Therefore, it is not likely that any of emission reduction strategies mentioned would increase emissions outside of California resulting in GHG emissions leakage.

The amount of GHG emissions in California due to the glass manufacturing industry's energy usage is 0.9 million metric tones of CO<sub>2</sub> equivalents (MMTCO<sub>2</sub>E) in 2006. In addition, a direct source of GHG emissions from the glass manufacturing industry is the CO<sub>2</sub> produced by the decomposition of two of the raw materials: soda ash and lime stone. This is estimated to be 0.1 MMTCO<sub>2</sub>E in 2006. Therefore, the total amount of GHG emission from the glass manufacturing industry in 2006 was about 1 MMTCO<sub>2</sub>E.

The container glass subsector, which produces bottles, jars, and other containers, is the industry's largest producer, manufacturing about 1.4 million tons of products in 2006 in California. Currently, three manufacturers account for about 95 percent of the national container glass market. The flat glass subsector has become increasingly global, with a rise in foreign ownership of U.S. facilities as well as increased U.S. participation in overseas plants. The fiberglass subsector, which produces insulation and textile/reinforcement fibers, is affected by the economic cycles of its primary markets: the construction, automotive, and marine industries. The press and blown glass subsector, also called specialty glass, is very diverse and consists of traditional products, such as lighting, cookware, and television glass components along with newer products such as fiber optics, photonics, flat screen displays, and LCD panels. This segment faces strong challenges from foreign producers, particularly in Europe and Asia, and from the use of alternative materials.

A direct regulation approach would include one or all of the following: emission limits on GHG emissions, increasing the percent of recycled glass (cullet) required in manufacturing glass to reduce energy consumption, or requiring advanced technologies. A voluntary program can be set in place by working with the glass manufacturing industry to encourage them to increase their use of cullet and other energy efficient processes that would be cost effective. An incentive-based program could include either a financial incentive program or a non-monetary incentive program used to encourage the use of the best technology to reduce GHG emissions, or energy efficient operations and maintenance procedures.

The most economically and technologically feasible strategy will be pursued. Remaining potential strategies that are not pursued due to technological or economic limitations may be revisited once the proposed measure has been in effect for a period of time.

### **Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials**

There are several possible approaches that can be adopted for the glass manufacturing measure. ARB is in the early stages of evaluating the possible approaches, and the following discussion is based on preliminary analysis. Cost associated with the various approaches can be better evaluated as measure development progresses. Staff anticipates that measures could be developed for consideration by ARB by 2011 and could achieve GHG emission reductions between 0.1 and 0.2 MMTCO<sub>2</sub>E by 2020.

#### **Use of Recycled Materials**

This measure would establish limits on the amount of cullet, require using the best technology to reduce GHG emissions, or establish energy efficient operation and maintenance procedures. With currently known technologies, this approach may achieve a goal of 8 to 15 percent reduction in greenhouse gas emissions by 2020. Finally, incentive programs could be used to encourage the use of best technology to reduce GHG emissions, or energy efficient operations and maintenance procedures. Using currently known technologies, an incentive only approach may achieve a goal of six to 12 percent reduction in greenhouse gas emissions by 2020.

This measure would increase the requirement for recycled glass (cullet) content. Currently, glass container manufacturers are required to use 35 percent cullet while fiberglass manufacturers are required to use 30 percent cullet for their production. The glass container manufacturing industry and others estimate that each percent increase of cullet use can decrease energy consumption by 0.2 to 0.5 percent. In addition, increased cullet use leads to decreased use of carbonate raw materials, which would further reduce the amount of greenhouse gas produced in the process. Another benefit to increased cullet use is decreased waste that would go into landfills.

#### **Equipment Efficiency**

This measure would require facilities to use the best technology to reduce GHG emissions or adopt energy efficient operation and maintenance procedures for manufacturing glass. The following emission reduction methods are under consideration.

The melting operation is the most energy intensive step in a glass manufacturing process. There are several methods to optimize the melting operation to reduce energy consumption for this process that could be used to meet an energy efficiency requirement.

Existing furnaces could be modified to include installation of control systems for the melting operation, minimize excess air and reduce air leakage, use of pre-mixed burners, application of adjustable speed drives on combustion air fans, capturing waste heat from flue gases by the use of waste heat boiler, use of bubbler to improve heat transfer, and type and position of the burners. Potential energy savings are between 0 to 11 percent of the process.

When furnaces are rebuilt or replaced, certain furnace designs can help reduce energy consumption. For example, considerations may include: end-fired furnaces versus cross-fired furnaces, various design features of regenerative furnaces, possibility of increasing the size of the regenerator to improve heat recovery efficiency, and the latest technologies for the application.

About 30 percent of U.S. glass furnaces now use oxygen enriched air. The energy savings of converting to an oxy-fuel furnace depend on the current furnace’s energy use, use of electric boosting, air leakage, glass type, and cullet use and vary between 5 to 45 percent (45 percent for replacing energy inefficient furnaces). Cost effectiveness varies and depends on location, specific circumstances, such as the current system’s fuel efficiency, costs of NOx emissions, cost of fuel, and cost of electricity.

Batch and/or cullet preheating can improve energy efficiency if the process allows. Cullet-preheaters use waste heat of the fuel-fired furnace to preheat the incoming cullet batch. Energy savings of cullet preheaters are estimated to be between 12 and 20 percent. Batch preheating is more difficult than cullet preheating, as clumping of incoming materials can affect the product quality and melter efficiency.

The Department of Conservation (DOC) is the agency that implements the California Beverage Container Recycling and Litter Act. If the approach is to increase the cullet used, ARB would work closely with DOC to ensure that any regulation did not interfere with their regulatory mandate. However, ARB would have the authority to adopt, implement, and enforce such a regulation if it is deemed appropriate.

Estimated capital costs for this measure are about \$15 million, with net annualized costs of about \$6 million.

**Appendix C: Industry-Other Measures Under Evaluation**  
**Table 31**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Glass Manufacturing Energy Efficiency	0.1 – 0.2	6	ARB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **F. OFF-ROAD EQUIPMENT**

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Off-road GHG emission sources are varied and include lawn and garden equipment, pleasure boats, construction equipment, industrial and commercial equipment, and equipment used in agriculture. The off-road emissions inventory is currently under analysis and will likely be updated with OFF-ROAD model. Therefore, the reduction strategies may apply to multiple sectors and be accounted for where applicable.

Many of the emission control technologies that are used successfully on on-road engines are later adapted for off-road engines and equipment use. The strategies being considered include solar-reflective paint and solar-reflective glass, reduced engine idling, electrification, and low friction oil.

### ***Off-Road Equipment***

#### **Solar-Reflective Paint and Solar-Reflective Glass**

Technologies like solar-reflective paint and solar-reflective glass can reduce the thermal load on a vehicle, its interior temperatures, and ultimately, fuel use. Many off-road vehicles and equipment are offering more amenities. Larger off-road vehicles and equipment, such as dumper trucks, graders, combines, and some tractors, come with amenities such as climate-controlled cabs with air conditioning and heat. As with automobiles, the use of an air conditioner increases fuel usage, and thus, more GHG emissions. These technologies would minimize that increase

Besides benefiting compression-ignition engines used in construction and agriculture equipment, solar-reflective paint and solar-reflective glass can also benefit marine engines used in passenger ferries and cruise ships, and locomotives.

#### **Reduced Idling Emissions**

Anti-idling rules have been adopted for new and in-use diesel trucks and in-use heavy-duty off-road diesel equipment. While current ARB regulations for in-use heavy-duty off-road diesel equipment do not require automatic engine cut-off switches to reduce idling, this technology could be required in off-road applications where safety or operational concerns allow.

Additionally, current ARB regulations do not affect off-road large spark-ignition engines (LSI) and equipment—anti-idling requirements can be extended to this equipment. Besides generating emissions, non-productive engine idling also increases fuel consumption, engine wear and maintenance costs.

For instance, truck idling consumes about one gallon of diesel fuel per hour. In the case of construction equipment, over a machine's life, idle time typically accounts for nearly 20 percent of the total fuel burned. As an example for construction excavators, if anti-idling regulations and technology were applied that reduced the idling time by 50 percent, about 2.9 metric tons of CO<sub>2</sub> per year could be reduced for each excavator retrofitted.

#### **Electrification**

The current ARB in-use heavy-duty off-road diesel equipment regulation provides regulatory incentive for replacing diesel engines with electric. However, electrification is not a requirement of that rule, nor does the regulation extend to LSI. Requiring electrification of off-road

equipment where possible would reduce emissions of GHGs, ozone forming pollutants, and particulate matter. For example, there are electric forklifts being used to reduce emissions in and around warehouses. Additional use of electric forklifts to replace combustion engine forklifts would not only reduce GHG emissions from this equipment, but emissions of carbon monoxide as well, a worker safety concern in enclosed spaces. Additionally, many freight facilities may still use diesel-powered forklifts to carry pallets and crates between the dock and warehouse. Electric forklifts are cleaner and more efficient to operate, producing no emissions at the facility. Staff proposes requiring more electric forklifts in these applications to reduce fuel consumption that results in GHG emission.

Recreational marine boats might also benefit from electrification. Electric boats are being used for cruising, all day fishing, rental boats, and tour boats. A regulatory requirement to electrify a percentage of electric boats for fleets such as rentals and tour boats might be feasible. Additionally, consumer awareness and incentive programs to promote electric boats might help with any voluntary measures that might be proposed.

**Low Friction Oil**

Like motor vehicles, low friction oil can help off-road engines run more efficiently and thereby, reduce the amount of fuel used. Tests performed on on-road vehicles have shown improvements in average fuel economy by 2-4 percent. It is expected that the use of low friction oils in off-road engines would have similar results.

**Appendix C: Industry-Other Measures Under Evaluation**  
**Table 32**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Costs or Savings†</b>	<b>Proposed Lead Agency</b>
Off-Road Equipment	Up to 0.5	TBD	ARB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **8. RECYCLING AND WASTE MANAGEMENT**

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This Sector includes the following measures:

### **Preliminary Recommendations**

**(RW-1) Landfill Methane Control Measure (Discrete Early Action)**

### **Other Measures Under Evaluation**

**Increasing the Efficiency of Landfill Methane Capture and LNG from Landfill Gas  
Commercial Recycling, Extended Producer Responsibility and Environmentally Preferable  
Purchasing  
Composting, Anaerobic Digestion and Waste-to-Energy**

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

## **Overview**

The Recycling and Waste Management sector includes the state's solid waste landfills, composting infrastructure, and recycling industries. When organic materials, construction materials and other municipal solid wastes are discarded, they end up in the State's landfills. In California however, much of the waste is turned into renewable resources and in the process, realizes significant GHG emission reductions. Increasing waste diversion from landfills beyond the current rate of 54 percent (which exceeds the 50 percent mandate) provides additional recovery of recyclable materials that will directly reduce GHG emissions. Recycled materials that are re-introduced into the manufacturing process provide energy value back into the process, and indirectly reduce the need for virgin materials extraction. Further, composting provides another life for organic materials rather than placing them into a landfill to decompose into methane and other gases.

Active landfills (approximately 145 statewide) are owned by private companies, mostly large waste disposal companies, or by municipalities. Closed landfills are scattered throughout the state and once provided service to specific localities. Other types of waste facilities, such as compost facilities or material recovery facilities (MRF), handle diversion of reusable materials (organic materials, traditional recyclables like paper, plastic, glass, metals, construction materials).

The largest emissions from the Recycling and Waste Management sector come from landfills and are in the form of methane, which is produced when materials placed in landfills decompose over time. Often, decades elapse and methane from this decomposition still occurs. Although methane is captured currently at many large landfill sites, there are still active landfill operations and closed landfill sites that continue to emit significant amounts that could be captured. ARB staff worked with the Recycling and Waste Management Subgroup of the Climate Action Team to develop possible measures to reduce landfill methane emissions.

ARB identified improved capture of landfill methane as an Early Action Measure. Methane that is currently being flared or emitted can be captured and further controlled, and can in some cases, be used as a fuel to replace conventional fossil fuels. In addition, methane capture can also reduce air quality impacts by capturing and destroying volatile organic compounds and other landfill gases that are emitted during the decomposition process. ARB staff is working closely with the California Integrated Waste Management Board (CIWMB) to develop this measure which ARB will be considering during early 2009.

In addition, the sector team identified a series of other viable measures that are currently non-regulatory, but would aid in the overall reduction of GHG emissions from the sector. Implementation of best management practices, increased composting, deployment of selected conversion technologies, commercial recycling, extended producer responsibility, environmentally preferable purchasing, and production of fuels/electricity from biomass were some of the measures to consider for the Draft Plan.

The diversion of organic material from landfills can provide a significant reduction in greenhouse gases through landfill methane avoidance, alternative energy production and water conservation. The CIWMB is undertaking efforts to increase production and markets for compost including development of a complete life cycle assessment of organic diversion alternatives; development of compost-based best management practices, compost specifications for agriculture, and a study examining the effectiveness of using compost as cover material to mitigate methane from landfills.

Extended producer responsibility and commercial recycling are additional ways to address GHG reductions. Extended producer responsibility would address the problem that many items are now produced without regard to their end-of-life disposition. Additionally, promoting commercial recycling would increase the rate for removing recyclables from the waste stream for efficient reuse. If more products are recyclable and are designed with an eye toward their end-of-life disposal, significant amounts of GHG could be reduced. Some of the benefits of extended producer responsibility and most of the benefits of increased commercial recycling would likely accrue outside of California. As a result, this measure would reduce both co-pollutants and global GHGs and would move towards the CIWMB's goal of a sustainable California where all resources are conserved to the maximum extent feasible. While most of the recycling and manufacturing may occur outside of California, some does occur in the state (e.g. glass, paper, and plastics manufacturing) and it is likely still significant.

CIWMB also identified technologies and outreach that would improve emission reduction through voluntary strategies. One method involves increasing the use of anaerobic digestion, a type of controlled, in-vessel decomposition of the organic fraction of the waste stream that allows for renewable energy production. Other renewable energy and fuel production technologies include liquefied natural gas (LNG) from landfill gas and fuels from biomass. Another method includes increasing outreach efforts on best management practices for efficient landfill operating practices to prevent the release of landfill gases and provide tools for landfill operators should they move towards methane capture ahead of the regulatory deadline. These best management practices could be used at smaller and closed landfills to reduce fugitive methane releases and would also provide tools and costs to consider in the event that the methane controls could be applied even though their amount of waste-in-place might exempt them from the requirements.

## Preliminary Recommendations

### ***(RW-1) Landfill Methane Control Measure (Discrete Early Action)***

Enhanced control of methane emissions from municipal solid waste landfills will require owners and operators to install gas collection and control systems at smaller and other uncontrolled active landfills. Additionally, all affected landfills will be required to satisfy enhanced methane monitoring requirements to ensure that their gas collection and control system is operating optimally and that fugitive emissions are minimized.

The Landfill Methane Capture Strategy is a discrete early action measure and is currently in the regulatory development process. The measure is to be fully adopted by January 1, 2010, but will likely have a phase in period to become fully effective. The preliminary one time estimated cost for adoption is approximately \$65 per ton of CO<sub>2</sub> reduced. Capital cost was estimated to be \$2,400,000 and annual operation cost of \$239,000.

In addition, this sector identified a series of other strategies that are currently non-regulatory, but will help with overall GHG reductions from activities that include increasing efficiencies of landfill methane capture, recycling and waste diversion. The segments below go into more detail regarding these other strategies identified in the Recycling and Waste Management Sector.

#### Appendix C: Recycling and Waste Management-Preliminary Recommendations

Table 33

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Landfill Methane Control Measure (Discrete Early Action)	1.0	1	ARB	Board Hearing Early-2009

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## Other Measures Under Evaluation

### ***Increasing the Efficiency of Landfill Methane Capture***

To support the landfill methane control measure, CIWMB recently approved a best management practices (BMP) guidance document that can be used as an outreach tool to optimize and increase the efficiency of landfill methane capture. Implementation of BMPs may further reduce emissions from landfills and improve gas collection efficiencies beyond the control measure. Emission reductions from specific BMPs have not been quantified at this time. ARB and CIWMB will work together to assess the need for regulatory action to mandate specific BMPs at California landfills.

### ***Liquefied Natural Gas (LNG) from Landfill Gas***

This measure implements grant-funded projects at two landfills to demonstrate commercial scale technologies for converting landfill gas to LNG vehicle fuel. Recovery of landfill methane that is combusted through flaring can be captured as a biomass renewable energy source. Executive order S-06-06 directs State agencies participating in the Bio-energy Interagency Working Group to enhance the sustainable management and development of biomass resources for electricity generation and production of alternative fuels (bio-fuels). However, substantial financial and technical barriers exist for in-state production of LNG from landfill gas. The technology transfer from these commercial projects, which are expected to conclude in June 2009, could provide significant GHG reduction opportunities.

### ***Commercial Recycling***

The commercial recycling measure focuses on increased commercial waste diversion. There are about 24,000 commercial businesses in California that generate over half of the statewide solid waste. Reductions in greenhouse gas emissions can be realized from solid waste management by recovering traditional recyclable materials from the commercial waste stream with the goal to remanufacture these materials, thus reducing the use of virgin raw materials. Traditional recyclable materials have significant intrinsic energy value that displaces fossil fuel energy requirements when introduced back into the manufacturing cycle.

The commercial recycling measure has an issue where it is unclear where the GHG emissions are occurring. Therefore, it is not clear if emissions would be reduced in California, or in another location where virgin raw materials are derived, or the location of re-manufacturing. Benefits from the commercial recycling measure include avoided methane emissions from landfill disposal by recycling materials from the waste stream. Furthermore, research and studies are planned to investigate potential for commercial recycling.

### ***Extended Producer Responsibility and Environmentally Preferable Purchasing***

Extended producer responsibility is a strategy to place a shared responsibility on the producers, and all entities involved in the life cycle of a product for reducing the health and environmental impacts that result from supply chain, production, use, and end-of-life management of a product. A major component of this measure includes product design changes that minimize a negative impact on public health and the environment at every stage of the product's lifecycle. By implementing extended producer responsibility additional environmental benefits could also be realized such as reductions in air emissions and water pollution along with waste minimization. Environmentally preferable purchasing (EPP) can reduce the quantity and toxicity of waste in California by purchasing recycled, repairable, and durable goods. This concept provides the State an opportunity to lead by example in reducing GHG emissions.

### ***Composting***

Various activities for increased the production and markets for compost and diverting these organic materials from landfills are being pursued as measures in this sector. Diversion of organic material can provide a significant reduction of greenhouse gases through landfill methane avoidance. Additional GHG emission reductions are achieved through beneficial offsets associated with reduced water consumption and fertilizer production resulting in energy

savings in pumping irrigation water and manufacturing and transporting fertilizer. CIWMB efforts to increase the production and markets for compost include a complete life cycle assessment of organic diversion alternatives; compost-based best management practices; development of compost specifications for agriculture; and a study examining the effectiveness of using compost as cover material to mitigate methane from landfills. However, because composting facilities emit Volatile Organic Compounds (VOCs), which are criteria pollutants that contribute to ozone formation these facilities may have some region-specific (i.e. San Joaquin Valley) air district permitting requirement obstacles.

### **Anaerobic Digestion and Waste-to-Energy**

Anaerobic digestion is a type of conversion technology that diverts organic materials from the waste stream to be utilized as feedstock for a digestion process that produces energy and displaces fuel or energy derived from fossil fuels in a sustainable manner. This measure would seek to increase anaerobic digestion of green waste, food waste and other organic components of the waste stream. Typically the energy produced by the anaerobic digestion process is used in the form of LNG, compressed natural gas (CNG), or electricity for on-site energy needs or in some cases, it can be exported to the energy grid.

The remaining waste to energy measures seek to expedite the deployment of GHG reducing technologies by providing funding that assists developers in demonstrating their technology for commercialization of promising emerging renewable technologies, such as projects involving biofuel technologies.

Benefits from these measures include avoided methane emissions by increasing waste diversion of organic materials from landfills, in addition to using collected methane for renewable waste-to-energy projects.

#### **Appendix C: Recycling and Waste Management-Other Measures Under Evaluation**

**Table 34**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Increasing the Efficiency of Landfill Methane Capture	TBD	TBD	CIWMB
Liquefied Natural Gas (LNG) from Landfill Gas	1.0	TBD	CIWMB
Commercial Recycling	up to 6.5 <sup>63</sup>	TBD	CIWMB
Extended Producer Responsibility & Environmentally Preferable Purchasing	TBD	TBD	CIWMB & DGS
Increase Production and Markets for Compost (studies underway for data development)	3.1 <sup>64</sup>	TBD	CIWMB

<sup>63</sup> Some GHG reductions may occur outside of California, pending results of costs-benefit/lifecycle analysis

<sup>64</sup> Preliminary estimate by CIWMB, based on 50% diversion of compostable organics from landfills

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Anaerobic Digestion	2.2	TBD	CIWMB

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## 9. FORESTS

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**This sector includes the following measures:**

### **Preliminary Recommendations**

#### **(F-1) Sustainable Forest Target**

- **Implementing Strategies:**
  - Forest Conservation
  - Forest Management
  - Afforestation/Reforestation
  - Urban Forestry
  - Fuels Management

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

### **Overview**

California's forests play a critical role in the State's carbon balance, with the unique capacity to remove CO<sub>2</sub> from the air and store it long-term as carbon. The forest sector is the only sector included in the Scoping Plan that provides a net removal of GHGs.

The goal of the Sustainable Forest Target, measure F-1, is to use Board of Forestry and Fire Protection authority to maintain this capacity, including regulations for sustainable forestry, post-harvest restocking, fire hazard reduction, timberland conversion and fire safety, and existing forest improvement assistance programs. The goal of strategies F-i through F-v is to enhance the capacity for forests to sequester and store more carbon through measures such as additional voluntary actions, expanded assistance programs and markets.

Current net forest sector emissions are approximately -5 MMTCO<sub>2</sub>E (2002-2004 average). This net number is negative because the gross emission rate from disturbances such as fires, harvesting, land conversion, and decomposition of wood and other forest products is less than the gross atmospheric uptake and sequestration of carbon from forest growth. Forests provide multiple ecological benefits (for example, habitat, structure, and nutrient cycling), as well as a suite of other human benefits or services on which we depend (for example, water storage, soil stability, air and water purification, wood products, and recreation).

The 33 million acres of forest land in California cover one third of the State. Ownership is split about evenly between the public and private sectors. Fifty-two percent of forest land is managed by the federal government, 45 percent by private landowners, and 3 percent is managed by the State. Stakeholders in the forest sector consist of private landowners, public land managers, non-profit organizations, agencies, local governments, and community-based groups. Forests can be characterized as tree-dominated landscapes which can support greater than ten percent tree canopy cover and include forestlands, woodlands, urban forests, and rangelands. The forest sector also includes all primary wood products, as well as wood fiber for bio-energy.

## **Preliminary Recommendations**

### **(F-1) Sustainable Forest Target**

This measure recognizes that the current abundance of forest carbon stock in California is, in part, a result of rigorous forest practice rules that tightly control forest management across the State. The California Forest Practice Rules are the most stringent in the country. The goal of the Sustainable Forest Target is to maintain the current -5 MMTCO<sub>2</sub>E net forest sink through 2020, using the mechanisms provided by the Forest Practice Rules, timberland conversion regulations, fire safety requirements, and forest improvement assistance programs, as well as the California Environmental Quality Act (CEQA) which mandates avoidance or mitigation of forest carbon losses to conversion. Establishing a sequestration target resonates internationally—deforestation is recognized as the single largest contributor to global GHG emissions—while also setting a precedent for the rest of the land base.

*Forest Practice Rules Mechanism:* Regulatory actions that affect carbon sequestration on private forest lands are enforced through the California Forest Practice Rules by the California Board of Forestry. For example, Forest Practice rule changes implemented in December 2004 will produce an additional annual -2.2 MMT CO<sub>2</sub>e reduction in 2020. The Board of Forestry and Fire Protection in conjunction with the Resources Agency, the California Department of Forestry and Fire Protection, and the Air Resources Board will evaluate how current regulations and programs address GHG emissions so that it can ensure achievement of the -5MMT CO<sub>2</sub>e target. This assessment includes updating approaches to estimating the annual forest inventory, developing a statewide forest carbon monitoring and assessment plan, and a re-assessment of the current regulatory framework in the context of carbon benefits.

*CEQA Mechanism:* Private lands are strongly influenced by development pressures. Local Government has the primary land use authority under the CEQA and Government Code. While local government has land-use authority for non-timber lands, the Board of Forestry and Fire Protection has pre-emptive land use authority for timberland where the land use is to be changed to a non forest management use. The Public Resources Code (PRC 4621 et.seq.) requires Timberland Conversion Permits (TLC) where the land use change will occur, and these permits are subject to CEQA. The CEQA process provides further authority for the conversion permit process to require mitigation for these projects. Regulatory changes for the TLC process could help direct conversion away from forest lands that provide net GHG benefits and identify potential mitigations. CEQA guidelines are being revised to ensure evaluation of GHG emissions and climate change impacts which will strengthen the ability to require mitigation for the loss of carbon stocks through the conversion of timberlands.

California forests face the additional threat of the impacts of global warming. Uncertainty about how much the climate will change and how feedbacks will affect forests make it particularly difficult to predict future emissions for this sector. Achieving the goal of -5MMTCO<sub>2</sub>E from the Forest sector by 2020 will require active participation by the private sector and local, state, and federal governments to fully implement. Jurisdiction or authority issues are a function of the land base and the specific actions needed to achieve the GHG benefits. Land-use conversion, and its impact on emissions, links the forest sector to the Land-Use and Local Government sectors under the Scoping Plan.

**Appendix C: Forests—Preliminary Recommendations**  
**Table 35**

Reduction Strategy	Potential 2020 Reductions MMT <sub>CO2E</sub>	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
Sustainable Forest Target	5	50	Board of Forestry and Fire Protection	2020

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

### **Implementing Strategies**

Five non-regulatory strategies have been identified to enhance the capacity for forests to sequester and store more carbon above the regulatory capacity.

- 1) Forest Conservation
- 2) Forest Management
- 3) Afforestation/Reforestation
- 4) Urban Forestry
- 5) Fuels Management

The most significant opportunities for near-term reductions come from using residual forest wood waste from fuels management and urban forestry strategies to displace fossil fuel in energy generation. Annual savings by 2020 are calculated as 4 MMT<sub>CO2E</sub>. The removal of fire-hazardous fuels from forests as an energy source has the dual benefit of reducing the frequency and magnitude of wildfire and the associated emissions. While the benefits of displaced fossil fuel use come from activities in the forest sector, the potential annual emission reductions are accounted for in the energy sector. By promoting the use of biomass for bio-power (electricity) and bio-fuel production, the forest biomass strategy proposes to achieve forest management goals by satisfying the growing demand for renewable energy sources and at the same time helping meet the state's bio-power objectives, including the Renewable Portfolio Standard.

- Conservation and fuel management implementation approaches are already underway, and will provide guaranteed reductions in 2020 through proposition funds 40, 50, and 84.
- Investment in the Afforestation/reforestation strategy in the near-term will lead to significant long-term (2050) benefits. This strategy may provide more than 23 MMT<sub>CO2E</sub> per year by 2050. The near-term GHG benefits of this strategy are small because site preparation activities may result in emissions.
- The offset market could provide 0.5 MMT<sub>CO2E</sub> per year in the 2020 timeframe, but as much as 13 MMT<sub>CO2E</sub> per year by 2050 for reforestation and forest management activities. The adoption of additional forestry protocols for actions under other strategies may enhance GHG benefits from markets.

- Strengthening the funding base for the California Forest Improvement Program (CFIP) will provide future consistency to support ongoing Afforestation/reforestation and Fuels treatment activities. Increased activity across the State, and the associated GHG reductions, could be maintained if the CFIP program funding were more continuous.

