SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Staff Report for:

Proposed Amended Rule 1111 – Reduction of NOx Emissions From Natural Gas-Fired Furnaces
Proposed Amended Rule 1121 – Reduction of NOx Emissions From Residential Type, Natural Gas-Fired Water Heaters

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EXECUTIVE SUMMARY

South Coast AQMD Rule 1111 – Reduction of NOx Emissions from Natural-Gas-Fired, Fan-Type Central Furnaces (Rule 1111), regulates oxides of nitrogen (NOx) emissions from natural gas-fired fan-type central furnaces with rated heat input capacity of less than 175,000 British thermal units per hour (Btu/hr), or for units with combined heating and cooling (package units), a cooling rate of less than 65,000 Btu/hour. Rule 1111 was adopted by the South Coast Air Quality Management District (South Coast AQMD) Governing Board in December 1978. The rule was amended in 2009 to lower the NOx emissions limit from 40 to 14 nanograms per Joule (ng/J). The rule was later amended several times to provide an alternative compliance option and extend the option that allows the manufacturer to pay a per-unit mitigation fee, in lieu of meeting the lower NOx emission limit. All furnace types have transitioned to 14 ng/J, except for mobile home furnaces for which the mitigation fee alternative compliance option will end by September 30, 2025.

South Coast AQMD Rule 1121 – Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters (Rule 1121) regulates NOx emissions from natural gas-fired water heaters with a rated heat input capacity of less than 75,000 Btu/hr. Rule 1121 was adopted by the South Coast AQMD Governing Board in December 1978. This rule was amended in 1999 to reduce the NOx emission limit from 40 ng/J stepwise to 10 ng/J and amended again in 2004 to extend the compliance dates of 10 ng/J limit for some categories. Currently, all Rule 1121 water heaters are meeting the NOx emissions limit of 10 ng/J, except for mobile home water heaters that are subject to an emissions limit of 40 ng/J.

Proposed Amended Rule 1111 – Reduction of NOx Emissions from Natural Gas-Fired Furnaces (PAR 1111), seeks further NOx emission reductions and implements the 2022 Air Quality Management Plan (AQMP) Control Measure R-CMB-02 – Emission Reductions from Replacement with Zero Emission or Low NOx Appliances – Residential Space Heating (Control Measure R-CMB-02). Proposed Amended Rule 1121 – Reduction of NOx Emissions from Residential Type, Natural Gas-Fired Water Heaters (PAR 1121), seeks further NOx emission reductions and implements the 2022 AQMP Control Measure R-CMB-01 – Emission Reductions from Replacement with Zero Emission or Low NOx Appliances – Residential Water Heating (R-CMB-01). Staff conducted a comprehensive BARCT assessment, which includes an analysis of the technical feasibility and cost-effectiveness of zero-NOx emission technologies for PAR 1111 and PAR 1121.

PAR 1111 and 1121 establish zero-NOx emission limits for space and water heating appliances with compliance dates differentiated for units installed in new or existing buildings. Space and water heating appliances for existing mobile homes will be exempt from the zero-NOx emission standards, and mobile home appliances will transition to zero-NOx emission appliances in new mobile homes or when existing mobile homes are replaced with new mobile homes. A Zero-NOx Manufacturer (ZEM) alternative compliance option is provided that establishes compliance targets for the sale of NOx-emitting and Zero-NOx emission appliances. The targets change over time to transition the market to zero-NOx emission appliances. The ZEM alternative compliance option also includes fees for the sale of all NOx-emitting appliances, with higher fees for the NOx-emitting appliances sold over the compliance target. The fees increase annually to reflect consumer price index. In addition, PAR 1111 and PAR 1121 have clarified and updated rule language, restructured the rule, removed obsolete language, and streamlined the labeling, recordkeeping, and reporting requirements.

PAR 1111 and PAR 1121 will each affect the manufacturers, distributors, retailers, resellers, and installers of space and water heating appliances that are used in over five million buildings, mostly residential homes. Staff estimates that upon full implementation, PAR 1111 will reduce NOx emissions by 4.05 tons per day (tpd), and PAR 1121 will reduce NOx emissions by 2.07 tpd. The public process for PAR 1111 and PAR 1121 consisted of eight working group meetings, four presentations to the Stationary Source Committee, a public workshop, a public consultation meeting, presentations to cities and Councils of Government, and many meetings with industry stakeholders, environmental and community groups, and technology vendors to obtain feedback.

