Technical Working Group Meeting

Proposed GWP Limit for New Stationary Air Conditioning Equipment

August 6, 2019

Kathryn Kynett

Greenhouse Gas Reduction Strategy Section

Research Division

California Air Resources Board

kathryn.kynett@arb.ca.gov

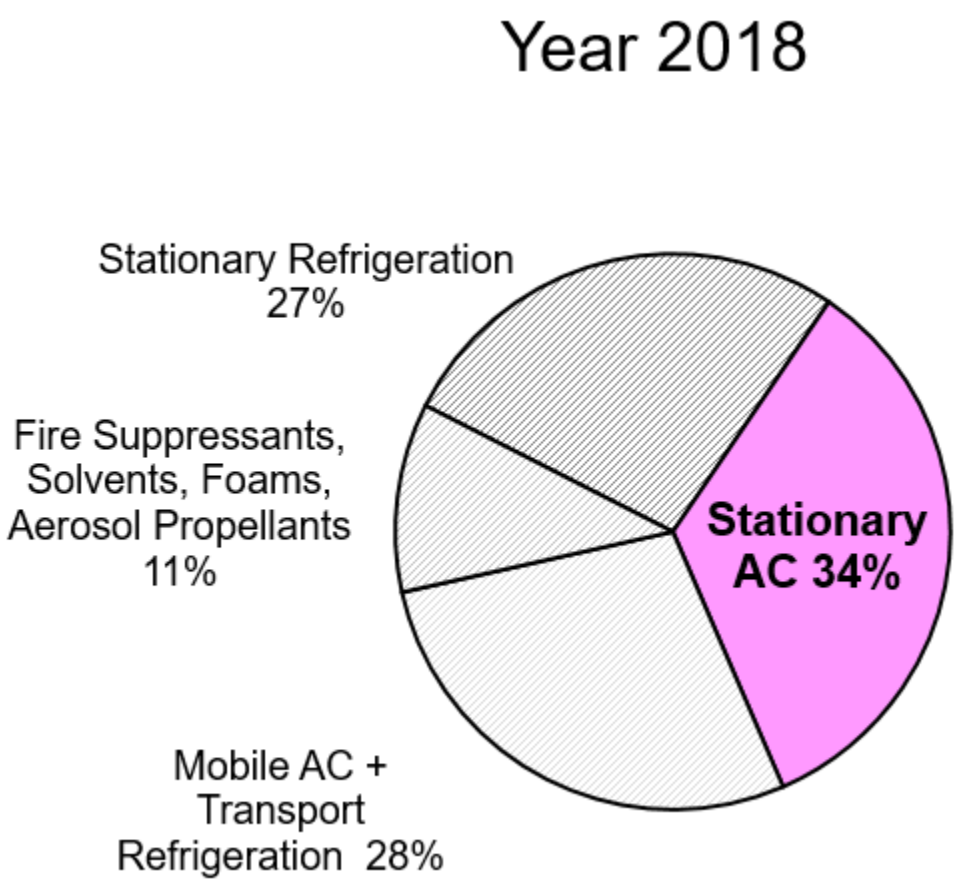
Phone: (916) 323-8598

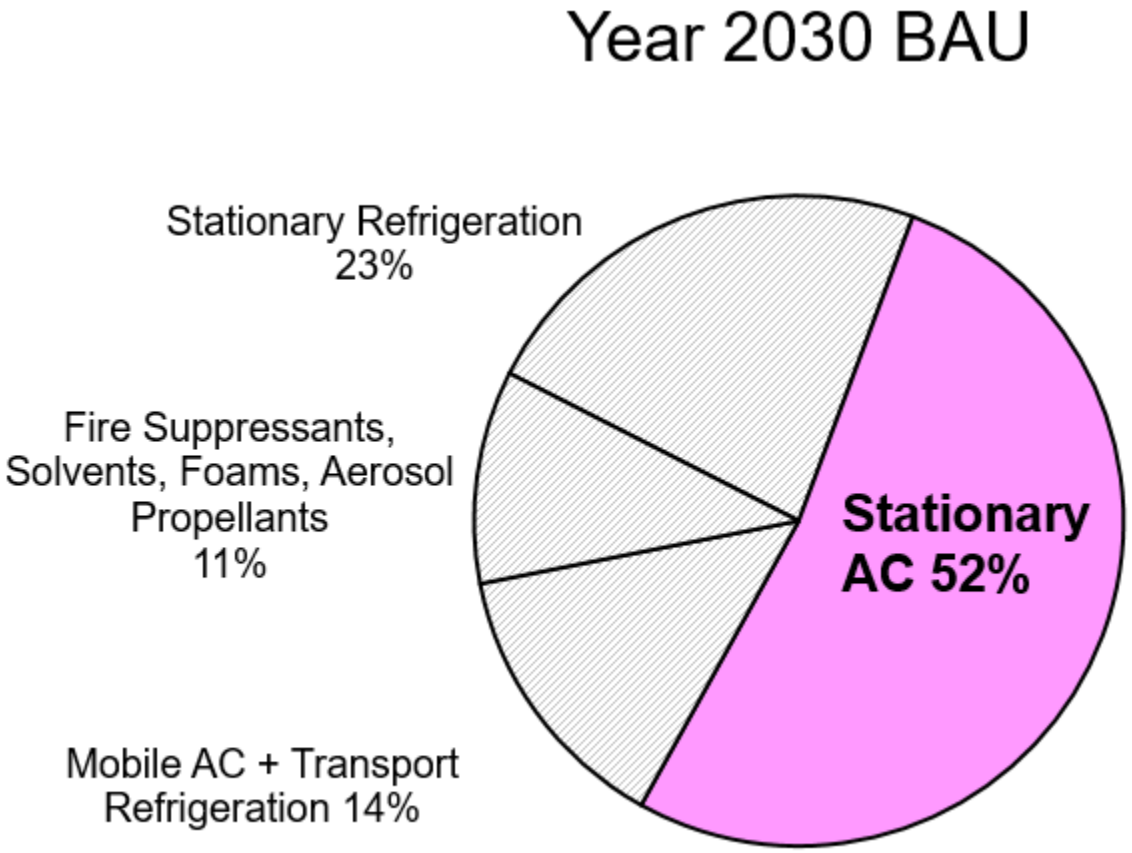
Today's Presentation

- Background
- Regulatory Proposal and Process
- Economic Analysis (SRIA)
- Enforcement Requirements
- Alternatives
- Next Steps
- Discussion

