Air Conditioning, Heating and Refrigeration Institute (AHRI) Air Conditioning Proposal Background Document and Proposed Regulatory Text

Air conditioning (AC) original equipment manufacturers (OEMs) will enable refrigerant recovery from 2022 to 2030 to offset the quantity of refrigerant higher than 750 GWP the OEM placed in new equipment shipped to and not exported from California in 2023 and 2024 in carbon dioxide (CO2) equivalent (eq) units (using CARB's Standardized Regulatory Impact Assessment (SRIA) leak rates and equipment lifetimes), GHG_I). The amount to be offset will be adjusted up or down (GHG_A) to recognize the refrigerant used in new equipment sold between 2023 and 2030 by: (1) Changes in refrigerant charge size and (2) Refrigerant GWP less than 750 GWP.

OEMs may facilitate recovery, purchase or use reclaimed refrigerant, or enable the destruction of recovered refrigerant in the equivalent quantity in CO2 eq units from 2022 to 2030 to compensate.

Background

Availability of R-410A for Recovery in California

Using CARB's estimated market volumes in 2017, AHRI estimates of R-410A that would be removed from the market and could be recovered based on CARB's model.

	2025	2026	2027	2028	2029	2030
Total R-410A available for recovery within California	431	871	1319	1775	2239	2712
Cumulative amount available	431	1302	2621	4395	6635	9347

If California contractors reclaimed 10% of the total R-410A reclaimed nationally, then California would have reclaimed approximately 270 tons of R-410A last year.[1] In the United States, 8,410 metric tons of refrigerant were reclaimed in 2019. Of that amount, 2,747 metric tons of R-410A were reclaimed.[2]

California Refrigerant Market

AHRI reviewed public and internal data to estimate the refrigerant market in California. By blending multiple approaches and using a wide variety of corroborated data sources, AHRI estimates that there are approximately 60,000-63,000 metric tons of R-410A in California and that approximately 6,600-7,200 metric tons of R-410A are shipped to California each year.

[1] According to sector-based equipment reporting in the Energy Information Administration (EIA)'s Commercial Building Energy Consumption Survey and Residential Energy Consumption Survey, between 8.5 and 12 percent of any HVACR product sector's market share is in California.

[2] Summary of Refrigerant Reclamation Trends. Environmental Protection Agency. Accessed from https://www.epa.gov/section608/summary-refrigerant-reclamation-trends.

- Approximately 2,700-3,100 metric tons of R-410A are used for servicing existing equipment in California each year.
- Approximately 3,800-4,300 metric tons of R-410A are used for charging new units entering service in California each year.

AHRI took three approaches to calculate the refrigerant use in California: (1) Equipment Shipment-Based Approach, (2) California Air Resources Board (CARB) Model-Based Approach, and (3) Refrigerant Shipment-Based Approach.

Equipment Shipment-Based Approach

AHRI used publicly available data from the Energy Information Administration (EIA)'s 2012 Commercial Building Energy Consumption Survey (CBECS) and 2015 Residential Energy Consumption Survey (RECS) and queried the data for residential AC, commercial AC, commercial heat pumps, and chillers. The weighted sums of each installation within the United States were used as the baseline of installed equipment. That data was then split into census divisions identified within CBECS and RECS. Population-weighted subsets of data were extracted for California to estimate the installed base of each type of equipment within the state. These baselines installed unit estimates were multiplied by California's growth rate from its Standardized Regulatory Impact Assessment (SRIA) to estimate the installed HVACR equipment base in 2023 (Appendix 1).

AHRI used refrigerant distributions from the Environmental Protection Agency (EPA)'s refrigerant Vintaging Model guidance document (page 230) to simulate the distribution of refrigerant type in each installation.[3]

Charge sizes, equipment lifetime, and leak rate were estimated from AHRI and DOE literature and California's SRIA.[4]

AHRI used this information and recorded the following parameters:

	Residential AC Units	Commercial AC Units	Commercial Heat Pump Units	Chillers
Equipment lifetime (years)	15	15	15	30
Charge Size (lbs)[5]	8.157	38	38	100

[3] AHRI set up a probabilistic model that took the refrigerant distributions for each type of equipment in EPAs Vintaging Model guidance. These distributions were summed for all equipment to find a weighted average for the proportion of each refrigerant in the installed base. These proportions were used in AHRI's calculations to estimate the R-410A installed base in California.

[4] DOE offers factsheets for AC equipment, chillers, heat pumps, and their respective lifetimes. Refrigerant charge guidelines can be found in AHRI Standard 340/360 and AHRI Standard 210/240. California's SRIA includes this information for its measurement of HVACR equipment in California.

[5] Shipment-weighted average based on California's SRIA and AHRI's public shipment data.

Leak Rate (per year)[6]	5%	5%	5%	5%
R410A Installed Market Share	86%	86%	86%	30%
R22 Installed Market Share	14%	14%	14%	0%
R134a Installed Market Share	0%	0%	0%	70%
R404A Installed Market Share	0%	0%	0%	0%

The leak rate was multiplied by the charge size and total number of units installed in California to estimate the amount of refrigerant used for servicing existing equipment per year. The result was multiplied by the proportion of equipment with R-410A to estimate the amount of R-410A used for servicing existing equipment each year, which was 2,736 metric tons per year.

Total number of units installed in California were divided by each installation's respective equipment lifetime to estimate the number of new units per year. This was multiplied by charge size and proportion of equipment with R-410A to estimate the amount of R-410A used for charging new equipment each year, which was 3,861 metric tons per year.