At full implementation by 2061, PAR 1111 and PAR 1121 is estimated to prevent 2,490 premature deaths, 10,200 cases of newly onset asthma, 1.17 million minor restricted activity days, and 2,484 emergency room visits. The health benefits would be monetized to about $25.43 billion to present value with 4 percent discount rate.

CHAPTER 1:BACKGROUND

INTRODUCTION

Rule 1111 – Reduction of NOx Emissions from Natural Gas-Fired Furnaces reduces nitrogen oxide emissions from gas-fired fan-type space heating furnaces with a rated heat input capacity of less than 175,000 Btu/hr or, for combination heating and cooling units, with a cooling rate of less than 65,000 Btu per hour. The rule applies to manufacturers, distributors, and installers of such furnaces. Most single-family homes, many multifamily residences, and some light commercial buildings in the South Coast AQMD use this type of space heating equipment.

Rule 1121 – Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters aims to reduce NOx emissions from natural gas-fired residential water heaters with a rated heat input capacity less than 75,000 Btu/hr. This rule applies to manufacturers, distributors, retailers, and installers of natural gas-fired units and requires water heaters to meet a 10 ng/J emission limit and mobile home water heaters to meet a 40 ng/J emission limit. This rule does not apply to water heaters used in recreational vehicles or large water heaters subject to Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters (Rule 1146.2).

Rule 1111 and Rule 1121 require manufacturers to certify that each natural gas unit model offered for sale in the South Coast AQMD complies with the emission limit using the test methods approved by the South Coast AQMD and U.S. EPA.

RULE 1111 REGULATORY HISTORY

Rule 1111 was adopted by the South Coast AQMD Governing Board in December 1978. The original rule required the applicable space heating furnaces to meet a NOx emission limit of 40 ng/J of heat output, which equivalent to a concentration of 61 parts per million by volume (ppmv) at a reference level of 3 percent oxygen and 80 percent Annual Fuel Utilization Efficiency (AFUE), beginning January 1, 1984.

NOx Emission Limit of 14 ng/J Established

Rule 1111 was amended in November 2009 to implement the 2007 AQMP Control Measure CMB-03. The 2009 amendment established a new lower NOx emission limit of 14 ng/J (equivalent to 22 ppmv at a reference level of 3 percent oxygen and 80 percent AFUE) and required the three major categories of residential furnaces, condensing (high efficiency), non-condensing (standard), and weatherized furnaces to meet the new limit by October 1, 2014, October 1, 2015, and October 1, 2016, respectively. Furthermore, new mobile home heating units, which were unregulated prior to the 2009 amendment, were required to meet a NOx limit of 40 ng/J by October 1, 2012, and 14 ng/J by October 1, 2018. To facilitate the depletion of existing inventories and to ensure a smooth transition to the new limits, Rule 1111 also provided a temporary 10-month exemption (e.g., a sell-through period) for units manufactured and delivered into the South Coast AQMD prior to the compliance date.

Mitigation Fee to Delay Compliance of 14 ng/J Furnaces

Rule 1111 was amended in September 2014 to provide an alternative compliance option. The alternative compliance option allowed original equipment manufacturers (OEM) to pay a per-unit mitigation fee for each furnace with NOx emissions certificated at 40 ng/J distributed or sold in South Coast AQMD, in lieu of meeting the 14 ng/J NOx emission limit.

Rule 1111 was amended six times from 2018 to 2023 to extend the mitigation fee end dates, increase mitigation fees, and allow limited exemptions for furnaces at high-altitude.

The mitigation fee end date for each type of furnaces is listed in the following table. All furnace types have transitioned to 14 ng/J, except for mobile home furnaces, which constitute about four percent residential furnace market share of the region. The mitigation fee alternative compliance option for mobile home furnaces will end by September 30, 2025, according to the current rule language.