Background

Hydrofluorocarbon (HFC) Emissions in California





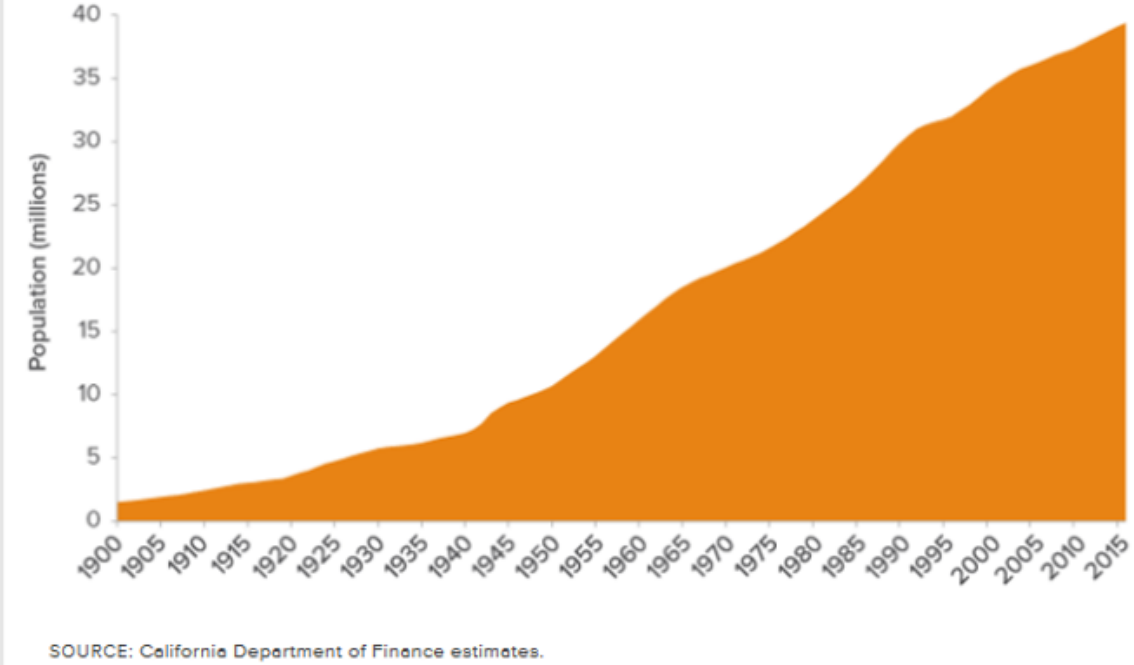
Majority of Emissions from AC Sector

[Source: CARB, 2018]

Increasing Demand for AC in California

Population Growth

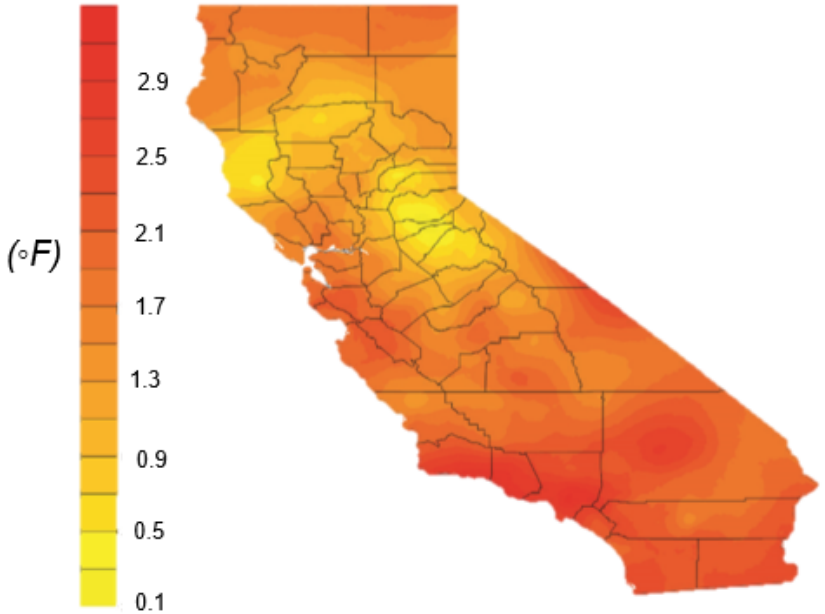
California has experienced rapid population growth



SOURCE: California Department of Finance estimates.

Climate Change

Observed Change in Annual Temperatures
(1986-2016 compared to 1901-1960)



[Sources: Public Policy Institute of California, 2017; California's 4th Climate Change Assessment, 2018]

Proposed Limit on Stationary Air Conditioning Equipment

Proposed GWP Limit on AC Equipment

- Effective January 1, 2023, new air conditioning systems must use a refrigerant with a global warming potential (GWP) value < 750

- Effective January 1, 2024, new chillers must use a refrigerant with a GWP value < 750 (consistent with SB 1013)

Status of <750 GWP Alternatives

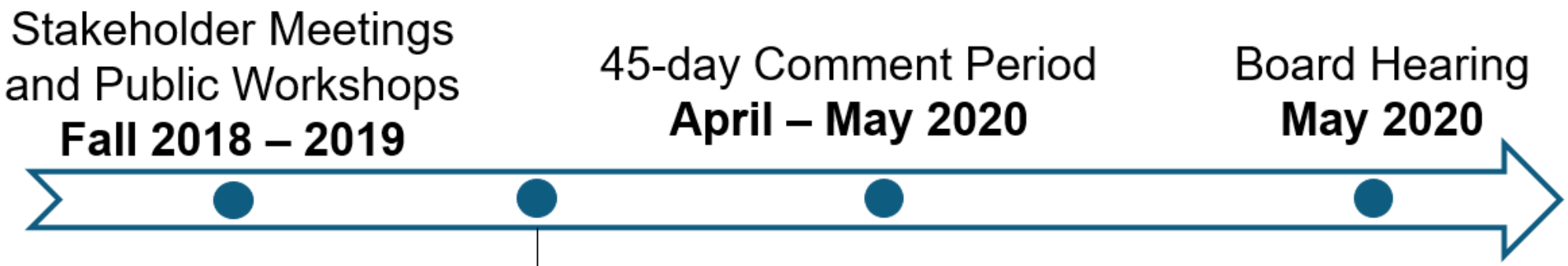
Category	Global Status	California Status
window/wall + portable	●	●
packaged terminal	●	◕
ductless split systems	●	◕
ducted split + package systems	◕	◕
VRV/VRF	●	◕

● commercially available

◕ Product under development or pending codes/standards updates

Regulatory Processes Overview

Rulemaking Overview



Staff present regulatory concepts

"Major" Regulation Econ Analysis - SRIA

Staff publishes proposal, costs and impacts in the "Initial Statement of Reasons" (ISOR or staff report)

Staff present proposal to Board

Board may accept proposal or direct staff to make changes

Solicit stakeholder input

Public may submit written or verbal comments on staff proposal to Board

Economic Analysis: Standardized Regulatory Impact Assessment (SRIA)

SRIA Overview

- Required if estimated economic impact exceeds $50 million, i.e., “major” regulation
  - Costs and benefits to businesses, individuals, and the environment
  - Macroeconomic impacts (jobs, investment, income) in California
  - Fiscal impacts
  - Costs and benefits for regulatory alternatives

CARB seeks and considers information given by stakeholders and interested parties