California's forests will play a role in the State's goal of reducing emissions but given the inherent uncertainty in quantifying emissions and sequestration in this sector, especially with climate change, additional research and the development of pilot projects and quantification tools are necessary. Strategies under this sector will require active participation by private landowners and local, state, and federal governments to fully implement and realize maximum GHG benefits. Strategies in the Forest sector will interact with those in other sectors including land use, waste management, agriculture, water, and electricity. Investing in research and quantification tools will be necessary to improve inventory and modeling accuracy.

### **Strategy: Forest Conservation**

California forests and woodlands continue to be developed and converted to non-forest uses. Cal Fire's Fire and Resources Assessment Program (FRAP) projects a conversion of 312,000 acres of forestland and 258,000 acres of woodlands between 2000 to 2020. In addition to residential and industrial development, forests and woodlands may also be converted for roads, powerlines, rail, pipelines, agriculture and rights-of-way.

Tools available to prevent or mitigate conversion include land use planning, conservation easements, and mitigation banking. Agencies or non-governmental organizations may buy or accept donations of forestland (fee title) easements or other interests to preserve and enhance them for forest uses such as habitat, recreation, community forestry, and timber management. When easements or other interests are sold or donated, the landowner can have the property assessed for the purposes of lowering their tax liability. To ensure carbon sequestration over the long term, these forest and woodland land purchases generally require permanent retirement of development rights, preclude uses that would reduce carbon stocks or sequestration capacity, and include management geared toward maintaining or increasing carbon sequestration through conservation management projects. Mitigation banking is quantified under the Afforestation/Reforestation strategy

The following implementation approaches have already been funded or have a high likelihood of funding available to them.

- Proposition 40 and 50 purchases of forest and woodland in 2005 and 2006. This implementation approach protected forests and woodlands from conversion through fee title or easements. These forests will continue to produce GHG benefits in the future as they mature.
- Proposition 84 purchases to conserve forest and oak woodland habitats
- Future funding. This measure assumes funding for forest and woodland conservation projects that is comparable to Proposition 84.

### **Strategy: Forest Management**

There are significant opportunities to increase the carbon storage on managed forest lands over the next few decades by increasing forest growth through healthy and fully stocked stands that utilize site potential for growth while resisting or minimizing emissions from fire, insects and

disease. Timberlands statewide are growing at approximately 2.4 percent per year and this represents about 70 to 75 percent of their potential. Many of the timberland owners in California could make voluntary choices to manage their forestlands at a level above the minimums of the Forest Practice Act and Rules.

This strategy includes the following implementation approaches, which are incentivized by the carbon market.

- Riparian Zone Extension. The voluntary extension of the existing riparian protection zones currently required by the Forest Practice Rules.
- Timber Stand Improvement. These activities include 1) removing hardwoods and increasing conifer stocking, 2) thinning stands to increase the growth rate for remaining trees, 3) optimizing rotation age from a carbon life cycle perspective, 4) planting additional trees where the existing stocks are not fully utilizing the biological potential of the site. The additional value of the carbon will provide the incentive for the private landowners to make the additional investment in their lands to better utilize the growth potential.

### **Strategy: Afforestation/Reforestation**

Forest activities can have both near-term and long-term GHG benefits. Tree planting has very significant long-term benefits. FRAP analysis shows that reforestation/afforestation planting activities over the next decade may reap more than 23 MMTCO<sub>2</sub>E annually by 2050. However, the near-term benefits provided by planting seedlings are minimal, since the removal of brush and replanting of trees initially produces a small increase of emissions.

Afforestation is the establishment of a forest in an area where the preceding vegetation was not forest. Reforestation is the establishment of native tree cover on lands that were previously forested, but have had less than ten percent tree canopy cover for a minimum of ten years.

The afforestation/reforestation strategy is implemented through a number of separate measures that cumulatively increase the acres of land that are forested annually.

- CFIP. The California Forest Improvement Program administered through Cal Fire authorizes the Department to provide technical and other assistance (cost share funding) to private landowners with ownerships 5,000 acres and under. Through additional funding the existing cost share program would be able to increase the amount of afforestation and reforestation that is done on private lands.
- State land reforestation. On state lands, authority exists to implement afforestation/reforestation projects.
- Federal land reforestation. On US Forest Service and other public lands, federal agencies have the authority to implement afforestation/reforestation projects.
- Mitigation. This measure analyzes potential GHG benefits of having CalFire and local government require reforestation mitigation of forest and woodland converted.
- Offset Program. Developing a market for GHG offsets will encourage landowners to reforest areas currently occupied with brush and other vegetative communities and to implement other conservation forest management practices.

### **Strategy: Urban Forestry**

The urban forestry strategy goal is to create GHG benefits by planting trees in urban areas through 1) carbon sequestration, 2) reducing energy demand due to shading, and 3) providing biomass for fossil fuel alternatives from urban “green” waste. Urban forests provide many co-benefits, such as reducing stormwater runoff, increasing property values, reducing VOC emissions, providing social benefits, among others. Many cities and organizations are actively involved in tree planting to expand the role of urban forests. In areas where urban development interfaces with wild lands individual land owners are also engaged in tree planting and various forms of vegetation management affecting fire risk reduction, forest carbon sequestration, and energy savings.

This strategy is already being implemented through government actions and voluntary planting on private property and potentially could result in the planting of over nine million trees through 2010 using voluntary and incentive programs.

The implementation approaches include:

- Agency planting. The State supports efforts by private and public landowners, non-profit organizations, and local governments in urban areas to keep planting suitable species of trees in strategic locations to provide maximum benefits of shade, minimal long-term care costs, and low capacity to emit smog-forming constituents.
- Voluntary planting. As voluntary actions, homeowners commonly plant trees on their property for a variety of reasons. Education and marketing can help achieve the strategic planting of these trees to maximize survival and benefits and can result in an additional 1.2 million trees planted annually. Through city and community based organizations there are several major initiatives to increase voluntary tree planting in California.

The GHG emission reductions from sequestration are listed in Table 5. Reductions from shading benefits (reduced air conditioner use) and bio-power, roughly 0.6 MMTCO<sub>2</sub>E, are not included because they will be reported in the energy sector to avoid double counting.

### **Strategy: Fuels Management**

The forest fuels management strategy would reduce greenhouse gas emissions through two implementation mechanisms.

- State and federal fuels treatment. The primary goal of the strategy is avoiding large, uncontrolled wildfires and the associated GHG emissions through mechanical treatment. Mechanical fuel treatment can include crushing brush and other fuels as well as removing trees that serve as ladder fuels to the crown.
- Forest biomass for use in bio-power and bio-fuel production. This strategy supports the goals of the Bioenergy Action Plan which targets untapped biomass resources to produce transportation fuels, electricity generation, and biogas including enhancement of the supply of biomass through fuel hazard reduction. Reductions could be as much as 3.7 MMTCO<sub>2</sub>E per year, but to avoid double-counting these reductions are tallied in the energy sector.

State fuel treatment activities are partially supported through existing proposition funding and CFIP. Additional funding would be needed to support greater activity. The forest acreage requiring treatment is significantly larger than the areas that can be addressed with available

State and federal funding. By promoting the use of biomass for bio-power (electricity) and bio-fuel production, the forest biomass strategy proposes to achieve forest management goals by satisfying the growing demand for renewable energy sources and at the same time helping meet the state’s bio-power objectives, including the Renewable Portfolio Standard.

It is commonly accepted that the reduction of total forest fuel load along with changing the structure and arrangement of those fuels has a positive effect on the ability of fire suppression forces to control a fire. Quantification of the GHG benefits associated with avoiding wildfire through fuels treatment is difficult because of the unpredictable nature of fire. The GHG benefits are very likely much larger than reported here, but the uncertainty warrants conservatism in the estimate.

**Appendix C: Forests—Implementing Strategies**  
**Table 36**

<b>Reduction Strategy</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>
Additional Forest Management Strategies <ul style="list-style-type: none"> <li>○ Forest Conservation</li> <li>○ Afforestation/ Reforestation</li> <li>○ Urban Forestry</li> <li>○ Fuels Management</li> <li>○ Forest Management</li> </ul>	Minimum 5	TBD	Cal Fire

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## 10. HIGH GWP

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This sector includes the following measures:

### Preliminary Recommendations

**(H-1) Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)**

**(H-2) SF<sub>6</sub> Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)**

**(H-3) High GWP Reduction in Semiconductor Manufacturing (Discrete Early Action)**

**(H-4) Limit High GWP Use in Consumer Products (Discrete Early Action)**

**(H-5) High GWP Reductions from Mobile Sources**

- Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems
- Air Conditioner Refrigerant Leak Test During Vehicle Smog Check
- Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers
- Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems

**(H-6) High GWP Reductions from Stationary Sources**

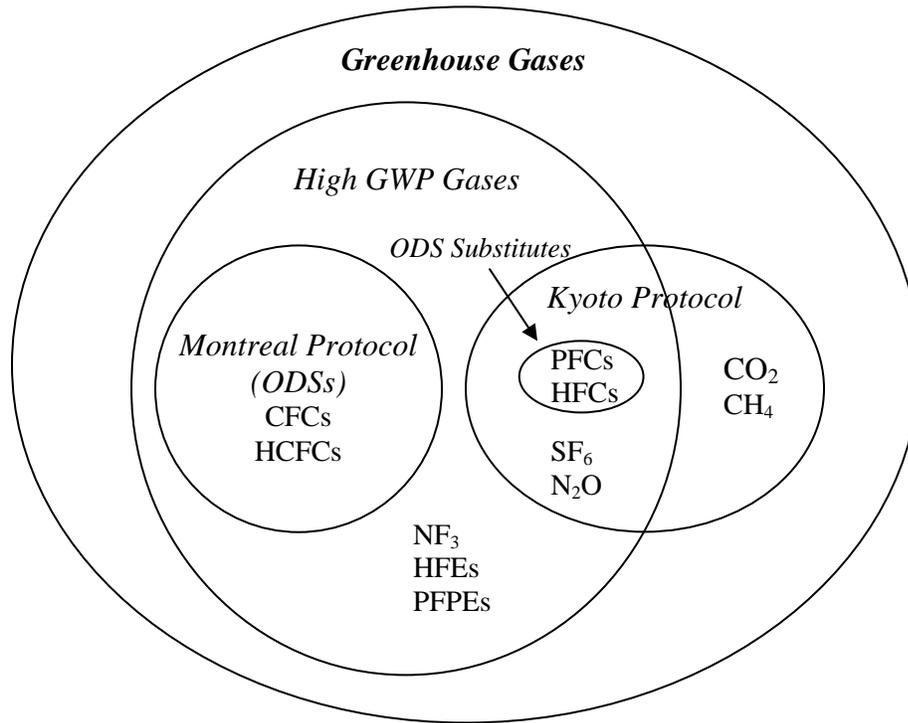
- High GWP Recycling and Deposit Program
- Specifications for Commercial and Industrial Refrigeration
- Foam Recovery and Destruction Program
- SF<sub>6</sub> Leak Reduction and Recycling in Electrical Applications
- Alternative Suppressants in Fire Protection Systems
- Residential Refrigeration Early Retirement Program

### **Overview**

While not a discrete sector of the California economy, the High Global Warming Potential (high GWP) sector consists of a broad range of sources that emit gases that have hundreds to thousands of times the climate impact as CO<sub>2</sub>. High GWP substances are largely used as refrigerants in stationary and mobile source air conditioning and refrigeration. However, high GWP gases are also used as foam-blowing agents, in electrical transmission, as fire suppressants, in consumer products, and in the semiconductor industry.

High GWP GHGs can generally be categorized as Kyoto Protocol gases, Montreal Protocol gases, and several miscellaneous gases not covered under either treaty.

Appendix C Figure 7



The first category of high GWP GHGs is ozone-depleting substances (ODS), which include chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). ODS production is controlled under the Montreal Protocol as a result of concerns about stratospheric ozone depletion, but emissions are not controlled. The underlying assumption of the Montreal Protocol is that the gases produced will eventually be emitted. However, for some end uses there can be a considerable time lag between gas production and emission. Because ODSs have been used as blowing agents in foams and are stored as refrigerants in various systems, there is a legacy of gases that will be emitted unless recovered, which are referred to as “banks”. Currently, ODS banks total over 600 MMTCO<sub>2</sub>E in California, even though most production of CFCs in developed nations stopped in 1996. The Montreal Protocol Technology and Economic Assessment Panel (TEAP) estimates that the majority of the CFCs, currently banked will be released to the atmosphere over the next several years unless preventative measures are taken. HCFCs will be produced in developed countries until 2020, and emissions and banks of these chemicals will continue to build until HCFC-22 phase-out begins in 2010.

As a result of the Montreal Protocol’s phaseout of ODSs, the gases have been replaced with hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), which are hence called ODS substitutes. Whereas ODSs have negative impacts for both climate change and stratospheric ozone, ODS substitutes are not ozone-depleting but are potent GHGs. CFCs typically have GWPs on the order of 2 to 10 times that of the HFCs, so preventing the emission of CFCs could result in major climate benefits. Along with sulfur hexafluoride (SF<sub>6</sub>), HFCs and PFCs are Kyoto Protocol gases and are specifically listed in AB 32.

Other high GWP GHGs include nitrogen trifluoride (NF<sub>3</sub>), hydrofluoroethers (HFEs), and perfluoropolyethers (PFPEs). Available information is presently insufficient to quantify the emissions and banks of these gases in California, but it is likely that the quantities are small.

Due to the reference to Kyoto sources in AB 32, ozone-depleting substances are not included in California's AB 32 1990 GHG inventory that defines the target for 2020. The majority of ODS substitutes are Kyoto gases and are thus included in the inventory. Emissions and banks of Kyoto Protocol gases are building as ODSs are phased out and are replaced by ODS substitutes. In total, the high GWP sector is currently estimated to represent on the order of 3 percent of the GHG inventory. However, the sector is growing rapidly primarily due to the increased use of substitutes for ozone-depleting substances (ODS).

A distinguishing trait of the high GWP emissions are that they are not used by a distinct economic sector, and that the gases are primarily of interest in the contexts of climate change and, for some gases, ozone depletion. That said, the high GWP emissions are of great importance because of the potency of the substances; for example, one pound of SF<sub>6</sub> has the same effect on global warming as 11 metric tons of CO<sub>2</sub>. In addition, banks of high GWP gases and their impending emissions are a unique situation. The combination of non-Kyoto GHGs and Kyoto GHGs leads to intricacies in estimating emission reductions from source categories that are in the inventory for some gases and excluded for others. The Draft Scoping Plan addresses these high GWP gases as a sector, as this is the most convenient method to design an overall emission reduction strategy.

A variety of strategies are being pursued to reduce high GWP GHG emissions at all stages of the life cycle. In the development and production phase, a preferred path to reduce or avoid entirely emissions from high GWP gases is to require and/or promote the use of safe and effective alternatives with either much lower GWP or no global warming impact. Examples of replacement measures include alternative fire suppressants and low GWP refrigerants in new motor vehicle air conditioning (MVAC) systems. For in-use products, measures to limit gas leaks are being pursued such as leak tightness specifications for commercial and industrial refrigeration. At the end of a product's life, measures emphasize recovery of high GWP gases, such as SF<sub>6</sub> recovery from electrical transmission and particle accelerators. Existing banks are targeted for destruction to avoid future emissions.

The low cost of many high GWP GHGs, as well as lack of incentives for emission control, has resulted in the current standard practice of simply re-charging leaky or poorly designed/maintained systems, or using high GWP GHGs in completely emissive processes. Low costs and the lack of enforced regulations limiting releases have also lead to low recovery and reclamation rates for many high GWP GHGs, meaning that venting occurs during maintenance or end of life disposal. A combination of a tracking, reporting, repair, recovery, recycling, and deposit program is proposed as a key mitigation measure. The aim of such a program is to use the price signal of a deposit (proportional to the GWP of emitted and banked gases) to incentivize alternatives and further promote efficient use and recovery of high GWP gases. The high GWP sector is also a viable candidate for establishing a fee program to better promote lower GWP alternatives, lower overall use and greater product recycling. For uses where there are not viable lower GWP alternatives and all reasonable emission reductions efforts have been exhausted, mitigation fees could be used to support offsetting all or a portion of the remaining

emissions. The role of a fee will be investigated as part of the process for reducing emissions from the high GWP sector.

Under business-as-usual, emissions from the sector are expected to triple over the next several years translating into emissions of high GWP Kyoto gases of over 40 MMTCO<sub>2</sub>E in 2020. The collection of recommended measures is expected to yield reductions of at least 15 MMTCO<sub>2</sub>E of Kyoto gases in 2020 with the potential for further reductions as new low GWP substitutes are developed. The use of fees within this sector could likely yield higher reductions. In addition, measures will also target sources of non-Kyoto high GWP gases, with substantial reductions in 2020 (over 15 MMTCO<sub>2</sub>E) expected for ODS, particularly from “banks” of materials. Although these reductions in non-Kyoto gases cannot be counted toward AB 32’s reduction requirement, the measures that target ODS will also yield reductions of ODS substitutes.

All high GWP measures presented in this document were identified in ARB’s October 2007 Early Action Staff Report. Following the development of the rules needed to implement these measures, staff will assess whether additional measures are necessary and feasible for achieving additional reductions in high GWP GHG emissions.

## **Preliminary Recommendations**

### ***(H-1) Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)***

The primary purpose of this measure is to reduce the emissions of the high GWP gas HFC-134a, a potent greenhouse gas (GHG) with a global warming potential (GWP) of 1,300, from activities associated with do-it-yourself (DIY) charging. In the future, this measure will be expanded or a complementary measure will be developed to govern professional servicing and repair of these systems.

Under normal operation, a motor vehicle air conditioning (MVAC) system may slowly lose refrigerant due to “normal” leakage. Larger leaks are generally due to compressor leaks, and malfunctioning hoses and connections. When a vehicle’s air conditioning system loses cooling effectiveness due to the loss of HFC-134a refrigerant, the vehicle owner has two choices for recharging. The system can be recharged or “topped off” using small cans of HFC-134a purchased at retail auto parts stores, or it can be serviced by a professional auto shop.

Do-it-yourselfers can save money by performing a MVAC system recharge using small cans of refrigerant instead of having a professional perform the recharge. However, the DIY rarely properly identifies the leak or performs repairs due to a lack of adequate training and/or equipment. It is also likely that DIY recharge of a MVAC system results in the release of more HFC-134a than a recharge performed by professionally trained and industry-certified technicians at a licensed auto repair facility.

The goal of this measure is to reduce or eliminate the emissions associated with nonprofessional servicing of MVACs. Under current procedures, emissions occur from servicing procedures,

unused refrigerant remaining in the used can (can heel), and unrepaired leaking systems when a DIYer recharges his MVAC.

ARB staff is presently considering two options for addressing emissions reduction from nonprofessional servicing of MVACs. One option would restrict the sale and import of the small cans of refrigerant and allow only professional servicing of MVACs. This proposal would eliminate DIY servicing and the emissions that go with it. MVACs would be serviced and repaired, as needed, by trained certified technicians. Some consumers would forgo air conditioning in order to avoid the added cost, and some would take their vehicle to the professional shops. At full implementation, up to about 1.7 million cans would no longer be available for the DIY market.

Potential emission reductions for the “small can” sales restriction would amount to approximately 0.47 MMTCO<sub>2</sub>E. The “can heel” emissions would be reduced because sales of small cans of refrigerant would not be permitted.

The other mitigation option under consideration would focus on reducing the emissions from the can heel. This proposal would require the installation of self-sealing valves on the small cans of refrigerant, along with a provision for an effective can deposit and return program to collect used cans of refrigerant directly from the customer for refrigerant recycling or destruction. The combination of sealed cans and refrigerant recovery would thereby minimize the emissions from can heels, but would not address MVAC system leaks.

The estimated emission reductions for the self-sealing valve and recycling program are 0.22 MMTCO<sub>2</sub>E in 2020. The Board is expected to consider the measure recommended by staff at its January 2009 hearing with an enforceability date by January 2010.

Related measures aim to ensure that professional servicing of MVACs in California is less emissive than current practices. ARB staff will explore the benefit of more stringent technician certification requirements, new requirements for returnable refrigerant 30 pound containers, and other steps to improve professional servicing to gain additional emission reductions.

## ***(H-2) SF<sub>6</sub> Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)***

SF<sub>6</sub> is a versatile gas used in a multitude of industries including use by utilities as well as the semiconductor industry. These two uses will be addressed as separate measures. This Discrete Early Action measure focuses on the non-utility/semiconductor-related emissions of SF<sub>6</sub>. Specifically, the measure will consider a potential ban on the use of SF<sub>6</sub> where technologically feasible and cost-effective alternatives are available, as well as a mitigation fee and/or a performance standard for other uses.

The main uses of SF<sub>6</sub> in California that are not directly related to utilities or semiconductor manufacturing include: magnesium casting, tracer gas use (including fume hood testing), consumer products, and medical uses (ultrasounds, eye surgery). Alternative gases are being pursued for magnesium die-casting, consumer products, and tracer gas uses. Medical use

emissions appear to be very low, and are proposed to be exempt from SF<sub>6</sub> bans due to low emissions, high costs, and lower effectiveness of alternatives.

Based on emission estimates for 2004, emission reductions by 2020 are expected to be up to 0.3 MMTCO<sub>2</sub>E, but could be as low as 0.1 MMTCO<sub>2</sub>E.

The largest expected costs are for the magnesium sector with capital costs of \$573,000 for equipment replacement for 2 facilities and a cost of \$50,000 per facility for training.<sup>65</sup> If turnover is high, this could be an annual cost. There are two California facilities that are known to be using SF<sub>6</sub> and one that may be using SF<sub>6</sub>. Depending on the alternative used, cost savings could be equivalent to \$54,000 annually. The cost savings are only applicable if SO<sub>2</sub> is the alternative used. Other alternatives are likely to be close in cost to SF<sub>6</sub>.

Costs for the other sectors cannot be quantified at this time. However, the capital costs and operating costs are expected to be small or may even come with a savings. Capital costs could occur if new detection equipment is needed. The cost of the alternative gas, which will be an operating cost, is likely to be the largest expense as large infrastructure changes are not needed. Alternatives are likely to be less expensive than SF<sub>6</sub> on a per-unit basis, but whether overall cost savings occur depends on the relative amounts of substitute gases needed.

### ***(H-3) High GWP Reduction in Semiconductor Manufacturing (Discrete Early Action)***

A specific subset of high GWP gas use is in the semiconductor industry. California semiconductor and related device production facilities employ approximately 9,300 employees, representing approximately 0.06 percent of total statewide employment. While these businesses are located throughout the State, they are concentrated in the Bay Area, primarily in the Silicon Valley.

Six local air quality agencies in the state currently regulate emissions of volatile organic compounds (VOCs) from the semiconductor and related devices industry. Federal law (National Emission Standards for Hazardous Air Pollutants) requires treatment of hazardous substances so that potential public health risks are mitigated. However, emission reductions of high GWP gases (which are not VOCs or toxic compounds) from these facilities have only occurred voluntarily through agreements with the U.S. EPA and a small number of California manufacturers.

An existing national, voluntary GHG reduction agreement with the U.S. EPA will expire in 2010. The Semiconductor Industry Association (SIA) is discussing renewing the agreement. California's proposed regulation could be used as a model for any new national regulatory or voluntary program.

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<sup>65</sup> Environment Canada. 1998. Powering GHG Reductions through Technology Advancement. Clean Technology Advancement Division, Environment Canada.

U.S. Environmental Protection Agency 2006. Global Mitigation of Non-CO<sub>2</sub> Greenhouse Gases. U.S.EPA Report 430-R-06-005. June 2006.

The semiconductor manufacturing industry uses multiple GHGs with a range of global warming potentials from 6,500 to nearly 24,000. The sector has considerable emissions but also has potential to be an important source of GHG reductions. This proposed measure is designed to reduce the emission of these gases by 50 percent from 2006 levels.

Based on the results of an industry survey conducted by ARB in 2008, the GHG emissions from more than 100 semiconductor and related devices facilities for 2006 (the latest reportable year) are approximately 0.3 MMTCO<sub>2</sub>E. This is lower than the initial estimate of 0.9 MMTCO<sub>2</sub>E<sup>66</sup> and reflects the current gas usage and control devices in-place.

Historical trends have shown that fabrication plants have either closed or relocated from California to other regions of the country or overseas. The trend is expected to continue regardless of actions to require lower emissions.

This is a discrete early action measure. The currently proposed regulation would require manufacturers to use process optimization, alternative chemistries, and abatement technologies in combination or separately to reduce emissions. Reductions are expected to be at least 50 percent or 0.15 MMTCO<sub>2</sub>E. This measure is currently in the regulatory development process and is scheduled for adoption in 2008 with a compliance date in 2012.

Process optimization primarily focuses on reducing gas use in the chemical vapor deposition (CVD) chamber cleaning process. This practice involves the use of detectors and/or process modifications to achieve the optimum gas usage to reduce excess emissions. As part of the voluntary national program, many participating manufacturers have implemented this option at their facilities. However, many California operators do not participate in that program and will realize emissions reductions benefits from process optimization.

The use of other chemicals during the CVD cleaning or circuitry etching processes is referred to as alternative chemistries, or chemical substitution. Alternative chemistries can include the use of high GWP gases that are more efficiently used in CVD chamber cleans or plasma etching, thereby reducing overall GHG emissions. For example, some manufacturers have substituted NF<sub>3</sub> for C<sub>2</sub>F<sub>6</sub> in CVD chamber cleans. Although NF<sub>3</sub> has a higher GWP than C<sub>2</sub>F<sub>6</sub> (17,000 for the former, 9,200 for the latter), much less NF<sub>3</sub> is used in the process so that overall emissions are reduced. It is important to note here that the proper use and control of NF<sub>3</sub> is accounted for in the emission reduction potential for this rule, it is not accounted for in ARB's GHG inventory because NF<sub>3</sub> is a non-Kyoto GHG.

Abatement technologies commonly involve a device that thermally destroys fluorinated gases and can be commercially applied to both etch and CVD chamber clean processes. High temperature and catalytic oxidation and plasma destruction are the most common technologies used to abate emissions. The performance of abatement systems can vary greatly depending on the abatement device and process parameters, such as temperature and gas flow rates. Nonetheless, abatement has proven to be a commercially available and effective method of controlling emissions of GHGs.

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<sup>66</sup> Based on applying a growth factor of 1.35 percent per year to ARB's 2004 inventory estimates

These devices can be costly and use large amounts of energy and cooling. If semiconductor manufacturers in California choose abatement as a compliance option, ARB believes that as few as 10 systems may be installed Statewide. These 10 systems would not significantly impact sector energy demand. While this technology results in some additional energy use, the destruction of these high GWP gases provides a net benefit in reducing GHGs.

#### **(H-4) Limit High GWP Use in Consumer Products (Discrete Early Action)**

Consumer products containing high GWP GHGs include pressurized containers that utilize HFC propellants<sup>67</sup>, as well as other miscellaneous products such as boat horns, dusters, and tire inflators.<sup>68</sup>

The objective of this measure is to reduce the use of compounds with high GWP when alternatives are available. To achieve reductions of GHG emissions, consumer product formulations would need to be changed to reduce or eliminate the use of high GWP compounds. The reduction in use of compounds with high GWP in consumer products is a long-term effort.

This measure was designated as a Discrete Early Action, and a regulation establishing a GWP limit of 150 for Pressurized Gas Dusters was adopted by ARB in June 2008 and will be enforceable by January 2010. Staff will propose GWP limits for additional consumer product categories, where feasible, which would also be enforceable by the deadline for discrete early action items.

Total GHG emissions reduction from consumer products is estimated to be 0.25 MMTCO<sub>2</sub>E in 2020. ARB staff estimates emissions reduction of 0.20 MMTCO<sub>2</sub>E from the regulation of Pressurized Gas Dusters.

