Proposed Amended Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters

Working Group Meeting #1

April 26, 2023, 10:00 AM (PDT)

Join Zoom Meeting:

https://scaqmd.zoom.us/j/96510927128

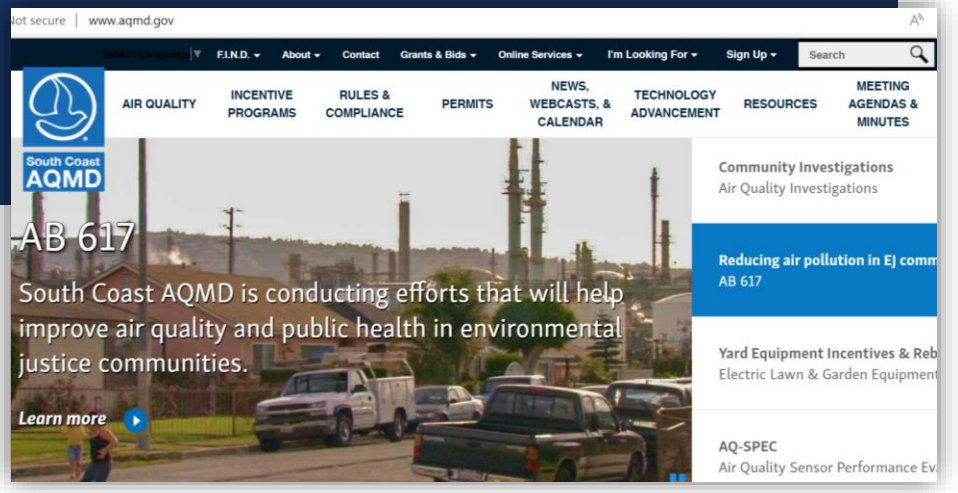
Meeting ID: 965 1092 7128

Agenda

- Background on Rulemaking Process
- Background on Rule 1146.2
- Rule Approach
- Key Challenges and Considerations
- Forthcoming Survey
- Next Steps
- Staff Contact

Rule Development Process Background

South Coast AQMD



Air Pollution Control Agency

- Orange County, portions of Los Angeles, San Bernardino, and Riverside Counties

Responsibilities

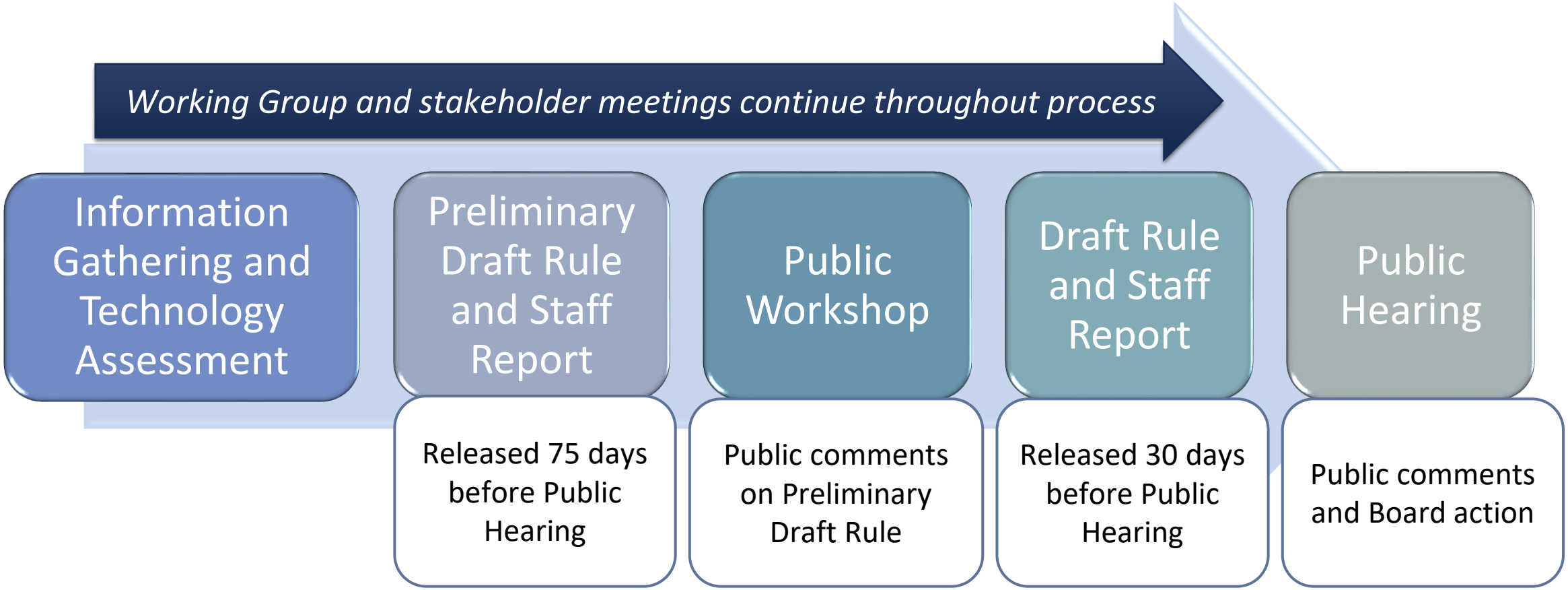
- Control emissions from stationary sources (e.g., power plants, refineries, gas stations, etc.)
- Monitor air quality and meet federal and state air quality standards
- Permit and inspect 28,400 affected businesses