Table 1-1: Mitigation Fee Option End Dates

Furnace Category	Mitigation Fee Option End Date
Condensing	September 30, 2019
Non-condensing	September 30, 2019
Weatherized	September 30, 2021
Mobile Home	September 30, 2025

Clean Air Furnace Rebate Program

In March 2018, the South Coast AQMD developed a rebate program for consumers who purchased and installed future compliant 14 ng/J furnaces in the South Coast AQMD. The purpose of the rebate program was to help commercialize future compliant furnaces and incentivize consumers to purchase and install them. On May 4, 2018, the South Coast AQMD executed the contract with Electric & Gas Industries Association (EGIA) to administer the Clean Air Furnace Rebate Program. On June 28, 2018, the rebate website was launched. The South Coast AQMD Governing Board initially approved funding of $3 million for the furnace rebate program, specifying a $500 rebate for each compliant furnace. In September 2020, the Governing Board approved additional funding of $3.5 million, modifying the program to specify a $500 rebate for up to 600 compliant weatherized furnaces, a $500 rebate for up to 200 high-altitude compliant condensing or non-condensing furnace installations, and a $1,500 rebate for each all-electric heat pump for central ducted space heating. Rebates for weatherized and high-altitude condensing and non-condensing furnaces ended on September 30, 2021, when remaining funds for those categories were reallocated for all-electric heat pump systems. Rebates for all-electric heat pump systems concluded in April of 2023 when funds were exhausted. The Clean Air Furnace Rebate Program incentivized the installation of over 5,300 ultra-low NOx furnaces for early implementation of 14 ng/J limit and over 2,400 all-electric heat pump installations after the implementation of 14 ng/J limit, with 25 percent of all-electric heat pump funds allocated to disadvantaged communities.

2022 AQMP Control Measure

In the 2022 AQMP, the Governing Board adopted control measure R-CMB-02: Emission Reductions from Replacement with Zero Emission or Low NOx Appliances – Residential Space Heating which proposed the development of zero-emission NOx limits for residential space heating when feasible. The 2022 AQMP Policy Brief for Residential and Commercial Building

Appliances[1] cited heat pumps as an energy-efficient, zero-NOx emission alternative to NOx-emitting natural gas furnaces.

PAR 1111 AFFECTED INDUSTRIES

PAR 1111 affects manufacturers, distributors, retailers, resellers, and installers of natural gas-fired furnaces for space heating with a rated heat input capacity less than 175,000 Btu/hr, or for combination heating and cooling units, a cooling rate of less than 65,000 Btu per hour. There are no OEMs of gas-fired furnaces located in the South Coast AQMD; however, these companies maintain regional sales offices and distribution centers in the South Coast AQMD with supply chains to support their products. The units affected by the proposed rule are mostly used in residential buildings for space heating.

The following table shows the North American Industry Classification System (NAICS) for the industries affected by PAR 1111. Staff estimated approximately 5,200,000 units in the South Coast AQMD are regulated by PAR 1111.

Table 1-2: PAR 1111 Affected Industries

Affected Industry	NAICS
Heating Equipment (except Warm Air Furnaces) Manufacturing	333414
Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	333415
Motor and Generator Manufacturing	335312
Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers	423610
Heating, Ventilation, and Air Conditioning (HVAC) Equipment Merchant Wholesalers	423730
Household Appliances, Electric Housewares, and Consumer Electronics Merchant Wholesalers	423620
Installers	238

RULE 1121 REGULATORY HISTORY

Rule 1121 was adopted by the South Coast AQMD's Governing Board on December 1, 1978. The objective of the rule is to reduce NOx emissions from natural gas-fired residential water heaters.

[1] The South Coast AQMD, Residential and Commercial Building Appliances, 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

Rule 1121 applies to manufacturers, distributors, retailers, and installers of residential natural gas-fired water heaters less than 75,000 Btu per hour.

Starting in 1982, Rule 1121 required that gas-fired water heaters meet a NOx emission limit of 40 ng/J of heat output, except gas-fired mobile home water heaters, which were required to meet a NOx emission limit of 50 ng/J of heat output.

NOx Emission Limit of 10 ng/J Established

In December 1999, Rule 1121 was amended to reduce the NOx emission limit. The amendment reduced the NOx limit in two steps from 40 ng/J to 20 ng/J on July 1, 2002, and 10 ng/J on January 1, 2005. The mobile home water heater emission limit was reduced from 50 ng/J to 40 ng/J, effective on and after January 1, 2000. Alternate equivalent emission limits expressed in part per million were also added. The rule also required manufacturers to provide a report by July 1, 2003, on their progress toward meeting the final emission limit in the rule.

Rule 1121 was included in the Settlement Agreement for the 1999 AQMP amendment. The Settlement Agreement included a commitment to begin the lower emissions limits implementation by 2005, allowing up to a 1-year extension to the implementation, or additional extensions if the Governing Board makes a finding of infeasibility.