In the case of Pressurized Gas Dusters, manufacturers of non-complying products are expected to reformulate their products by switching from the use of HFC-134a (GWP of 1,300) to HFC-152a (GWP of 140). 18 of 90 products in the Pressurized Gas Duster category currently comply with the GWP limit of 150, representing a market share of 86 percent, based on sales. HFC-152a is less expensive per pound than HFC-134a, so it is anticipated that there would be a raw ingredient cost savings in virtually every case. The total cost of the measure to reduce GHG from Pressurized Gas Duster products is about \$450,000 over ten years, or \$45,000 per year.

#### **(H-5) High GWP Reductions from Mobile Sources**

##### **Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems**

The measure requires low global warming potential (GWP) refrigerants with overall improved lifecycle climate performance for new Motor Vehicle Air Conditioning (MVAC) systems, with initial emphasis on AC systems used for heavy-duty and off-road vehicle application, followed by a MVAC requirement in light-duty vehicles.

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<sup>67</sup>Hair sprays, deodorants, household products, spray paints may contain HFCs propellants, but are considered to be minor sources. Metered dose inhalers also contain HFCs, but due to medical necessity, low-GWP replacements are not currently being pursued in the Early Action Measures or Scoping Plan.

<sup>68</sup>Automotive products such as cans of refrigerant used for do-it-yourself (DIY) MVAC recharging, are covered within the mobile sources sub-sector rather than the consumer products sub-sector.

Currently, almost all new passenger vehicles sold in California come equipped with an air conditioning system that utilizes HFC-134a refrigerant (GWP=1,300). A/C systems typically leak refrigerant over time and their leakage rates increase with vehicle age. In addition, the use of the AC system requires energy from the vehicle's engine. On an annual basis, this accounts for up to 5 percent of the total vehicle fuel usage. Fuel consumption while the AC is on can increase by over 20 percent. Thus, in general, either lower amounts of HFC-134a refrigerant or low GWP refrigerants in tighter AC systems with improved efficiency is desirable. New HFC alternative refrigerants with lower GWP values are expected to become available substitutes for HFC-134a in new MVACs.

The core of the measure would focus on developing new regulations requiring (1) that new MVACs use refrigerants with GWP below a specified threshold (to be determined) in new vehicles not subject to California's adopted vehicle GHG emission standards (AB 1493) and (2) improvements in MVACs system performance for reduced indirect emissions. For vehicles subject to AB 1493, this measure would explore further MVAC improvements when the first phase of the rule is fully implemented. This measure would apply to all MVACs in vehicles certified for sale in California after 2016, impacting about 7 million light-duty vehicles and about 2 million medium and heavy-duty vehicles by the year 2020.

The central premise of the proposed measure is the replacement of high GWP refrigerants used in California's MVACs with lower GWP alternatives that also represent better lifecycle climate performance (LCCP) than the current refrigerant. Indirect emissions can be three times the direct emissions from typical MVAC. Thus, the rules would be designed to promote a shift towards better overall MVAC performance. With low GWP refrigerants there is a corresponding reduction of the impact from MVAC servicing and releases at the vehicle/equipment end of life.

Direct and indirect emissions from air conditioning systems in California's on-road light-duty vehicles (LDVs) are already governed by the regulations resulting from AB 1493 through the 2016 new model year. Accordingly, manufacturers can use low GWP alternative refrigerants as one tool for complying with ARB limits on GHG emissions for the entire vehicle or for generating early compliance emission credits. Air conditioning systems in all other on-road classes and all off-road vehicles are presently unregulated by California. This measure would cover those classes of vehicles not included in the AB 1493 regulation.

Development of this measure will benefit from consideration of a similar regulation calling for the phase out of HFC-134a beginning with new types of vehicles in 2011 adopted recently by the European Union. Staff will explore the potential GHG reductions from a similar phase out of HFC-134a (or other high GWP refrigerants) used in other vehicle classes in the California fleet such as heavy-duty on- and off-road vehicles including new as well as in-use systems. Again, the identification of suitable alternatives would be based on lifecycle climate performance. In all cases, careful attention will be paid to ensure the indirect emissions are also lowered via the deployment of more energy efficient systems.

Anticipated reductions for 2020 are expected to be 0.7 MMTCO<sub>2</sub>E for light-duty vehicles and 1.8 MMTCO<sub>2</sub>E for heavy-duty vehicles for a total of 2.5 MMTCO<sub>2</sub>E for a universal phase out of HFC-134a in new and in-use MVACs in California.

### **Air Conditioner Refrigerant Leak Test During Vehicle Smog Check**

There are 11 million Smog Checks performed annually as part of California's vehicular inspection and maintenance (I/M) program. As originally proposed, the measure would add a refrigerant leak check to the "pass" criteria for California Smog Checks. As a result, all motor vehicle air conditioning (MVAC) systems would be required to meet a leak standard, or be emptied and precluded from further use (unless the leak is repaired to meet the standard).

The goal of this measure is to reduce the number of in-use MVACs that are leaking excessively. The reduction would be calculated based on the number of vehicles failing the MVACs Smog Check and subsequently repaired. This measure would prevent the ongoing "leak-recharge-leak" cycle associated with the use of small cans of refrigerant by do-it-yourselfers to systems that need repair but are not fixed.

In order for this measure to be implemented, ARB would work with the Bureau of Automotive Repair (BAR) and the Department of Consumer Affairs (DCA) would have to develop a new A/C test protocol and incorporate it into Smog Check procedures. The vehicle owner would see a slight increase in the duration and cost of the Smog Check biannual inspection.

The potential emission reductions from this measure is up to about 0.5 MMTCO<sub>2</sub>E per year by 2020. Due to the increased time and equipment required for the MVAC system test, the consumer price of a Smog Check is estimated to increase by about \$20 per check. However, staff's assessment of this measure has continued to evolve. Given that new MVACs are tighter and require less refrigerant, the relative importance of the measure will continue to decline as it is generally limited to older vehicles. Further, there may be more efficient approaches outside of Smog Check that can facilitate the identification and repair of leaky MVACs. Staff has already begun to explore alternative approaches for mitigating emissions that are not tied to the Smog Check program.

### **Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers**

As noted by the Environmental Justice Advisory Committee, refrigerated shipping containers accumulate in major ports and the refrigeration systems on these containers may leak high GWP refrigerants. Therefore, ARB proposes a measure to address the refrigerant remaining in the decommissioned containers' cooling systems, the leakage from these containers, and their disposal as they approach their end-of-life (EOL). These types of containers upon reaching EOL may not undergo proper refrigerant recovery.

This measure would improve compliance with a Federal Clean Air Act regulation by the U.S. EPA (40 CFR 82) that prohibits venting of certain types of refrigerant, including HFCs, to the atmosphere when refrigeration equipment is serviced or dismantled. Thus, the intent of this measure is to mitigate any impacts from releases, either intended or accidental, of refrigerant from refrigerated shipping containers. Venting is avoided by recovering refrigerants with specialized equipment. The recovered refrigerant can be re-used by the owner or transferred to re-processors approved by U.S. EPA.

Since there are no firm statistics related to the degree of compliance with the requirements of 40 CFR 82, no quantitative goals can be proposed yet. The ultimate goal will be to recover the

refrigerant remaining in the refrigerated shipping containers at decommissioning and eliminate the greenhouse gas emissions from this source.

Implementation of this measure may be similar to the one enforcing the federal ban on releasing refrigerants to the atmosphere for the servicing or dismantling of Motor Vehicle Air Conditioning (MVAC) systems. After the recovery from a decommissioned container, it may be desirable to disable the refrigeration unit as well, which could require a regulation. The anticipated approach would emphasize enhanced enforcement of existing federal requirements for recovery via audits of activities and documentation. Including oversight, inspection, recordkeeping and reporting requirements with this approach may require regulations.

The primary reason for implementing the recovery of refrigerant from decommissioned refrigerated shipping containers is to reduce greenhouse gas emissions. However, any destruction of ozone depleting substances that were used in older refrigeration systems will prevent the negative impacts on stratospheric ozone that would have resulted from the ODS emissions. Staff will develop estimated emission reductions as well as mitigation costs to determine the degree to which the measure represents a viable emission reduction option. The assessment of the potential emission reductions as well the costs is too early to make this determination.

### **Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems**

The goal of this measure is improved compliance with existing regulations<sup>69</sup> prohibiting the venting of certain types of refrigerant, including HFCs, to the atmosphere when motor vehicle air conditioning (MVAC) equipment is serviced or dismantled. Venting is avoided by recovering refrigerants with specialized equipment before dismantling or servicing. The recovered refrigerant can be re-used or transferred to re-processors approved by U.S. EPA for proper disposal.

ARB, U.S. EPA, the California Department of Motor Vehicles (DMV), and the Bureau of Automotive Repair (BAR) will be involved in the implementation of this measure.

Much of the field work in a cooperative enforcement program could involve the enforcement staff of the local agencies that enforce county and State ordinances regarding disposition of automotive fluids, such as brake fluid, engine oil, coolant, and transmission fluid. These agencies could receive a “leveraging” effect for their programs if ARB and US EPA resources are made available in a cooperative program for enforcing the federal refrigerant-recovery regulation.

The potential reductions from dismantling are on the order of 0.07 to 0.3 MMTCO<sub>2</sub>E per year in 2020. Further, it is anticipated that a collaborative arrangement with the U.S. EPA has the potential to yield reductions with a modest resource commitment.

There are no added costs associated with the proposed measure beyond those currently imposed. Any incurred expenses are costs that the dismantler or technician has avoided so far only through failure to comply with the existing federal regulation.

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<sup>69</sup> Existing federal regulation (40 CFR 82.154) bans the release to the atmosphere of high GWP refrigerants at the end-of-life (EOL) or during equipment servicing.

## **(H-6) High GWP Reductions from Stationary Sources**

### **High GWP Recycling and Deposit Program**

This measure would require commercial and public facilities with large stationary air conditioning and refrigeration equipment to minimize emissions of high GWP refrigerants through reporting, leak repair, improved servicing, and end-of-life control. The measure is also anticipated to include deposit elements.

This program could include several components: 1) leak repair, reporting, technician certification, and registration/permitting requirements for refrigeration and air conditioning equipment using high GWP refrigerants; and 2) a deposit/rebate program accompanied by restrictions on cylinders and other containers used to store and transport high GWP gases.

The South Coast Air Quality Management District currently requires facilities with refrigeration and air conditioning systems containing more than 50 pounds of ozone depleting substances to submit annual reporting of refrigerant usage. The program also requires that facilities report leaks. ARB staff has extrapolated reported data from SCAQMD to estimate potential statewide reductions. Based on this extrapolation, it is expected that roughly 86,000 facilities in California could be affected by ARB's program; of the 86,000, staff estimate that 10,000 facilities have both air conditioning and refrigeration systems while 76,000 facilities have only air conditioning systems.

Preliminary estimates are that in 2020, emission reductions could total 7.7 MMTCO<sub>2</sub>E of ozone depleting substances (ODS) and 6.3 MMTCO<sub>2</sub>E of HFC refrigerants. The reductions would occur as a result of improved leak detection and repair, along with installation of new equipment, and ODS phase out.

Estimates for monitoring costs are \$2,500 per facility for equipment and \$100 in annual operating costs. Repair of air conditioning systems is roughly \$2,500 (\$2,000 in labor costs and \$500 in parts and refrigerant), while system replacement would cost on the order of \$20,000. For refrigeration, repair is estimated to cost \$11,000 (\$3,000 in labor costs and \$8,000 in parts and refrigerant), while system replacement would cost on the order of \$500,000. Statewide costs are estimated at about \$9 million in 2020. The potential savings due to reduced refrigerant and energy consumption require further evaluation. However, due to the reduced consumption of refrigerant, the measure is expected to result in a savings in 2020 on the order of \$75 million. Additional analyses are underway on potential costs associated with requirements to assure safe disposal of equipment and refrigerant (e.g., a cylinder deposit program) and to refine these preliminary estimates.

### **Specifications for Commercial and Industrial Refrigeration**

This measure proposes new specifications for commercial and industrial refrigeration systems to both reduce emissions of high GWP refrigerant and to increase energy efficiency of the units. The measure would apply to a portion of commercial and industrial refrigeration systems, including large direct expansion (DX) refrigeration systems used in supermarkets, cold storage warehouses, and industrial processes, including food processing. Commercial refrigeration systems also include retail food standalone equipment (open and closed food display cases) and refrigerated vending machines.

Emissions from refrigeration and air conditioning (RAC) systems are categorized as (1) direct refrigerant emissions via leaks during use as well as servicing and end-of-life emissions and (2) indirect emissions (CO<sub>2</sub>-equivalent emissions resulting from energy use).

Because the piping required for connection of all the cases can be miles long, DX systems may contain very large refrigerant charges, typically several thousand pounds; they are also leaky, with average leak rates in California are estimated to be 20 – 30 percent. Leaks result from vibration and thermal expansion of numerous pipes, threaded joints, fittings, and valves. Oftentimes, refrigerant pipe work is inaccessible, and leaks cannot be found or repaired. Ruptures can result in huge refrigerant losses, with GHG emissions exceeding several thousand metric tons carbon dioxide equivalent.

In terms of potential control strategies, reduction of leaks and charge sizes in direct expansion systems is of primary importance. Reduction of charge size not only reduces the potential for high GWP emissions from system ruptures, but reduces future high GWP refrigerant banks in California. Refrigerant banks are sources of future emissions, and without a recovery/destruction program in place, will eventually be emitted during equipment charging, lifetime, and end-of-life (EOL).

The regulation is expected to establish performance limits. Options for reducing leaks and charge sizes/GWPs include replacement of DX systems with indirect systems, i.e. secondary loop (SL) systems, and energy efficiency improvements through closed cases, floating head pressure controls, and best available display case components, standalone equipment and vending machines. This performance-based measure is expected to address direct and indirect emissions reductions during the lifetimes of commercial and industrial refrigeration systems.

For new commercial and industrial refrigeration systems, this measure would establish a low leak rate (e.g., 2 percent) as well as a possible limit on the product of charge size and refrigerant GWP less than a specified threshold. Secondary loop systems and advanced CO<sub>2</sub> systems are both being explored as potential options for reducing emissions from new commercial and industrial refrigeration applications. In addition, staff will work with the California Energy Commission as well as other stakeholders to explore establishing energy efficiency goals for new and existing retail food systems (e.g., 30 percent reduction in energy use). Compliance with performance standards for new commercial/industrial refrigeration installations and for retail food installations is expected to start by 2012.

As the old DX systems turnover, high GWP GHGs will need recovery, reclamation, and destruction or reuse. Refrigerant recovery and destruction is being addressed as part of other strategies in the high GWP sector.

In total, direct and indirect GHG emission reduction potential from this measure in 2020 is estimated to be at least 4 MMTCO<sub>2</sub>E. Additional benefits of this measure include stratospheric ozone protection for the estimated 50 percent of DX systems that currently employ HCFC-22, an ozone-depleting GHG.

Currently, first installation costs for SL systems are higher than existing DX systems, with average costs estimated to be 15-20 percent greater, or around \$100,000<sup>70,71</sup>. The incremental costs associated with incorporating energy efficient equipment into new retail food installations is expected to be small relative to overall refrigeration system construction costs. Based on an estimated value of 40 percent lower maintenance and repair costs relative to the annual DX maintenance and repair cost in California (~\$64,000<sup>72</sup>), the annual operations cost savings is on the order of \$25,000, though considerably more work needs to take better to evaluate the net costs of the various options.

Average capital costs for supermarket refrigerant systems are on the order of \$1.7 million, with systems having a 20-year lifetime. Due to increased energy efficiency, the operations savings from reduced electricity use are estimated at \$700,000 annually.

The capital costs of upgrading existing systems or installing new systems are expected to be passed along to customers, so in the case of retail food stores and food processors, increased food and beverage costs are possible and will need to be evaluated.

### **Foam Recovery and Destruction Program**

Waste insulation foam that is currently landfilled continues to emit high GWP GHGs into the atmosphere.<sup>73</sup> The goal of the measure is to reduce these emissions to as close to zero as possible, by recovering waste foam prior to landfilling, and destroying the high GWP GHGs within the foam.

Plastic insulating foams containing high GWP blowing agents are used in refrigerators, freezers, building insulation, transport refrigerated units, and miscellaneous sources. For insulating foam containing high GWP GHGs, the vast majority are used in building insulation (65 percent of banks and emissions) and appliances (mainly refrigerators and freezers, about 30 percent). After the appliance or insulating material has reached the end of its life, the waste foam is often landfilled, and the high GWP gases within the foam are eventually emitted into the atmosphere.<sup>74</sup> Typically, about one-fourth of the GHGs remaining in foams during their disposal are released to the atmosphere as the foam is processed (e.g., broken or shredded). Of the GHGs that remain within foams that are landfilled about 60 percent are captured and combusted by landfill gas collection systems with the balance eventually being released to the atmosphere.

The program can be implemented using measures that provide regulatory standards or incentives for the recovery and collection of foam. Either approach would necessitate banning any waste foam from landfills or recovering high GWP gases at the point of appliance recycling or building demolition, deconstruction, or renovation.

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<sup>70</sup> Van D. Baxter, Oak Ridge National Laboratory, IEA Annex 26: Advanced Supermarket Refrigeration/Heat Recovery Systems, Final Report Volume 1 – Executive Summary, April 2003.

<sup>71</sup> Cynthia Gage (USEPA) ASHRAE presentation: “Experiences with Secondary Systems”, 2/05.

<sup>72</sup> Maintenance and repair costs for supermarkets are on the order of \$2.35/square foot for California, which, multiplied by the average square footage, 27,000 square feet (from ARMINES), gives \$63,450 annually: <http://www.whitstonerresearch.com/news/archive/1998/980828.htm>

<sup>73</sup> USEPA, U.S. High GWP Emissions 1990-2010: Inventories, Projections and Opportunities for Reductions, EPA 000-F-97-000, June 2001

<sup>74</sup> IPCC/TEAP, IPCC Special Report on Safeguarding the Ozone Layer and the Global Climate System, Issues related to Hydrofluorocarbons and Perfluorocarbons, 2005.

Using a goal of 100 percent of waste foam diverted from landfills and sent to recovery and destruction facilities by 2020, 6,000 Metric Tons of waste foam containing HFCs would be recovered in 2020. At this level, annual HFC emissions reduction would be about 1.0 MMTCO<sub>2</sub>E, though a more probable estimate would assume a 50% recovery rate. ODS recovery and destruction will occur simultaneously with HFC reduction, equivalent to an additional 5.5 MMTCO<sub>2</sub>E in 2020.<sup>75</sup>

U.S. EPA estimates that automated foam recovery at appliance EOL costs approximately \$8 per appliance while manual foam recovery at appliance EOL costs approximately \$60 per appliance.<sup>76</sup> Foam recovery from building insulation can be accomplished at a cost that ranges from about \$70 to \$100/ MMTCO<sub>2</sub>E.<sup>77</sup>

Capital costs of upgrading a facility are estimated to be about \$3.6 million; a typical facility would have a lifetime of 20 years.

### **SF<sub>6</sub> Leak Reduction and Recycling in Electrical Applications**

Gas-insulated circuit breakers are the largest source of fugitive SF<sub>6</sub> emissions in California electricity systems. In addition, gas-insulated substations (GIS) constitute a smaller source of SF<sub>6</sub> emissions. In general, older equipment produces more fugitive emissions than newer equipment. Moreover, particle accelerators utilize and emit SF<sub>6</sub> from equipment similar to that found in electrical transmission and distribution equipment. Particle accelerators also use SF<sub>6</sub> as a quenching medium.

This measure will reduce emissions of SF<sub>6</sub> within the electric utility sector and at particle accelerators by requiring the use of best achievable control technology for the detection and repair of leaks, and the recycling of SF<sub>6</sub>. Additionally, particle accelerator industry representatives are considering the use of possible substitute mediums.

SF<sub>6</sub> is primarily released when equipment is opened for routine servicing. Sometimes, SF<sub>6</sub> is vented to the atmosphere during servicing, but increased environmental awareness and large increases in the cost of SF<sub>6</sub> during the mid-1990's have significantly reduced this practice.

The estimated emissions annual reduction of 0.07 MMTCO<sub>2</sub>E is based on the projected 2020 emissions of 0.22 MMTCO<sub>2</sub>E multiplied by the U.S. EPA reduction estimate of 20 percent for leak detection and repair and ten percent for recycling and recovery. This is a conservative estimate because the trend for emissions is downward.

This measure would establish a regulation mandating a performance standard. Utilities and other affected entities would comply by using leak detection and repair (LDAR) abatement equipment to reduce system leakage. The proposed performance standard would mandate and enhance

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<sup>75</sup> U.S. EPA, Vintaging Model for ODS and High-GWP GHG Emissions, 2006.

<sup>76</sup> U.S. EPA communication with ARB Research Division staff October 2007; based on research conducted by U.S. EPA using the Vintaging Model; David Godwin (USEPA), Marian Martin Van Pelt and Katrin Peterson (ICF Consulting), Modeling Emissions of High Global Warming Potential Gases from Ozone Depleting Substance Substitutes, 2003.

<sup>77</sup> Caleb Management Services. Foam Recovery and Destruction Cost Estimates from Pilot Programs in Europe and Japan, 2007. Policy Advisory for IPCC Foam Emissions Research. Forwarded to ARB May 21, 2008.

current voluntary federal SF<sub>6</sub> recycling standards. Voluntary industry practices have established an 80 percent SF<sub>6</sub> recovery rate, based on perceived economic efficiencies of recovery equipment. The proposed standard would increase recovery and recycling to 100 percent of the SF<sub>6</sub> contained in electrical and particle accelerator equipment without substantially increasing the industries' costs.

Annual operating costs are estimated to be \$300,000 for LDAR and recycling. However, it is assumed that all SF<sub>6</sub> saved during leak detection and maintenance activities represents a cost savings, because the facility SF<sub>6</sub> purchase and consumption rate will decrease. The cost savings from SF<sub>6</sub> is \$420,000 annually, yielding a net cost savings of \$120,000.

### **Alternative Suppressants in Fire Protection Systems**

This measure will consider alternative suppressants in total flooding (fixed) and streaming (portable) fire suppression systems. Most fire suppression systems originally used halons, ozone depleting compounds whose production was phased out following the Montreal Protocol. While new systems have moved to halon alternatives, halon is still available for recharging existing systems through recycling of halon from decommissioned systems. ARB is coordinating its evaluation of potential mitigation measures with several stakeholders including the Office of the State Fire Marshal.

Over 16 percent of total flooding systems have moved to high GWP suppressants.<sup>78</sup> In comparison, streaming systems have moved almost exclusively to non-GWP agents, but there are some high GWP suppressants on the market. This measure will concentrate on total flooding systems but will also determine if there are reduction options for the streaming market.

The emissions of high GWP gases from fire protection systems come from intentional use as a fire suppressant, leakage, and accidental discharges. In total, emissions are estimated at 1.5-2 percent of the overall chemical quantity annually. The US Environmental Protection Agency has developed voluntary guidelines to minimize non-fire emissions of HFCs and PFCs, and the fire protection industry has implemented a data collection effort to better understand emissions.

In addition to emissions, the continued use of high GWP agents in new systems will result in a build-up (or bank) of high GWP gases in fire suppression systems. Banks of high GWP gases are of concern because these gases will eventually be emitted, unless they are collected and destroyed or recycled. Leak reduction can minimize current emissions and recycling can reduce the bank growth.

The goal of this measure is two-fold: to reduce emissions and banks of high GWP gases from the fire protection sector, and to ensure low end-of-life emissions from halon systems. For high GWP systems, this measure will consider options for existing and new systems for both total flooding and portable applications. Leak reduction, mitigation fees, use of lower GWP agents, and end-of-life agent recycling and destruction are potential options to be examined. Most halon systems will reach their end of life by 2020, so a goal of this measure is to have all halon systems that are decommissioned either recycle or destroy the halon.

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<sup>78</sup> U.S. EPA. Global Mitigation of Non-CO<sub>2</sub> Greenhouse Gases. U.S. EPA Report 430-R-06-005. June 2006.

As noted above, this measure will have an effect on both emissions and banks. Emissions should be reduced to less than 0.1 MMTCO<sub>2</sub>E with an effort to ensure limited growth in high GWP banks between 2012 and 2020. Business-as-usual projections show a doubling of emissions in that time period. Depending on the availability of alternatives it may be possible to prevent growth in the banks altogether. Annual emissions reduction is estimated to be less than 0.1 MMTCO<sub>2</sub>E in 2020.

Cost estimates are uncertain at this time given the lack of data on the number of systems and volume of protected space in California. Assuming installation of low or non-GWP suppressants in systems coming online between 2010 and 2015, statewide one-time costs vary from \$10 million to \$12 million for 2012-2015 with annual costs ranging from \$200,000 to a savings of \$200,000, depending on the substitute gas. For systems coming online between 2015 and 2020 the statewide one-time cost is approximately \$3 to 4 million with annual costs ranging from \$70,000 to a savings of a similar amount.<sup>79</sup> These estimates assume a 20-year equipment lifetime. The resulting costs may seem high per metric ton of CO<sub>2</sub>E emitted because the capital costs occur upon installation of the system, but emissions occur slowly (2 percent per year) over 20 years or longer. Costs only account for emissions and not the increasing banks of high GWP agents. Staff is in the very preliminary stages of assessing both the emission reduction potential as well as the costs for this category. As such, the viability of the measure will continue to be assessed as the analysis proceeds.

### **Residential Refrigeration Early Retirement Program**

This non-regulatory measure involves partnering with existing voluntary programs to retire inefficient residential refrigeration appliances such as refrigerators and freezers. Appliance early retirement includes the recovery of high-GWP refrigerants and blowing agents for reclamation or destruction to avoid GHG emissions. If all waste refrigerant and foam blowing agents are properly reclaimed or destroyed GHG emissions avoidance benefits may be significant. Staff believes that by partnering with organizations such as utilities they can facilitate an increase the role of appliance early retirement programs as another option for reducing GHG emissions. Part of the measure would include providing information to assist with the proper disposal of appliances including the insulating foams that include high-GWP substances as blowing agents.

Based on California law all appliances are required to be recycled and the refrigerant recovered, but there is no requirement to recover foam blowing agents. A primary benefit of this measure would be the recovery and destruction of foam blowing agents from retired appliances. Residential appliances targeted for early retirement will begin with pre-1996 refrigerators using refrigerants and foam blowing agents that total about 9,900 metric tons carbon dioxide equivalent (MTCO<sub>2</sub>E) per appliance. The goal of this measure is to increase early retirement rates of inefficient residential appliances.

This measure will be coordinated with the Foam Recovery/Destruction measure, another early action measure that is expected to require EOL recovery of high-GWP refrigerants and foam blowing agents from appliances. The Residential Refrigeration program will focus on operating refrigerators, while the Foam Recovery/Destruction measure will focus on non-operating refrigerators.

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<sup>79</sup> Ibid.

Current tools to encourage early retirement of appliances consist of the U.S. EPA Responsible Appliance Disposal program, a promotional program to support retailers and utilities using best practices in appliance disposal, and utility companies' energy efficiency programs. The primary solution considered under this measure is to support these programs. This support may be provided directly through ARB's existing outreach efforts or potentially through development of mechanisms to increase incentives provided to consumers, businesses, and/or appliance recyclers. Additionally, ARB could potentially evaluate opportunities for recognizing ODS destruction as part of the broader program that the ARB develops.

In 2020, there are potential one-year direct GHG emission reductions of 0.1 MMTCO<sub>2</sub>E, which are primarily from Kyoto gases. Additionally, there are potential one-year indirect GHG emission reductions resulting from energy savings, which are a result of retirement of inefficient residential refrigeration appliances.

