2022 AQMP: RESIDENTIAL AND COMMERCIAL BUILDINGS

Working Group Meeting #5

September 9, 2021

https://scaqmd.zoom.us/j/95318386582

Teleconference Dial In:+1 669 900 6833

Webinar ID: 953 1838 6582

Agenda

- Summary of the previous Working Group Meeting
- State and local building policies
- Residential and commercial space and water heating
  - Zero and near-zero emission technologies
  - Preliminary staff considerations for new buildings
  - Control measure updates
- Residential and commercial cooking
  - Zero and near-zero emission technologies
  - Control measure updates
- Next Steps

Summary of Previous Working Group Meeting

- **June 17, 2021 WG Meeting:**
  - Approach for residential and commercial building control measures for the 2022 AQMP
  - Proposed concepts for 2022 AQMP residential and commercial building control measures by source categories

STATE AND LOCAL BUILDING POLICIES

State and Local Agencies Building Policies

- Current California Energy Commission (CEC) Title 24 rule development (2022 code) will set the energy baselines that builders must adhere to in new construction from 2023 onward, including mandatory requirements for:
  - Single family, multifamily, and commercial new buildings electric ready measures
- California Air Resource Board (Resolution 20-32 California Indoor Air Quality Program Update on November 19, 2020) supports:
  - "Updates of the Title 24 2022 Code for electrification of appliances, including stoves, ovens, furnaces, and space and water heaters, for all new buildings"
  - "Development of rules and/or best practices, in coordination with air districts, to reduce NOx and other harmful appliance emissions, and promote electrification"
- Bay Area AQMD is initiating a rulemaking process and proposing zero emission space and water heating by 2029 for residential buildings

Local Building Policies

- According to an article by Sierra Club*, as of August 2021, 49 cities primarily in Northern California have adopted ordinances to reduce their reliance on gas, among which:
  - About 40 cities mandate all-electric space and water heating for residential new buildings
  - Some of the ordinances also require:
    - All-electric cooking and laundry dryers for residential buildings; and/or
    - All-electric appliances for commercial buildings or all buildings (exceptions apply)
  - Others require all-electric readiness and higher energy efficiency with mixed fuel in advance of Title 24 requirements
- While most of those cities are near Bay Area, staff is not aware of any city in the South Coast AQMD that has adopted an all-electric appliance mandate

* *Reference: California's Cities Lead the Way to a Gas-Free Future | Sierra Club*

ZERO AND NEAR-ZERO EMISSION TECHNOLOGIES

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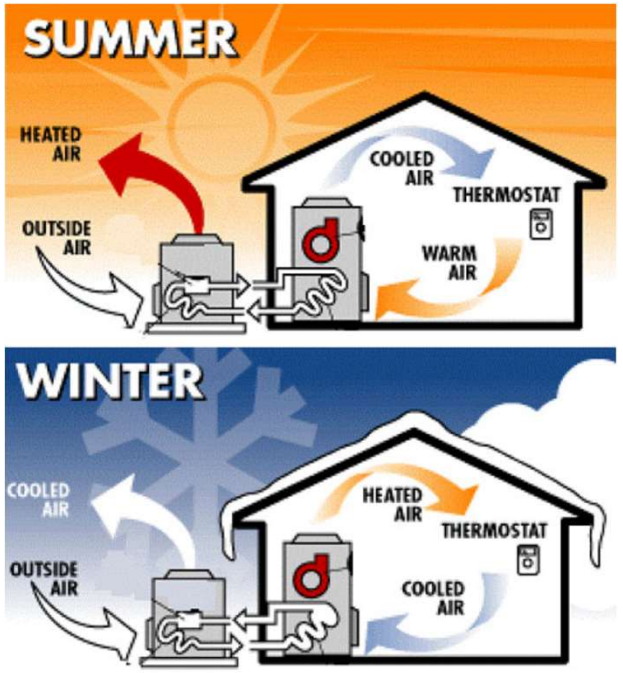
FOR SPACE AND WATER HEATING