South Coast AQMD rules (or regulations) provide mandatory requirements to:

- Implement control measures identified in the Air Quality Management Plan, Governing Board directives, or administrative needs; and
- Facilitate compliance with the federal Clean Air Act and to implement the state air quality program

Staff develops rules through a public process

Overview of Rule Development Process



Working Group Meetings

Comprised of stakeholders, including:
- Industry
- Environmental groups
- Community members
- Public agencies

Meetings are:
- Held throughout rulemaking process
- Open to public

Objective:
- Build consensus, work through issues
- Opportunity for early input
- Solicit feedback from regulated industry

Takeaways for:
- Stakeholders' issues and concerns
- Industry terms, practices, etc.
- Applicable control technologies

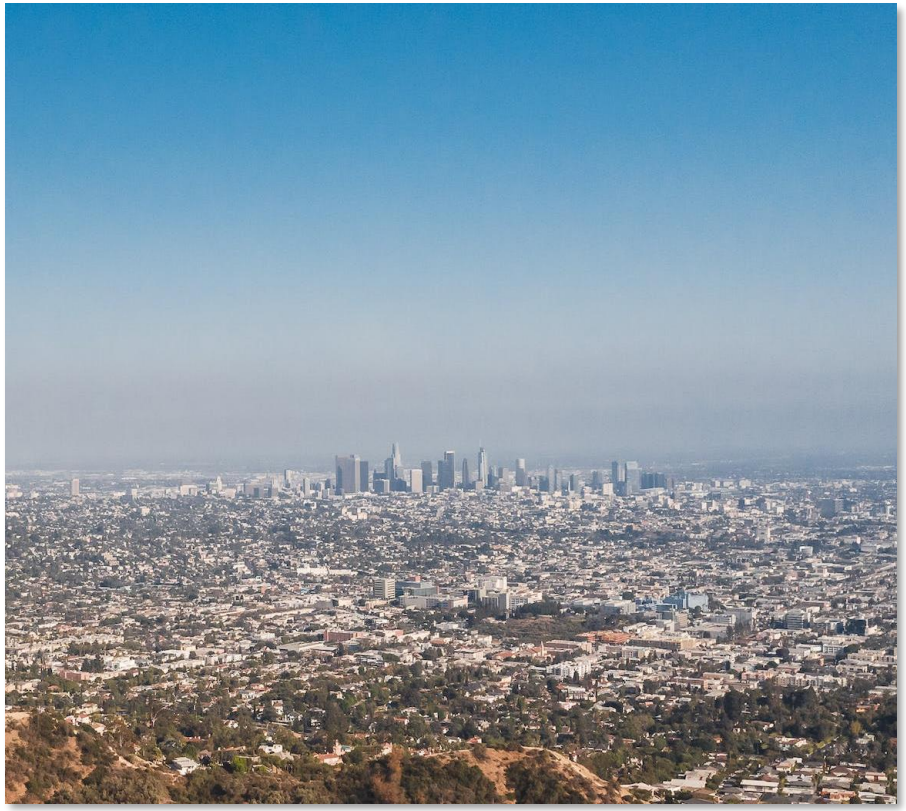
Stakeholder Input

- Stakeholders can provide input during working group meetings and the rulemaking process
- Early input is strongly encouraged to help develop proposed rule amendments and to address issues
- Working Group Meetings, individual meetings, and site visits allow staff to speak directly with stakeholders and discuss individual issues