**Appendix C: High GWP-Preliminary Recommendations**  
**Table 37**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
H-1: Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)	0.2 - 0.5	2.4	ARB	2009/2010
H-2: SF <sub>6</sub> Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)	0.3	0.1	ARB	2009/2010
H-3: High GWP Reduction in Semiconductor Manufacturing (Discrete Early Action)	0.15	3	ARB	2008/2012
H-4: Limit High GWP Use in Consumer Products				
Pressurized Gas Duster GWP Limit of 150	0.20	<0.1	ARB	2008/2012+
Other Consumer Product Categories	0.05		ARB	Ongoing
H-5: High GWP Reductions from Mobile Sources		See Separate Entries Below		
Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems	2.5	16	ARB	2010/2015
Air Conditioner Refrigerant Leak Test During Vehicle Smog Check	0.5	TBD	ARB/ BAR	2011/2012*
Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers	<0.1	TBD	ARB	2011/2012
Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems	0.1	0	ARB	2009/2010*
H-6: High GWP Reductions from Stationary Sources		See Separate Entry Below		

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/ Implementation Timeframe
High GWP Recycling and Deposit Program	6.3	-66	ARB	2009/2010
Specifications for Commercial and Industrial Refrigeration	4.0	0.6	ARB	2010/2011
Foam Recovery and Destruction Program	1.0	100	ARB	2009/2010
SF <sub>6</sub> Leak Reduction and Recycling in Electrical Applications	0.1	-0.1	ARB	2010/2012
Alternative Suppressants in Fire Protection Systems	0.1	2	ARB	2010/2011*
Residential Refrigeration Early Retirement Program	0.1	-6	ARB	2010/2011*

\*Informational items as they are non-regulatory or the regulations would be adopted by another organization (e.g., fire suppression strategy is expected to be adopted by Cal/Fire via amendments to Title 24).

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## 11. AGRICULTURE

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This sector includes the following measures:

### Preliminary Recommendations

(A-1) Methane Capture at Large Dairies

### Areas of Research/Opportunities for future GHG Emission Reductions

Fertilizer Use Efficiency

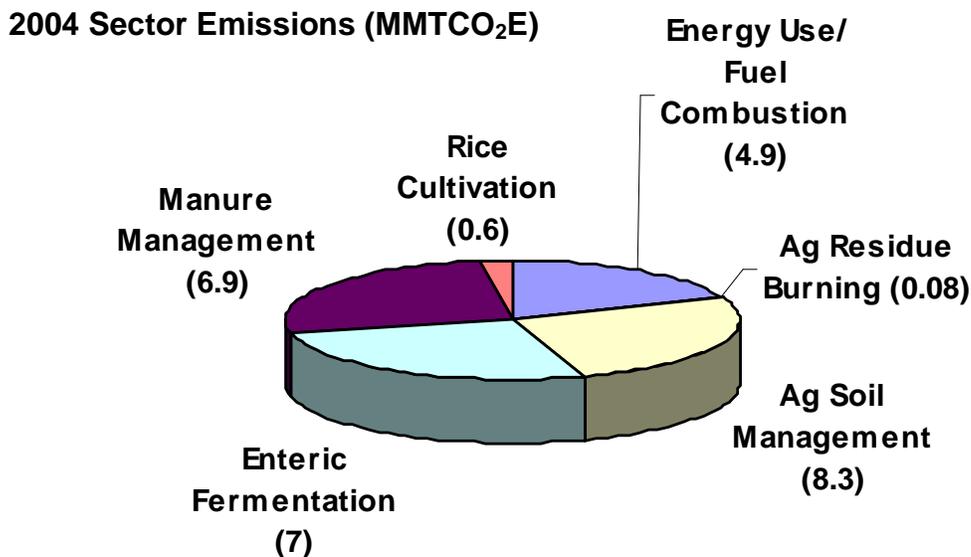
Efficiency Improvements

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

### Overview

Agriculture is a major industry in California with approximately 76,000 farms covering a total of 26.3 million acres. For purposes of the GHG inventory and AB 32 implementation, the agricultural sector includes on-farm emissions from animals and from crop cultivation and management but does not include post-farm processing and distribution or manufacture of inputs such as pesticides or fertilizer. On-farm sources include emissions from animal wastes, energy use (including fuel combustion), crop residue burning, enteric fermentation, soil management practices (such as fertilizer and manure applications and soil liming), and anaerobic decomposition of organic matter.

Appendix C: Agriculture Figure 8



In 1990, the agricultural sector emitted an estimated 23.4 MMTCO<sub>2</sub>E, representing five percent of the statewide total. This figure increased to 27.9 MMTCO<sub>2</sub>E in 2004, or six percent of the statewide total. The emissions forecast for the sector shows an increase in emissions to 29.8 MMTCO<sub>2</sub>E in 2020; the primary driver behind the projected increase is growth in dairy livestock.

The agricultural sector presents several opportunities to reduce GHG emissions and help California achieve the reductions necessary to meet the goals of AB 32. GHG reduction strategies for the agricultural sector include voluntary actions and research activities which will support quantification of voluntary actions along with future strategies. Many of the voluntary strategies presented for the agricultural sector were identified by the Economic and Technology Advancement Advisory Committee.

As described below, the Draft Scoping Plan includes a recommended measure for methane capture at large dairies through use of manure digester systems. In the near-term implementation of digesters would be voluntary. This voluntary approach in the initial years would encourage investment in the technology and improve cost effectiveness over time. The voluntary approach will be re-assessed at the five-year Scoping Plan update to determine if the program should be made mandatory by 2020. This reassessment will include performance, cost-effectiveness, other actions needed to facilitate implementation, and other factors.

Increased efficiency in California's agricultural operations is also recommended in the Draft Plan. In particular, the Draft Plan notes the initiation of a two phase research effort to better understand N<sub>2</sub>O emissions from fertilizer applications. Phase 1 of this effort will address the variables affecting emissions and based on the findings, Phase 2 will explore opportunities for emission reductions. Additional efficiency measures such as water efficiency, improved irrigation pump efficiency, and optimal tire inflation (for fuel savings) are potential strategies for reducing GHG emissions, although further analysis is needed as noted below. Such actions can also provide cost savings to farmers while contributing to the State's efforts to meet ambient air quality standards through co-reductions of criteria pollutant emissions.

In addition to the strategies in the Draft Scoping Plan, there are other opportunities for the agricultural sector to reduce GHG emissions. One of these areas is the utilization of agricultural biomass for electricity generation and fuel production. Approximately 8 million tons of agricultural biomass is available for use annually; however, only 1.1 million tons is currently utilized largely due to technological impediments. Traditionally, this biomass has been burned on-site, incorporated into the soil, chipped, or sent to a landfill. More productive use of this material will reduce GHG emissions related to its disposal or decomposition, and serve as a renewable energy source. Utilization of this material would complement regulatory programs requiring farmers to reduce open burning of residues by providing a disposal avenue for biomass that would have otherwise been burned, subjected to anaerobic decomposition, or disposed of in landfills. Development of bioenergy sources, which supports California's renewable energy goals, will be tracked and accounted for in the energy sector.

Increasing carbon sequestration in plants or soils offers another potential opportunity for the agricultural sector. Under certain conditions, practices such as conservation tillage, cover cropping, and incorporating soil amendments may increase or retain soil carbon. Sequestration

can also be increased on rangelands or in on-farm plantings such as permanent crops, hedgerows, or riparian restoration projects.

Further research is also needed to understand and quantify the benefits of practices to reduce direct methane emissions from livestock digestive processes.

Gaps in scientific knowledge and scientific uncertainty in existing data on many agricultural strategies make the identification of real, permanent, additional, verifiable and enforceable reduction measures difficult to immediately implement. The extent to which these and other voluntary GHG reduction activities occur, depends on data to support the development of quantification protocols and the availability of economic incentives such as marketable emission reduction credits, grants, tax incentives, or renewable energy incentives.

## **Preliminary Recommendations**

### **(A-1) Methane Capture at Large Dairies**

The primary driver behind the projected increase in agricultural GHG emissions is growth in dairy livestock. California is home to about 1,800 dairies with over 1.7 million dairy cows. The resulting manure is a significant source of methane. In 2004, GHG emissions from livestock waste were 6.9 MMTCO<sub>2</sub>E, almost 25 percent of total agricultural emissions. Methane from manure can be captured through the installation and use of an anaerobic digester. The methane gas produced by the digester can be used as an alternative to natural gas in combustion, power production, or as a transportation fuel.

Digesters are tanks or covered lagoons in which bacteria break down manure in an oxygen-free environment to create biogas, a mix of primarily methane (60 to 70 percent) and carbon dioxide (30 to 40 percent).<sup>80</sup> The biogas is captured in the tank or lagoon, and can either be flared, yielding CO<sub>2</sub>, burned to run a turbine and create electricity, or cleaned to create natural gas. GHG reductions occur because methane, which is 23 times as potent as CO<sub>2</sub>, which would have been released to the atmosphere without a digester.

Encouraging the capture of methane through use of manure digester systems at large dairies will provide early voluntary emission reductions and promote the use of renewable energy. In the near-term, investment in digesters will be voluntary. Economic incentives such as marketable emission reduction credits, favorable utility contracts, or renewable energy incentives will be key to early implementation. This voluntary approach in the initial years should encourage investment in the technology and improve cost effectiveness over time. The voluntary approach will be re-assessed at the five-year Scoping Plan update to determine if the program should be made mandatory by 2020.

This measure would be coordinated with the manure management protocols for quantifying GHG reductions. The protocols will be presented to the Air Resources Board in late 2008. While providing a sound quantification methodology will ensure that reductions achieved are

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<sup>80</sup> Managing Manure with Biogas Recovery Systems: Improved Performance at Competitive Costs. U.S. Environmental Protection Agency. <http://www.epa.gov/agstar/pdf/manage.pdf>

real, permanent, verifiable and enforceable, there are still barriers to wide adoption and implementation of digester technologies. The installation and operation of digesters have cross-media impacts and must be assessed by multiple agencies including ARB, local air districts, Regional Water Boards and the California Integrated Waste Management Board. Another issue highlighted by digester operators is that contracts from utilities contain few incentives for selling excess electricity or gas into the utility electrical grid or gas distribution system. ARB will continue to work with stakeholders and other agencies to address these barriers. Adoption of the voluntary protocol will offer a pathway to quantify and verify the GHG benefits. Allowing time for the technology to be more widely demonstrated will help to facilitate the transition from a voluntary to a regulatory approach.

It is estimated that individual digester costs would be on the order of \$4-5.8 million for a dairy with at least 1,000 head. Typical digesters have an estimated useful project life of about 15 years. Annual operation and maintenance costs could range from \$150,000 to \$300,000, depending on energy production equipment.

**Appendix C: Agriculture-Preliminary Recommendations**  
**Table 38**

Reduction Measure	Potential 2020 Reductions MMTCO <sub>2</sub> E	Net Annualized Cost (\$ Millions)†	Proposed Lead Agency	Adoption/Implementation Timeframe
Methane Capture at Large Dairies	1	156	ARB	2017-2020

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **Areas of Research/Opportunities for future GHG Emission Reductions**

### **Fertilizer Use Efficiency**

Emission reductions from fertilizer use are among the potential future strategies for the agricultural sector, but the reduction potential is not quantified at this time. The application of nitrogen fertilizers leads to nitrous oxide (N<sub>2</sub>O) emissions. ARB adopted a measure calling for collaborative research on nitrogen land application as an Early Action measure in October 2007. Consequently, ARB has begun a research program to better understand the variables affecting emissions (Phase 1) and based on the findings explore opportunities for emission reductions (Phase 2).

N<sub>2</sub>O accounts for roughly 15.6 MMTCO<sub>2</sub>E, or 2.8 percent, of California's 2004 Statewide GHG inventory. Current estimates indicate that agricultural soil produces more than 50 percent of overall N<sub>2</sub>O emissions in California, contributing an estimated 8.1 MMTCO<sub>2</sub>E. The N<sub>2</sub>O in soil is primarily derived from nitrogen-rich substances such as plant residues, manure amendments,

and nitrogen fertilizers. Because N<sub>2</sub>O is generated through microbiological processes of nitrification and denitrification in soil as part of the natural nitrogen cycling, its emission is closely related to the amount of nitrogen compounds in the soil. Limiting input of nitrogen sources into the agricultural ecosystems coupled with alternative agricultural management practices that affect physical, chemical, and biological properties of the soil environment, and consequently soil microbial activities offer opportunities to mitigate N<sub>2</sub>O emissions.

The first step in this research effort is the establishment and validation of N<sub>2</sub>O emission estimates under California-specific conditions, which will help refine the greenhouse gas emissions inventory. California has a unique opportunity to explore the effects of dynamic changes in soil moisture, due to controlled irrigation, on the emissions of N<sub>2</sub>O. The N<sub>2</sub>O inventory assessment will inform subsequent work to identify strategies that reduce nitrogen losses (which can be up to 50 percent), prolong nitrogen residence time in soil, and benefit crop uptake.

### **Efficiency Improvements**

Another aspect of the agricultural sector's strategy is the opportunity to reduce GHG emissions through improved operational efficiency. Among the efficiency measures that could be pursued and developed for the future are water efficiency and conservation, irrigation pump efficiency improvements, and maintenance of correct tire pressure for on-farm equipment, among other general operational efficiency improvements.

Agricultural water efficiency and conservation beyond current practice offer the potential for GHG reductions, as well as benefits for the State's water resources. The agricultural sector accounts for approximately 80 percent of California's total water use and approximately 43 percent of California's total water supply.<sup>81,82</sup> While individual farmers can reduce water consumption (and realize reduced water costs), further analysis is needed to determine an appropriate course of action for achieving widespread GHG reductions from agricultural water use.

Irrigation pump efficiency could be improved through on-site testing of agricultural water pumps, pump repairs, and the promotion of scientifically-determined irrigation scheduling practices. Such improvements would be expected to reduce either electricity or diesel fuel consumption for farmers, with associated cost savings.

Another option for improving on-farm equipment efficiency is through the maintenance of correct tractor tire pressure. Proper tire inflation based on the tire load can result in significant fuel savings, increased productivity, and reduced soil compaction during primary tillage

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<sup>81</sup> Department of Water Resources. Agricultural Water Use Program. <http://www.owue.water.ca.gov/agdev/>

<sup>82</sup> In addition to being a potential strategy to reduce GHG emissions, using water more efficiently may help the agricultural sector cope with potential reductions in water availability associated with the ongoing impacts of climate change on the hydrologic cycle.

operations, based on a UC Davis study.<sup>83</sup> The study found that tractors using correct tire pressure required approximately 20 percent less diesel fuel and increased productivity by 5 to 10 percent. The reduction in fuel consumption reduces both GHG and criteria pollutant emissions, and the reduced soil compaction could potentially reduce N<sub>2</sub>O production in soil.

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<sup>83</sup> Lancas, K.P., S.K. Upadhyaya, and M. Sime. 1994. Traction and soil compaction due to low pressure tires. Unpublished report. Agricultural Engineering Department, University of California Davis

## **12. STATE GOVERNMENT**

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**This sector includes the following measures**

### **Preliminary Recommendations**

**Business Travel**

**State Fleet**

**Facilities**

**Energy Production/Procurement & Non- Facility Energy Use**

**Environmentally Preferable Purchasing**

**Employee Practices**

**The State's Carbon Shadow**

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

### **Overview**

State government includes college campuses, veterans homes, medical, military, and law enforcement facilities, prisons, parks, water, energy and public works projects, and hundreds of office buildings, each having its own specific carbon footprint. With approximately 356,000 employees at more than 100 agencies, 290 million square feet of building space, 50,000 vehicles, and \$6 billion in annual goods and services procurements, State government is a considerable source of GHG emissions and must do its share to reduce emissions.

State government must play a leadership role in reducing greenhouse gas emissions (GHG), not only as a regulatory entity that creates programs to reduce emissions from industry, commercial endeavors, and the general public, but also by reducing emissions from its own facilities and operations. This section focuses on State government facilities and operations and on the State's "Carbon Shadow". The State is committed to reduce its own GHG emissions by 30 percent in 2020 – a 15 percent reduction from current levels.

Many agencies have taken aggressive approaches to energy conservation and efficiency, however, a system-wide approach to reduce GHG emissions is still in the early stages. The priority system-wide approaches to emission reductions should include:

- Focus on energy efficiency and resource conservation. Immediate and significant emission reductions can be easily attained through simple steps to conserve the energy we do use.
- Adopt a GHG reduction policy that encourages a reduction in both vehicle and air travel. Since travel is such a large source of emissions, a policy will provide strong support for telecommuting, alternate work week schedules and tele- and video conferencing.
- Establish an inventory of all State GHG emissions. This is critical to establishing a baseline from which impact and progress can be measured. Register with the California Climate Action Registry or similar climate registry to facilitate the process.

- Conduct a review of laws, regulations, policies and procedures to evaluate their effect on the procurement of vehicles. Over the years, older mandates can become contradictory or redundant when newer directives are added. A review will identify where clarification is necessary.

Require each board, department, office to coordinate and integrate GHG reductions in all areas of their operations in concert with program services delivery to ensure that all aspects minimize GHG emissions.

- Take advantage of current and future technologies to reduce GHG emissions. Through strategic automation and consolidation of cross-departmental processes and effective use of the Internet, staff can reduce paper and energy use while dramatically improving service to the public and regulated entities. E-government, appropriately designed, enables government to better meet its business needs by delivering timely and efficient services, greater transparency and better access.
- Reduce, reuse, recycle, and buy environmentally preferred goods and services. Solid waste management practices are a quick, easy, and effective area to focus efforts to reduce the amount of products and materials being used, to get the maximum use out of them, and to ensure recycling occurs at the end of their useful life. Purchasing products that have recycled-content, and are energy efficient, long lasting, and easily repaired, maximizes the economic and environmental benefits from the purchases that are made.

The remainder of this section will discuss current and potential future GHG emission reduction efforts within business travel, State fleet, facilities, energy production, procurement and non-facility use, environmentally preferable purchasing, employee practices, and the State's "Carbon Shadow".

## **A. BUSINESS TRAVEL**

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Transportation is one of the largest sources of the State's emissions. Minimizing travel whenever possible and choosing the least emitting mode when transportation is necessary will yield GHG reductions. Reducing travel related emissions results in correlating reductions in fuel, maintenance, and vehicle replacement expenditures. This is an opportunity for significant cost savings while having a minimal impact on the services the State provides.

### **GHG Reduction Efforts**

With budgets tightening and costs rising, many agencies have already responded by limiting travel. Some travel is always necessary as many types of work, events, and presentations must be conducted in person. However, there are many opportunities to minimize travel by relying more on video conferencing, teleconferencing and similar meeting and information sharing technologies.

The Department of General Services' (DGS) current vehicle rental contract offers hybrid, low emission, and high efficiency vehicles. Advanced requests may be needed to ensure a vehicle is available when needed, but emphasizing the need for these vehicles, will increase their availability. Alternate fuel and bio-fuel vehicles, including ethanol (E-85), compressed natural

gas (CNG), and electric hybrid vehicles are available through the state garage and should be used to the maximum extent possible. Because of the increased availability of flex-fuel vehicles, an ethanol pump has been installed at the State garage in downtown Sacramento and at the California Highway Patrol facility in West Sacramento. Also, ARB is working on a low carbon fuel standard (LCFS) that will reduce emissions from fuel use throughout State government and California.

Some agencies and campuses are making use of electric carts and bicycles for short local trips. Groundskeepers and maintenance staff also find carts and bikes are quick and easy ways to get around.

### **Potential Future Efforts**

The State should consider a statewide policy limiting air and vehicle travel and requiring an analysis of the least emitting travel options to the most travelled destinations. Agencies should encourage greater use of public and alternative transportation for state travel. Especially in areas of high density state offices, incentives and policies that promote the benefits of walking, riding bikes, and using electric carts for short, local trips should be established. These zero emission transportation options should be expanded upon to increase their availability and use.

DGS has a number of initiatives to encourage the State work force to travel “greener” and “smarter.” A requirement for contractors to provide accurate and timely reporting data to DGS will enable them to determine emissions of state travel activities. Improving travel services through airline, automobile rental and credit card vendors could also make travel more efficient. Following a common practice of most trucking and delivery services, GPS tracking of certain percentages of fleet vehicles would foster better understanding of travel routes and provide for coordinated trip planning and alternative fueling stations.

The State car rental contracts expire in 2008 providing an opportunity to increase the supply of alternative and hybrid vehicles in the contracts. Automobile rental vendors currently under contract with the State, nationally operate 73,000 flex-fuel cars and trucks that can use E-85, along with 4,000 hybrid cars. The State's new contract should require car rental companies to provide alternative fuel and hybrid vehicles to State employees traveling on business. Earlier this year, one of the State's automobile rental vendors, launched a car-sharing program, enabling downtown dwellers, State employees who carpool, or those who use mass transit to rent hybrid cars by the hour for use during the day. DGS Fleet should pilot this program in larger cities in the state.

The State airline contract is up for renewal this year, and language should be incorporated into the contract that requires airlines to calculate emissions on frequently traveled pairs of city destinations for State business. This data should be provided to DGS on a quarterly basis to enable more strategic travel planning. City destinations should be selected that require less auto travel to get to meeting locations, and alternative means of travel or the use of video and teleconferencing technology should be considered.

DGS will also host the State Green Lodging Program. As part of this program, DGS will instruct State agencies to book certified green and sustainable hotels/motels for their overnight stays. Also, DGS Fleet is planning to develop a Meeting & Conference Unit, which will provide State

agencies with meeting planning services. The unit will recommend that agencies book their lodging in the same hotel they have scheduled meetings and conferences whenever possible to minimize travel to and from the location.

Agencies will be encouraged to use pre-arranged shuttle transportation from car rental companies and hotels to and from the airport. DGS Fleet also plans to centralize taxi cab service and will require contracted taxi companies to provide emissions data to DGS and to incorporate alternative fuel vehicles into their fleets. DGS will continue to encourage the use of local transit and alternative fuel van shuttle services.

## **B. STATE FLEET**

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This sub-section consists of practical strategies on coordination, vehicle management, and operations that the State should implement to reduce the emissions of its own fleet. Many of the recommendations can be applied to fleets and vehicles outside of government, such as cities, counties, and the private sector. Because many of these recommendations are extensions or expansions of existing efforts, this section does not follow the format of the other sections.<sup>84</sup>

The State fleet consists of approximately 50,000 vehicles and pieces of mobile equipment, operated by over 100 entities. About 40,000 of the State's vehicles are light-duty, passenger vehicles. The State fleet represents about 0.2 percent of the 33 million vehicles registered with DMV and accounts for about 0.34 MMTCO<sub>2</sub>E per year of GHG emissions.

This section is focused on the executive branch, but the State should actively share information and practices with the UC, CSU, and Community College systems, Bureau of Automotive Repair, local agencies that purchase vehicles through State contracts, and federal agencies. This sharing and coordination may be achieved through a statewide task force of agencies with fleets and/or with an interest in vehicle emissions.

Actions to reduce GHG emissions include the conversion of the California Highway Patrol (CHP) Fleet to Ethanol-85 vehicles, a Caltrans policy to only purchase hybrids and dual-fuel vehicles where available, and the installation of E-85 pumps at the CHP West Sacramento Fleet facility and at the DGS state garage in downtown Sacramento. These and many other efforts, as described below, have been implemented, but may have a long lead time before realizing substantial reductions.

### **Coordination & Information Management Strategies**

A single database that contains detailed information on each vehicle with fuel use and maintenance history will improve the management and emissions calculations of the fleet. At the end of 2008, DGS Fleet is due to complete the installation of an automated Fleet Asset Management System (FAMS) to capture this data from State agencies and fuel purchasing systems. State agencies should report their entire fleet into FAMS to insure the most accurate emissions calculations and other vehicle related metrics.

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<sup>84</sup> Calculations derived from ARB, Feb 28, 2008 AB32 Implementation Update: Transportation. Information by fuel is available at <http://www.arb.ca.gov/cc/inventory/data/data.htm>

As FAMS improves the coordination and information management of fleet data, it will identify how agencies can operate “leaner and cleaner” fleets—practices that could be modeled and implemented statewide. FAMS can also be used to create best practices to be shared with all State agencies, local jurisdictions, and private sector fleets.

To increase the State’s cognizance of vehicle procurement and sales, DGS Fleet should work with the DOF and the DMV to consider becoming the title-holder for state vehicles. This would require a major reorganization of DGS Fleet resources to provide efficient service to operating agencies and to insure a close working relationship with the DMV. The State Equipment Council exists to assist in the management of the state’s mobile assets, so DGS Fleet should also work through the Council to determine whether or not to proceed with this recommendation. A reduction in the number of title-holding entities from about 100 to just a few could make fleet data far more accurate, which would enable the state to set and monitor proactive objectives to meet the goal of reducing State government emissions by 30 percent.

### **Vehicle Management Strategies**

One of the fastest ways to reduce fleet emissions is to replace old vehicles with new, more efficient ones. Vehicles often stay in the fleet for ten years or more and, with age, become less efficient and require more maintenance. At some point, it is a better investment to procure replacement vehicles. Also, newer vehicles usually have more advanced pollution control systems than older vehicles, reducing smog-forming co-pollutants. The State should identify the most polluting vehicles in the fleet and replace those vehicles as a priority. With FAMS information, DGS Fleet, DGS Procurement, and the Bureau of Automotive Repair should work with operating agencies to present cost-benefit analyses of vehicle replacement.<sup>85</sup> During this process, DGS Fleet should work through the State Equipment Council to identify inefficient vehicle assignments and work to consolidate those assignments to reduce the overall number of vehicles in the fleet.

### **Fuel Use**

About two-thirds of the fuel used by the State fleet is purchased at private sector gas stations. DGS Fleet is working with Caltrans and US Bank, manager of the Voyager Fleet Credit Card system, to identify the locations of these gas stations. With this information, ARB and CEC should direct alternative fuel infrastructure funds to locations with the highest amount of state use to make the fueling of the State’s alternative fuel vehicles as easy and convenient as possible.

To analyze the State’s use of transportation fuels, DGS Fleet should develop a comprehensive, annual report of fuel use and make it available to the public online.

### **Alternative fuels, hybrids, and infrastructure**

An immediate, concerted effort is needed to make alternative fuel available to State vehicles and the private sector. Considering the array of alternative fuel technologies available today, a portfolio for the State fleet, in the near term, should mostly consist of biofuels, hybrids, electric, and CNG. Additionally, ARB is developing a low carbon fuels standard that will reduce emissions by reducing the carbon intensity of fuel sold throughout California.

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<sup>85</sup> The federal government keeps passenger vehicles for 3 years or 60,000 miles. See FMR 102-34.280 at <http://tinyurl.com/3tum57>

To comply with federal Energy Policy Act<sup>86</sup> (EPAct) and other laws, the State has adjusted its procurement policies to buy alternative fuel vehicles. The principal technology that California's fleet and many others have adopted is flex-fuel E85 (flexible-fuel from 100 percent gasoline to 85 percent ethanol/15 percent gasoline). Today, there are over 3,000 flex-fuel vehicles in the State fleet, and possibly 350,000 flex-fuel vehicles<sup>87</sup> on the road in California.

The use of bio-fuels is detailed in the state's Bio-Energy Action Plan, the Low-Carbon Fuel Standard, and the CEC's Alternative Fuels Plan. But the implementation of these plans is limited by a confusing regulatory environment for alternative fuel distribution. This regulatory environment has made it so difficult to distribute alternative fuel that, today, only four E85 pumps are available to the public, and there may be only a few more by the end of 2008. In contrast, there are thousands of retail gasoline service stations in California.<sup>88</sup> As a result, the majority of the flex-fuel vehicles in the state currently operate on gasoline only.

Expanding the statewide infrastructure of commercial, alternative fuel stations could contribute to the reduction of emissions far more than any strategy that affects the state's fleet alone. A thorough review of existing regulations could lead to a streamlining of requirements while improving the needed safeguards. An immediate action may be for ARB to convene a taskforce of federal, state, and local regulatory agencies to design and implement a "one-stop-shop" for the permitting of alternative fuel manufacturing and distribution infrastructure. This program should be closely coordinated with funding from AB 1811 (2006, ARB), AB 118 (2007, CEC) and any federal programs.