Zero Emission Technologies

All-electric heat pump HVAC

- Uses electricity to run a compressor that transfer heat between warm and cool spaces
- Can provide heating and cooling replacing an air conditioning unit and furnace
- Pairs with an air handler to circulate and regulate indoor air
- More energy efficient than conventional gas equipment
- Especially effective for space heating in mild climates
- Primary strategy for decarbonizing space heating
- Operates at 220 volts or more that may require electric panel upgrade for existing buildings



https://bertieair.com/maintain-hvac-efficiency-in-unpredictable-weather

Heat pump water heaters

- Heat pumps also can be used to heat water – either as a stand-alone water heating system, or as combination water heating and air conditioning system
- Typically requires 220 volts or more
  - 120-Volt plug-in heat pumps are developed for residential water heating

Solar water heaters

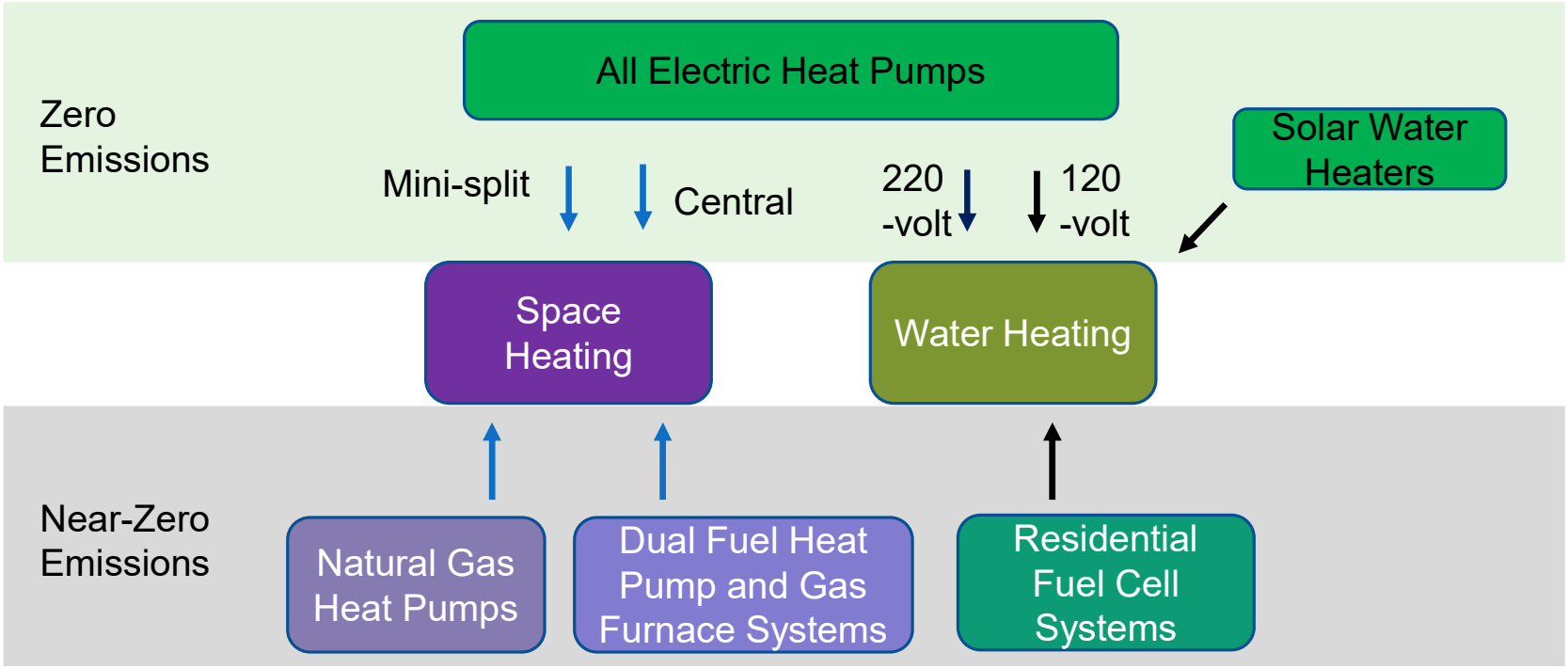
Near Zero Emission Technologies

- **Residential fuel cell system**
  - Has been available commercially in Europe since 2009
  - Comprised of a fuel cell unit and a hot water storage unit
  - The system generates electricity and heat through a chemical reaction combining hydrogen extracted from LP gas or natural gas with oxygen in the air
  - The heat can be used to supply hot water
- **Natural gas heat pumps**
  - A natural gas engine powers the heat pump's compressor in the outside unit and electricity powers the fans and controls
  - For space heating and cooling
- **Dual fuel heat pump and gas furnace system**
  - An electric heat pump with a traditional gas furnace
  - For space heating and cooling