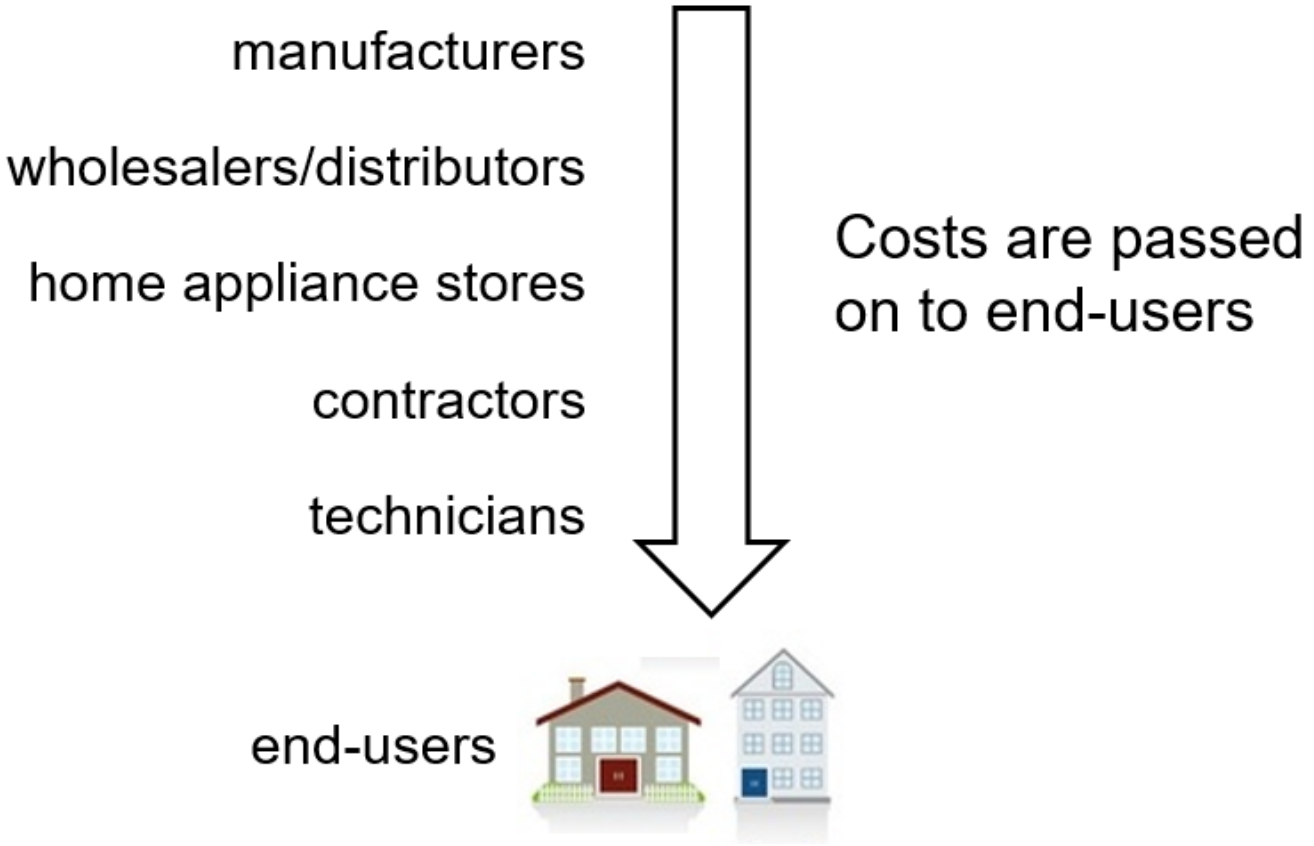
SRIA Overview (continued)

- Baseline costs – costs of traditional AC systems (first + ongoing)
- Added costs – how much more does it cost for < 750 GWP equipment compared to baseline?
- Growth rates of affected equipment

Economic Analysis (SRIA)
Preliminary Analysis and Input Requested

a. Affected Entities
b. Cost by Equipment Category
c. California AC Market
d. Component Replacements (Existing Systems)

SRIA – Who is affected by the proposed regulation?



AC Equipment Categories

small self-contained AC + dehumidifiers

portable

window and through-the-wall

packaged terminal AC (PTAC)
packaged terminal HP (PTHP)

dehumidifiers

residential + commercial (ducted/ductless)

split and packaged AC/HP
<65,000 BTUH (Residential)

split and packaged AC/HP
≥65,000 BTUH (Commercial)

chillers
(Commercial)

1. **Are we capturing all the equipment types that would be affected by the proposed regulation?**
2. **What is the best way to distinguish residential versus commercial equipment? Capacity?**

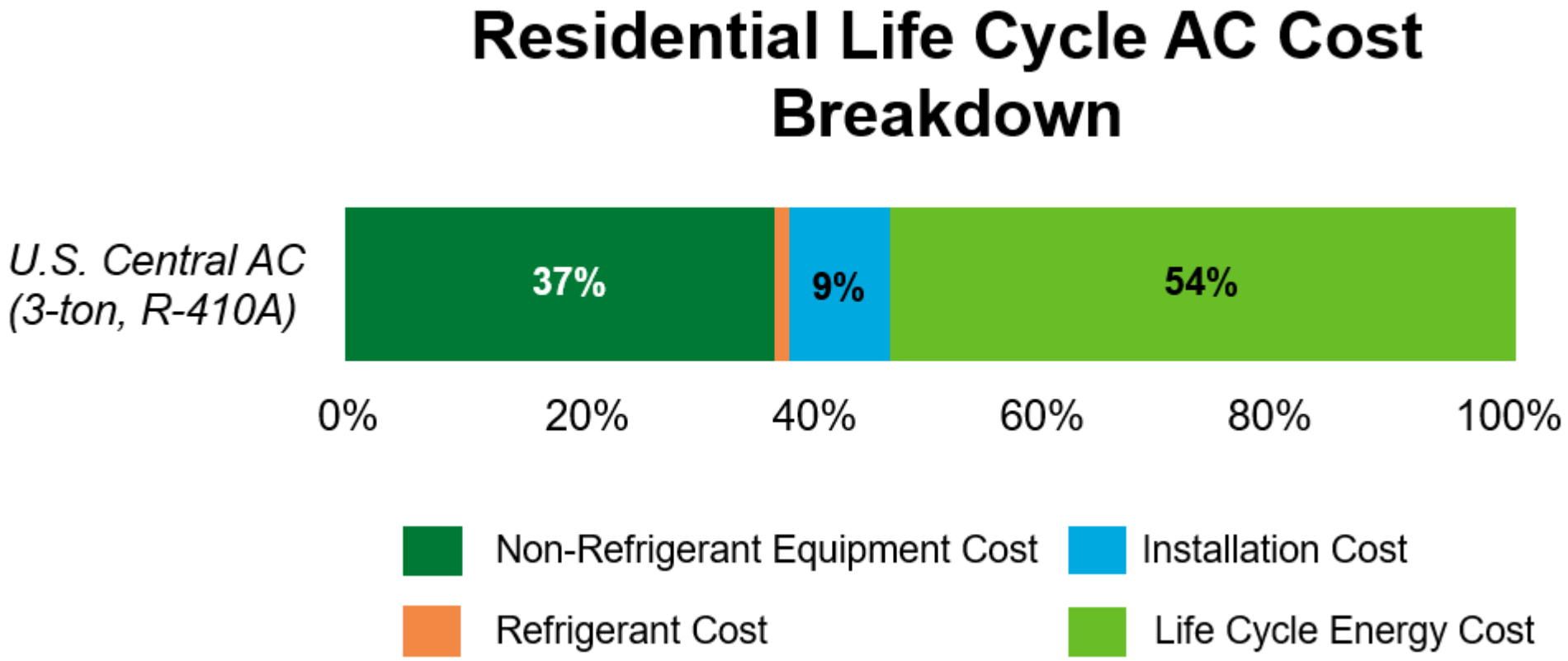
What added costs are associated with a refrigerant change?