Request a Delay in the Compliance Date

Manufacturers reported their progress towards meeting the emission limits by July 2003 and requested a delay in the compliance date and exemptions for power vented and direct vented water heaters. In addition, manufacturers requested to delay residential water heaters less than 50 gallons for one year and residential water heaters greater than 50 gallons for an additional two years.

Staff submitted a report to the Governing Board in January 2004, where the January 2005 compliance date was found to be infeasible, and the Governing Board directed staff to proceed with the rule development.

Extension of Compliance Date and Mitigation Fee

The most recent amendment to Rule 1121 in September 2004 extended the emission limit of 10 ng/J by one year for conventional water heaters less than or equal to 50 gallons, two years for conventional water heaters greater than 50 gallons, and three years for direct-vent, power-vent, and power direct-vent water heaters. The mitigation fee program for the interim rule limit was extended for three years and changed from $1.80 per water heater to $3.00 per water heater. The rule also required manufacturers to provide a report on progress towards meeting the interim and final rule limits for direct-vent, power-vent, and power direct-vent water heaters. The mitigation fee period ended when the 10 ng/J emissions limit was implemented from 2006-2008, depending on water heater type.

2022 AQMP Control Measure

In the 2022 AQMP, the Governing Board adopted control measure R-CMB-01: Emission Reductions from Replacement with Zero Emission or Low NOx Appliances – Residential Water Heating. The control measure proposed the development zero-NOx emission standards for water heating appliances installed in new and existing buildings, when feasible. All-electric heat pumps were mentioned as an option for zero-emission water heating.

PAR 1121 AFFECTED INDUSTRIES

PAR 1121 affects manufacturers, distributors, retailers, resellers, and installers of natural gas-fired water heaters with a rated heat input capacity less than 75,000 Btu/hr. There are no OEMs of gas-fired water heaters located in the South Coast AQMD; however, these companies do maintain regional sales offices and distribution centers in the region, and the supply chains to support their products. The units affected by the proposed rule are mostly used in residential buildings for domestic hot water needs.

The following table shows the NAICS for the industries affected by PAR 1121. Staff estimated approximately 5,100,000 units in the South Coast AQMD are regulated by PAR 1121.

Table 1-3: PAR 1121 Affected Industries

Affected Industry	NAICS
Hot Water Heating System Installation	238220
Water Heater Controls Manufacturing	334512
Water Heaters, Gas and Electric, Merchant Wholesaler	423720
Major Household Appliance Manufacturing	335220
Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers	423610
Household Appliances, Electric Housewares, and Consumer Electronics Merchant Wholesalers	423620
Installers	238

PUBLIC PROCESS

PAR 1111 and PAR 1121 were developed through a public process that began in the last quarter of 2023 and included a series of working group meetings, individual stakeholder meetings, and site visits to affected facilities. South Coast AQMD staff held eight working group meetings on October 5, 2023, November 28, 2023, January 31, 2024, April 4, 2024, June 20, 2024, August 15, 2024, December 4, 2024, and February 13, 2025. The working group is comprised of representatives from manufacturers, trade organizations, permit stakeholders, businesses, environmental groups, residents, public agencies, consultants, and other interested parties. The purpose of the working group meetings was to present and discuss staff's BARCT assessment and the development of the proposed amendments and NOx limits for PAR 1111 and PAR 1121. Staff presented initial preliminary draft rule language at the working group meeting on June 20, 2024. A public workshop was conducted on October 3, 2024. After a considerable amount of feedback on the proposed rules concept, including concerns on the affordability of zero-NOx emission appliances and lack of consumer choice with the proposed future effective zero-NOx emission standards, staff changed the rule concept. The new rule concept was discussed during Working Group Meeting #8 and detailed in a Public Consultation Meeting held on March 6, 2025. The

following table summarizes the working group meetings held throughout the development of PAR 1111 and PAR 1121 and provides a summary of the key topics discussed at each of the working group meetings.