Zero/Near-zero Emission Technologies - Challenges

- Challenges on implementing zero and near-zero emission technologies include:
  - Contractors and homeowners are more familiar with current fossil fuel technologies
  - High upfront cost associated with electrical panel upgrades for existing homes and buildings
  - Space for installation
    - A challenge for existing buildings
    - Not a major concern for future new buildings in California that would be all electric ready
  - In-depth analysis and discussion would be conducted in future rulemaking

Zero and Near-Zero Emission Technologies for Space and Water Heating



PRELIMINARY STAFF CONSIDERATIONS FOR NEW BUILDINGS

Proposed Control Measure for New Buildings

- Consider to implement zero emission technologies
  - For space and water heating appliances in residential and commercial new buildings

Residential New Buildings

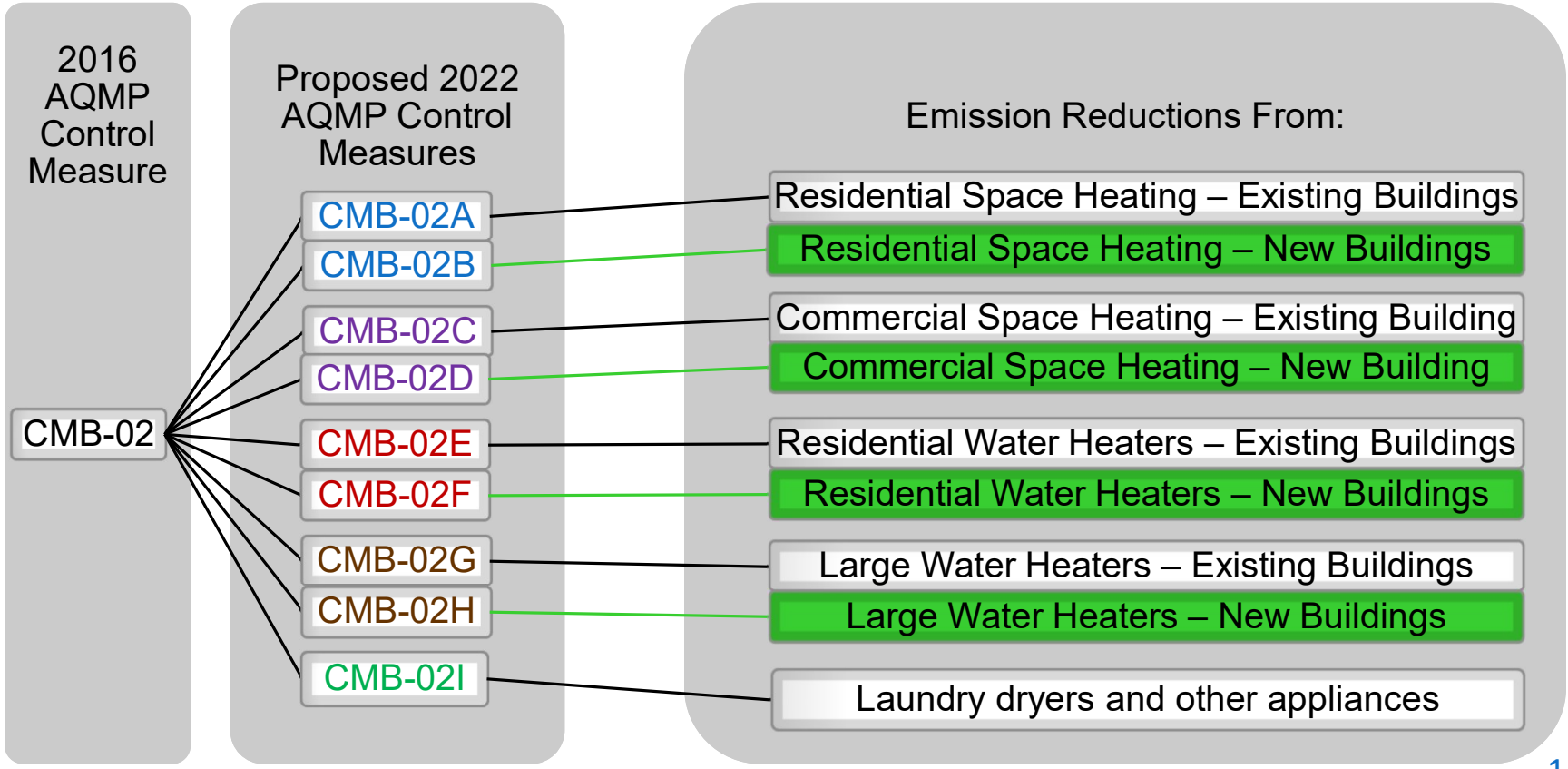
- Space heating
- Water heating

Commercial New Buildings

- Space heating
- Water heating

CONTROL MEASURE UPDATES - FOR SPACE AND WATER HEATING

Proposed 2022 AQMP Control Measures Based on CMB-02



2022 AQMP Initial Concepts for CMB-02A and CMB-02B

Emission Reductions From Residential Space Heating

Applicability

- Residential furnaces subject to Rule 1111 with heat input ≤175,000 BTU/hr:
  - CMB-02A: Existing buildings
  - CMB-02B: New buildings

Background

- Rule 1111
  - 65% NOx reduction (from 40 to 14 ng/j) starting October 2019
  - 14 ng/J furnaces available for:
    - Condensing and non-condensing furnaces
    - Weatherized furnaces*
  - Incentives early deployment through Clean Air Furnace Rebate Program

Emissions Inventory

- 11.7 tons per day NOx emissions (2018 inventory) (estimated 4.1 tons per day after full implementation)

* Compliance date for weatherized furnaces is October 2021

Residential Space Heating
CMB-02A – Existing Buildings

Implementation Approaches

- Continue to implement Rule 1111 and Clean Air Furnace Rebate Program for existing buildings
- Consider technology assessment for a lower NOx emission limit for future implementation (e.g., 7 ng/J)
- Expand incentives for zero emission technologies (e.g., all electric heat pump)

Estimated Emission Reductions

- Rule 1111 implementation:
  - ➢7.6 tons per day NOx reductions over 25 years (65% of 2018 inventory)