For diesel vehicles, biodiesel is a viable option as most manufacturers warrant their engines for the use of biodiesel up to 20 percent (B20), although some are still limited to 5 percent (B5). A transition by Caltrans from 100 percent petroleum diesel to various percentages of biodiesel could result in a reduction of hundreds of thousands of gallons of petroleum diesel annually. Therefore, it is recommended that all bulk diesel contracts provide at least 5 percent (B5) biodiesel.

Hybrid electric vehicles are popular with state employees and can make a significant reduction in petroleum use. Plug-in hybrid electrics promise to make an even greater contribution to the reduction in petroleum use, and therefore, emissions. DGS should work through the State Equipment Council to study the infrastructure needed to plug in the state's dedicated-electric and plug-in hybrid vehicles where they are stored. State agencies should determine if their building electrical systems are sufficient for vehicle recharging. Based on the cost, which could be the cost of an extension cord in many cases, the State should consider funding the infrastructure as part of its strategy to reduce emissions.

Manufacturers no longer produce bi-fuel Compressed Natural Gas (CNG) vehicles, and only one manufacturer remains a bidder for annual state vehicle procurement contracts in the dedicated CNG passenger vehicle category. However, CNG, and its relative, propane, will probably

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<sup>86</sup> The federal Energy Policy Act (EPAct 1992, 2005) requires certain fleets to purchase alternative fuel vehicles for 75 percent of their light-duty vehicles acquired in each model year (Sept 1 - Aug 31).

<sup>87</sup> According to the California Ethanol Vehicle Coalition, there are an estimated 350,000 flex-fuel vehicles in California. <http://www.calevc.org/docs/CEVC1007Support.pdf>

<sup>88</sup> CEC, 2001-2002 data, [http://www.energy.ca.gov/gasoline/gasoline\\_stations/index.html](http://www.energy.ca.gov/gasoline/gasoline_stations/index.html)

continue to play important roles in centralized, municipal fleet operations, especially in non-attainment areas for criteria pollutants. Today there are only 193 natural gas fueling stations located in California.<sup>89</sup> Many of these stations have public access but do not recognize or accept the State's Voyager fuel card. While CNG remains in use by the state, DGS Fleet should work through the State Equipment Council to identify CNG and propane fueling stations and with US Bank to enable those stations to accept the Voyager card. This would make it easier for state employees to use the stations and increase the state's ability to track the use of these fuels.

### **Operations & Maintenance**

Other strategies that can immediately reduce fuel use and emissions include a strict adherence to proper tire inflation pressures, correct viscosity oil use, replacing engine air filters based on environmental operating conditions, and properly recharging air conditioning units. Cruise control, though sometimes viewed as a luxury, should be required in State passenger vehicles as it can also reduce fuel consumption.<sup>90</sup>

DGS should work with CEC, ARB, and vehicle manufacturers to develop ways to efficiently reduce vehicle cabin temperatures. Some suggestions include passive air circulation, reflective roof paint, and improved window glazing. Vehicle air conditioning can use a significant amount of energy, and in most passenger cars today, the air conditioner is automatically engaged when using the windshield defrost. DGS Procurement should work with DGS Fleet and operating agencies to add a requirement to vehicle procurement specifications to enable the driver to control the use of the air conditioner in any air handling mode, and to ensure that vehicles are compliant with the requirements contained in the Pavley legislation.

For the last ten years, DGS Fleet has coordinated the use of re-refined motor oil throughout the fleet, which has contributed to a reduction in petroleum use. This program should be studied by an appropriate regulatory agency to determine its success and share any best practices with other fleets and the private sector.

There are additional best practices for vehicle maintenance that should be implemented. For example, the federal General Services Administration (GSA) manages the maintenance and repair of approximately 300,000 vehicles through five call centers that approve and track maintenance costs. Once call centers collect repair data from commercial vendors previously authorized to perform specific services, GSA notifies its fuel card provider (Voyager) to initiate payment of the charges. This system allows GSA to control maintenance and repair costs, and to collect operational data. Payments to vendors are also expedited using the Voyager card as a payment tool rather than utilizing the government's regular invoice payment system. Usually, this type of information is not collected by state vehicle operating agencies, but it has the potential to significantly improve the management of the fleet and reduce energy use and environment impacts. Therefore, it is recommended that DGS Fleet implement a program similar to GSA's.

## **C. FACILITIES**

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<sup>89</sup> DOE Alternative Fueling Station Locator: <http://afdcmap2.nrel.gov/locator/FindNearResult.asp>

<sup>90</sup> ARB and CEC ongoing efforts on cool paints, tire inflation, cruise control, and air conditioning.

In large part, our primary objective in reducing GHG emissions is to reduce the amount of energy we use and to ensure the energy we do use is produced as cleanly as possible. In this Appendix, we have separated the discussion on energy use into two sections – Part C on facilities/building use and Part D on Non-facility energy use such as traffic signals and lighting for roadways, parks, tunnels, and bridges.

The State is taking aggressive action to “green” State buildings by implementing a wide variety of efforts to address climate change, reduce pollution and waste, and increase energy efficiency. According to DGS, the Executive Branch owns and operates 103 million square feet of building space – much of which is in the form of office buildings. A recent analysis of the 2004 California GHG inventory estimated that buildings represent approximately 25 percent of the total 480 MMTCO<sub>2</sub>E generated in 2004. For additional information on specific measures, see the Green Building section in part 6 of Appendix C.

## **GHG Reduction Efforts**

In the following discussion, you will see many references to Leadership in Energy and Environmental Design (LEED). It is important to note that commercial buildings as defined by standard building codes are eligible for certification under a number of categories including LEED for New Construction (NC) and LEED for Existing Buildings (EB). There are also multiple levels to the rating system, including certification, or achieving higher silver, gold, and platinum levels.

### **Green Building Initiative**

Executive Order (EO) S-20-04, known as the “Green Building Initiative” or GBI, requires State agencies to reduce the amount of electricity purchased from the grid that is used in State-owned buildings by 20 percent by 2015, and, in so doing, reduce greenhouse gas emissions associated with the production of fossil fuel-based power. It also requires all new and renovated State-owned facilities to be designed, constructed and operated as certified LEED Silver or higher buildings. The Governor’s EO also urges all schools built with State funds to be resource and energy efficient.

### **Baseline & Benchmarking: Measuring a Building's Energy Performance**

The EO also calls for benchmarking the energy performance of all State buildings. The California Energy Commission’s Benchmarking Workgroup, California utility companies, and State agencies are working collaboratively to measure the energy efficiency of State buildings by using the federal Energy Star Portfolio Manager benchmarking tool.

In addition to analyzing energy performance against a baseline, the State can use benchmarking to compare a building with properties of similar characteristics, such as geographic location, size, operations and age. The Benchmarking Workgroup will collect and summarize energy consumption data provided by State agencies and will report annually on the progress toward attaining the energy reduction goal including recommendations on any changes in rules or procedures to ensure the goal is met.

### **New State Facilities**

All new State buildings and major renovations of 10,000 sq. ft. and over, subject to Title 24, are required to be designed, constructed and certified at a minimum of LEED-NC Silver or higher. Smaller buildings are being designed to meet LEED standards.

Some agencies, such as Caltrans, have adopted LEED standards for all in-house new construction and rehabilitation projects. In support of this effort, Caltrans project engineers and architects are working with DGS to become LEED certified. Caltrans is also near completion of a LEED policy directive that guides all internal facility projects.

### **Leased State Facilities**

DGS and other State agencies are seeking U.S. EPA Energy Star rating for facility leases of 5,000 square feet or more beginning in 2006 for new leases, and beginning in 2008 for renewal leases (including meeting an Energy Star rating for purchasing or operating electrical equipment such as computers, printers, copiers, refrigerators, and unit air).

The State leases almost nine million square feet of office, storage and other space. Under EO S-20-04, preference is given to the most energy efficient buildings. California is seeking leases with a U.S. EPA Energy Star energy efficiency score of no less than 75 (out of a possible 100 points) or higher. In addition, LEED certification is being sought for build-to-suit (where the project will be built as the buyer or lessee specifies) leased facilities. The DMV office in Riverside is the first build-to-suit lease that has been certified with a LEED Silver rating.

### **Existing State Facilities**

The EO requires all existing state buildings larger than 50,000 square feet to meet LEED existing building requirements no later than 2015. A minimum of LEED – EB Certified is required to ensure energy-efficient, green building operations and maintenance, however, DGS has voluntarily increased this goal to LEED – EB Silver.

DGS has received approval from the U.S. Green Building Council, the architect of the LEED rating system, to participate in a pilot program for volume LEED-EB registration for the entire DGS-owned portfolio. This pilot program will be a major undertaking and yield major energy savings through product, system, and maintenance upgrades, while streamlining the LEED certification process.

The Department of Motor Vehicles (DMV) has worked with the State's Investor Owned Utilities to identify energy conservation measures and accompanying incentives for its State-owned facilities. A DMV study indicates a potential for reduced annual electricity consumption by approximately 6 million kWh, about a 20 percent savings, which will equate to approximately a 7.44 MMTCO<sub>2</sub>E reduction of greenhouse gas emissions and a savings of over \$750,000, each year. DMV is currently working with DGS to pursue a portfolio-wide approach to complete the identified measures.

### **Energy Efficiency by Retro-commissioning/Retrofitting**

Statewide, all commercial buildings (state owned and privately owned) use approximately 36 percent of the State's electricity and account for a large percentage of GHG emissions. Since the State spends approximately \$500 million on electricity per year for all State owned buildings

including the UC and CSU system, the State is committed to aggressively reduce State building electricity usage. Executive branch buildings 50,000 square feet and larger are undergoing the retro-commissioning process to optimize existing energy systems and improve energy performance.

Retro-commissioning (RCx) or Existing Building Commissioning is a process that identifies operational problems and repairs them rather than relying on major equipment replacement. The process involves a diagnostic monitoring and functional testing of building systems with the implementation of measures to capture energy savings. Each building will be re-commissioned every five years after initial retro-commissioning to take advantage of new energy technologies.

Thus far, 25 State RCx projects are at or near completion. The RCx projects completed to date are projected to achieve an average estimated savings of 10.6 percent in electricity consumption and 15.8 percent in natural gas use.

### **Energy Services Companies**

Following EO S-20-04, DGS is establishing an energy services companies (ESCO) program to perform energy services performance contracts for State buildings. A performance contract is an agreement made between the State and an ESCO, in which an ESCO guarantees energy savings that are expected to result from the implementation of an energy project, such as installing new equipment, doors, and windows, or adding insulation. Performance contracts are an essential component of a comprehensive State energy efficiency program, as described in the Governor's Green Building Initiative. The State's primary energy efficiency investment goal is to capitalize on energy efficiency measure opportunities at each facility through equipment performance savings. Post implementation measurement and continuous monitoring of the energy systems will allow the project to automatically generate real-time mandated reports as required by EO S-20-04.

### **Locating State Facilities**

The State needs to site its facilities in a manner that is consistent with the State's planning priorities (Chapter 1016, Statutes of 2002) and the regional planning process outlined in the Scoping Plan. By locating its facilities in a way that promotes resource-efficient development and supports public transit, the state can enhance its partnership with local and regional governments in meeting the greenhouse gas reduction targets.

## **Future GHG Reduction Efforts**

### **New Sacramento Central Heating and Cooling Plant in Sacramento**

State and Consumer Services Agency and DGS are spearheading the greening efforts to build the new Central Plant according to LEED Gold certification. The new Central Plant will serve the heating and cooling needs of the State Capitol and 22 other State-owned buildings in downtown Sacramento's Capitol Area when it is completed towards the end of 2010.

The new plant will have increased energy efficiency and a greatly reduced need for water. The new facility will have cooling towers for extracting heat from the buildings, eliminating the need to use well water or to discharge water into the Sacramento River. The plant will also feature a 4.25 million gallon, thermal energy storage tank. With the tank in place, DGS will be able to

produce reserves of chilled water during off-peak energy demand times. The new plant will reduce water use by 90 percent compared to the existing plant. Solar panels will also be installed on the new facility to power the energy needs of the office space within the plant.

### **California Utilities Join Forces to Save Energy In State Buildings**

In its effort to significantly increase the level of energy efficiency in state-owned buildings, DGS is collaborating with Southern California Edison, Pacific Gas and Electric Company, San Diego Gas & Electric and Southern California Gas Company, to provide nearly \$17 million in incentives for the implementation of energy-saving programs in State facilities. SMUD and other publicly owned utilities have also been strong allies in the State's efforts to cut GHGs.

### **Energy Efficiency Building Tools**

DGS has developed a standardized building management manual, "*Better Building Management for a Better Tomorrow*," for use in all DGS-managed buildings. The manual establishes green policies and procedures to ensure energy and resource-efficient practices are implemented and maintained. The manual is available to other State agencies and the general public as an example of a policy manual that meets the criteria of several LEED-EB credits requiring management policies.

In addition, Lawrence Berkeley Lab's EnergyIQ building benchmarking tool can also be used to benchmark government buildings and help determine their efficiency and potential for GHG emission reductions.

## **D. ENERGY PRODUCTION, PROCUREMENT, & NON-FACILITY USE**

This section focuses on efforts to produce/purchase clean energy and to reduce non-facility energy use.

### ***GHG Reduction Efforts***

#### **Clean Energy Production and Procurement**

State agencies are working with energy suppliers to increase the procurement of energy from renewable sources such as solar, hydro-electric, and natural gas. Increased deployment of renewable resources is essential for reducing greenhouse gas emissions and reaching AB 32 goals. Over the last three decades, the State has built one of the largest and most diverse renewable generation portfolios in the world. Currently, about 11 percent of the State's electricity is from renewable energy sources including solar, wind, geothermal, and biomass.

The Green Building Initiative (Executive Order S-20-04) tasks State government to demonstrate leadership in energy efficiency and environmental responsibility in State buildings, while also reducing the impact State facilities have on climate change. In response, a number of State agencies have invested in solar energy projects. For instance, DGS has a number of projects underway (for more detail see Part C. Facilities). Caltrans has numerous photovoltaic (PV) projects being funded via the Internal Revenue Service Clean Renewable Energy Bonds (CREB) program. PV powered remote telecommunications, cathodic protection of bridges (using a low level electrical charge to retard the chemical decay/rust), and emergency call boxes have been in

place since the late 1980s. The Department of Agriculture (local fairs and CalExpo) has implemented PV systems that generate more than 8 MW of power.

Through these and many other efforts, 4.2 megawatts of clean, on-site solar energy has been installed at State-owned facilities since 2006, and more are on the way. An additional 23 megawatts of on-site solar energy are planned for installation at State prisons, mental hospitals and CSU campuses beginning in 2008. Stationary fuel cell applications are also being evaluated for State facilities.

Another effort is the DGS purchases of natural gas for large State government "non-core" users - those with meters that use more than 250,000 therms per year. The bulk of the gas used by these agencies is provided through the DGS contract, however, there is still some gas provided by the gas utilities. Currently, 8 agencies and almost all eligible UC and CSU campuses use about 200 million therms of natural gas annually. Approximately 60 percent of this natural gas goes to boiler use and 40 percent for on-site electricity co-generation. As the rules that penalize "departing load" (customers who elect to generate their own power in an effort to escape higher contracted electricity supply rates are currently charged a fee by the utility) will end over the next few years, there are already increasing signs of interest in co-generation projects.

In addition, the Department of Water Resources (DWR) is actively implementing strategies to reduce GHG emissions, such as energy procurement strategies involving combined cycle natural gas and renewable fuels for the State Water Project (SWP). As part of this strategy, the SWP has decided not to renew its ownership interest in a coal-fired power plant when its contract for that power expires in 2013. DWR is also voluntarily developing a renewable energy portfolio standard for the SWP. Through these efforts, DWR anticipates achieving GHG reductions above and beyond the AB 32 requirements well in advance of the deadlines.

### **Efficient Energy Use and Conservation**

The Governor's Executive Order (EO) S-20-04 requires State agencies to reduce grid-based energy purchases for state-owned buildings by 20 percent by 2015, through cost-effective efficiency measures and distributed generation technologies. In response, many State agencies have taken significant steps to achieve the needed reductions that can be transferred to other agencies. Many reductions achieved at State facilities are detailed in Part C. Facilities of This Section

The following is an example of energy conservation efforts undertaken by Caltrans:

- Traffic Signals - Statewide conversion of signals to energy efficient light emitting diode (LED) fixtures was completed in 2002. The next generation of higher efficiency LED signals are starting to replace units installed in the 1990's.
- Roadway Lighting - "Points of Conflict" on State owned roadways (Federal Interstate Highways, State Highways and roads) are lighted at intersections, on/off ramps, and points of merging and separation. Higher efficiency lighting, control, and location options are all under study to improve efficiencies and safety.

- Roadway Sign Lighting - Illumination of informational signage located over the roadway. Statewide deployment of high efficiency induction lighting systems are almost complete.
- Bridge and Tunnel - Lighting systems used on bridges and tunnels are being reviewed for energy use reductions.
- Bulk Green Energy Procurement - Savings as a direct result of buying bulk discount energy, leads to more clean energy purchasing and less coal generated electricity use.

If all conservation projects are found cost effective and fully implemented, 2004 data forecasts that Caltrans would:

- Reduce daytime and/or nighttime electrical grid loads.
- Save over 205 million kilowatt-hours in annual energy consumption.
- Payback project costs through savings in energy and maintenance costs.
- Save approximately \$162 million in forecasted ten-year net present value (NPV) from implemented projects.

Caltrans is also engaged in efforts to improve inter-modal centers at ports, develop new pavement products like rubberized asphalt using old tires, reuse of old concrete on-site as base and sub-base fill rather than transporting it to a landfill, change wharf and pier piling treatments, manage storm water run-off, reduce herbicide use, increase use of native plantings to reduce water use, and fund field testing as part of a long term continuing quality improvement program.

### **Potential Future Efforts**

The State should focus efforts on low-cost, high return energy conservation efforts. The supply of renewable energy should be increased through both production and procurement, including increasing solar and other distributed renewable generation capacity. The State will continue to pursue technologies that reduce the load on water pumps and other large electric motors, and increase compact fluorescent lighting (CFL) and LED lighting in parks, tunnels, bridges, parking, and roadways.

Encouraging appropriate state agencies to facilitate state and local government infrastructure improvements may yield energy savings beyond buildings, i.e. pumping water, traffic signals, and outdoor lighting. Funding and financial incentives should be sought for these infrastructure improvements and to increase the supply of clean renewable energy.

## **E. ENVIRONMENTALLY PREFERABLE PURCHASING**

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Environmentally preferable purchasing (EPP) focuses on using goods and services that have a reduced negative impact on human health and the environment compared to competing products. These products use fewer materials, water and energy, are produced locally, are reusable and/or recyclable, and require less end-of-life management. All of these attributes result in a reduced impact on the natural environment. With the State annually purchasing approximately \$6 billion in goods and services, State buyers have a responsibility to promote EPP while providing quality products and excellent value, environmental benefits, and a solid market to suppliers.

## **GHG Reduction Efforts**

### **State Law Requires EPP**

California law (AB 498, Public Contract Code, sections 12400-12404) and Executive Orders (EO S-20-04, S-7-04, and S-3-04) requires DGS to promote and to increase EPP by coordinating with other agencies, creating training programs, and publishing an EPP Best Practices Manual. The State's new "Environmentally Preferable Purchasing Best Practices Manual" provides State purchasing officials with information on dozens of environmentally friendly products and services. It contains information outlining environmental guidelines for purchasing many common items. Additionally, the manual identifies ways to reduce waste in the office, shop, or facility; allows buyers to choose from numerous product categories; and identifies the impacts associated with the manufacture and purchase of numerous products and services.

### **Recycled Content Product Contracts**

The State Agency Buy Recycled Campaign (SB 1106, PCC 12200-12217) is a joint effort between the California Integrated Waste Management Board (CIWMB) and DGS to implement State law requiring State agencies and the Legislature to purchase products with postconsumer recycled content. The Procurement Division at DGS has established contracts that offer recycled content products to assist agencies in meeting the mandate of ensuring a minimum of 50 percent of the dollars spent on products within 11 categories is spent on recycled products. Recycled content products are defined as having various quantities of postconsumer content.

### **Current Recycled Content and Green Contracts**

- **Open Office Panel Systems Contract:** The new Open Office Panel Systems (modular cubicles) contract has raised the bar substantially by moving to a best value procurement contract that allows up to 40 percent of the scoring to be applied to environmentally preferable attributes. The contract requires the use of recycled content materials, energy efficient task lighting (additional points for LED task lighting), and reduced emissions of volatile organic compounds (VOCs). It also encourages manufacturers to eliminate certain hazardous substances from their products and to reduce solid waste through reusable and recyclable shipping and packaging materials.
- **The California Lamp contract:** The California Lamp contract is a mandatory low-mercury lamp contract for T-8, T-12, and compact fluorescent lamp purchases. The California Lamp contract reduces mercury levels in fluorescent lamps to less than 5 milligrams per lamp and offers electronic ballasts to increase the efficiency of lighting fixtures. All three suppliers provide for the collection and responsible disposal of used lamps as part of their contracts.
- **Recycled latex paint contract:** This contract provides paint in a wide variety of colors containing up to 50 percent postconsumer paint. Recycled latex paint reduces the solid waste stream by recovering extra paint that may otherwise require disposal as hazardous waste and it reduces the emission of VOCs.
- **California Gold Sustainable Carpet Standard:** The California Gold Sustainable Carpet Standard requires up to ten percent postconsumer material content in new carpet and the recycling of old carpet to divert the material from landfills. This comprehensive standard

also reduces specified toxic compounds and VOCs. The California Gold Sustainable Carpet Standard will become the basis of a new national standard. LEED credits are available for the use of carpet meeting this standard.

- The current DGS personal computer (PC) Goods solicitation requiring Electronic Product Environmental Assessment Tool (EPEAT) Silver or better for Desktops, Notebooks, Tablets and Monitors is scheduled to be awarded in June, 2008. The evaluation process awards additional points to products that are certified EPEAT Gold.
- Copy Paper Contract: The new paper contract requires all State agencies to purchase copy paper with a minimum of 30 percent postconsumer content. However, many agencies and departments use 50 – 100 percent postconsumer content copy paper, much of it produced without the use of chlorine compounds for bleaching. The Office of State Publishing uses postconsumer content paper and soy-based inks whenever possible. Janitorial paper products and paper bags with a minimum of thirty percent postconsumer content are also available.
- Vehicle Contract: California is revising the methodology for evaluating vehicle purchasing contract bids to comply with the mandates of AB 236, which requires DGS to consider GHG emissions and fuel efficiency in fleet purchases. Current specifications also restrict the use of chrome plating and lead wheel weights. Recycled motor oil and antifreeze are used to maintain state vehicles, and retreaded tires are used for trucks and heavy-duty vehicles.
- Disposable Food Service Supplies: California has mandated the elimination of polystyrene in all line items of this contract and will purchase bio-based alternatives.

### **Potential Future Efforts**

The State will continue its leadership role by undertaking a thorough analysis of goods and services it uses, and developing strategies to ensure a system-wide application of product evaluation methodologies that consider carbon intensity in purchase decisions. These policies and practices should also extend to the contractors that provide the State with goods, services or consultation.

DGS Procurement may propose modifications to the vehicle and equipment bidding process to increase the variety of vehicles available for departments' needs. This is consistent with the need to consider total value, not just lowest bid, in procurement. For example, the cost of replacing tires that require frequent changing due to lower quality may outweigh any savings gained by accepting the lowest bid. Fewer tires purchased generally means fewer emissions through the entire product lifecycle, particularly as the state increases its efforts to calculate end-to-end emissions of its procurement and operations.

A related effort includes revising existing contract language to address GHG emissions, including the need to identify the carbon intensity of products, and to reduce emissions from the delivery to end-of-life management of products. Work is needed to research GHG values for other products to develop metrics and specifications to be included in bid documents. Those values could then be used to conduct a review of state purchasing to identify the high priority

products and services for GHG emissions reduction potential and establish a priority list of contracts to revise.

Ensuring that purchasing documents, specifications, and contracting procedures do not contradict each other and do not deter or inhibit the purchase of environmentally preferable products is an effort that will yield definite results. Once completed, designing and implementing programs and processes to increase the purchase of environmentally preferable products will be a much simpler task. Efforts such as restricting the purchase of single-sided printers and copiers, and requiring all state documents to be printed duplex will be much easier to enact with clear direction and authority.

The development of an automated procurement tracking tool to be used by all State agencies for all purchasing that tracks EPP, and specifically GHG emissions will facilitate tracking and reporting progress. The tool should also enable contractors to report on the carbon footprint of their products, operations and supply chain, including a third-party certification of the data provided. This effort will need to be targeted first to the largest suppliers and then phased in to others over time.

California participated in the drafting of the Midwest Governor's Association's Bio-based Product Procurement Initiative and is currently working with the USDA to establish a national data base of bio-based products. These products will then become available on statewide contracts. Future contracts for industrial cleaning supplies will require that all catalog items identified as "green" be certified to acceptable standards by an independent third party. State agencies will be blocked from buying any non-certified items where a comparable certified option is available, and regular and accurate reporting will be required on environmentally preferable purchases.

Efforts are underway to develop carbon labels for consumer products that will allow consumers to compare products by their carbon footprint. Also, the coolcalifornia.org carbon calculator will soon have a built-in decision-support tool that will help users estimate the change in their GHG footprint if they take specific actions. These efforts will help provide the raw data needed by buyers to track and report the emissions their purchases are responsible for.

## **F. EMPLOYEE PRACTICES**

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The initial carbon footprint audits conducted by a number of agencies have made it apparent that employees play a huge role in reducing GHG emissions. Choices regarding employee commutes, air and business travel, lodging, lighting use, and plug load all heavily impact energy use and the resulting GHG emissions. With employees having such an impact on these areas, all State agencies must involve employees in adopting policies to cut emissions and to conduct a consistent education and training effort.

### ***GHG Reduction Efforts***

#### **GHG Emissions Audit**

All the cabinet level State agencies, the CSU system and most UC campuses have joined the California Climate Action Registry (CCAR). By joining CCAR, they are obligated to prepare

and submit annual GHG emissions inventories. CCAR registration establishes an emissions baseline and gives the agency a blueprint for future reduction efforts.

### **Environmental Management System (EMS)**

An EMS is an integrated set of management processes designed to continually identify, prioritize, and improve the environmental impacts of an organization. An EMS integrates environmental management throughout daily operations, budget and human resource planning, and strategic planning. Cal/EPA has been involved in an agency-wide EMS since 2001. The EMS effort focuses on building-related operations and on the business processes and employee and stakeholder practices that relate to business operations. EMS is an excellent process to both institutionalize GHG reduction efforts and harness the power and influence of staff to maximize impact and achievement.

### **Agency-wide Policy Development**

Many agencies have been actively involved in reducing energy use for years. With the recent push from AB 32, much effort and attention is again focused on the burning of fuel for various purposes causing GHG emissions. More information is available now about the development of baseline emissions from which reductions can be measured, as well as technological advancements and case studies. The quantity and quality of this information is increasing daily. Sharing the successes and case studies among all State government is needed now so that all agencies can implement best practices to their fullest.

This flow of information within and among agencies can best be achieved by adopting policies. Policies are effective ways of communicating the same measure to a large number of people. They are especially effective in ensuring that efforts made by dedicated people are not lost over time as those employees move to other jobs or retire. Many agencies have policies already, while others, like ARB's Carbon Neutral Policy, are being drafted or considered.

### **Information Technology (IT) Efforts**

IT equipment is one of the fastest growing segments of energy use in office buildings. Many efforts are under way to reduce energy consumption from IT equipment. For example, DGS has installed centralized server-based power management software that yields energy savings of thirty to forty percent. DMV and Caltrans have or are considering implementation of this software.