- Factory changes
- Design changes
- Performance optimization
- Certify new products
- Additional safety features (sensors for A2Ls)
- Transportation costs
- Technician training
- Different tools

➢Specific to California market

➢AC costs come down over time (learning curve)

Energy costs dominate the life cycle costs of ACs



[Source: "The Future of Air Conditioning for Buildings, 2016]

Room AC + Dehumidifiers
Preliminary Cost Estimates (stakeholder input/reports)

small self-contained AC + dehumidifiers

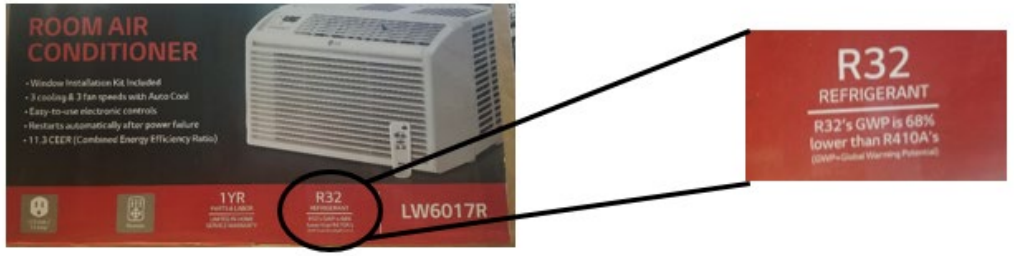
portable

window and through-the-wall

packaged terminal AC (PTAC)
packaged terminal HP (PTHP)

dehumidifiers

- How many self-contained AC + dehumidifiers are shipped to California?
- Some units are sold with R-32 at no added cost. What % of the market is now R-32?
- What alternatives refrigerants are being considered for PTHP and dehumidifiers?



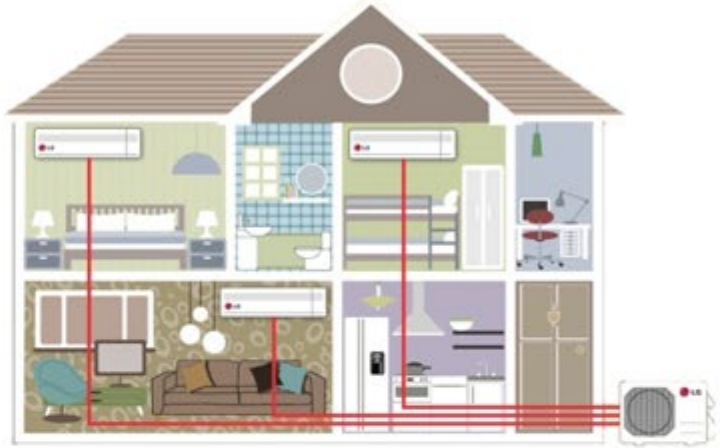
R-32 available today (GWP <750)

Residential AC
Preliminary Cost Estimates (stakeholder input/reports)

packaged systems

split systems (ducted)

split systems (ductless)



	Baseline (Avg.)	Added Cost
Equipment	$4,000	5-15%
Installation	$3,200	0-10%
Maintenance/Repairs	?	0-10%

Commercial AC
Preliminary Cost Estimates (stakeholder input/reports)

Small – Medium (<50 lb.)

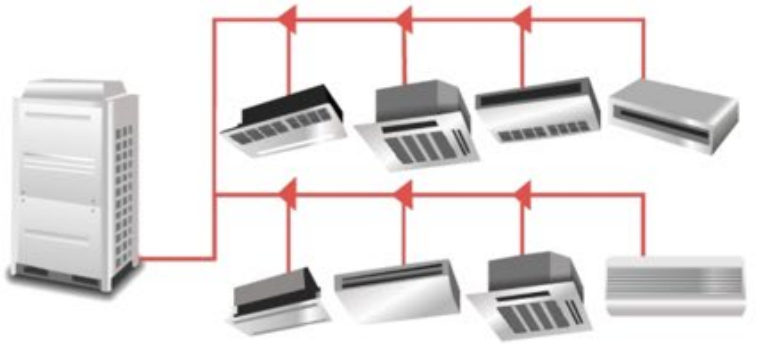
65,000 – 185,000 BTUH
(5 to 15 Ton)

Large (50 lb. +)

185,000 BTUH+
(16 to 60 Ton)

	Baseline (Avg.)	Added Cost	Baseline (Avg.)	Added Cost
Equipment	**$9,000**	**5-15%**	**$25,000**	**5-15%**
Installation	**$7,200**	**0-10%**	**$20,200**	**0-10%**
Maintenance/ Repairs	**?**	**0-10%**	**?**	**0-10%**

Variable Refrigerant Flow/Volume (VRF/VRV) Preliminary Cost Estimates (stakeholder input/reports)



	R-410A	Added Cost
Equipment	$30,000	5-15%
Installation	$24,000	0-10%
Maintenance/Repairs	?	0-10%

1. How much more energy efficient are these systems?
2. How much do these systems leak?

California Market Characterization – How many units?

In 2018…

14 million homes
100,000 new homes

→ 54% existing homes have a central AC
100% new homes install a central AC
system lifetime: 15 years

→ 7.6 million existing systems
504,000 system replacements
100,000 new systems

AHRI Shipment Data: 640,000 units *(8% of U.S. Sales)*
37,000 units *(12% of U.S. Sales)*

>700,000 commercial and other nonresidential buildings

→ 100% of new buildings have an AC
System lifetime 15 years

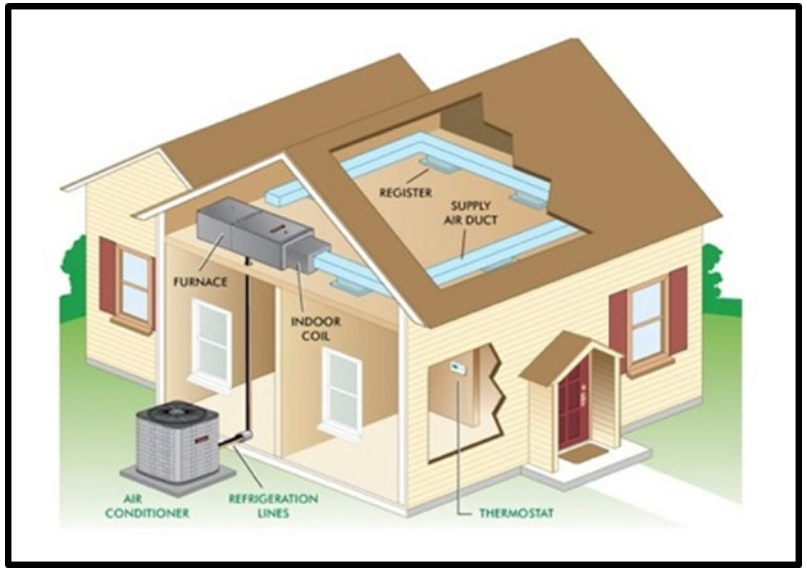
→ 900,000 existing systems
60,000 system replacements
10,000 new systems

…proposed regulation takes effect in 2023

Market Characterization – System Replacement and Repairs

New Equipment
- First installation or full system changeout
- Component replacement

1. What portion of shipments are for full system changeouts versus single component replacements?
2. How can we allow for component replacement?

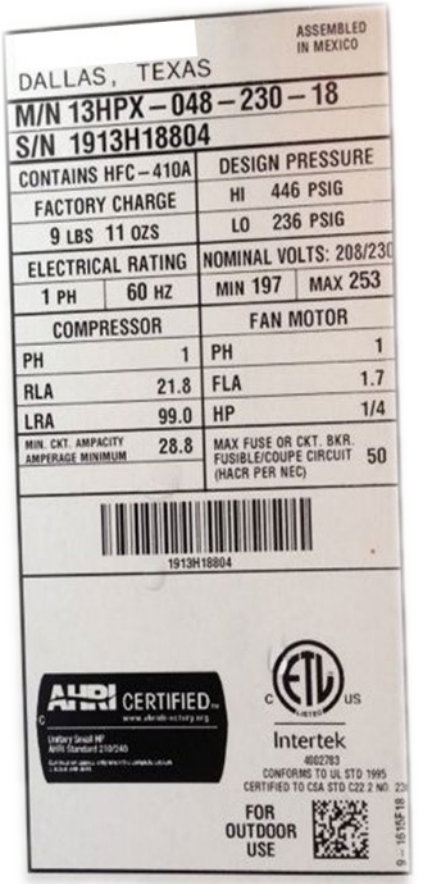


Enforcement Requirements (Stakeholder Input Requested)

Enforcement Requirements

- Recordkeeping (manufacturers/distributors)
- Date and refrigerant type included on label

Dates can currently be encoded, what would the impact be of a requirement to use a format that clearly indicates the year?