- Future Rule 1111 implementation for existing buildings if 7 ng/J NOx limit deemed feasible:
  - NOx reductions TBD
- Incentives:
  - ➢NOx reductions TBD

Residential Space Heating
CMB-02B – New Buildings

Implementation Approaches

- Propose zero-emission standard space heating for new homes through a regulatory implementation approach
- Explore other implementation approaches as part of the rule development process

Estimated Emission Reductions

- NOx reductions TBD

2022 AQMP Initial Concepts for CMB-02C and CMB-02D

Emission Reductions From Commercial Space Heating

Applicability

- Commercial space heating furnaces with heat input >175,000 BTU/hr and <2,000,000 BTU/hr (Space heating furnaces with higher capacity are regulated by Rule 1147)
  - CMB-02C: Existing buildings
  - CMB-02D: New buildings

Background

- Commercial space heating between 175,000 BTU/hr and 2,000,000 BTU/hr are unregulated for NOx emissions
- ~ 93 percent of commercial buildings use non-electric heating fuel[1]
- Baseline NOx levels for individual units are not known

Emission Inventory

- 2.5 tons per day NOx emissions (2018 inventory)

[1] *www.greenbiz.com/article/trend-commercial-buildings-go-all-electric*

Commercial Space Heating
CMB-02C – Existing Buildings

Implementation Approaches

- Develop rule to regulate NOx emissions from gas-fired furnaces between 175,000 and 2,000,000 BTU/hr
- Explore use of incentives for early adoption of zero emission technologies

Estimated Emission Reductions

- Rule implementation for existing buildings:
  - ➢NOx reductions TBD
- Additional reduction would be achieved by incentives

Commercial Space Heating
CMB-02D – New Buildings

Implementation Approaches

- Propose zero-emission standard space heating for new commercial buildings through a regulatory implementation approach
- Explore other implementation approaches as part of the rule development process

Estimated Emission Reductions

- NOx reductions TBD

2022 AQMP Initial Concepts for CMB-02E and CMB-02F

Emission Reductions From Residential Water Heaters

Applicability

- Residential water heater with heat input ≤ 75,000 BTU/hr:
  - CMB-02E: Existing buildings
  - CMB-02F: New buildings

Background

- Regulated by Rule 1121
- Last amended September 2004
- Current NOx emission limit of 10 ng/J (15 ppm) has been fully implemented since 2008

Emission Inventory

- 1.9 tons per day NOx emissions (2018 inventory)