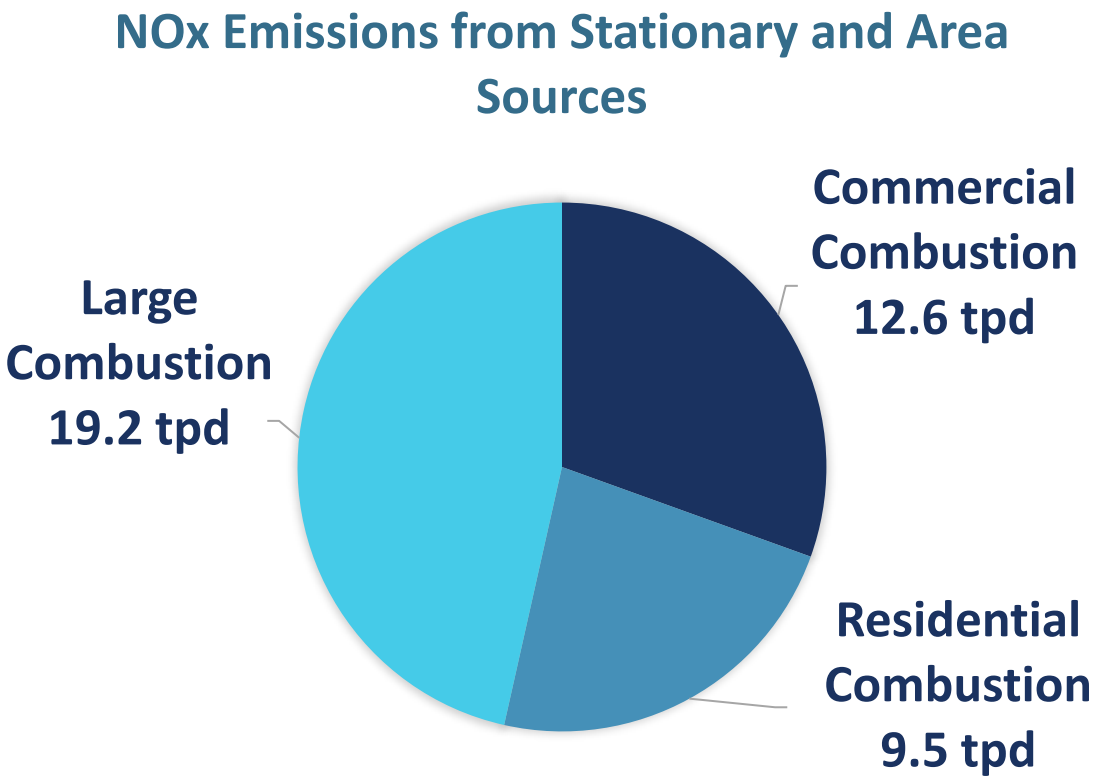
Rule 1146.2 Background

Residential and Commercial Sectors

- The South Coast Air Basin is home to around 17.5 million residents
  - 44% of the California population
  - Approximately six million housing units
  - Commercial space for shopping, entertainment, and places of employment
- Residential and commercial buildings differ widely
  - Periods of construction, size, purpose, and locations within different climate zones
- Consumption of energy within residential and commercial sectors results in both direct and indirect criteria pollutants and greenhouse gas emissions



Residential and Commercial Buildings Combustion Sources



- Appliances emit about 22.1 tons per day (tpd) of nitrogen oxides (NOx)
  - Roughly 54% of 2037 NOx emissions are from commercial and residential combustion
  - NOx emissions are primarily from space and water heating, cooking, and some other appliances combusting natural gas

Building Appliances – Zero-Emission Pathways in California

Bay Area AQMD (BAAQMD)

- Adopted Rules 9-4 and 9-6 in March 2023 establishing zero-emission standards with compliance dates ranging from 2027 to 2031 based on equipment type, use, and size for space and water heating equipment in residential and commercial buildings

California Air Resources Board (CARB)

- Commencing process to adopt a zero-emission standard for new space and water heaters sold in California beginning in 2030, as specified in the State Implementation Plan adopted in September 2022

California Energy Commission (CEC)

- Passed state building codes in 2021, effective in 2023, that encourage the proliferation of zero-emissions solutions

Los Angeles City Council

- Voted in 2022 to ban most gas appliances and hookups in new construction
- Will require all new residential and commercial buildings in Los Angeles to be built to achieve zero-carbon emissions