DMV's Desktop Support Unit developed an in-house energy management solution, using existing software programs designed to aggressively adjust computers to a more energy efficient mode when not in use. Since the initial implementation on nearly 3,000 computers, the initiative has reduced average monthly electricity consumption by more than 86,000 kWh, reduced average monthly greenhouse gas emissions by more than 53.5 tons and saved California taxpayers an average of more than \$11,000 per month.

Implementation of the department's total inventory of more than 5,000 computers is nearly complete and, when fully implemented, will reduce the department's annual electricity consumption by more than 1,700,000 kWh, reduce annual greenhouse gas emissions by more than 1100 tons and save California's taxpayers more than \$230,000 per year.

Caltrans estimates there are about 18,000 computers distributed statewide, and along with servers, printers, plotters, modems, hubs, fax machines, and attached devices (like hard drives,

scanners, CD-ROM burners, etc.), consume from 27 to 35 million kWh/yr. “Energy Star” systems reduce energy consumption when units are not used for set periods of time. This reduction in operation may save up to forty percent of normal operational cost, although turning off equipment when it is not needed is still the best form of energy conservation.

### **Other Non – IT Energy Conservation Efforts**

Simple conservation efforts such as turning off lights when not in use, including non-essential overhead lighting in day-lit areas, lighting in unoccupied rooms, equipment and storage areas reduces energy use. Turning off overhead lighting as appropriate and using task lighting if daylight is inadequate for workspaces, switching off decorative lighting, signage and other lighting inside and out (if not necessary for security and safety) are simple yet effective ways to reduce energy use. Security and safety lighting should be maintained at the lowest, yet acceptable levels.

Techniques used to make efficient use of natural daylight includes closing blinds and window coverings on all solar exposed windows during appropriate times of the day or when rooms are not in use to block direct sunlight which increases room temperature. When not in direct sunlight, open blinds and shades to reduce or eliminate the need for overhead lighting. After business hours, turn off monitors, printers, and other equipment except for essential equipment needed for after hours operation (e.g., e-mail, email servers, fax machines or other essential equipment). Some offices will need to leave personal computers on after hours for security reasons, however, they can be set to energy-saving modes.

Thermostats should not be set below 78 degrees F in summer unless such a temperature in a particular job or occupation may expose employees to a health and safety risk. It is also critical to keep windows and doors closed when HVAC systems are in use to prevent loss of conditioned indoor air to the outside and minimize use of portable electric devices (e.g., microwaves, toaster ovens, electric heaters, or personal fans). Employees should consider dressing in appropriate warm weather business attire.

### **Potential Future Efforts**

Some State agencies have adopted policies that impact emissions but encouraging more agencies to adopt specific GHG emission reduction policies would increase and coordinate efforts statewide. This may be an opportunity to revitalize existing energy conservation policies as well, or to address other issues in a combined environmental protection policy or EMS with strong executive support and training. The policy should ensure employee orientation and training stresses energy and GHG emission reduction practices. Provide EMS and LEED training where appropriate.

These policies should all promote telework and flex schedules to reduce commute miles. With such a high percentage of emissions emanating from employee commuting and travel, it is imperative to increase participation in these emission reduction strategies. A centralized information clearing houses for alternative transportation options in major State employment centers should also be maintained.

Agency policies will also be an appropriate place to discourage driving on short trips. Particularly in the downtown area where agencies are clustered together and on college and

university campuses, staff should be encouraged to walk, bicycle or make use of electric carts on short trips. Agencies should provide bicycles and carts for these purposes and conduct surveys on their usefulness on various lengths of travel.

There are myriad efforts that agencies can undertake to reduce emissions. One such area is updating office equipment so that there are fewer devices and are more efficient, e.g., multi-purpose printer/copier/faxes instead of 1 device for each purpose. An overall reduction of print jobs through reminders on printers and copiers and messages sent via email about reducing paper use will save both electricity and paper. Ensuring all new printers/copiers purchased are duplex capable and are defaulted to duplex, while a common practice by some, remains an elusive goal for many.

High parking costs can be an incentive to carpool or to use public transportation. It is recommended that DGS examine parking costs at state garages and compare them to local private lots. If rates charged to drivers are significantly lower, then the rates should be increased to discourage individual driving and reduce emissions. Parking subsidies for state employees should also be factored into this review as they reduce parking costs for individuals at an expense to agency budgets.

Perhaps the single most important action any agency can take is to conduct a GHG emission audit. While many agencies have conducted audits or registered with CCAR already, a concerted effort must be made to continue to encourage additional agencies to follow suit. It is imperative to establish a baseline to begin identifying priority areas to cut emissions and maximize efficiencies.

## **G. THE STATE'S CARBON SHADOW**

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The previous discussion has focused on specific actions that can reduce GHG emissions directly attributable to State government (the traditional view of “carbon footprint”). The following discussion will briefly outline a strategy to invoke the leveraging capabilities of State government to influence GHG reductions by entities with which the state does business and whom are effected by State policies and decisions. This has come to be referred to as the State’s “carbon shadow”.

A prime example of the influence the State can generate is as an investor. Through its two largest pension systems, the State has an investment portfolio in excess of \$400 billion. These funds can be leveraged to support companies, programs, and projects that reduce GHG emissions. Public Employees Retirement System (PERS) and State Teachers Retirement System (STRS) should continue to examine their real estate portfolio for opportunities to increase energy savings, invest in energy efficient buildings, and/or devote a greater portion of the Clean Technology Investment Portfolio to advanced energy efficiency/green technologies.

Another GHG reduction opportunity for the State is in the use of bond funds. Ownership of the emission reductions resulting from State bond funded projects will remain with the State. Those emission reductions should not be considered the property of the entity that received the bond funds, nor shall they be entitled to seek further financial gain from those reductions. Instead the

reductions will belong to the State, and ultimately be retired for the good of the environment and of the citizenry.

The influence of the State’s carbon shadow can also be exerted in the area of evaluating bills, administrative directives, regulations, policies, projects, and programs, in terms of their impact on GHG emissions. State government must institutionalize the evaluation of GHG emissions as part of the review and approval process for all major funding requests and projects. This policy should be mirrored by local jurisdictions and the private sector, thereby ensuring that GHG emissions are factored into all major decisions and long range planning processes throughout the state.

Another shadow effect that the State can have is in the area of employee commutes. While not technically considered business travel, emissions related to employee commutes should be addressed by state government systemwide. Agencies must take steps to further reduce commute emissions by increasing telecommuting and flex schedules to reduce the number of days employees need to travel to work. When coming into the office, employees should be rewarded for taking public transportation, carpooling, biking, or other means of reduced emission travel. These practices will also be picked up by local government and the private sector to amplify the influence of state government.

**Appendix C State government-Preliminary Recommendations**

**Table 39**

<b>Reduction Measure</b>	<b>Potential 2020 Reductions MMTCO<sub>2</sub>E</b>	<b>Net Annualized Cost (\$ Millions)†</b>	<b>Proposed Lead Agency</b>	<b>Adoption/ Implementation Timeframe</b>
State Government	1-2	TBD	Various	TBD/Ongoing

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## **13. CARBON FEE**

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The measure being described in this section is a carbon fee intended to achieve emission reductions through changes in economic activity and individual behavior. The discussion is not directly related to ARB's development of an administrative fee regulation to cover the costs incurred by state agencies for implementation of AB 32, or to smaller directed fees such as the recommended public goods charge on water. ARB will initiate a regulatory proceeding to develop the administrative fee later this summer.

### **Background**

A carbon fee is a market-based GHG reduction strategy that would deliver emission reductions by affecting the relative prices of products within the economy. By making carbon-intensive products relatively more expensive compared to lower-carbon products, carbon fees are designed to drive consumption and investment toward more efficient and less GHG-intensive products. Like all regulatory programs, in order to be effective, a carbon fee program would need to be well designed, and include strong monitoring, reporting and enforcement rules, including strict penalties for non-compliance. In addition, AB 32 includes specific criteria that ARB must consider before adopting regulations for market-based measures to implement AB 32, and directs the Board to the extent feasible to design any market-based compliance mechanisms to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants (HSC § 38570).

In order to deliver significant emission reductions, carbon fees would need to be set at levels high enough to produce behavioral changes and would need to be spread across those sectors of the economy responsible for a large majority of GHG emissions. The specific level at which the fee is set is contingent upon the amount of GHG reductions for which the carbon fee program is designed to achieve. The higher the fee, the greater the emission reductions that could be expected. Under a carbon fee program there is price certainty for firms subject to the fee. Unlike a cap and trade program, however, a carbon fee program does not establish an absolute limit on emissions.

Carbon fees would be set to increase over time. The fees would be set high enough to drive investment and fuel use choices toward more efficient and lower carbon options. The fee level and rate of increase would be guided by economic modeling that considers the availability, phase-in, and cost of achievable technologies, and guided by a price structure that would stimulate changes to lower carbon activities. Carbon fees would be administered by the ARB, and would be assessed at the same rate per MMTCO<sub>2</sub>E. Should the Board approve the Carbon Fees Option, a specific fee schedule would be established to define the rate of increase between 2012 and 2020. Any adjustments to the fee schedule would be undertaken through the regulatory process and involve public review and input.

### **Design Options**

ARB is currently evaluating several possible design scenarios that could be used for a carbon fee program. Under a "downstream" approach, fees would be imposed on facilities that fall within ARB's mandatory reporting jurisdictional authority. This would include facilities like power

plants, electricity retail providers and marketers, oil refineries, hydrogen plants, cement plants, cogeneration facilities, and other industrial sources that emit more than 25,000 tons per year of CO<sub>2</sub>. Under this approach, transportation sources of GHG emissions, which account for approximately 40 percent of statewide GHG emissions, would not be covered.

Under an “upstream” approach, fees would be levied at or closer to the point that natural gas, gasoline, diesel fuel, and electricity imports enter the California economy. This option would achieve broader coverage of emissions sources, potentially covering over 90 percent of GHG emissions in the state if expanded to include industrial process and high global warming potential emissions. It would also be possible to implement a fee that reflected a hybrid of the two primary approaches.

The level of the fees would need to be set based on economic modeling to evaluate the amount of emission reductions likely to be achieved from different fee levels. To incent significant reductions, fees would likely need to be set between \$10 to \$50 per metric ton of MMTCO<sub>2</sub>E. For every \$10/metric ton, the fees would increase the wholesale price of coal-fired electricity by \$0.01 per kilowatt-hour, of gasoline by \$0.10 per gallon, and natural gas by \$0.05 per therm. While this type of price signal would have some effect on consumer buying patterns, the larger effect would be on the investment decisions and fuel choices made by suppliers of goods and services.

### **Implementation Options**

Implementing an upstream carbon fee would require the development of a monitoring and reporting system to track all fossil fuels produced in or imported into California, as well as fuel exports. The Market Advisory Committee describes what this type of program would look like for an upstream cap-and-trade program. The administrative details relating to who is regulated would be the same for an upstream carbon fee or for an upstream cap-and-trade program.

For transportation fuels, ARB would establish a system to monitor the amount of carbon sold by refiners and importers in the form of gasoline and transport diesel fuel. Approximately 30 such sources are located in the state (including refiners, importers, and blenders).

The fees would be levied on all natural gas processing plants, the state’s seven interstate natural gas pipelines, and pipelines from Mexico. Data on fossil fuel flows are currently collected by a diverse group of municipal, state, and federal regulatory agencies, though this information is of varying quality and collected for different reporting periods. A system would be needed to track imports of coal. Some industrial sources that have significant process emissions (mainly cement and nitric acid production) and suppliers of high-GWP gases would also need to be included.

Emission fees for California-bound electricity that is generated by power plants outside the State would be assessed on firms that deliver electricity to the California power grid. These entities would include independent power marketers that purchase electricity imports for sale to California utilities, California utilities that import their electricity from other states, and independent out-of-state electricity generators that sell or contract electricity directly to the California utilities or the California grid operator.

**Appendix D: Western Climate Initiative  
Recommendations**

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## Western Climate Initiative



### **Western Climate Initiative**

### **Draft Design Recommendations on Elements of the Cap-and-Trade Program**

May 16, 2008

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## Introduction

The Western Climate Initiative (WCI) began in February 2007 when the Governors of Arizona, California, New Mexico, Oregon, and Washington agreed to:

- join The Climate Registry;
- develop a regional greenhouse gas reduction goal consistent with their state goals; and
- design a multi-sector market-based mechanism by August 2008 to help meet the greenhouse gas reduction goal.

The five Governors invited other states, provinces and tribes to join the WCI or to participate as observers. Since the initial signing, the Premiers of British Columbia, Manitoba, and Quebec and the Governors of Montana and Utah have joined the Initiative. The states of Alaska, Colorado, Idaho, Kansas, Nevada and Wyoming participate as observers, as do the provinces of Ontario and Saskatchewan and the Mexican border states of Baja California, Chihuahua, Coahuila, Nuevo Leon, Sonora, and Tamaulipas.

The WCI Partners issued their regional greenhouse gas reduction goal on August 22, 2007 (see: <http://www.westernclimateinitiative.org/ewebeditpro/items/O104F13006.pdf>). The regional goal is a 15 percent reduction from 2005 levels by 2020. This regional, economy-wide goal is consistent with the state and provincial goals of the WCI Partners and does not replace the Partners' existing goals. The WCI Partners also re-committed to do their share to reduce regional GHG emissions sufficiently over the long term to significantly lower the risk of dangerous threats to the climate. Current science suggests that this will require worldwide reductions in carbon dioxide emissions of 50 percent to 85 percent below current levels by 2050.

On October 29, 2007, the WCI Partners released their Work Plan of WCI activities through August 2008 for public review and comment. Comments on the Work Plan were requested and more than 100 organizations and individuals submitted comments. As directed by the Governors and Premiers, the Work Plan describes the process for developing design recommendations for a proposed cap-and-trade program as one element of the WCI's effort to identify, evaluate, and implement ways to reduce greenhouse gas (GHG) emissions and achieve related co-benefits.

### ***Developing Design Recommendations for a Cap-and-Trade Program – The Process***

Five WCI subcommittees (each chaired by one of the Partners) are working toward a cap-and-trade program design that all Partners can embrace and implement. The five subcommittees and their purposes are:

- **Reporting:** Recommend the reporting system needed to support the WCI program.
- **Electricity:** Define the point of regulation for the electricity industry.
- **Scope:** Identify the other sectors and sources to include in the cap-and-trade program in addition to the electricity sector.
- **Allocations:** Specify how to distribute emission allowances.
- **Offsets:** Examine whether and how emission offset projects should be included.

Each subcommittee is comprised of staff from partner and observer jurisdictions, and each has support from various consultants working under contract to WCI. The subcommittees meet regularly by conference call and at times hold face-to-face meetings.

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All subcommittees have incorporated stakeholder involvement and feedback to help design the program. The stakeholder process includes three workshops. The first was held in Portland on January 10, 2008 and was attended by more than 300 people with another 200 people participating via Webinar. Before the workshop, each of the five subcommittees released for public review and comment papers describing the major options under consideration. After the workshop, each subcommittee held a conference call to get extra stakeholder input and answer questions.

Information about the WCI is regularly updated on the WCI website. The website is also the portal through which stakeholders and the public can submit comments to the Partners and sign up for the WCI listserv ([www.westernclimateinitiative.org](http://www.westernclimateinitiative.org)).

**Outreach during March – August 2008**

The WCI outreach activities described below supplement the individual outreach conducted by each of the partner states and provinces.

Activity	Date
<p><b>Scope of Work for Economic Analysis</b></p> <ul style="list-style-type: none"> <li>▪ See <a href="http://www.westernclimateinitiative.org/Economic_Analysis.cfm">http://www.westernclimateinitiative.org/Economic_Analysis.cfm</a> for stakeholder involvement opportunities .</li> </ul>	March 3, 2008
<p><b>Initial Draft Design Recommendations Released</b></p>	
<ul style="list-style-type: none"> <li>▪ Scope and Electricity</li> </ul>	March 5
<ul style="list-style-type: none"> <li>▪ Offsets, Allocations, and Reporting</li> </ul>	April 3
<ul style="list-style-type: none"> <li>▪ Offsets Workshop in Vancouver, BC</li> </ul>	March 26
<p>Stakeholder Workshop in Salt Lake City to discuss draft subcommittee recommendations</p>	May 21
<p>Draft Program Design Recommendations for public review and comment</p>	Mid-July
<p>Stakeholder Workshop in San Diego</p>	July 29
<p>WCI Program Design Recommendations released</p>	Early September 2008

As called for in the WCI agreement, the WCI Partners are working diligently toward a set of recommendations for the design of a regional cap-and-trade program. The Partners will complete their work on this first phase of the regional program by the end of August and will release their report in early September. The report will also describe next steps, including the expected timelines and critical paths for states and provinces to implement the program.

***Draft Recommendations on Elements of the Cap-and-Trade Program***

The draft recommendations that follow were developed collaboratively by the WCI Partners. As WCI continues to refine and assess these draft recommendations, it welcomes stakeholder feedback on all the concepts presented in this document.

The goal is to present the draft recommendations for a preferred, fully-integrated program at the July 29 stakeholder workshop in San Diego. Between now and then work will continue to create a program design that helps achieve GHG reduction goals fairly and effectively.

The WCI Partners stress that as they continue to evaluate the scope and design of the cap-and-trade program, they will carefully examine economic impacts, including the impact on consumers and businesses in each jurisdiction. The WCI will model the economic impacts for all sectors that may be included to ensure that the program is cost-effective and fair to consumers and businesses while also meeting the environmental objective.

Also, WCI recognizes that policies that complement the cap-and-trade program will be needed to motivate investments in improved efficiency and other measures to reduce emissions. The WCI will examine a full set of complementary policies as part of the analyses supporting implementation of the cap-and-trade program.

Finally, it is important to point out that the programs developed through this regional initiative will ultimately be implemented through laws, regulations, and policies at the state and provincial level. A high degree of regional consistency is important for the success of the program, but the WCI Partners are diverse geographically, economically, and demographically, and each state and province has unique factors that it will have to address when implementing this program.

Therefore, the WCI Partners are focused on developing a program that builds on the strength of consistent regional approaches, while at the same time understanding that each Partner must have the flexibility to implement the program in a way that addresses the unique characteristics of their jurisdiction.

## **Draft Recommendations**

The WCI Partner states and provinces are pleased to present these draft recommendations on the regional cap-and-trade program for ongoing review and comment by stakeholders and the public. The recommendations focus on the following:

- Reporting
- Scope
- Electricity
- Allocations
- Offsets
- Regional Organization

## **Reporting**

A robust and credible reporting system will be the backbone of the WCI cap-and-trade program. This system must ensure that emissions are quantified and reported accurately and transparently. This will allow regulators in participating jurisdictions to assess compliance of regulated sources, measure progress against state, provincial and regional targets, and generate public trust in this progress. Also, all market participants will rely on the reporting system to make decisions that will be the basis for transactions. Confidence in the reporting system will be critical to the success of the WCI program.

The WCI is fortunate that several GHG reporting systems exist that can inform the design of and perhaps even underpin the WCI reporting system. The Reporting Subcommittee has assessed many of these systems and anticipates that the WCI reporting system will be as consistent as possible with existing systems.

The WCI Partners unanimously agree that the WCI reporting system should rely heavily on the infrastructure that The Climate Registry (TCR) is designing. TCR is a collaboration between U.S. states, Canadian provinces and Mexican states to establish a common infrastructure for measuring and reporting GHG emissions. TCR's objective is to provide a common set of tools that will support a broad range of state and provincial policies. All of the WCI Partners are members of the Board of Directors of TCR.

### ***Draft Recommendations for Reporting***

- Breadth/Scope of Reporting  
The WCI recommends that reporting requirements apply to the capped sectors and to certain non-capped sectors that may be phased in later (will have to determine which sectors - lower thresholds may apply).
- Initiation of Reporting  
The WCI recommends that reporting start before cap-and-trade commences in order to avoid reporting-related delays to the start of the cap-and-trade program.
- Coordination Among Partner Jurisdictions

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The WCI recommends developing essential requirements for a model WCI reporting rule by the end of 2008 and will incorporate consideration for jurisdictions that already have reporting rules adopted or in process.

- Data Management and TCR Interaction  
The WCI recommends sources report either (a) directly to jurisdictions (which would then upload the data to TCR's central repository), or (b) through TCR's program framework (which would then download the data to the necessary jurisdiction(s)).
- Verification  
The WCI recommends establishing essential quality assurance elements for reported data. These elements will be consistent across jurisdictions. Each jurisdiction will have an oversight mechanism to ensure compliance with the reporting requirements. As part of this mechanism, each jurisdiction will establish procedures to ensure that the quality assurance elements are met. This could include requiring third-party verification, rigorous compliance audits or other appropriate approaches.
- Administrative Costs & Fees  
The WCI recognizes that jurisdictions may collect fees from sources that report directly to them and contract with TCR to administer the program. Jurisdictions may also accept data directly from TCR if they choose to do so; entities that report through TCR may have to pay an additional fee if one is required by the jurisdiction(s).
- Mandatory Federal Greenhouse Gas Reporting  
The WCI recommends getting involved in federal GHG reporting program development in the U.S. and Canada to ensure that federal reporting programs are harmonized with the jurisdictions' interests to the greatest extent possible.

### ***Summary of Major Comments Received to Date on Reporting Recommendations***

Stakeholders have expressed general agreement with the WCI Design Principles relevant to reporting. Stakeholders want a reporting system that is fair, easy to manage, and not costly for reporters or Partner jurisdictions. Stakeholders generally support a transparent and robust accounting system for consistent and accurate reporting of emissions across sectors and jurisdictions. WCI's efforts to harmonize WCI reporting and future federal greenhouse gas reporting are also supported.

Most stakeholders agree that reporting should not be limited to sectors and sources within the cap, but should also include sectors that are likely to be phased in to the market system later. Opinion is divided on whether reporting should extend beyond this scope to sources that are not likely to be in the cap-and-trade system.

Stakeholders overwhelmingly support the idea of beginning reporting before cap-and-trade commences. Many commenters cited the need for WCI to have accurately measured emissions as a basis for allocating allowances.

Commenters generally support development of a single WCI reporting rule, citing the advantages of administrative simplicity and cost effectiveness. Stakeholders are concerned that a lack of consistency would undermine confidence in the use of reported data in a market

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system. For some commenters, however, continuity with existing jurisdictional reporting systems was a higher priority, and these commenters favored more loosely coordinated rules with common core elements.

Stakeholder opinion remains divided on whether reporting should be made directly to The Climate Registry (TCR) or to the Partner jurisdictions for upload to TCR. In part, this disagreement may reflect the different interests of reporters with sources in multiple jurisdictions versus those with sources in only a single jurisdiction. Multi-jurisdictional reporters tend to favor direct reporting to TCR for the simplicity of one-stop reporting, while single-jurisdiction reporters tend to favor combining greenhouse gas emissions reporting with their existing air pollutant reporting directly to the jurisdictions.

Stakeholders also differ on whether third-party verification should be required, either WCI-wide or as an option for individual jurisdictions. Supporters generally see third-party verification as essential to ensuring the accuracy and consistency of data that will be converted to financial credits or liabilities, and point to corporate financial audits as an appropriate analogy. Others see third-party verification as redundant to the jurisdictional compliance and enforcement provisions that will be applicable to reported data. This latter view is held most strongly by electricity generation commenters, who cite their existing requirements for continuous emissions monitoring of carbon dioxide from power plants. Reducing uncertainty over verification costs may help to resolve this issue.

Commenters are divided on whether reporting fees should go directly to TCR or to Partner jurisdictions which would then contract with TCR for its data management services. This issue is related to the question of where the data should be reported, and similar considerations are raised on either side. Some commenters are also concerned that governmental accountability for funds will be lacking or diminished if fees go directly to a non-profit entity.

Design of the reporting system will continue beyond the September 2008 announcement of WCI Program Design. Completion of the essential requirements for GHG reporting rules is scheduled for December 2008. During this period, the Reporting Subcommittee will develop more specific proposals and will seek stakeholder comment. Greater specificity may help to resolve some stakeholder concerns. Comment will be sought on key issues including:

- Emissions quantification methodologies for specific sectors and source types;
- Design of the reporting system, including the user interface and the relationship to TCR's mandatory reporting support function;
- Thresholds for reporting;
- Operational boundaries for reporting;
- Verification and/or other quality assurance requirements; and
- Other details in the essential requirements for Partner GHG emissions reporting rules.

## Scope

Scope defines the GHG emissions that are included in the cap-and-trade program, including:

- The sectors that fall under the cap.
- The emissions sources that fall under the cap.
- The greenhouses gases that fall under the cap.
- The point(s) of regulation where the cap would be enforced.

From the scope definition, any entity or facility must be able to tell whether it has a compliance obligation under the cap, and which of its emissions are subject to the obligation. The “point of regulation” is the portion of the scope definition that identifies the entities that have the obligation to surrender GHG emission allowances to cover GHG emissions.

The draft recommendations are based on the WCI’s analysis and assessment of the Major Options released in January 2008. The WCI developed and applied evaluation criteria to the major options, taking into account stakeholder comments received in writing and during conference calls.

### ***Draft Recommendations for Scope***

- Industrial and Commercial Sources

The WCI recommends a base program from the start of the cap-and-trade program that includes the electricity sector, large stationary combustion sources, industrial process and waste management emissions, and fossil fuel production and processing. (Please see Electricity section for information on recommended approaches for that sector.) All six GHGs are recommended for inclusion.

The WCI recommends that high priority be placed on developing GHG reporting protocols for the fossil fuel production and processing sector so that as much of this sector as possible can be included in the cap-and-trade program from the start.

- Transportation Fuels

Emissions from transportation fuels are the single largest source in the region (about 36 percent of total emissions), and must be addressed through an effective combination of near-term and long-term policies. Most Partners have a strong interest in including transportation fuels in the cap-and-trade program. However, before recommending how best to reduce emissions in this sector, analyses of the economic impacts of various options for including transportation fuels in the program will be examined, including the potential effectiveness of alternative policies for reducing these emissions. Options to be considered include the potential to phase in transportation fuels in a later stage of the program, other fiscal measures to regulate this sector, and special consideration for low-income populations and other communities most adversely impacted by consequent price change in the sector. It is anticipated that a decision on how to address transportation fuels will be informed by economic modeling and additional analysis in the coming months.

- Residential and Commercial Fuel Combustion

The WCI recommends including residential and commercial fuel combustion in the cap-and-trade program and acknowledges that individual jurisdictions may instead utilize comparable

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fiscal measures, such as British Columbia's carbon tax, to regulate these sectors. The WCI is also considering whether to include these emissions within the program beginning with the first or second compliance period. The point of regulation for including the emissions from this fuel use would be at the point where these fuels are distributed, including: local distribution companies for natural gas; an appropriate upstream point for propane (LPG), such as refineries and wholesalers; and fuel oil distribution points (which may vary among partner jurisdictions).

- **Thresholds**

The WCI recommends using an emission threshold to define the facilities that would have a regulatory compliance obligation under the cap-and-trade program. The WCI recommends setting the threshold so that at least 90 percent of non-power plant stationary source fuel combustion emissions WCI-wide are covered by the program. Based on an initial review of available data, the WCI believes that a threshold within the range of 10,000 to 25,000 metric tons of CO<sub>2</sub>E per year per facility may achieve this objective and to assure consistent coverage of facilities within industries and across jurisdictions. The WCI is continuing to evaluate this threshold range, and is examining whether categories of facilities should be included or excluded from coverage regardless of their annual emissions rate. WCI is still considering whether, and at what level, to apply thresholds to electricity sector entities that have compliance obligations.