Residential Water Heaters
CMB-02E – Existing Buildings

Implementation Approaches

- Potential Rule 1121 amendment for a lower emission limit if feasible for existing buildings
- Explore use of incentives for early adoption of zero emission technologies

Estimated Emission Reductions

- Rule 1121 implementation:
  - ➢NOx reductions TBD
- Incentives:
  - ➢NOx reductions TBD

Residential Water Heaters
CMB-02F – New Buildings

Implementation Approaches

- Propose zero-emission standard water heating for new homes through a regulatory implementation approach
- Explore other implementation approaches as part of the rule development process

Estimated Emission Reductions

- NOx reductions TBD

2022 AQMP Initial Concepts for CMB-02G and CMB-02H

Emission Reductions From Large Water Heaters/Small Boilers

Applicability

- Large water heaters/small boiler with heat input ≤ 2,000,000 BTU/hr:
  - CMB-02G: Existing buildings
  - CMB-02H: New buildings
- Includes pool heaters
- Excludes residential water heaters currently regulated under Rule 1121

Regulatory Background

- Regulated by Rule 1146.2
- Current NOx emission limit (established in 2006):
  - 14 ng/J (20 ppm) for new units
  - 55 ppm for existing units =< 400,000 BTU/hr
  - 30 ppm for existing units >400,000 BTU/hr and =< 2,000,000 BTU/hr

Emission Inventory

- 0.6 tons per day NOx emissions (2018 inventory)

Large Water Heaters/Small Boilers
CMB-02G – Existing Buildings

Implementation Approaches

- Potential Rule 1146.2 amendment based on the result of the upcoming technology assessment*
  - Analysis at 2006 amendment assessed 12 ppm NOx limit
- Consider incentives for replacing certain high emitting ≤ 0.4 MMBtu/hr units with zero emission units

Estimated Emission Reductions

- Future Rule 1146.2 implementation for existing buildings if 12 ppm NOx limit deemed feasible:
  - ➢ NOx reductions TBD
- Incentives
  - ➢ NOx reductions TBD

** Specified under Rule 1146.2 (c)(13)*

Large Water Heaters/Small Boilers
CMB-02H – New Buildings

Implementation Approaches

- Propose zero-emission standard water heating for new commercial buildings through a regulatory implementation approach
- Explore other implementation approaches as part of the rule development process

Estimated Emission Reductions

- NOx reductions TBD

Summary Of CMB-02 Series

Control Measures		Rules	Proposed Method Of Control
CMB-02A	Residential Space Heating - Existing Buildings	R1111 - 14 ng/J	• Regulatory approach: lower emission limit • Incentives for zero-emissions
CMB-02B	Residential Space Heating - New Buildings		• Regulatory approach: zero emissions
CMB-02C	Commercial Space Heating - Existing Buildings	Unregulated	• Regulatory approach: lower emission limit • Incentives for zero-emissions
CMB-02D	Commercial Space Heating - New Buildings		• Regulatory approach: zero emissions
CMB-02E	Residential Water Heating - Existing Buildings	R1121 - 10 ng/J (15 ppm)	• Regulatory approach: if lower emission limit would be feasible • Incentives for zero-emissions
CMB-02F	Residential Water Heating - New Buildings		• Regulatory approach: zero emissions
CMB-02G	Larger Water Heaters/Small Boilers - Existing Commercial Buildings	R1146.2 - 20 ppm	• Regulatory approach: lower emission limit • Incentives
CMB-02H	Larger Water Heaters/Small Boilers - New Commercial Buildings		• Regulatory approach: zero emissions
CMB-02I	Laundry Dryers and Other Appliances		• Incentives

ZERO AND NEAR-ZERO EMISSION TECHNOLOGIES

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FOR RESIDENTIAL AND COMMERCIAL COOKING

Zero/Near-Zero Emission Technologies

Residential Cooking

- **Electric Units**
  - No direct NOx emissions
  - Heat by passing electricity through heating elements such as below smooth ceramic top (radiant) or through traditional coils
- **Induction Cooktop**
  - No direct NOx emissions
  - Electric current directly heats cookware and prevents heat loss
  - Energy Efficient
- **Low NOx Burner Technologies (e.g., Lawrence Berkeley Lab Ring Burner)**
  - Can be applied to any type of gas burner
  - Demonstrated on gas cooktop and water heater
    - Requires further testing and commercialization
  - Up to 70% potential NOx reductions

https://www.homedepot.com/p/LG-STUDIO-30-in-Radiant-Electric-Cooktop-in-Stainless-Steel-with-Dual-Elements-and-SmoothTouch-Controls-LSCE305ST/300933334#overlay