Enforcement Requirements

Residential Central AC

New Construction Market

Typical Distribution Chain

Replacement Market

Typical Distribution Chain

Direct-to-Dealer Distribution Chain

Do other types of equipment also use these distribution pathways?

[Source: U.S. Department of Energy, Technical Support Document, 2016]

Regulatory Alternatives (Stakeholder Input Requested)

Next Steps and Anticipated Timelines

Stationary AC Equipment	
Public workshops and Stakeholder meetings	1st workshop: October 2018
	Technical Working Group: March 6, 2019
	Technical Working Group: August 6, 2019
	2nd Workshop: Fall 2019
45-Day Notice	March/April 2020
Board Meeting	May 2020
Regulation Effective Date	January 1, 2023

To consider your input on the cost data in our economic analysis, we need your feedback by ***September 1***

Feedback and Questions – Contact Us

Richie Kaur, Proposed HFC Regulations on Refrigeration, Virgin Refrigerant Sales Limit
richie.kaur@arb.ca.gov; (916) 323-1506

Kathryn Kynett, Proposed HFC Regulation on AC
kathryn.kynett@arb.ca.gov; (916) 322-8598

Glenn Gallagher, SB1013 and Proposed HFC Regulations
glenn.gallagher@arb.ca.gov

Aanchal Kohli, Incentive Funding and Proposed HFC Regulations
aanchal.kohli@arb.ca.gov

Pamela Gupta, Manager, Greenhouse Gas Reduction Strategy Section
pamela.gupta@arb.ca.gov

Michael FitzGibbon, Branch Chief, Research Division
michael.fitzgibbon@arb.ca.gov

For more information, please visit:
Stationary Hydrofluorocarbon Reduction Measures Website

Technical Working Group Meeting
Proposed HFC Limit for Stationary Refrigeration Equipment

August 6, 2019

Richie Kaur

Greenhouse Gas Reduction Strategy Section

Research Division

California Air Resources Board

Richie.kaur@arb.ca.gov

Phone: (916) 323-1506

Today's Presentation

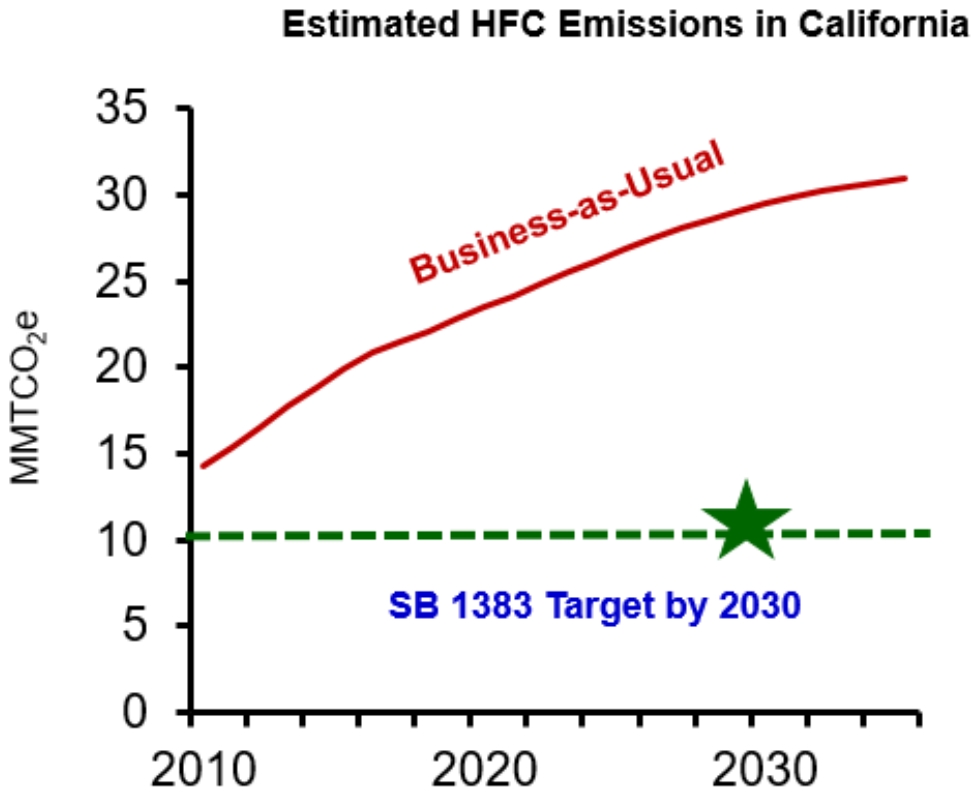
- Background
- Proposed HFC Regulations
- Regulatory Process Overview
- Economic Analysis (SRIA)
- GWP Limit on Stationary Refrigeration Equipment
- Discussion Topics – Seeking Stakeholder Input
- Next Steps and Anticipated Timelines

Background

HFCs are the fastest growing greenhouse gases

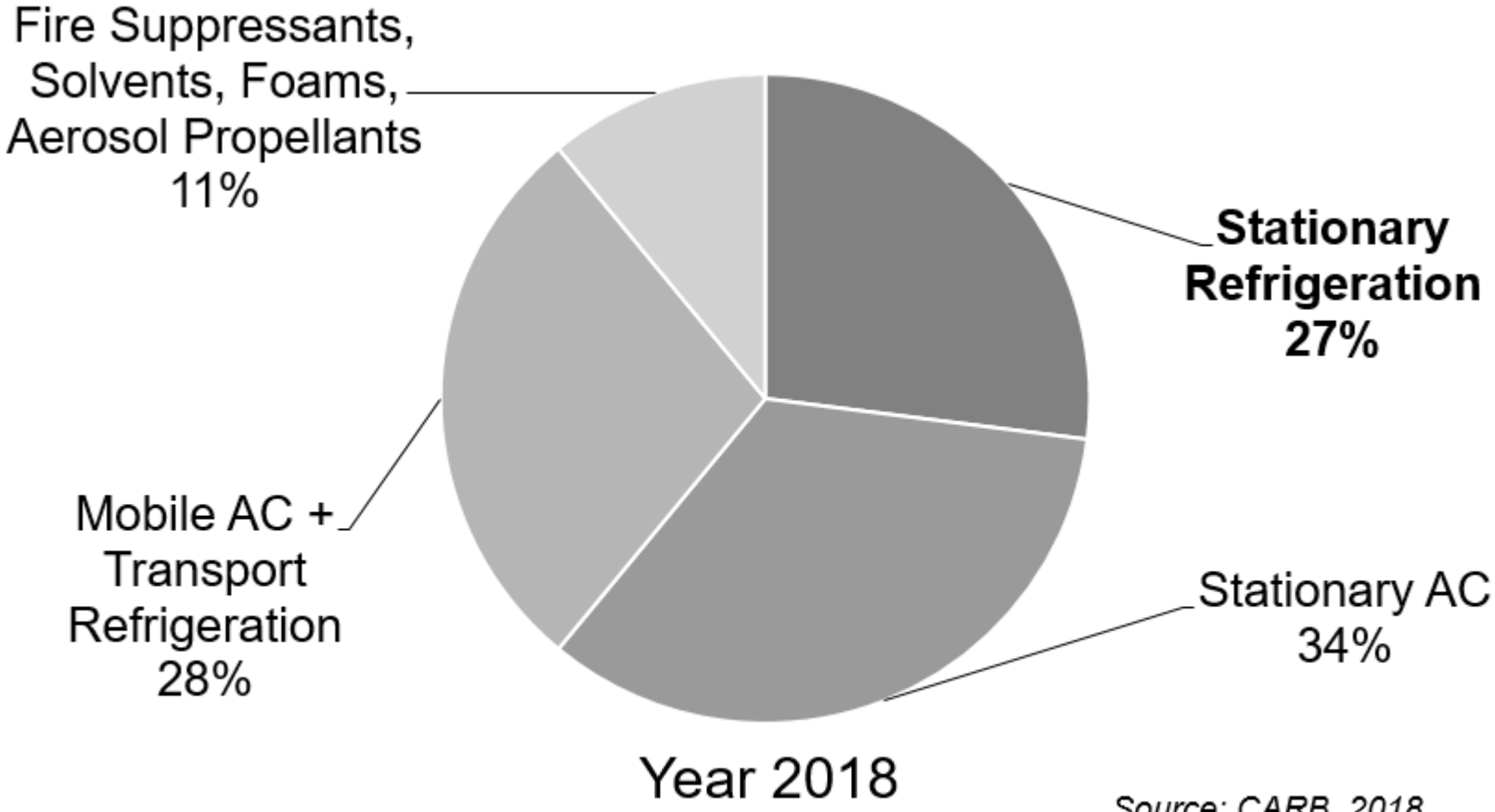
- Currently 4% of California GHG emissions **(Increasing to 10% by 2030 under BAU)**