California Air Resources Board (CARB) Model-Based Approach

AHRI reviewed CARB's November 2017 HFC Emission Factors modeling document to estimate the amount of refrigerant used in new equipment and for service in California. The total number of installed units were multiplied by refrigerant charge size to estimate the installed base of refrigerant. AHRI assumed a 5% leak rate and a 15-year lifetime based on the SRIA to calculate refrigerant used for service and to charge new equipment in California.

The leak rate was multiplied by the charge size and total number of units installed in California to estimate the amount of refrigerant used for servicing existing equipment per year. Approximately 3,000 metrics tons of refrigerant are used for servicing existing equipment in California.

Total number of units installed in California were divided by each installation's respective equipment lifetime to estimate the number of new units per year. Approximately 4,000 metric tons of refrigerant are used for charging new equipment installed in California each year.

Refrigerant Shipment-Based Approach

AHRI reviewed refrigerant consumption data from the Consumer Cost Impacts of U.S. Ratification of the Kigali Amendment to estimate the amount of refrigerant used in California each year. Total exports of refrigerant were subtracted from total imports and production of refrigerant to estimate the total amount of refrigerant used each year. AHRI split the proportion of different types of equipment into census divisions identified within CBECS and

[6] Clodic (2010) estimates leak rates for HVACR equipment. These leak rates are consistent with the SRIA.

RECS. Population-weighted subsets of data were extracted for California to estimate the installed base of each type of equipment within the state.

Based on this approach, approximately 4,200 metrics tons of refrigerant are used for servicing existing equipment in California and approximately 3,058 metric tons of refrigerant are used for charging new equipment installed in California each year.

Economic Impact of AHRI's Recovery Proposal

Based on the range of refrigerant used in new equipment (3,800-4,300 metrics tons per year) and the reduction in charge size and GWP from new refrigerants, between 426[7] and 1,850 metric tons of refrigerant must be recovered to offset the CO2 equivalent for R-410A being used in California in 2023 and 2024 rather than a refrigerant with a GWP below 750.[8]

AHRTI Project 8018 found that cost to recover and reclaim refrigerant ranges from $1.20-$1.60 per pound.[9] The cost to the industry to offset the use of R-410A for 2023 and 2024 will range from approximately $1,127,000 to $7,232,000.

It is AHRI's understanding that shipping fluorocarbons costs approximately $0.05 per pound.[10] This will add approximately $46,900-$226,000 in shipping costs to the industry.

The total cost to manufacturers for recovery of refrigerant is estimated to cost between $1,174,000 to $7,458,000.[11]

Finally, AHRI understands that contractors can pay up to $25 per cylinder to return refrigerant to a distributor.[12] In the future, contractors would likely save the $25 refrigerant recovery fee. Contractors are responsible for the cost of dedicated recovery cylinders.[13] Since these cylinders

[7] See attached spreadsheet for more details.

[8] AHRI assumed that 3,800-4,300 metric tons per year of R-410A refrigerant were installed between 2023 and 2025, resulting in a total installed refrigerant base between 7,600-8,600 metric tons of refrigerant during this time. These values were multiplied by 5.6% and 21.5%, respectively to obtain a range of refrigerant recovery needed to meet CARB's goals.

[9] AHRI Project 8018 Final Report. January 2016. Page 15 and 24. Canada and Australia have had success with their refrigerant recovery and reclaim programs. In the research report, AHRI found that a $1.20-$1.59 per pound of refrigerant rebate was needed to incentivize the recovery of refrigerant ($3.50 CAD per kg and $5 AUD per kg, respectively).

[10] Shipping costs are minimal, however both AHRI Project 8018 and an ACHR News survey of refrigerant recovery businesses (Reclaim Survey: Where to Go, What it Costs, 2008) found minor shipping costs are still included within the business costs associated with refrigerant recovery and reclamation.

[11] AHRI multiplied the cost per pound of recovery by the pounds of refrigerant recovery needed to estimate recovery costs. Shipment costs per pound of refrigerant were also multiplied by the refrigerant recovery needed to estimate shipping costs. These two values were summed to calculate total cost to industry.

[12] ACHR News survey of refrigerant recovery businesses (Reclaim Survey: Where to Go, What it Costs, 2008) found cylinder return as a typical cost of business.

[13] AHRI reviewed currently available recovery cylinders on the market and found costs ranged between $180-$500.

typically carry 24 pounds of refrigerant, between 18 and 78 cylinders will need to be returned.[14] Contractors may already own these cylinders.

Administrative Controls

AHRI understands that CARB requires any proposal to be enforceable and easy to administer. AHRI proposes that equipment manufacturers self-certify and declare their progress to CARB annually, subject to auditing by CARB upon request. This will create a minimal burden to the industry (less than 24 hours per year) and ensure CARB will achieve its GHG reduction goals

Examples of Compliance Options

OEMs may enable or facilitate the recovery of refrigerant at the end of life by a number of actions including but not limited to the following. OEMs may combine these options. Other options may not have been explored at this writing.

- OEMs may use reclaimed refrigerant in new AC systems during 2023 and 2024
- OEMs may include contractual agreement that distributors return a certain amount of recovered refrigerant to reclaimers
- OEMs may include contractual agreement that distributors sell a certain amount of recovered refrigerant to reclaimers
- OEMs may provide incentives to their channel partners to recover refrigerant
- OEMs may provide incentives to their channel partners to use reclaimed refrigerant.
- OEMs may buy credits for recovery / reclaim from competitors or reclaimers.

Finally, OEMs may convert a portion of their products in 2023 and 2024 to a low GWP refrigerant.

[14] Examining Recovery Cylinder Capabilities. 2007. *ACHR News*.