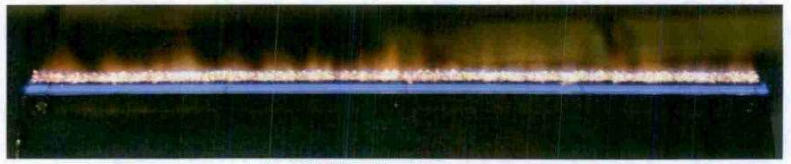
US application #15/942,915 filed on April 2, 2018, "Apparatus and Method for Burning a Lean, Premixed flame"

Zero/Near-Zero Emission Technologies

Commercial Cooking

- **Electric units**
  - Convection ovens, griddles, fryers, cooktops, broilers

- **Low NOx Burner Technologies**
  - **High Efficiency and Low-NOx Combo Ribbon Burner Combustion System for Baking Oven- *under development***
    - AQMD/GTI Contract: integrate ribbon & infrared burner in baking ovens
    - Up to 25% potential NOx reductions
    - Additional testing expected by 2022



Infrared-Ribbon Simultaneous Operation
SCAQMD/GTI Proposal "High Efficiency and Low-NOx Combo Ribbon Burner Combustion System Demonstration

  - **Ultra Low NOx Commercial Deep Fat Fryer- *under development***
    - AQMD/GTI Contract: 2 Fryer prototypes utilizing new and existing fryer designs
    - Up to 80% potential NOx reductions
    - Additional testing expected by the end of 2022
  - **Lawrence Berkeley Lab Ring Burner**
    - Can be applied to any type of gas burner; demonstrated on gas cooktop and water heater
      - Requires further testing and commercialization
    - Up to 70% potential NOx reductions

CONTROL MEASURE UPDATES

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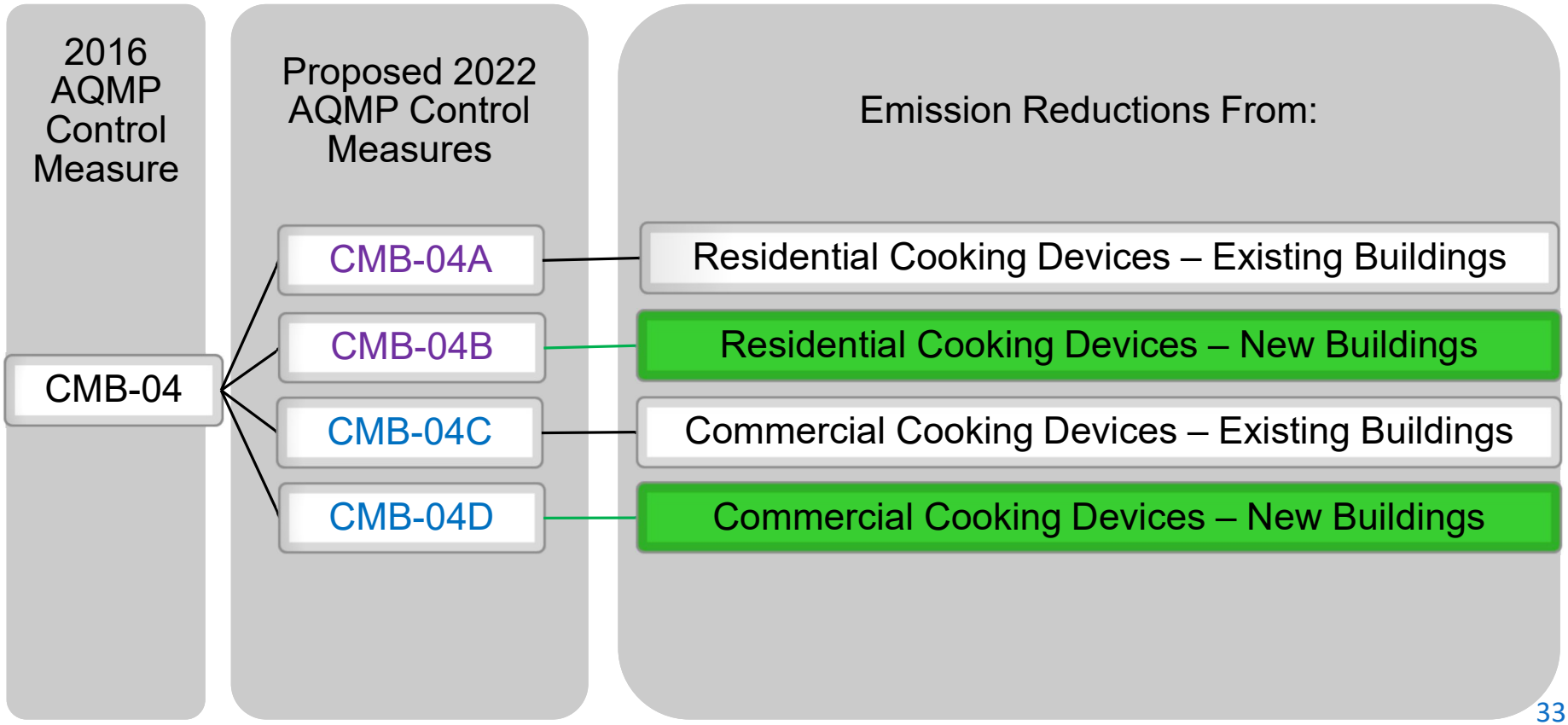
FOR RESIDENTIAL AND COMMERCIAL COOKING