- SB 1383 reduction goal: 40% below 2013 levels by 2030 **(one-half of today's HFC emissions)**



Source: CARB, 2018

Sources of HFC Emissions in California



Source: CARB, 2018

Majority of Emissions from Refrigeration and AC Sector

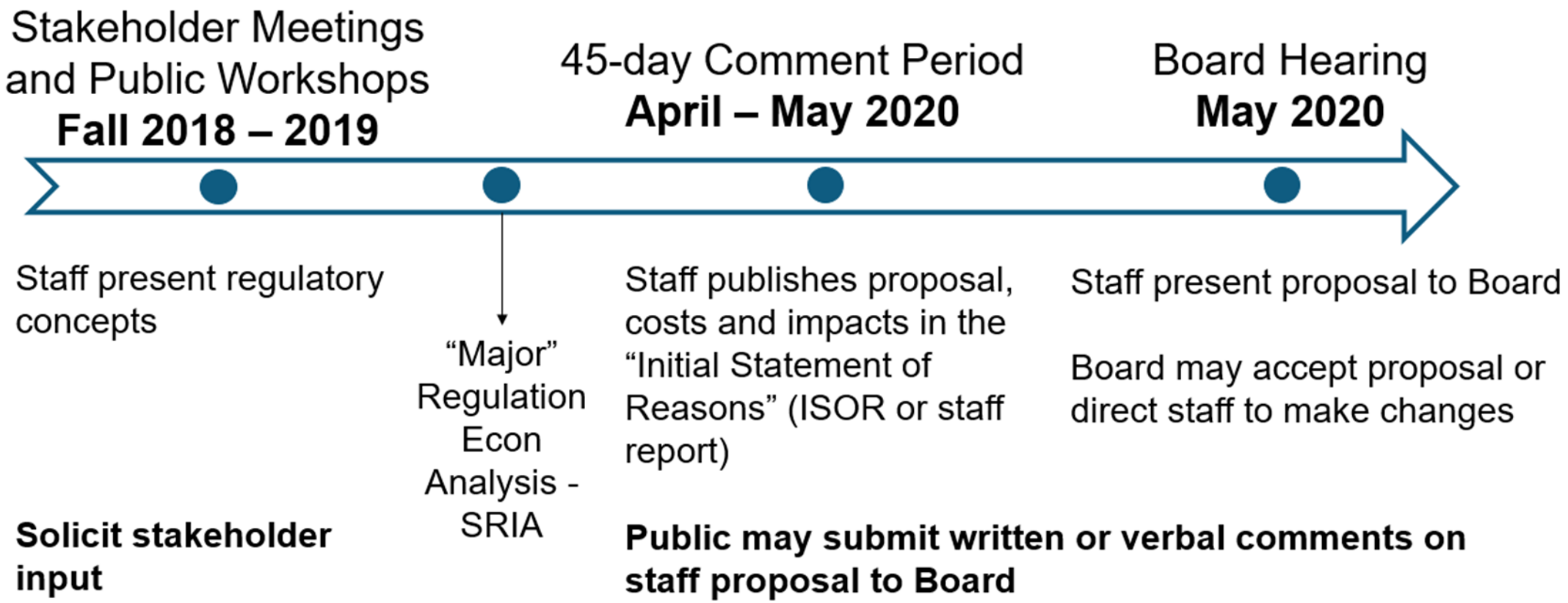
Proposed HFC Regulations

Proposed HFC Reduction Measures Overview

- **Proposed Equipment GWP Limits (Board Hearing, May 2020)**
  - **Stationary Refrigeration**: New equipment containing more than 50 lbs. of refrigerant, GWP < 150, starting January 1, 2022
  - **Stationary AC**: New Equipment, GWP < 750, starting January 1, 2023
- **Proposed Virgin Refrigerant Sales Prohibition (Separate Board Hearing, TBD)**
  - No sales, distribution, or import for use in California, of virgin refrigerants with a GWP of 1500 or greater (GWP threshold still under consideration)

Regulatory Process Overview

Regulatory Process Overview



Economic Analysis: Standardized Regulatory Impact Assessment (SRIA) Overview

SRIA Overview

- Required if estimated economic impact (costs and savings) exceeds $50 million, i.e., “major” regulation

- Included in the economics chapter in the ISOR (released as part of the 45-day notice)

SRIA Overview (Cont'd)

- The SRIA includes:
  - Direct Costs and Benefits to Businesses, Individuals, Environment
  - Macroeconomic Impacts (jobs, investment, income) in California
  - Fiscal Impacts
  - Analysis of Regulatory Alternatives