South Coast AQMD Residential and Commercial Buildings Working Group

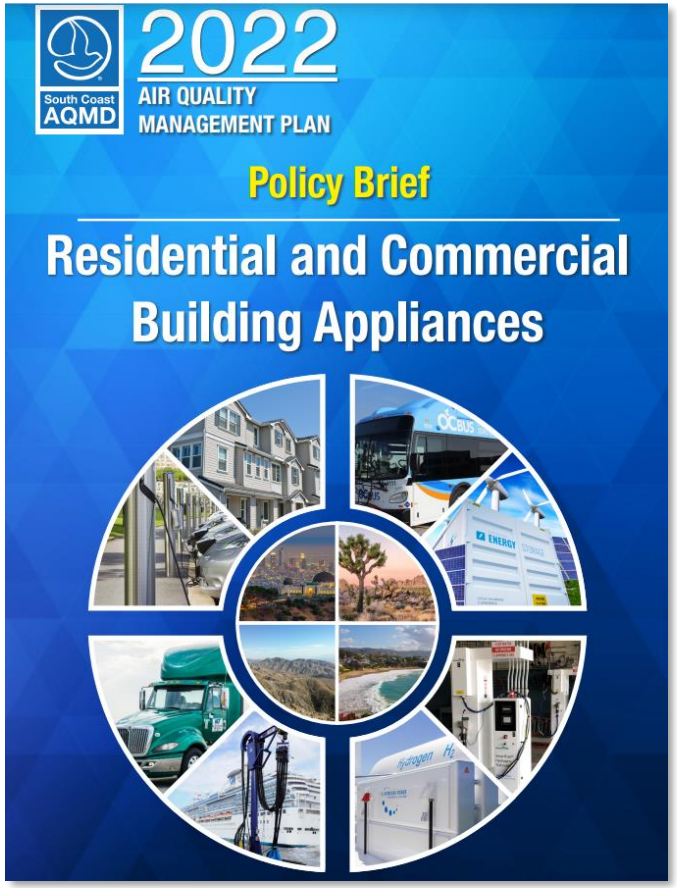
Residential and Commercial Buildings Working Group was established in December 2020 to develop control strategies

- Five meetings were conducted

The South Coast AQMD 2022 Air Quality Management Plan (AQMP)* was adopted in December 2022

For Residential and Commercial Buildings:

- Seven control measures were adopted
- One policy brief** was prepared



* http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan

** http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/buildings_final.pdf?sfvrsn=22

2022 AQMP Control Measures for Building Appliances

The 2022 AQMP establishes a path for improving air quality and meeting federal air pollution standards by 2037

- Aggressive push to zero-emission technologies required across all sectors wherever feasible to meet stringent standards

Focus on zero-NOx-emission standards for space heating, water heating, and cooking appliances

- Transitional alternative could be allowed if installing a zero-emission unit is determined infeasible, e.g.:
  - Colder climate zones
  - Architectural design obstacles

- **R-CMB-01 – Residential Water Heating** *(Rule 1121)*
- **C-CMB-01 – Commercial Water Heating** *(Rule 1146.2)*
- **R-CMB-02 – Residential Space Heating** *(Rule 1111)*
- **C-CMB-02 – Commercial Space Heating** *(New Rule 1111.1)*
- **R-CMB-03 – Residential Cooking** *(New Rule)*
- **C-CMB-03 – Commercial Cooking** *(TBD)*
- **R-CMB-04 – Residential Other Combustion Sources** *(TBD)*

Building Appliances Rule Development

Rule development will be conducted in phases, with the first phase focused on space and water heating:

Rulemaking Phase	Rule	2022 AQMP Control Measure	Anticipated Date
Phase 1 (current focus)	1146.2	C-CMB-01 (Commercial water heating)	September 2023
	1111	R-CMB-02 (Residential space heating)	2024 (first or second quarter)
	1121	R-CMB-01 (Residential water heating)	2024 (first or second quarter)
	1111.1 (new)	C-CMB-02 (Commercial space heating)	2024 (first or second quarter)
Phase 2	TBD (new)	R-CMB-03 (Residential cooking)	TBD
	TBD	R-CMB-04 (Residential other combustion sources)	TBD
	TBD	C-CMB-03 (Commercial cooking)	TBD

Commercial Water Heating

Control Measure C-CMB-01

- Reduce NOx emissions from commercial building water heating sources
  - Require zero-emission units for installations in new and existing buildings
  - Low-NOx transitional alternative when installing zero-emission unit infeasible

Rule 1146.2

- NOx emissions from natural gas-fired water heaters, boilers, and process heaters with a rated heat input capacity ≤ 2,000,000 Btu/hr
  - Applies to manufacturers, distributors, retailers, re-furbishers, installers, and operators
  - Requires unit model certification and recertification every three years by manufacturers
  - Last amended in 2006 to lower NOx emission limit from 30 to 20 ppm

Current Rule 1146.2 NOx Emission Limits

Type 1 (≤ 400,000 Btu/hr)

- Estimated 40,000 units
- NOx emission limit:
  - **14 nanograms per joule** (ng/J) (or **20 ppm** @3% O2)
  - Type 1 pool heaters: 40 ng/J NOx (55 ppm)