- **Future Program Expansion**

The WCI recommends that the scope of the cap-and-trade program be capable of expanding over time. Possible factors for bringing in additional sources into the program include:

- Advancements in monitoring technologies, procedures, and/or protocols which would enable the cost-effective inclusion of additional sources and types of greenhouse gas emissions, or smaller-sized sources within currently covered categories, particularly if mandatory reporting data show these sources to be larger contributors than expected;
- Sources or sectors whose exclusion from the program leads to emissions leakage or competitiveness issues;
- Resolution of legal or administrative issues that had precluded the inclusion of a source or sector; and
- Addition of new jurisdictions to the cap-and-trade program.

Sources that are considered as viable offset projects at the start of the cap-and-trade program may become part of the program at a future date.

### ***Summary of Major Comments Received to Date on Scope Recommendations***

The WCI Scope Subcommittee has received public comment at in-person meetings, on conference calls for stakeholders, and in written form. These public comments responded to the options papers released by the WCI in January 2008 and the draft recommendations released in March 2008.

The WCI received written comments from 38 organizations in response to the major options paper, and from 43 organizations in response to the draft recommendations. Many of these

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organizations represented multiple entities, including businesses and non-profits. Stakeholders also provided comments at teleconferences on February 12 and March 11, 2008 and at the public workshop in Portland on January 10, 2008. The subcommittee requested and received comments on a large number of topics, including sector coverage, point of regulation, thresholds for inclusion of specific sources, greenhouse gas coverage, phasing of source inclusion, coverage of transportation fuels and residential and commercial natural gas, as well as specific concerns for various industries, sectors and sources.

In general, most comments supported a broad coverage of sources under a cap-and-trade program with a point of regulation as close to the point of emissions as possible. Stakeholders asked the subcommittee to include as many sources as administratively and technically possible in order to increase the availability of low-cost emission reductions and to lower the total cost of the cap-and-trade program. Comments also addressed the following:

- Many comments emphasized the importance of available and correct quantification methods in order to include a source in the program, and of reliable data for the design and operation of the program. These comments focused on a desire to avoid double counting emission reductions and to ensure the integrity of a trading system.
- Comments also reflected a desire for certainty about which sources would be included, especially if the program phased in new sources over time.
- Some comments asked for further analysis of outstanding issues such as the inclusion of transportation fuels and commercial and residential natural gas, and suggested varying approaches for these sources. These issues, particularly the inclusion of transportation fuels, received substantial attention. One-third of the comments received after the release of the major options paper related to the issues of transportation fuels.
- Many comments expressed concern that sources not covered under a cap-and-trade program remain responsible for the emission reductions necessary to achieve the regional greenhouse gas emissions target.

The subcommittee remains interested in receiving stakeholder comments. The subcommittee's recommendations include a number of topics that will require further consideration, including transportation fuels and emission source thresholds. The subcommittee has carefully reviewed and considered stakeholder comments in order to formulate the draft recommendations contained in this document.

## Electricity

### *Draft Recommendations for Electricity*

- Point of Regulation and Coverage  
The WCI recommends a point of regulation for the electricity sector that maximizes coverage and minimizes emissions leakage.
  - A generator-based approach to covering the electricity sector is preferable.
  - The generator-based option will be most effective with universal participation throughout the Western interconnect.
  - A proposal to bring in additional generators serving the Western interconnect will be developed, including a date by which those other jurisdictions will join the WCI. If the additional Western Electric Coordinating Council (WECC) jurisdictions do not join by that date, the WCI will continue to develop the first jurisdictional deliverer approach described below.
  - Because not all generators serving the western interconnect are currently within the WCI, additional measures are needed to maximize coverage and minimize leakage.
  - The first jurisdictional deliverer approach should address the coverage and leakage issues during the transition to full WECC participation in the WCI:
    - The first jurisdictional deliverer approach covers all emissions generated in WCI and all emissions attributable to electricity delivered in WCI but generated outside WCI.
- Leakage  
The WCI recommends exploring additional complementary measures to reduce leakage.
- Allocation in the Electricity Sector  
The point of regulation does not dictate the method of allocation, and the Partners are continuing to work on the allocation issue.

The Electricity Subcommittee is now in the process of working through questions raised by the Partners, including how additional generation in the WECC can be brought into the WCI, and how the first jurisdictional deliverer approach would actually be implemented in Partner jurisdictions.

### ***Summary of Major Comments Received to Date on Electricity Recommendations***

To date, the WCI Electricity Subcommittee has received more than 100 comments from more than 60 parties, or coalitions of parties. The comments have come from utilities, trade groups, environmental NGOs (non-governmental organizations), religious institutions, and public interest groups interested in social justice.

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Some commenters have noted that a federal approach would be preferable to WCI because leakage would be reduced. Others have called for no action by the WCI because a federal approach may eventually appear. Initially, the subcommittee suggested five options for the point of regulation for electricity. Each option had some support from at least a portion of those who commented, while many parties have requested that WCI not make a final decision until economic modeling is completed. However, consensus seems to have emerged around two approaches: generator-based and first jurisdictional deliverer (FJD).

Many commenters have called for a generator-based approach if all WECC jurisdictions participate in the WCI. Some commenters have argued that additional measures beyond a generator-based approach would be necessary to prevent contract shuffling and windfalls to electricity importers. Parties have suggested that the additional measures could include complementary measures, a load-generator hybrid, and FJD.

Some commenters have advocated starting with a generator-based approach and eventually shifting to FJD. Others have called for optional phasing in of FJD. Still others have advocated using FJD as the starting point. Some parties are concerned about the tracking necessary for load-based approaches and FJD, and they are worried that either method may have high administrative costs. Commenters have also expressed concern about the potential for gaming the system under the hybrid approaches. Some commenters are concerned about grid stability with any approach. The WCI Partners are still assessing the public comments and other analyses to determine the appropriate point of regulation for this sector within the regional program.

Many parties have commented on allowance allocation in the electricity sector. Requests have run the gamut from advocating for 100 percent auctioning to promoting 100 percent free allocation. Many parties have called for auctioning with auction revenues used for the benefit of consumers by giving the auction proceeds to rate-regulated entities or directly to consumers. Many commenters have worried about competitive impacts to businesses in the WCI under designs that include auctions. Some parties have requested that one or more economic sectors be exempted from auctioning. Parties have advocated allocation protocols based upon historical emissions, load, or output singularly or in combination. Similarly, commenters have advocated for apportionment among Partners based upon Partner targets, averaging of Partner targets, historical emissions, load, output, population, and GDP (gross domestic product), singularly or in combination.

Many parties have commented that combined heat and power (CHP) facilities should be covered under a separate sector and given credit for lower emissions. Other parties have noted that if a CHP facility produces fewer emissions, it should do well if it is regulated under the electricity sector like other generators. Some parties have called for unique treatment for their particular situations, while other commenters have requested even treatment for all entities across the sector. Parties have also called for a set-aside of allowances for the voluntary renewables market to ensure that market's viability.

## **Allocations**

### ***Draft Recommendations for Allocations***

- Regional Cap and Allowance Budgets

The WCI recommends establishing a regional cap that will decline over time, and each Partner will have an allowance budget within the cap. Actual emissions from any given Partner could be greater or less than its allowance budget, depending on the extent of inter-jurisdictional allowance trading.

The regional cap will be equal to the sum of the Partner allowance budgets. Reductions achieved by the cap plus reductions from uncapped sources resulting from complementary measures should achieve the WCI regional goal of a 15 percent reduction below 2005 levels by 2020.

The initial regional cap and Partner allowance budgets will be set through 2020. The regional cap and each Partner's allowance budget will not be adjusted except as necessary to account for changes in WCI membership, sectors added to the cap, errors discovered in data used to determine the cap or the Partner budgets, which may become apparent after the start of mandatory reporting, or errors that resulted in either under-allocation or over-allocation of allowances. Such adjustments will take effect at a regionally coordinated and designated time, such as the beginning of the relevant compliance period.

- Distribution of Allowances by Partners

The WCI recommends that once the allowance budget has been established for each Partner, allowances will be issued by each Partner rather than issued by a regional organization. Allowances will be of equivalent use and value throughout the WCI region, regardless of which Partner issues the allowances.

- Establishment of Cap-and-Trade Partner Budgets

The WCI recommends that each Partner's allowance budget will be established in a transparent manner. This will be consistent with the emission reductions that the WCI must realize from the sources covered by the cap-and-trade program in order to achieve the WCI economy-wide emissions reduction goal.

The Partners will develop a methodology for calculating the Partner allowance budgets. The methodology should set the Partner allowance budgets at the levels needed to achieve the WCI economy-wide emissions reduction goal.

The WCI seeks comments from stakeholders on the methodology for establishing Partners' allowance budgets and the factors to be included in the methodology.

- Partners' Initial Allowance Budgets

The WCI recognizes the potential conflict between the need to begin the cap-and-trade program as soon as possible to reduce GHG emissions, and the need for accurate data to calculate allowances for the regional cap and individual Partner budgets. Substantial emissions data is already available due to reporting under existing regulatory requirements for other pollutants and energy consumption, as well as the GHG emissions inventories and forecasts compiled by the Partners, but data from mandatory reporting of GHG emissions may be necessary for more precise allocations of allowances. With this in mind, the calculation of the regional cap and the Partner allowance budgets for the initial years of the cap-and-trade program will recognize potential concerns about data accuracy and will be

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adjusted in ensuing years as necessary if mandatory reporting reveals significant data errors.



- Partner Discretion to Issue Allowances

The WCI recommends each Partner initially have flexibility to issue, beyond the minimum percentage auction amount discussed below and subject to the sector-specific assessments discussed below, its remaining allowances as it sees fit, including:

- auctioning more than the minimum amount of allowances;
- issuing some or all of the remaining allowances for free;
- holding some or all of the remaining allowances within a compliance period; and/or
- retiring some or all of the remaining allowances.

The WCI recommends each Partner initially have discretion to issue allowances differently to different sectors within its jurisdiction. Each Partner may decide how and to whom to issue the allowances in its allowance budget, subject to the minimum auction requirement and the sector-specific assessments of competition outlined below.

While each Partner initially will have flexibility in how it allocates the allowances beyond the minimum auction amount, at the beginning of the relevant compliance period, each Partner will be required to advise the other WCI Partners how it intends to allocate the remaining allowances, so that the WCI can make the Partners' plans public in a coordinated fashion. This procedure will help reduce the potential for adverse impacts on auction prices by preventing allowances from being "dumped" into the market unexpectedly.

Any Partner that chooses to hold allowances must allocate or retire those allowances by the end of the applicable compliance period. A Partner will not be able to hold allowances beyond the end of the compliance period. These requirements will help reduce market instability by providing more certainty about the volume of allowances available during a compliance period.

The Partners will continue to examine the impacts of Partners using different approaches to allocate allowances to the same sectors and will seek comments from stakeholders on this issue.

The Partners also will continue to consider the impacts of Partners making different use of auction proceeds and will seek comments from stakeholders on this issue.

While the Partners initially will have flexibility to issue allowances, over time, the WCI will seek to standardize distribution of allowances as much as possible.

- *Sector-Specific Assessment of Competition Among WCI Jurisdictions:*  
While the Partners initially will have significant flexibility in issuing allowances, a diverse array of allocation procedures could yield significant cost differentials among competing firms or industries among WCI jurisdictions. There may be cases where it is necessary to assess whether allocations to a particular sector should be treated uniformly by all Partners in the WCI region to address competition among entities within the WCI region. This potential could be minimized through a continued dialogue among the Partners and harmonization of allocation procedures and the use of auction proceeds where appropriate.

The Partners believe that only a few sectors face significant risks of unfair competition from differing allocation methods among the WCI Partners, and a harmonized approach would be limited to carbon-intensive industries facing significant competition among WCI jurisdictions. For such cases, a case-by-case sector-specific analysis will be conducted jointly by the WCI Partners to determine whether consistent allocation is needed to address such disparities within the WCI. This approach will provide for an efficient cap-and-trade program while providing the Partners flexibility to address their individual priorities.

- *Sector-Specific Assessment of Competition with Non-WCI Jurisdictions:* While the Partners initially will have significant flexibility in issuing allowances, a diverse array of allocation procedures could yield significant cost differentials among competing firms or industries within the WCI and those outside the WCI, resulting in leakage outside the WCI region. There may be cases where it is necessary to assess whether allocations to a particular sector should be treated uniformly by all Partners in the WCI region to address competition and leakage from entities outside the WCI region. This potential can be minimized through a continued dialogue among the Partners and harmonization of allocation procedures and the use of auction proceeds where appropriate.

The Partners believe that leakage of this type is likely an issue only for bulk commodity sectors with high GHG emissions per unit of output that face significant non-WCI competition, and a harmonized approach would be limited to carbon-intensive industries facing significant competition outside the WCI region. For such cases, a sector-specific analysis will be conducted jointly by the WCI Partners to determine whether consistent allocation is needed to address non-WCI region leakage. This approach will provide for sufficient standardization for an efficient cap-and-trade program while providing the Partners flexibility to address their individual priorities.

- Minimum Auction Percentage  
The WCI recommends each Partner auction a minimum percentage, between 25 percent and 75 percent, of its allowance budget through a coordinated regional auction process. Each Partner will auction allowances throughout the WCI region and will receive the proceeds of the auction.

The Partners will determine a specific minimum percentage auction amount. The WCI seeks comments from stakeholders on this question.

Because multiple Partners would be simultaneously auctioning allowances through a single pool, the auction could result in Partners auctioning or selling some of their allowances to entities in other jurisdictions. This outcome is fully consistent with the concept of regional trading and the importance of allowances having equivalent use/value for compliance purposes throughout the WCI region.

- Phased Increase of Auctioning  
Greater emphasis could be given to free allocation in the early years of the program (and more to auctions in later years) as a means to mitigate business and consumer

cost impacts and to provide transition assistance, in addition to using auction proceeds for these purposes. Some Partners may choose to provide more time for an allowance market to develop before capped entities must purchase larger portions of their allowances in an auction.

The minimum percentage of allowances to be auctioned should be increased over time, potentially to 100 percent. Even before such an increase, each Partner will have discretion to auction more than the minimum percentage of its allowances as it sees fit.

- Credits for Early Reductions  
The WCI recommends each Partner have discretion to give credit for early actions, but any credit for early action must come from within the cap and will come out of the individual Partner's allowance budget. Early action credits will not be added to or be on top of the amount of allowances in each Partner's allowance budget.
- Banking  
The WCI recommends purchasers and covered entities be allowed to bank allowances, without restrictions on the amount of allowances that may be banked or on how long they may be banked.
- Borrowing  
The WCI recommends that borrowing of allowances from future compliance periods not be allowed.
- Compliance Periods  
The WCI recommends the compliance periods be three years long.

Multi-year compliance periods will provide covered entities with flexibility for compliance and in planning for (or responding to) large and unexpected changes in the allowance market or in other markets, such as energy markets, which may affect allowance prices. They also will provide programmatic flexibility for the WCI—for example, to ensure a steadily declining cap. The Partners note that three years is the length of the compliance periods chosen by the Regional Greenhouse Gas Initiative (RGGI).

- Initial Compliance Period  
To accommodate start-up issues, both from the covered entity standpoint and the regulatory standpoint, the WCI recommends that the initial compliance period include special rules, such as a two-year period, or other measures to assist in the transition into a cap-and-trade system, while maintaining the integrity of the cap and value of the allowances.
- New Partners  
The WCI recommends allowances for new Partners be in addition to the existing allowance budgets for current Partners. The regional cap will be expanded to accommodate emissions from the new Partner.

Once the cap-and-trade program has been instituted, new Partners will come into the cap-and-trade program at a regionally coordinated and designated time, such as the beginning of the relevant compliance period.

- Timelines for Partner Activities

The Partners will develop a schedule for various WCI efforts, including launching the cap-and-trade program, establishing emissions baselines and Partner allowance budgets, undertaking any case-by-case discussions on competition or leakage issues which may affect Partner allocation plans and other various allocation-related efforts.

### ***Summary of Major Comments Received to Date on Allocations Recommendations***

The WCI Allocations Subcommittee issued its Draft Design Recommendations for public comment on April 2, 2008. Fifty-six (56) comments were received from stakeholders by the April 16, 2008 deadline, with an additional five (5) comments received after the deadline. The subcommittee is still reviewing the comments and has not yet determined whether any of the draft allocations recommendations should be modified in light of the comments.

A diverse group of stakeholders provided comments on the draft allocations recommendations, including industry/trade associations (15), utilities (13), NGOs (11), government agencies (3), private citizens (2), and miscellaneous business entities (12). Nineteen (19) of the comments came from stakeholders with multi-state operations or interests; the remainder came as follows: Washington (10), California (9), Oregon (5), British Columbia (4), Arizona (4), Canada (3) and New Mexico (2).

Not surprisingly, the commenters provided a wide diversity of comments on the draft recommendations, with little consensus on several key issues. For example, comments on the WCI's draft recommendations regarding the regional cap and the Partner allowance budgets included the following divergent perspectives:

- The allowance budgets should be based on load or output.
- The allowance budgets should be based on historical emissions.
- The allowance budgets should be based on the state and provincial goals.
- Partner budgets should be identical to Partner commitment to the regional goal.
- Budgets should not be determined until accurate data are available.
- Budgets should include some set aside (3-5 percent) of allowances for new entrants.

Similarly, while some commenters called for free allocation of allowances to utilities, others argued for auctioning a significant percentage of the allowances. A number of commenters (e.g., NGOs) called for 100 percent auctioning, while others (e.g., utilities) argued that only a very small percentage (5 percent or less) of allowances should be auctioned, if at all.

There also were differences of opinion about the degree of flexibility that Partners should have to allocate allowances. Some who opposed flexibility expressed concern that the lack of uniformity could result in leakage. To minimize potential for leakage, one commenter suggested adopting consistent rules for reporting, tracking and compliance obligations. Another suggested distributing allowances to a third party.

There was a general level of support expressed for the WCI's draft recommendation regarding credits for early reductions, but a few commenters preferred that credits come from outside each Partner's allowance budget.

By the same token, more commenters than not supported the WCI's draft recommendations to allow unlimited banking but prohibit borrowing of allowances. Commenters supported the recommended three-year compliance periods by a wide margin. And to the extent that comment was received on the desirability of a regional organization, it was well received.

Finally, some commenters offered advice on topics not directly addressed in the draft allocations recommendations, including the following:

- Develop an independent Market Oversight Committee to develop best practices to guard against market manipulation, hold down consumer costs and avoid burdens on state economies.
- Consider more practical alternatives to address hoarding of allowances.
- Have a cost containment mechanism
- Have a safety valve.
- Do not have a safety valve.
- Have a price ceiling for allowances for a defined period.
- Allow only emitters to participate in auctions.
- Allow anyone to purchase allowances at auctions.

The WCI appreciates the range of ideas and perspectives expressed in the comments and will give them serious consideration as we move develop the draft design document.

## Offsets

### *Draft Recommendations for Offsets*

The primary role of the offset program is to reduce the overall compliance costs for the cap-and-trade system, by enabling the offset market to deliver lower-cost emission reduction options than are available in the sectors/sources included in the cap-and-trade system. In addition, by lowering overall costs, an offset program can potentially offer greater environmental benefits. The offset program can also serve to encourage innovation, co-benefits, greenhouse gas emission reductions from sources not covered by the cap-and-trade system and removals by sinks.

- Offset project types and protocols

The WCI recommends:

- development of an initial set of eligible project types and approved protocols prior to cap-and-trade program launch;
- developing a process to review and approve other project types and related protocols proposed by project developers;
- using protocols that are standardized to the extent possible; and,
- making use of, and adapting if needed, existing protocols as appropriate.

- Offset projects approved through the WCI offsets program

The WCI should consider a method that gives priority to offset projects located within WCI jurisdictions. The method should also consider other roles of the offset system, such as ensuring that co-benefits occur within the region.

In addition to those offset projects approved within its jurisdictions, the WCI should consider approving offset projects located throughout Canada, the United States, and Mexico, where such projects would be subject to comparably rigorous oversight, validation, verification and enforcement as those located within the WCI jurisdictions and would not undermine the ability for the WCI to link to other trading systems.

- Tradable units from government-regulated GHG emission trading systems

For compliance purposes, the WCI should consider allowing individual regulated entities to use tradable units (offsets and allowances) from other government-regulated GHG emission trading systems that the WCI recognizes as meeting similarly rigorous criteria for environmental integrity.

The WCI should ensure accounting systems are in place to prevent using tradable units more than once for compliance.

- Quantity Limits

The WCI recommends limiting the use of offsets and non-WCI tradable units for compliance by individual regulated entities:

- to ensure that meaningful emission reductions take place within the sources covered by the cap-and-trade system.
- in recognition that foregoing emission reductions at facilities covered by the cap-and-trade program in the WCI states has the potential to forego health benefits and other benefits near those facilities.

The WCI Offsets Subcommittee will consider making a specific draft recommendation to the WCI, based on further analysis and considering the level of the cap set for the cap-and-trade system.

### ***Summary of Major Comments Received to Date on Offsets Recommendations***

In each of the opportunities for stakeholder engagement on the design of a cap-and-trade system for the Western Climate Initiative, there has been strong support for including an offset program. Stakeholders have expressed a desire to see the offset program focus on ways to reduce the overall cost of meeting GHG emission reduction targets, whether through reduced compliance costs for emitters, reduced economic impact for consumers, or increased economic opportunities to encourage emission reductions. Stakeholders have also shown a strong and consistent concern for the environmental integrity of the offset program, realizing the direct connection between the integrity of the offsets and the integrity of the regional target.

Many stakeholders feel that offsets should be allowed to enter the WCI system from sources outside the WCI, by project approval through the WCI process or as approved trading units from other cap-and-trade systems. A number of stakeholders also believe there are compelling economic, environmental and social reasons to give priority to offset projects from within the WCI or to phase in other regions over time as experience grows. Several stakeholders suggested ways to develop or design limits on the type of offsets, including basing limits on project location. The WCI Offsets Subcommittee recognizes that offset projects must reduce or remove GHG emissions and may have co-benefits regardless of where the project is located, and will continue to examine the balance of economic, environmental and social benefits in the design of the program.

Given the encouragement to focus the offset program on reducing cost for the cap-and-trade system, some stakeholders find the concept of limiting the use of offsets to be counterproductive, reasoning that limiting the use of lower cost compliance alternatives simply means higher cost compliance. Other stakeholders argue that an oversupply of inexpensive offsets could reduce the impetus for capped emitters to make progress on direct emission reductions. The subcommittee invites further suggestions on the design of limits or alternative methods to balance the use of offsets with reductions under the cap.

Stakeholders generally supported the recommendation to establish a centralized administrative body to perform routine processing and management functions.

## Regional Organization

### *Draft Recommendations for Regional Organization*

WCI recognizes that a regional organization will be helpful for coordinating Partner activities and improving efficiency by centralizing the execution of administrative tasks. While WCI is continuing to identify suitable roles for a regional organization, the following options have been identified to date:

- Although emission allowances will be issued and distributed by each Partner, a regional organization may be directed to coordinate the regional auction of allowances, track emissions and allowances, monitor and report on market activity, and conduct other activities. A centralized offset registry is also required that integrates with the emissions and allowance tracking system.
- A regional organization may provide a venue for coordinating analyses of competitiveness and leakage issues resulting from potentially divergent allocation procedures among the WCI Partners. Such issues could be resolved through this regional organization or some other forum.
- A regional organization may provide a forum through which each Partner updates the other Partners every two years on its progress toward achieving the regional goal and its individual goal
- The administrative structure of the offsets program should combine optimal aspects of jurisdiction-by-jurisdiction, public-private partnership, and centralized regional approaches, and may draw from existing programs. The role of a regional organization may include:
  - coordinating review and adoption of protocols for offsets;
  - coordinating review and issuing of offsets;
  - providing the criteria and means to accredit service providers to deliver validation and verification services for offsets.

Each jurisdiction will retain its regulatory authority and enforcement responsibilities. By centralizing administrative tasks and coordinating Partner activities, the regional organization will help reduce administrative costs and improve program transparency and consistency.