- **CARB seeks and considers information given by stakeholders.**

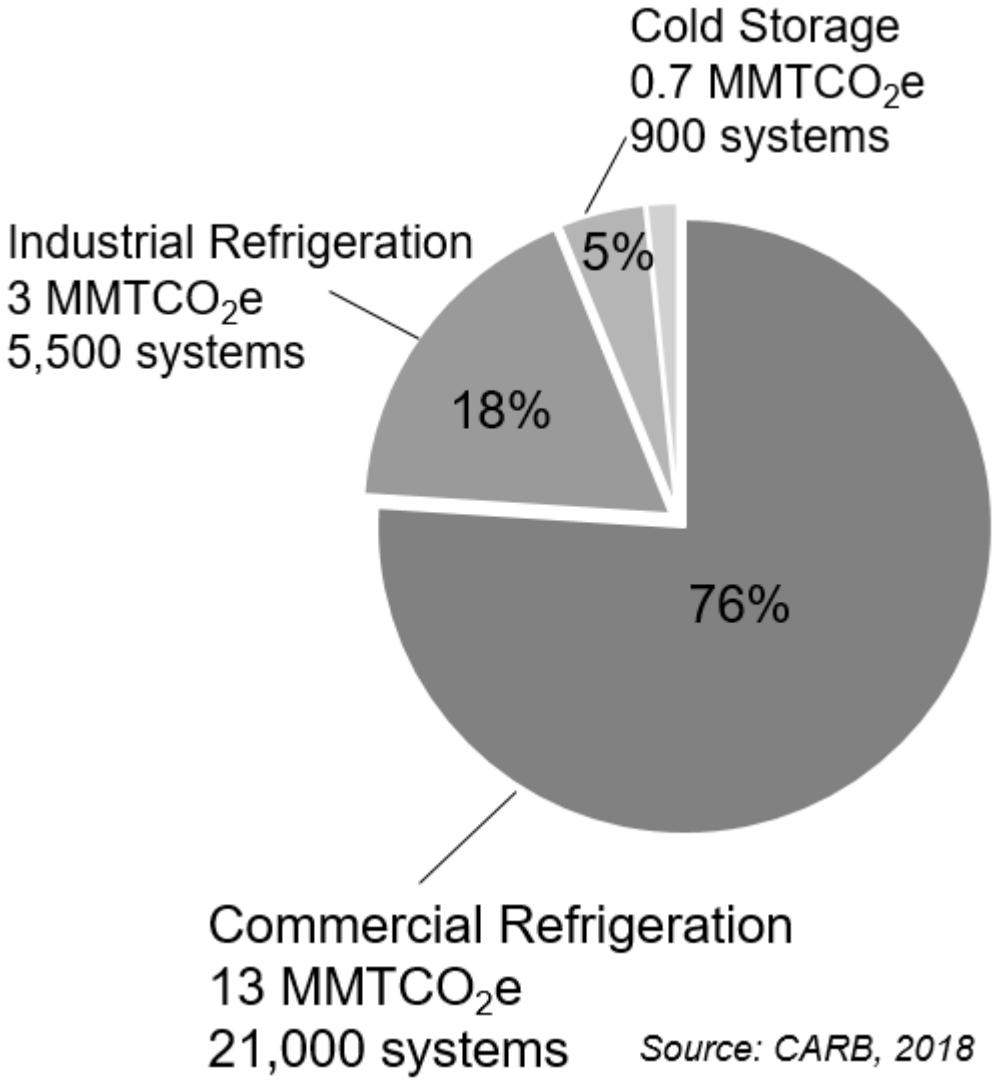
Proposed GWP Limit on Stationary Refrigeration Equipment

Proposed GWP Limit on Refrigeration Equipment

- **New equipment containing more than 50 pounds of refrigerant,**
- **GWP < 150, January 1, 2022**
- Affected End-uses
  - Commercial Refrigeration – retail (supermarkets, grocery stores) + non-retail
  - Industrial Process Refrigeration – manufacturing and/or processing
  - Cold Storage – warehouses, packaging and storage facilities

Image for illustrative purposes only. Sources: wikipedia.com, gea.com, shutterstock.com

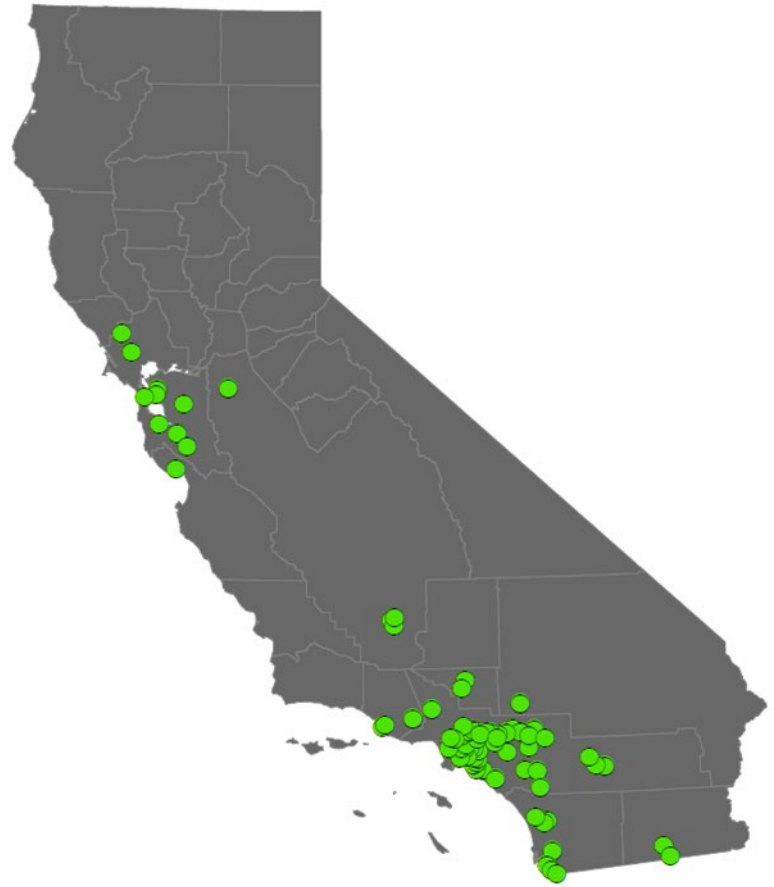
Current HFC Use in Stationary Refrigeration > 50 lb. Systems in CA



- RMP – largest systems reporting refrigerant purchase, use and leaks since 2012
- 6,600 facilities; ~28,000 systems
- Total banked refrigerant: 17 $MMTCO_2e$
- Average GWP: 2,700

Low-GWP options for Stationary Refrigeration

End-Use Sector	System Sizes	Low-GWP Options Currently Available
Supermarkets and grocery stores	Large (≥ 2000 lb)	t-CO_2, HC/CO_2, NH_3/CO_2, HFO?
	Medium (200 – 2000 lb)	
	Small (50 – 200 lb)	t-CO_2 , HCs, HFO?
Cold storage warehouses, Industrial refrigeration	All Sizes	***Majority already use NH_3*** others: NH_3/CO_2 , HFO?



100+ supermarkets in California using low-GWP refrigerants in 2018

Discussion Topics (Stakeholder Input Requested)

1. Economic Impacts
2. a) Enforcement Requirements; b) Definition of “New Refrigeration Equipment”
3. Feasibility of 150 GWP Limit for New and Existing Facilities
4. Feasibility of 750 GWP Limit on Refrigeration/Process Chillers
5. Regulatory Alternatives

Discussion Topics (Stakeholder Input Requested)

1. Economic Impacts

1. Economic Impacts

Data requested for SRIA:

- Growth rates of affected equipment
- Baseline costs – costs of traditional HFC systems (first + ongoing costs)
- Added costs – How much more does it cost for < 150 GWP systems compared to baseline?

End-user cost estimates will be discussed in this presentation

Commercial Refrigeration
Preliminary Cost Estimates (stakeholder input/reports)

- Supermarkets: 45,000 sq. ft. size, average charge 3,500 lb.
- Grocery stores: 15,000 sq. ft. size, average charge 1,000 lb.
- Other: Non-retail and other retail

End-Use	Equipment Costs $		Installation Costs $		Routine Maintenance $/year		Refrigerant $/lb.		Added Electricity $/year
	Baseline	Added (%)	Baseline	Added (%)	Baseline	Added (%)	Baseline	Added (%)	
Supermarkets	600,000 to 1M	15% to 20%	250,000 to 450,000	-10% to +10%	5,000 to 7,000	TBD	5 to 10	-30% to -50%	Potential Savings
Grocery Stores	200,000 to 300,000		90,000 to 140,000		2,000 to 3,000				
Other	Baseline: 30% lower than retail Added: Same as above								

Industrial Process Refrigeration & Cold Storage Except Chillers Preliminary Cost Estimates (stakeholder input/reports)

- Large Facilities, Average Refrigerant Charge 8,500 lb.
- Medium and Small Facilities: Average Refrigerant Charge 1,000 lb.