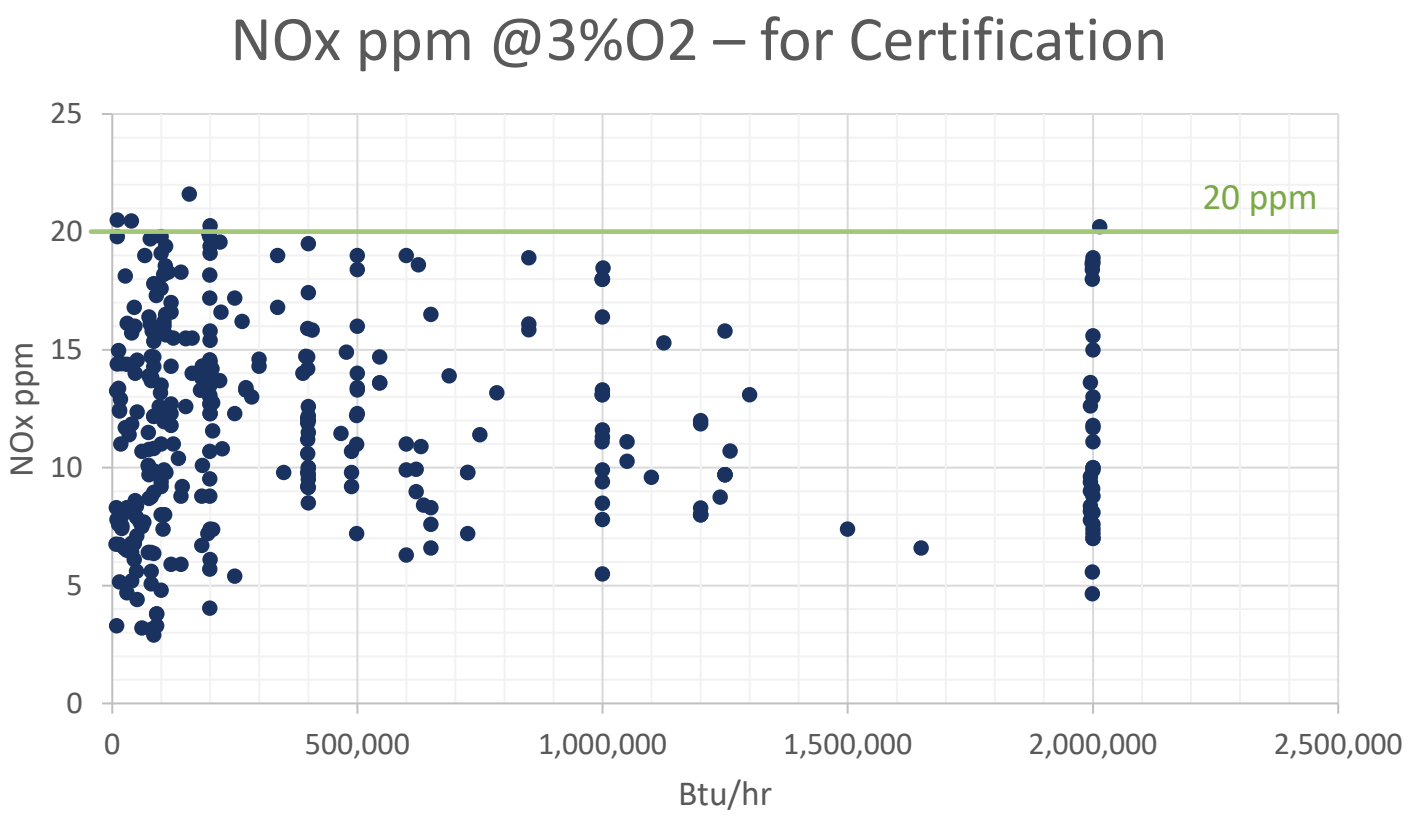
Type 2 (> 400,000 and ≤ 2,000,000 Btu/hr)

- Estimated 20,000 units
- NOx emission limit:
  - **14 nanograms per joule** (ng/J) (or **20 ppm** @3% O2)

2022 AQMP baseline emissions and emission reduction commitment

- NOx emissions inventory for C-CMB-01 in tons per day is 0.45 in 2032 and 0.42 in 2037
- AQMP emission reduction commitment for C-CMB-01 in tons per day is 0.04 in 2032 and 0.25 in 2037