Proposed 2022 AQMP Control Measures Based on CMB-04



2022 AQMP Initial Concepts for CMB-04A and CMB-04B

Emission Reductions From Residential Cooking Devices

Applicability

- Residential cooking devices:
  - Stoves
  - Ovens
  - Griddles
  - Broilers
  - Others

Background

- No regulation for NOx emissions
- Incentives for high energy efficiency units may be provided by some organizations
  - SoCal Gas
  - Southern California Edison

Emissions Inventory

- 1.3 tons per day NOx emissions (2018 inventory, updated)

Residential Cooking Devices
CMB-04A – Existing Buildings

Implementation Approaches

- Two-step approach
- Step 1: Conduct a technology assessment that includes emissions testing of various types of cooking devices to establish emissions rates
- Step 2: Based on the results of Step 1, develop a rule that applies to manufacturers, distributors, and installers establishing emission limits and explore use of incentives to encourage use of near and zero emission technologies

Estimated Emission Reductions

- NOx reductions TBD

Residential Cooking Devices
CMB-04B – New Buildings

Implementation Approaches

- Under development (e.g., regulatory requirements, incentives)
- Promote zero or near-zero technologies

Estimated Emission Reductions

- NOx reductions TBD

2022 AQMP Initial Concepts for CMB-04C and CMB-04D

Emission Reductions From Commercial Cooking Devices

Applicability

- Commercial cooking devices:
  - Ovens
  - Fryers
  - Roasters
  - Griddles
  - Broilers
  - Cooking stoves
  - Others

Background

- Most of commercial cooking devices are area sources that do not require an AQMD permit
- Rule 1153.1 regulates some commercial cooking devices
- Incentives for high energy efficiency units may be provided by some organizations
  - ENERGYSTAR Energy Efficiency Program

Emissions Inventory

- 1.2 tons per day NOx emissions (2018 inventory)

Commercial Cooking Devices
CMB-04C – Existing Buildings

Implementation Approaches

- Two-step approach
- Step 1: Conduct a technology assessment that includes emissions testing of various types of cooking devices to establish emissions rates
- Step 2: Based on the results of Step 1, develop a rule that applies to manufacturers, distributors, and installers establishing emission limits and explore use of incentives to encourage use of near and zero emission technologies
- Rule 1153.1 Emissions of Oxides from Commercial Food Ovens is currently undergoing an amendment, and a Best Available Retrofit Control Technology assessment is being conducted

Estimated Emission Reductions

- NOx reductions TBD

Commercial Cooking Devices
CMB-04D – New Buildings

Implementation Approaches

- Under development (e.g., regulatory requirements, incentives)
- Promote zero or near-zero technologies

Estimated Emission Reductions

- NOx reductions TBD

Next Steps

- Continue to identify low-emission and zero-emission technologies and implementation approaches
- Continue to evaluate the feasibility of proposed implementation approaches
- Continue technology assessment of various types of devices
- Estimate preliminary emissions reductions for future years
- Continue preliminary write up of a residential/commercial building control measures for 2022 AQMP and provide to WG for input

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