Facility Size	Equipment Costs $		Installation Costs $		Routine Maintenance $/year		Refrigerant $/lb.		Added Electricity $/year
	Baseline	Added (%)	Baseline	Added (%)	Baseline	Added (%)	Baseline	Added (%)	
Large	800,000 to 1.2M	15% to 20%	200,000 to 300,000	-10% to +10%	5,000 to 7,000	TBD	5 to 10	-30% to -50%	-10% to -20%
Medium and Small	200,000 to 400,000		50,000 to 100,000		2,000 to 3,000				

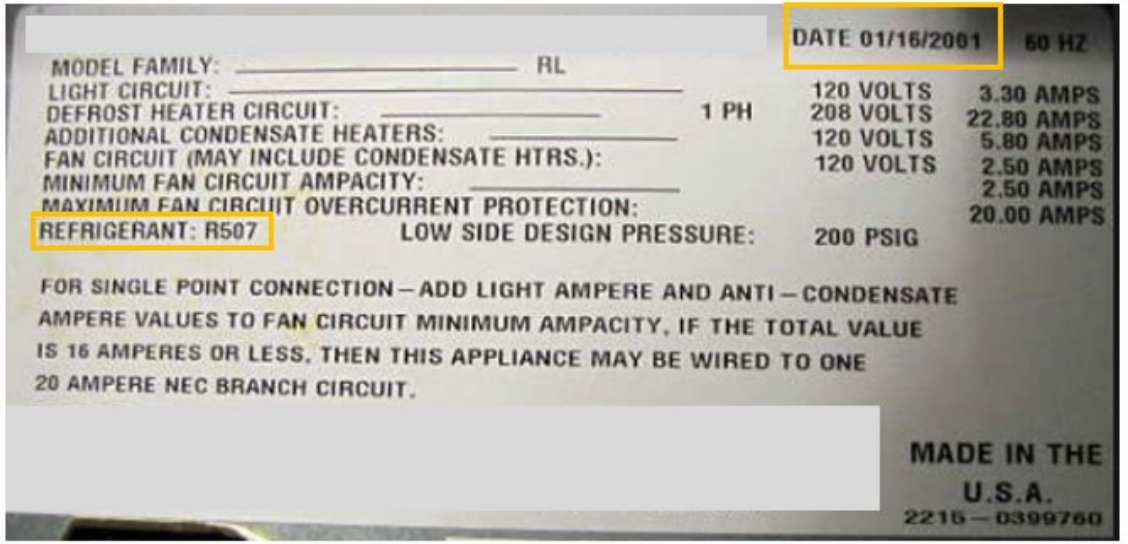
Discussion Topics (Stakeholder Input Requested)

2a. Enforcement Requirements

Enforcement Requirements

Manufacturers

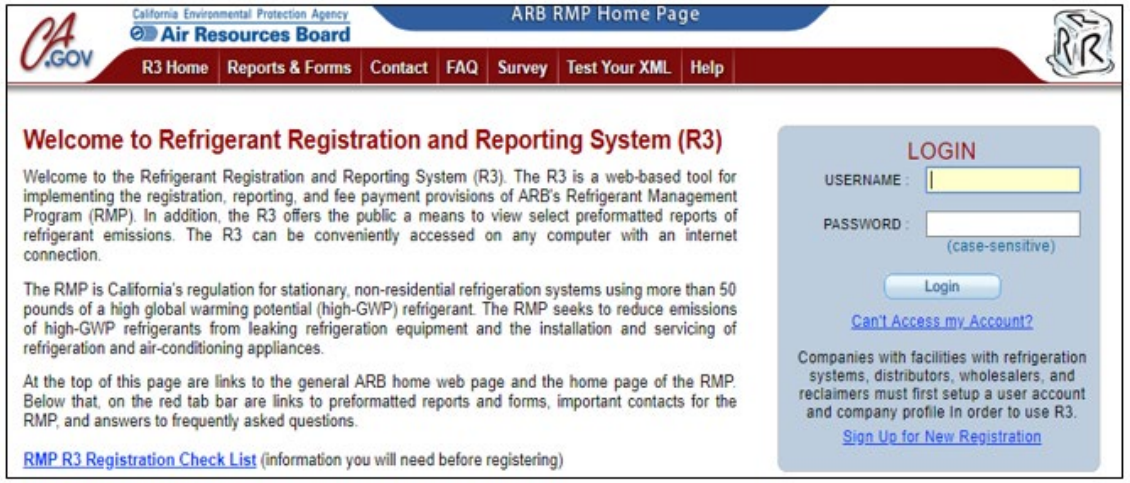
- Recordkeeping
- Date and refrigerant type included on label



End-users

- One-time registration for <150 GWP facilities in RMP (no fee)

Q. Any challenges?



Defining "New Refrigeration Equipment"

Current definition of "New Refrigeration Equipment" in CARB's 2018 Regulation[1]:

(1) Any refrigeration equipment that is **first installed using new or used components**;
or
(2) Any refrigeration equipment that is **modified** such that it is: (i) Expanded after the date at which this subarticle becomes effective, to handle an expanded cooling load by the addition of components in which the **capacity of the system is increased**, including refrigerant lines, evaporators, compressors, condensers, and other components; or (ii) Replaced or cumulatively replaced after the date at which this subarticle becomes effective, such that the **capital cost of replacing or cumulatively replacing components exceeds 50 percent of the capital cost of replacing the entire refrigeration system.**

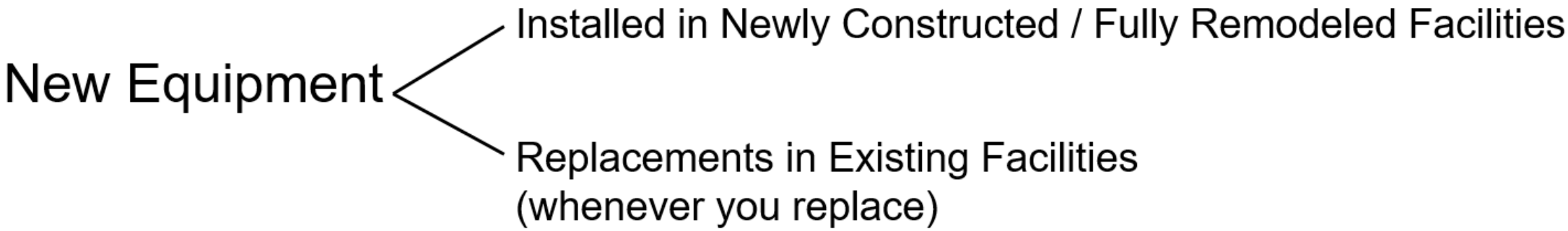
Q. Will this definition work for this proposed regulation?

1 HFC Rulemaking webpage

Discussion Topics (Stakeholder Input Requested)

3. Feasibility of 150 GWP Limit for New and Existing Facilities

Feasibility of Low-GWP Equipment in New and Existing Facilities



Why is this important?

e.g., ~4,000 supermarkets in CA; New construction: Only 1 – 2% per year

Most of the new systems will go into existing stores

Q. Feasibility of low-GWP systems in existing stores, for all system sizes > 50 lb.?

Discussion Topics (Stakeholder Input Requested)

4. Feasibility of 750 GWP Limit on Refrigeration / Process Chillers