Emission Levels Of Unit Models



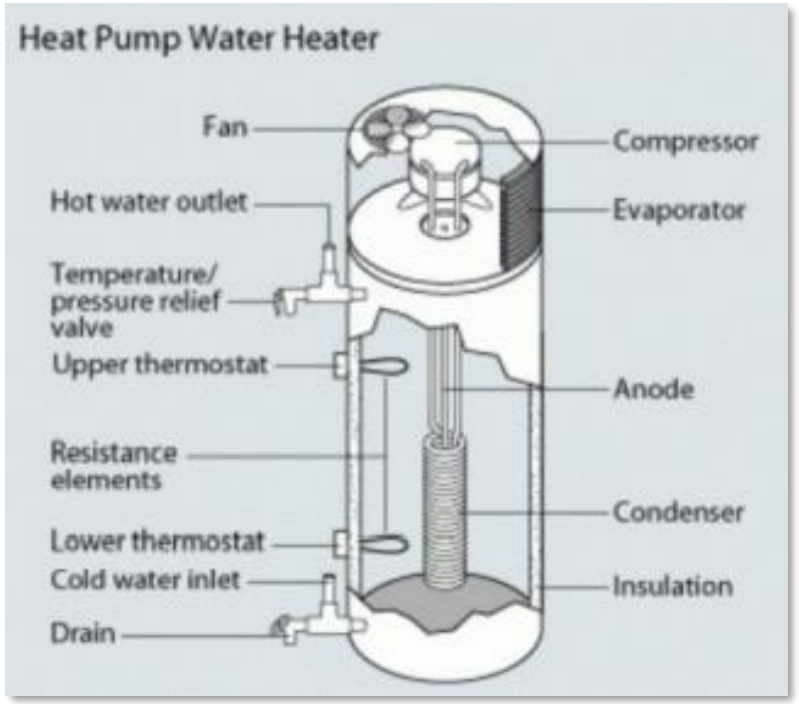
Staff reviewed 137 source tests conducted since 2017 for models required to be certified at 20 ppm for NOx emissions

- 39 models (28% of models) were tested <12 ppm
- 21 models (15% of models) were tested <10 ppm

Zero-Emission Technologies for Commercial Water Heating

The primary zero-emission technologies for water heating include:

- **Heat pump water heaters**
  - Use electricity to pull heat from surrounding air, water, or ground
    - Air-to-water heat pumps
    - Air source heat pumps
    - Integrated or split systems
  - Highly efficient: Two to three times more energy efficient than conventional electric resistance water heaters*
- **Commercial electric water heaters**
  - Temperature: Up to 190° F water
  - More efficient than most gas units
- **Commercial solar water heaters**
  - Range in size to cover hot water use from offices to large industry



https://www.energy.gov/energysaver/heat-pump-water-heaters

Zero-Emission Technologies for Commercial Water Heating

Split system heat pump water heater

Split heat pump water heater with water tank

- Draw heat energy from ambient air or available source water
- Can be located as far as 50 feet apart
- Compressor located outside takes heat from outdoor air rather than indoor air

Integrated heat pump with water tank

- Packaged as a single unit
- Most are sized for residential and light commercial applications
- Can be rooftop units for one or multiple zones

Integrated heat pump water heater

Zero-Emission Technologies for Commercial Water Heating

Tankless/mini-tank (point-of-use) electric water heater

- Initial cost of tankless water heater and installation tends to be higher than for tank-style water heaters
- Energy efficient – only heats water when necessary
- Provide hot water at consumption point, eliminating costly temperature loss in long piping runs

Electric resistance water heating with storage

- Generally consists of insulated steel tank with two electric resistance elements that heat the water
- Available in large range of sizes for commercial market

Point-of-use electric water heater

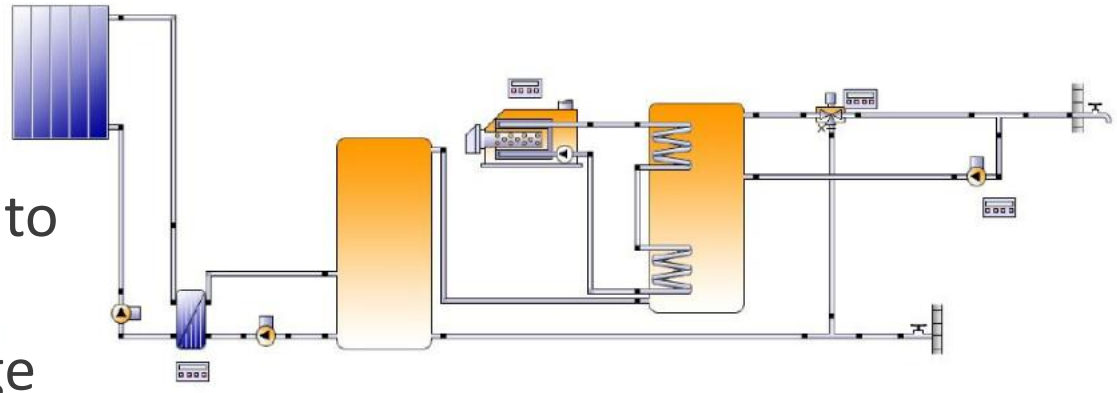
Zero-Emission Technologies for Commercial Water Heating

Commercial hybrid electric water heater

- Heat pump and resistant electric heating
- Pulls heat from the air around it to heat water
- Uses less energy than a standard electric water heater

Commercial solar water heating

- Solar thermal hot water systems
- Range in size from conventional sized systems to large industrial applications
- Flat plate collectors, a controller, pump, storage