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**Appendix E: List of Measures**

List of Measures

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## Preliminary Recommendations

**Appendix E—List of Preliminary Recommendations by Sector**  
**Table 40**

No.	Measure Description	Estimated Reduction (MMTCO <sub>2</sub> E)
	State Leadership	1-2
	Regional Cap-And-Trade Program (covering 85 percent of California's total emissions in 2020)	35.15
<b>Transportation</b>		
T-1	Pavley I and II – Light-Duty Vehicle GHG Standards	31.7
T-2	Low Carbon Fuel Standard (Discrete Early Action)	16.5
T-3	Other Vehicle Efficiency Measures Low Friction Oil Tire Pressure Program (Discrete Early Action) Cool Paints	4.8
T-4	Ship Electrification at Ports (Discrete Early Action)	0.2
T-5	Goods Movement Efficiency Measures Port GHG Targets Vessel Speed Reduction Other Efficiency Measures	3.5
T-6	Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)—(Discrete Early Action)	1.4
T-7	Medium- and Heavy-Duty Vehicle Hybridization	0.5
T-8	Heavy-Duty Engine Efficiency	0.6
T-9	Regional Performance-Based VMT Targets and Local Government Action	2
T-10	High Speed Rail	1
<b>Electricity and Natural Gas</b>		
E-1	Energy Efficiency Utility Energy Efficiency Programs Building and Appliance Standards Additional Efficiency and Conservation	15.2
E-2	Increase Combined Heat and Power Use by 32,000 GWh (Net reduction includes avoided transmission loss benefits)	6.9
E-3	Renewable Portfolio Standard (33% by 2020)	21.2
E-4	California Solar Program (including New Solar Homes Partnership)	2.1
CR-1	Energy Efficiency Utility Energy Efficiency Programs Building and Appliance Standards Additional Efficiency and Conservation	4.2
CR-2	Residential Solar Water Heater Installation (AB1470 goal)	0.1

List of Measures

<b>Water</b>		
W-1	Water Use Efficiency	1.4
W-2	Water Recycling	0.3
W-3	Water System Energy Efficiency	2
W-4	Reuse Urban Runoff	0.2
W-5	Increase Renewable Energy Production	0.9
W-6	Public Goods Charge for Water	TBD
<b>Industry</b>		
I-1	Energy Efficiency Audit at Large Stationary Sources	TBD
<b>Recycling and Waste Management</b>		
RW-1	Landfill Methane Control (Discrete Early Action)	1
<b>High GWP</b>		
H-1	Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)	0.5
H-2	SF <sub>6</sub> Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)	0.3
H-3	High GWP Reduction in Semiconductor Manufacturing (Discrete Early Action)	0.15
H-4	Limit High GWP Use in Consumer Products (Discrete Early Action)	0.3
H-5	<ul style="list-style-type: none"> <li>High GWP Reductions from Mobile Sources</li> <li>Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems</li> <li>Air Conditioner Refrigerant Leak Test During Vehicle Smog Check</li> <li>Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers</li> <li>Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems</li> </ul>	3.3
H-6	<ul style="list-style-type: none"> <li>High GWP Reductions from Stationary Sources</li> <li>High GWP Recycling and Deposit Program</li> <li>Specifications for Commercial and Industrial Refrigeration</li> <li>Foam Recovery and Destruction Program</li> <li>SF<sub>6</sub> Leak Reduction and Recycling in Electrical Applications</li> <li>Alternative Suppressants in Fire Protection Systems</li> <li>Residential Refrigeration Early Retirement Program</li> </ul>	11.6
<b>Agriculture</b>		
A-1	Methane Capture at Large Dairies	TBD
<b>Forests</b>		
F-1	Sustainable Forest Target	5

**Appendix E—List of Preliminary Recommendations by Tons**  
**Table 41**

Measure No.	Measure Description	Estimated Reduction (MMTCO <sub>2</sub> E)
	State Leadership	1-2
	California Cap-And-Trade Program Linked to WCI: Emissions cap of 365 MMTCO <sub>2</sub> E covering electricity, transportation, residential/commercial and industrial sources by 2020.	35.15
T-1	Pavley I and II – Light-Duty Vehicle GHG Standards	31.7
E-3	Renewable Portfolio Standard (33% by 2020)	21.2
T-2	Low Carbon Fuel Standard	16.5
E-1	Energy Efficiency (32,000 GWh of reduced demand) <ul style="list-style-type: none"> <li>• Utility Energy Efficiency Programs</li> <li>• More Stringent Building and Appliance Standards</li> <li>• Additional efficiency and conservation</li> </ul>	15.2
H-6	High GWP Reductions from Stationary Sources <ul style="list-style-type: none"> <li>• High GWP Recycling and Deposit Program</li> <li>• Specifications for Commercial and Industrial Refrigeration</li> <li>• Foam Recovery and Destruction Program</li> <li>• SF<sub>6</sub> Leak Reduction and Recycling in Electrical Applications</li> <li>• Alternative Suppressants in Fire Protection Systems</li> <li>• Residential Refrigeration Early Retirement Program</li> </ul>	11.6
E-2	Increase Combined Heat and Power Use by 32,000 GWh (Net reduction includes avoided transmission loss benefits)	6.9
F-1	Sustainable Forest Target	5
T-3	Vehicle Efficiency Measures <ul style="list-style-type: none"> <li>• Tire Pressure Program (Discrete Early Action)</li> <li>• Low Friction Engine Oils</li> <li>• Tire Tread Program</li> <li>• Low-Emissivity Automotive Body and Window Coatings</li> </ul>	4.8
CR-1	Energy Efficiency (800 million therms reduced consumption) <ul style="list-style-type: none"> <li>• Utility Energy Efficiency Programs</li> <li>• More Stringent Building and Appliance Standards</li> <li>• Additional efficiency and conservation</li> </ul>	4.2
T-5	Goods Movement Efficiency Measures <ul style="list-style-type: none"> <li>• Systemwide Efficiency Improvements</li> </ul>	3.5

List of Measures

Measure No.	Measure Description	Estimated Reduction (MMTCO <sub>2</sub> E)
H-5	High GWP Reductions from Mobile Sources <ul style="list-style-type: none"> <li>• Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems</li> <li>• Air Conditioner Refrigerant Leak Test During Vehicle Smog Check</li> <li>• Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers</li> <li>• Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems</li> </ul>	3.3
E-4	Million Solar Roofs (including California Solar Initiative and New Solar Homes Partnership)	2.1
T-9	Regional Performance-Based VMT Targets and Local Government Action	2
W-3	Pumping and Treatment Efficiency	2
T-6	Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)(Discrete Early Action)	1.4
W-1	Water Use Efficiency	1.4
T-10	High Speed Rail	1
RW-1	Landfill Methane Control (Discrete Early Action)	1
W-5	Increase Renewable Energy Production	0.9
T-8	Heavy-Duty Engine Efficiency	0.6
T-7	Medium- and Heavy-Duty Vehicle Hybridization	0.5
H-1	Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)	0.5
W-2	Water Recycling	0.3
H-2	SF <sub>6</sub> Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)	0.3
H-4	Limit High GWP Use in Consumer Products (Discrete Early Action)	0.3
T-4	Ship Electrification at Ports (Discrete Early Action)	0.2
W-4	Reuse Urban Runoff	0.2
H-3	High GWP Reduction in Semiconductor Manufacturing (Discrete Early Action)	0.15
CR-2	Residential Solar Water Heater Installation (AB1470 goal)	0.1
I-1	Energy Efficiency Audit at Large Stationary Sources	TBD
W-6	Public Goods Charge for Water	TBD
A-1	Methane Capture at Large Dairies	TBD

## Other Measures Under Evaluation

**Appendix E—List of Other Measures Under Evaluation by Sector  
Table 42**

Measure Description	Estimated Reduction (MMTCO <sub>2</sub> E)
<b>Transportation</b>	
Feebates for New Vehicles	2-6
Congestion Pricing	up to 1
Pay-as-you-drive	up to 1
<b>Land Use and Local Government</b>	
Indirect Source Rules for New Development	up to 1
Programs to reduce vehicle trips	up to 1
<b>Electricity</b>	
Additional Energy Efficiency (up to 8,000 GWh) Utility Energy Efficiency Programs Building and Appliance Standards	up to 4
Additional Efficiency and Conservation	
Million Solar Roofs (up to 5,000 MW total install by 2020 including New Solar Homes Partnership)	up to 1
Reduce Coal Generation by up to 13,000 GWh	up to 8
Residential Solar Water Heater Installation (beyond AB1470 goal)	up to 1
<b>Cement</b>	
Carbon Intensity Standard for Cement Manufacturers	1.1-2.5
Carbon Intensity Standard for Concrete Batch Plants	2.5-3.5
Waste Reduction in Concrete Use	0.5-1
<b>Industry</b>	
Refinery Energy Efficiency Process Improvement	2-5

## List of Measures

Removal of Methane Exemption from Existing Refinery Regulations	0.01-0.05
Oil and Gas Extraction GHG Emission Reduction	1-3
GHG Leak Reduction from Oil and Gas Transmission	0.5-1.5
Industrial Boiler Efficiency	0.5-1.5
Stationary Internal Combustion Engine Electrification	0.1-0.2
Glass Manufacturing Efficiency Equipment Efficiency Use of Recycled Material	0.1-0.2
Off-Road Equipment	up to 0.5

**Appendix E—List of Other Measures Under Evaluation by Tons  
Table 43**

<b>Sector</b>	<b>Measure Description</b>	<b>Estimated Reduction (MMTCO<sub>2</sub>E)</b>
Electricity	Reduce Coal Generation by up to 13,000 GWh	up to 8
Transportation	Feebates for New Vehicles	2-6
Industry	Refinery Energy Efficiency Process Improvement	2-5
Electricity	Additional Energy Efficiency (up to 8,000 GWh) Utility Energy Efficiency Programs Building and Appliance Standards Additional Efficiency and Conservation	up to 4
Cement	Carbon Intensity Standard for Concrete Batch Plants	2.5-3.5
Industry	Oil and Gas Extraction GHG Emission Reduction	1-3
Cement	Carbon Intensity Standard for Cement Manufacturers	1.1-2.5
Industry	GHG Leak Reduction from Oil and Gas Transmission	0.5-1.5
Industry	Industrial Boiler Efficiency	0.5-1.5
Transportation	Congestion Pricing	up to 1

List of Measures

Transportation	Pay-as-you-drive	up to 1
Land Use and Local Government	Indirect Source Rules for New Development	up to 1
Land Use and Local Government	Programs to reduce vehicle trips	up to 1
Electricity	Million Solar Roofs (up to 5,000 MW total install by 2020 including New Solar Homes Partnership)	up to 1
Electricity	Residential Solar Water Heater Installation (beyond AB1470 goal)	up to 1
Cement	Waste Reduction in Concrete Use	0.5-1
Industry	Removal of Methane Exemption from Existing Refinery Regulations	0.01-0.05
Industry	Stationary Internal Combustion Engine Electrification	0.1-0.2
Industry	Off-Road Equipment	up to 0.5
Industry	Glass Manufacturing Efficiency Equipment Efficiency Use of Recycled Material	0.1-0.2

## List of Measures

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**Appendix F: California's Greenhouse Gas  
Emissions Inventory**

## Greenhouse Gas Inventory

The inventories presented here are summaries of 1990, 2004, and 2020 projected BAU as discussed in the Draft Scoping Plan. For detailed 1990 and 2004 inventories please see:

<http://www.arb.ca.gov/cc/inventory/inventory.htm>

More detailed information about the 2020 inventory will be released in July at the above web address. Comments on this forecast can be submitted at:

<http://www.arb.ca.gov/cc/scopingplan/spcomment.htm>

## **Greenhouse Gas Emission Inventory and Forecasting**

ARB is responsible for developing the California Greenhouse Gas Emission Inventory. The Inventory accounts for all greenhouse gas (GHG) emissions within the state of California and supports the AB 32 Climate Change Program. The Inventory also serves as the basis for developing future year GHG emission forecasts necessary to support measure development and Scoping Plan recommendations. ARB staff has developed a year 2020 “business-as-usual” (BAU) forecast of GHG emissions for use in developing the Draft Scoping Plan.

### **Greenhouse Gas Emission Inventory**

ARB’s current GHG emission inventory is based on statewide fuel use, process, and activity data to estimate emissions. These estimates use the actual amount of all fuels combusted in the state, which accounts for over 85 percent of the greenhouse gas emissions within California.

This approach to inventory development is referred to as “top-down” because data are collected in the aggregate for the entire state, not at the level of the individual facility or emission-point. In contrast, a “bottom-up” inventory uses data from individual sources to determine emissions and sums those emissions to form a statewide total. Once ARB’s mandatory reporting regulation is implemented, facility-specific data will become available and will be used to further improve the inventory. Current GHG emissions data can be found on ARB’s website at:

<http://www.arb.ca.gov/cc/inventory/inventory.htm>

### **Business-as-Usual 2020 Emissions**

ARB staff estimated 2020 business-as-usual GHG emissions, which represent the emissions that would be expected to occur in the absence of any GHG reductions actions. ARB staff estimates the statewide 2020 business-as-usual greenhouse gas emissions will be 596 MMTCO<sub>2</sub>E. Emission reductions from the recommended measures in the Draft Scoping Plan total 169 MMTCO<sub>2</sub>E, allowing California to attain the 2020 emissions limit of 427 MMTCO<sub>2</sub>E.

The 2020 BAU emissions estimate was derived by projecting emissions from a past baseline year using growth factors specific to each of the different economic sectors. For the purposes of the Draft Scoping Plan, ARB used three-year average emissions, by sector, for 2002-2004 to forecast emissions to 2020. At the time the Scoping Plan process was initiated, 2004 was the most recent year for which actual data were available.

This 3-year average of known emissions will dampen unusual variations in any given year that would make the baseline year unrepresentative for forecasting. For example, an unusually hot, dry year might cause much higher power consumption and less hydroelectric power generation, and therefore increased emissions associated with power generation than would have otherwise been expected.

### **Forecasting Method**

Growth factors are sector-specific and are derived from several sources, including the energy demand models generated by California Energy Commission (CEC) for their 2007 Integrated Energy Policy Report (IEPR), business economic growth data developed for ARB’s criteria pollutant forecast system (CEFS), population growth data from the California Department of Finance, and projections of vehicle miles traveled from ARB’s on-road mobile source emissions

## Greenhouse Gas Inventory

model, EMFAC2007. For the electricity and other energy sectors, ARB consulted with CEC to select the most appropriate growth factor.

ARB's forecasting method is similar to other GHG forecasting approaches, including the method used in the Climate Action Team 2006 Report. Where appropriate, ARB used updated and improved growth factors for estimating 2020 emissions sector-by-sector. These future emissions are projected in the absence of any policies or actions that would reduce emissions. The resulting BAU estimates are compared to the 2020 target set by the Board in December 2007 to determine the total statewide GHG reductions needed.

### **Sector Forecasts**

Descriptions of the 2020 BAU forecasts for the major sectors of the inventory are given below with key assumptions staff used to estimate these future emissions.

#### **Electricity**

The 2020 business-as-usual emissions forecast for the electric power sector is 139.2 MMTCO<sub>2</sub>E. These emissions are the result of in-state power generation plus specified and unspecified imported power. BAU forecasted emissions assume that all growth in electricity demand by 2020 will be met by in-state natural gas-fired power plants. Expected growth in renewable power to meet the current and proposed Renewables Portfolio Standard (RPS) is not included in the BAU. This allows the Draft Scoping Plan reductions from increasing renewable power generation to be additive with the BAU forecasted 2020 emissions.

The 2020 BAU forecast for emissions from specified sources of imported electricity (i.e., power received from specific out-of-state power plants) is assumed to decrease resulting from the closure of one coal-fired power plant (i.e., Mojave) previously supplying imported electricity. The demand previously served by the closed plant is now replaced by in-state natural-gas generation.

Based on outputs from the CEC's electricity demand models, in-state electricity generation and specified imports will not meet the State's full electricity demand in 2020. The remaining demand is assumed to be met by unspecified imported electricity (i.e., power received from a mix of power generating sources outside the State).

#### **Transportation**

GHG emissions in 2020 from the transportation sector as a whole are expected to increase from current levels to 225.4 MMTCO<sub>2</sub>E. This forecasted increase is dominated by increases in emissions from on-road transportation, i.e., passenger cars and heavy-duty trucks. To forecast on-road transportation emissions, ARB staff used 2007 fuel sales data obtained from the California Board of Equalization and estimated 2020 emissions based on the growth in projected vehicle miles traveled (VMT) derived from EMFAC2007. This BAU forecast assumes no change in vehicle fleet mix over time.

#### **Industrial**

The industrial sector consists of large stationary sources of GHG emissions and includes oil and gas production and refining, cement plants, and large manufacturing facilities. Emissions for this

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sector are forecasted to grow to 100.5 MMTCO<sub>2</sub>E by 2020, an increase of approximately five percent from the average emissions level of 2002-2004.

Business-as-usual forecasted emissions for this sector are variable, but overall are not expected to grow substantially. Most of the growth from this sector comes from the fuel use and process emissions of two industries: Cement Plants and Refineries.

Emissions from the combustion of natural gas are expected to grow for some industries (e.g., cement plants) and decline for others (e.g., food processors). These assumptions of growth and decline in natural gas demand are based on outputs from energy demand modeling conducted by CEC staff for the 2007 IEPR.

### **Landfills**

Forecasted BAU emissions in 2020 for landfills are 7.7 MMTCO<sub>2</sub>E. This forecast uses a recognized landfill gas emissions model developed by the Intergovernmental Panel on Climate Change (IPCC) and data from the California Integrated Waste Management Board (CIWMB).

The forecast reflects assumptions regarding the continued decay of existing waste in landfills and estimates on the amount and character of new waste deposited in landfills through 2020.

### **Commercial & Residential**

The Commercial and Residential sector is expected to contribute 46.7 MMTCO<sub>2</sub>E or about eight percent of the total statewide GHG emissions in 2020. Forecasted BAU emissions from the Commercial sector include combustion emissions from natural gas and other fuels (i.e., diesel) used by office buildings and small businesses. Residential emissions result primarily from natural gas combustion used for space heating and for hot water heaters.

Growth in emissions from the Commercial and Residential sector is due primarily to the expected increase in population and assumed increase use of natural gas. Emissions from the use of other fuels, such as diesel fuel, are assumed to remain relatively constant over time.

### **High Global Warming Potential Gases**

The forecasted BAU 2020 emissions of High Global Warming Potential (High-GWP) gases are 46.9 MMTCO<sub>2</sub>E. High-GWP gases, including sulfur hexafluoride (SF<sub>6</sub>) from electric utility applications, substitutes for ozone depleting substances (ODS) (primarily HFCs and PFCs), and other High-GWP gases used in semiconductor manufacturing and other industrial processes are combined under one sector for purposes of the Draft Scoping Plan. Assumptions used to forecast business-as-usual emissions of High-GWP gases vary by GHG.

SF<sub>6</sub> emissions occur primarily from leaks in electrical transmission system equipment in which SF<sub>6</sub> is used as an electrical insulator. SF<sub>6</sub> leaks are constant from a given piece of electrical equipment and are not related to the use of the equipment. The probable expansion of the electrical transmission system infrastructure is assumed to result in more SF<sub>6</sub> emissions from leaks. However, at the same time, technical improvements to the transmission system equipment result in fewer leaks, reducing SF<sub>6</sub> emissions. ARB assumes that the effect of an expansion of the electrical transmission system infrastructure, combined with the technical improvements to the equipment in the system, will result in no net change in emissions in 2020.

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Emissions of HFCs and PFCs as ODS substitutes occur from their use in refrigeration and air conditioning systems, among other commercial and industrial applications. The high business-as-usual forecasted emissions in 2020 comes about as ODSs are rapidly replaced by ODS substitutes, as more ODSs are phased out.

### **Agriculture**

BAU emissions from the agriculture sector are forecasted to increase about seven percent from current levels to 29.8 MMTCO<sub>2</sub>E in 2020, due exclusively to the assumed increase in livestock population. The agriculture sector includes emissions from livestock, i.e., digestive processes and manure management; combustion of liquid and gaseous fuels used for irrigation and crop production; emissions from fertilizer use and application of other soil additives; and emissions from agricultural residue burning.

Agricultural residue burning and livestock emissions were forecasted using ARB's criteria pollutant forecasting approach. Forecasted emissions from the combustion of natural gas were estimated using outputs from the 2007 IEPR developed by CEC. Other agriculture-rated emissions were either held constant or extrapolated using historical trends to obtain a 2020 BAU estimate.

### **Forestry**

The forestry sector is unique in the inventory because it includes emissions from forest and rangeland disturbances, such as wildfires and wood decomposition, as well as removal (or sinks) of CO<sub>2</sub> from the atmosphere due to carbon sequestration into woody tissues. The inventory combines positive emissions and negative removals into a single, net value.

Several factors are operating to potentially decrease net GHG emissions from the forest sector. These factors include loss of forest land due to conversion to other uses and increased threat of wildfires. Because of this, forest sinks have decreased from the 1990 estimate (-6.7 MMTCO<sub>2</sub>E) to a current level of approximately a -5 MMTCO<sub>2</sub>E. As a result of the continuing effects of these factors, the 2020 forecast for net emissions from the forest sector is zero. This assumes that forest emissions and sinks will balance in 2020.

Appendix F Table 44  
**California GHG Inventory by Category as Defined in the Scoping Plan**  
 (millions of metric tons of CO<sub>2</sub> equivalent)

Inventory Summary for Scoping Plan (June 26, 2008)	Emissions (MMTCO <sub>2</sub> E)	
	2002-2004 Average	2020 Forecast
<b>Transportation</b>	<b>179.3</b>	<b>225.4</b>
<i>On Road</i>	<i>168.7</i>	<i>209.1</i>
Passenger Vehicles	133.9	160.8
Heavy Duty Trucks	34.7	48.3
<i>Ships &amp; Commercial Boats</i>	<i>3.3</i>	<i>6.3</i>
<i>Aviation (Intrastate)</i>	<i>3.2</i>	<i>4.8</i>
<i>Rail</i>	<i>3.0</i>	<i>3.8</i>
<i>Unspecified</i>	<i>1.2</i>	<i>1.4</i>
<b>Electric Power</b>	<b>109.0</b>	<b>139.2</b>
<i>In-State Generation</i>	<i>52.5</i>	<i>87.2</i>
Natural Gas	44.2	78.8
Other Fuels	8.4	8.4
<i>Imported Electricity</i>	<i>56.5</i>	<i>52.0</i>
Unspecified Imports	24.3	26.1
Specified Imports	32.2	25.9
<b>Commercial and Residential</b>	<b>41.0</b>	<b>46.7</b>
<i>Residential Fuel Use</i>	<i>28.5</i>	<i>32.1</i>
Natural Gas	26.9	30.6
Other Fuels	1.6	1.5
<i>Commercial Fuel Use</i>	<i>11.9</i>	<i>14.0</i>
Natural Gas	10.5	12.3
Other Fuels	1.4	1.6
<i>Commercial Cogeneration Heat Output</i>	<i>0.6</i>	<i>0.7</i>
<b>Industrial</b>	<b>95.9</b>	<b>100.5</b>
<i>Refineries</i>	<i>35.0</i>	<i>36.7</i>
<i>General Fuel Use</i>	<i>21.3</i>	<i>19.8</i>
Natural Gas	14.0	11.7
Other Fuels	7.3	8.1
<i>Oil &amp; Gas Extraction</i>	<i>14.2</i>	<i>14.2</i>
Fuel Use	13.4	13.4
Fugitive Emissions	0.8	0.7
<i>Cement Plants</i>	<i>9.7</i>	<i>12.6</i>
Clinker Production	5.7	7.6
Fuel Use	4.1	5.0
<i>Cogeneration Heat Output</i>	<i>9.2</i>	<i>9.3</i>
<i>Other Process Emissions</i>	<i>6.4</i>	<i>7.9</i>

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<b>Inventory Summary for Scoping Plan (June 26, 2008)</b>	<b>Emissions (MMTCO<sub>2</sub>E)</b>	
	<b>2002-2004 Average</b>	<b>2020 Forecast</b>
<b>Recycling and Waste</b>	<b>5.6</b>	<b>7.7</b>
<i>Landfills<sup>1</sup></i>	<i>5.6</i>	<i>7.7</i>
<b>High GWP</b>	<b>14.7</b>	<b>46.9</b>
<i>Ozone Depleting Substance Substitutes</i>	<i>12.9</i>	<i>45.0</i>
<i>Electricity Grid SF<sub>6</sub> Losses<sup>2</sup></i>	<i>1.0</i>	<i>1.0</i>
<i>Semiconductor Manufacturing<sup>1</sup></i>	<i>0.8</i>	<i>0.8</i>
<b>Agriculture</b>	<b>27.7</b>	<b>29.8</b>
<i>Livestock</i>	<i>13.9</i>	<i>16.2</i>
Enteric Fermentation (Digestive Process)	7.0	8.2
Manure Management	6.9	8.0
<i>Crop Growing &amp; Harvesting</i>	<i>9.2</i>	<i>9.2</i>
Fertilizers	7.1	7.1
Soil Preparation and Disturbances	2.0	2.0
Crop Residue Burning	0.1	0.1
<i>General Fuel Use</i>	<i>4.6</i>	<i>4.5</i>
Diesel	3.3	3.3
Natural Gas	0.7	0.5
Gasoline	0.4	0.4
Other Fuels	0.2	0.2
<b>Forestry</b>	<b>0.2</b>	<b>0.2</b>
<i>Wildfire (CH<sub>4</sub> &amp; N<sub>2</sub>O Emissions)</i>	<i>0.2</i>	<i>0.2</i>
<b>TOTAL GROSS EMISSIONS</b>	<b>473.5</b>	<b>596.4</b>
<i>Forestry Net Emissions</i>	<i>(-4.7)</i>	<i>0.0</i>
<b>TOTAL NET EMISSIONS</b>	<b>468.8</b>	<b>596.4</b>

<sup>1</sup> These categories are under the Industrial Sector in ARB's GHG Emission Inventory

<sup>2</sup> This category is under the Electric Power Sector in ARB's GHG Emission Inventory

Appendix F Table 45  
**California GHG Inventory by Sector (millions of tonnes of CO<sub>2</sub> equivalent)**  
*(CO<sub>2</sub> equivalence based upon IPCC Second Assessment Report's Global Warming Potentials)*

<b>Categories Included in the Inventory.</b>	<b>1990</b>	<b>02-04</b>	<b>2020</b>
<b>Agriculture &amp; Forestry</b>	<b>23.62</b>	<b>27.91</b>	<b>30.01</b>
<i>Ag Energy Use</i>	4.50	4.63	4.47
<i>Ag Residue Burning</i>	0.12	0.08	0.08
<i>Ag Soil Management</i>	6.54	8.40	8.40
<i>Enteric Fermentation</i>	6.67	7.03	8.17
<i>Forest and Range Management</i>	0.19	0.19	0.19
<i>Histosol Cultivation</i>	0.18	0.14	0.14
<i>Manure Management</i>	5.00	6.88	7.99
<i>Rice Cultivation</i>	0.41	0.56	0.56
<b>Commercial</b>	<b>14.43</b>	<b>12.45</b>	<b>14.63</b>
<i>CHP: Commercial (UTO)</i>	0.40	0.56	0.66
<i>Communication</i>	0.07	0.09	0.11
<i>Domestic Utilities</i>	0.34	0.50	0.58
<i>Education</i>	1.42	1.04	1.22
<i>Food Services</i>	1.89	2.44	2.87
<i>Health Care</i>	1.32	1.23	1.44
<i>Hotels</i>	0.67	0.64	0.76
<i>National Security</i>	0.56	0.18	0.21
<i>Not Specified</i>	5.58	3.26	3.83
<i>Offices</i>	1.46	1.85	2.17
<i>Retail &amp; Wholesale</i>	0.68	0.60	0.70
<i>Transportation Services</i>	0.03	0.05	0.06
<b>Electricity Generation (Imports)</b>	<b>61.58</b>	<b>56.82</b>	<b>52.36</b>
<i>Specified Imports</i>	29.61	32.17	25.89
<i>Unspecified Imports</i>	30.96	24.30	26.13
<i>Transmission and Distribution (SF<sub>6</sub>)</i>	1.02	0.34	0.34
<b>Electricity Generation (In State)</b>	<b>49.05</b>	<b>53.22</b>	<b>87.88</b>
<i>CHP: Commercial</i>	0.70	0.80	1.46
<i>CHP: Industrial</i>	14.54	20.27	31.38
<i>Merchant Owned</i>	2.33	26.01	44.60
<i>Utility Owned</i>	29.92	5.45	9.75
<i>Transmission and Distribution (SF<sub>6</sub>)</i>	1.56	0.69	0.69
<b>Industrial</b>	<b>103.03</b>	<b>99.02</b>	<b>105.84</b>
<i>CHP: Industrial (UTO)</i>	9.70	9.20	9.27
<i>Flaring</i>	0.15	0.11	0.11
<i>Landfills</i>	6.26	5.64	7.66
<i>Manufacturing</i>	31.98	27.27	28.93
<i>Mining</i>	0.03	0.25	0.19
<i>Not Specified</i>	2.63	2.10	2.27
<i>Oil &amp; Gas Extraction</i>	14.65	14.19	14.19
<i>Petroleum Marketing</i>	0.02	0.00	0.00
<i>Petroleum Refining</i>	32.82	35.03	36.72
<i>Pipelines</i>	1.63	1.45	1.79
<i>Waste Water Treatment</i>	3.17	3.78	4.72
<b>Residential</b>	<b>29.66</b>	<b>28.52</b>	<b>32.10</b>
<i>Household Use</i>	29.66	28.52	32.10
<b>Transportation</b>	<b>150.67</b>	<b>179.31</b>	<b>225.40</b>
<i>Aviation (intrastate)</i>	5.13	3.18	4.84
<i>Not Specified</i>	3.01	1.21	1.35
<i>On Road</i>	137.99	168.66	209.10
<i>Rail</i>	2.33	3.00	3.76
<i>Water-borne (within 24 nautical miles from California coast)</i>	2.21	3.26	6.35

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<b>Not Specified (across all sectors)</b>	<b>1.27</b>	<b>16.21</b>	<b>48.19</b>
<i>Unspecified fuel combustion</i>	1.23	3.34	3.20
<i>Use of substitutes for ozone depleting substances</i>	0.04	12.87	44.99
<b>Summary of Categories Included in the Inventory.</b>	<b>1990</b>	<b>02-04</b>	<b>2020</b>
<b>Gross California Emissions</b>	<b>433.29</b>	<b>473.45</b>	<b>596.41</b>
<b>Sinks from Forests and Rangelands</b>	<b>-6.69</b>	<b>-4.67</b>	<b>0.00</b>
<b>Net California Emissions</b>	<b>426.60</b>	<b>468.78</b>	<b>596.41</b>
 <b>Categories Excluded from the Inventory.</b>	 <b>1990</b>	 <b>02-04</b>	 <b>2020</b>
<b>Transportation</b>	<b>59.02</b>	<b>46.01</b>	<b>84.30</b>
<i>Aviation (interstate and international)</i>	33.95	34.06	53.02
<i>Water-borne (interstate and international)</i>	25.06	11.94	31.28
<b>Summary of Categories Excluded from the Inventory.</b>	<b>1990</b>	<b>02-04</b>	<b>2020</b>
<b>Total Excluded Emissions</b>	<b>59.02</b>	<b>46.01</b>	<b>84.30</b>

## **APPENDIX G: ECONOMIC MODELING ASSESS POTENTIAL IMPACTS OF AB 32 SCOPING PLAN**

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To be included in Draft Scoping Plan Supplemental Analysis

Description of Preliminary  
Economic Modeling

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## **Appendix H: Environmental Impacts**

To be included in Proposed Scoping Plan

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