Commercial solar water heating

Zero-Emission Technologies for Commercial Water Heating

Commercial electric boiler

- No air intake or exhaust venting required, saves on installation cost
- Compact design, quiet operation, energy efficient
- Design for heavy-duty, continuous demand of commercial and industrial applications
- Assuming 2,000 lb/hr boiler capacity would be close to 2 MMBtu/hr, Rule 1146.2 boilers could be fully converted to the electric version

Electric boiler

Zero-Emission Technologies for Commercial Water Heating

Commercial heat pump boiler

- All-electric heat pump with an optional built-in backup electric boiler (for very cold days)
- Energy efficient and energy saving
- Temperature control can monitor and anticipate Btu needs
- Meet the full heat load regardless of climate

Heat pump boiler

Dual fuel heat pump boiler

- Near-zero-emission technology
- Hybrid heating system integrates both boiler and air source or ground source heat pump
  - Gas boiler supplementing the heat pump
  - Equipment works conjointly, but boiler only supplements when heat generated is inadequate

Zero-Emission Technologies for Commercial Water Heating

Large volume electric commercial water heaters

- Large range of storage models, including 2,500-gallon
- Electric hot water boiler
  - Up to 11.5 million Btu/hr
  - Designed for heavy-duty, continuous demand of commercial and industrial applications
  - Energy efficient, compact design, quiet operation

Electric hot water boiler

Large volume electric water heater

Zero-Emission Pool Heaters

Electric swimming pool heaters

- According to the Pool Center, the general rule for the size heat pump you need for your pool is a 50,000 Btu pool heater for 10,000 gallons of water
  - ~75,000 Btu for 15,000 gallons; ~100,000 Btu for 20,000 gallons
- Electric heater is more efficient than gas pool heaters

Swimming pool heat pumps

- Quiet operation, compact design, large Btu size range, for above-ground and in-ground pools
- Dual thermostat to differentiate between very low/high temperatures; user-friendly control panel
- Heat pumps are more efficient than gas and electric pool heaters

Zero-Emission Pool Heaters

Swimming pool solar heaters

- Made up of solar collectors, filters, pumps, control valves
- Some solar pool heaters work as a regular pool cover
  - Keep algae and debris out
  - Help to reduce evaporation
- Some are standalone units, with collectors mounted on roofs or anywhere near the pool

Solar in-ground swimming pool heater

Rule Approach for PAR 1146.2

Staff will conduct a BARCT analysis to implement control measure C-CMB-01 from the 2022 AQMP

The rulemaking process will evaluate and address:


Technology development (technology neutral)


Feasible and cost-effective emission limits


Potential implementation timeline


Impact assessment


Upcoming state and federal regulations


Stakeholders' concerns

Key Challenges

Zero-emission technology feasibility and market availability

- Some products are ahead of others (e.g., residential water heaters ahead of commercial/boilers)
- Rule 1146.2 covers a broad range of products and requirements
  - Potential off-ramp where zero-emission installation is deemed infeasible (e.g., structural or sizing challenges)
  - Higher water temperature requirements for restaurant operations
  - Cold climates/high altitudes (including heat pump response time)
- Installation complexity in larger commercial buildings
- Noise impacts

Considerations

Socioeconomic and equity

- Cost of zero-emission appliance technology and electric upgrade
- Emergency replacements

Alignment with rules and strategies of other agencies

- CARB's rulemaking for state-wide standards
- BAAQMD's rules adopted in March 2023 (zero-NOx-emission by 2031 for commercial water heating)

Electric grid infrastructure

- Electric load impacts, load shifting and demand response
- Capacity-related infrastructure needs

Forthcoming OEM Survey

Building Appliances OEM Survey – Forthcoming

After this Working Group Meeting, staff will be reaching out to manufacturers with a survey to gather more information to aid the rule development process

Building Appliances OEM Survey – Forthcoming

The survey, with a focus on zero-emission technologies, will cover:

- **Type(s) of Technology** (e.g., all-electric heat pump, zero-emission fuel cell water heater, etc.)
- **Application** (e.g., for installation in residential or commercial buildings)
- **Available Models** (including information such as heating capacity, single-stage vs. variable speed, ductless vs. ducted)
- **Energy Efficiency Range(s)**
- **Current Annual Sales in the South Coast AQMD Region** (compared to sales of natural gas units)
- **Incremental Manufacturing Cost of this Technology** (versus comparable natural gas units)
- **Concerns** (regarding replacement of natural gas units, installation, etc.)
- **Focus of Current and Future Development**

Building Appliances OEM Survey – Forthcoming (*cont.*)

The survey will also include additional questions for building appliances:

Any suggestions of **sources or public domain information** such as a database for zero-emission unit sales and technologies?

Is there any special **design or application of the technology** that requires building modifications such as an electrical panel upgrade?

What are the **limitations** of its application?

Is there any installation that we can **conduct a site visit** for, especially installation of zero-emission space or water heaters for **multifamily and commercial buildings**, and zero-emission water heaters for **residential or commercial pools**?

Do you provide **space heating natural gas furnaces** with a rated heat input capacity greater than 175,000 Btu/hr but no more than 2 million Btu/hr?

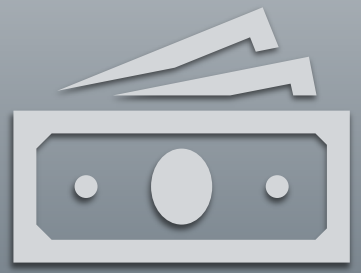
For **residential space heating**, what are your **annual sales of wall furnaces** in the South Coast AQMD region?

Next Steps and Staff Contact

Next Steps

Tentative Schedule for Proposed Amended Rule 1146.2:

- Send out the manufacturer survey after this meeting
- Public Workshop – June 2023
- Stationary Source Committee – June 2023
- Public Hearing – September 2023



Incentives:

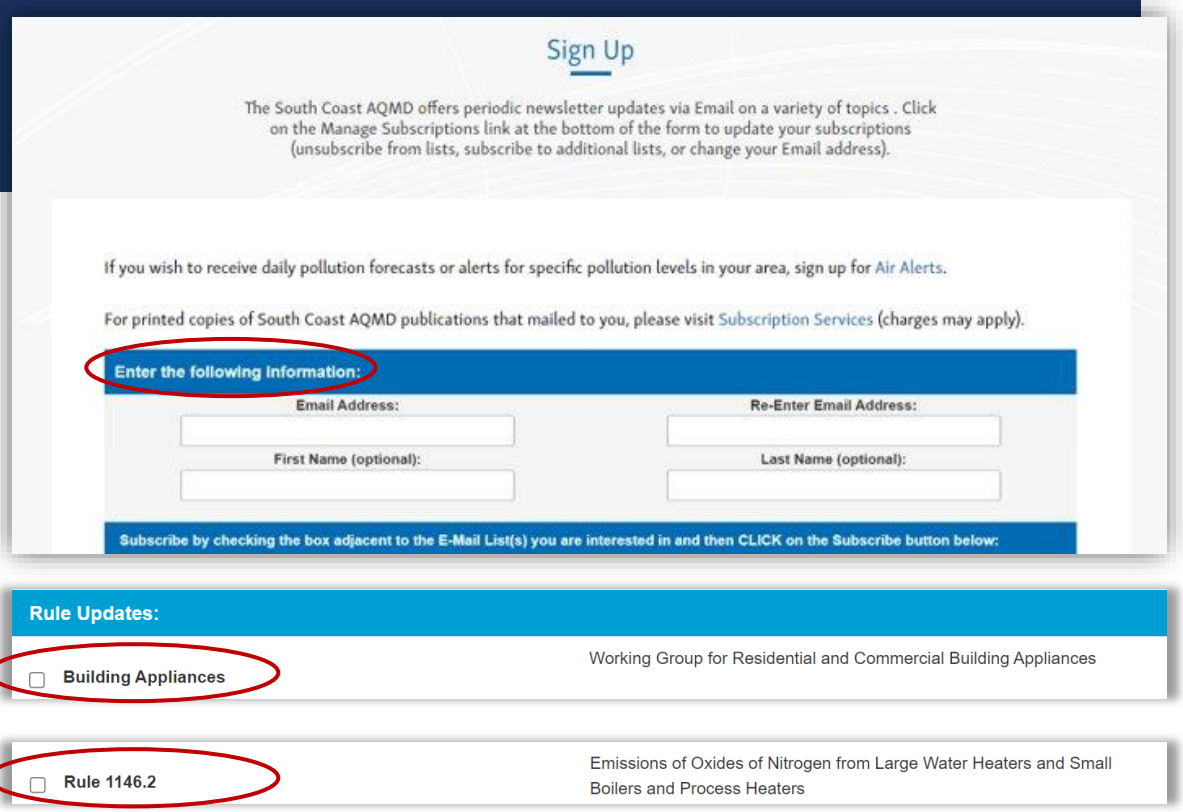
- Potentially launch a new rebate program for building appliances in 2023 similar to the current CleanAir Furnace Rebate Program

New webpage for more information on Building Appliances Rules:
http://www.aqmd.gov/home/rules-compliance/residential-and-commercial-building-appliances

Sign Up for Notifications

- To receive newsletter updates via email for notifications regarding the 1146.2 rule development and other forthcoming building appliances rules, please subscribe by checking the **Rule 1146.2** and **Building Appliances** check boxes located under Rule Updates: http://www.aqmd.gov/sign-up

- To receive printed copies of South Coast AQMD publications via mail, please visit: http://www.aqmd.gov/nav/contact/subscription-services



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