Table 1-4: Summary of Public Process

Date	Meeting Title	Highlights
October 5, 2023	Working Group Meeting #1	• Rule Development Process • Control Measures for Space and Water Heating • BARCT Assessment • Technologies • Manufacturer Survey • Incentives
November 28, 2023	Working Group Meeting #2	• Follow-up to stakeholder comments from Working Group Meeting #1 • Presented cost-effectiveness methods, assumptions, and initial results
January 31, 2024	Working Group Meeting #3	• Follow-up to stakeholder comments from Working Group Meeting #2 • Analysis of requirements in mobile homes • Updates to cost-effectiveness calculations • Presented affordability analysis method, assumptions, and initial results • South Coast AQMD rebate program for zero-emission units
April 4, 2024	Working Group Meeting #4	• Follow-up to stakeholder comments from Working Group Meeting #3 • Summary of site visits to mobile homes • Discussion of wall and floor furnaces • Discussion of commercial space heating • Cost-effectiveness for wall and floor furnaces, and commercial furnaces • Proposed rule concepts
June 20, 2024	Working Group Meeting #5	• Follow-up to stakeholder comments from Working Group Meeting #4 • Summary of site visits to multifamily buildings • Rule language proposals
August 15, 2024	Working Group Meeting #6	• Follow up to stakeholder comments from Working Group Meeting #5 • Summary of site visit to single family home and multifamily homes • Feasibility of 120V heat pump water heaters • Tenant protections

Date	Meeting Title	Highlights
		• Updates to rule language
October 3, 2024	Public Workshop	• Background on Rule 1111 and Rule 1121 • PAR 1111 rule language • PAR 1121 rule language
October 18, 2024	Stationary Source Committee	• Regulatory history and background • Estimated emission reductions • Anticipated challenges and proposed solutions
December 4, 2024	Working Group Meeting #7	• Staff outreach efforts • Updates to cost-effectiveness • Replacement cost examples • Updates to proposed rule language • Go Zero rebate program development
December 20, 2024	Stationary Source Committee	• Public outreach updates • Site visits • Anticipated challenges and proposed solutions • Affordability and cost examples
February 13, 2025	Working Group Meeting #8	• Staff outreach efforts • Summary of concerns about previous rule concepts • New rule concept proposal • Go Zero rebate program development
February 21, 2025	Stationary Source Committee	• Updated public outreach efforts • Presented new rule concept with compliance targets and mitigation fees • Updates to emissions reductions
March 6, 2025	Public Consultation Meeting	• Detailed the third preliminary draft PAR 1111 and PAR 1121 • Discussed updated cost effectiveness analysis
March 21, 2025	Stationary Source Committee	• Updated committee on rule development progress • Discussed mitigation fee options

Staff held many meetings with stakeholders who are potentially impacted by this rulemaking. In addition, staff conducted dozens of site visits with stakeholders as listed in the following table.

Table 1-5: Summary of Site Visits

Date	Location
March 15, 2023	Southern California Edison Energy Education Center

Date	Location
June 8, 2023	Southern California Edison Energy Education Center
August 29, 2023	Rheem Manufacturing Company, Raypak
December 8, 2023	Oakridge Mobile Home Park
January 11, 2024	Lake Los Serranos Mobile Home Park
January 17, 2024	Corona Del Rey Apartments
March 14, 2024	The Fountains Mobile Home Park
May 2, 2024	Jia (Multifamily)
May 2, 2024	Pearl MDR (Multifamily)
May 22, 2024	Ava Burbank (Multifamily)
May 22, 2024	Ava Toluca (Multifamily)
July 18, 2024	A Single-Family House in Mission Viejo (120V heat pump water heater)
August 7, 2024	Newport Ridge Apartment Homes (Multifamily)
August 7, 2024	San Paulo Apartment Homes (Multifamily)
August 7, 2024	New Construction Single Family Home in Irvine
September 5, 2024	Palmeras Apartments in Irvine
September 5, 2024	Baywood Apartments in Newport Beach
October 23, 2024	Mountain Communities Hospital
October 23, 2024	Indoor Weather Shop
October 23, 2024	Spade & Spatula
October 23, 2024	Dual Fuel Single-Family Residence

Date	Location
October 23, 2024	All Electric Single-Family Residence
October 23, 2024	Pali Adventure Camp
October 29, 2024	Centre Club (Multifamily)
January 7, 2025	University of California Irvine (UCI) All-Electric Hospital
February 11, 2025	California State University Dominguez Hills

CHAPTER 2: BARCT ASSESSMENT

INTRODUCTION OF BARCT ASSESSMENT

The purpose of a BARCT assessment is to assess available pollution controls to establish emission limits for specific equipment categories consistent with state law. Under Health and Safety Code Section 40406, BARCT is defined as:

> "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source."

The BARCT assessment follows a framework through the rule development process and includes public participation. The following figure illustrates the overall BARCT assessment approach.

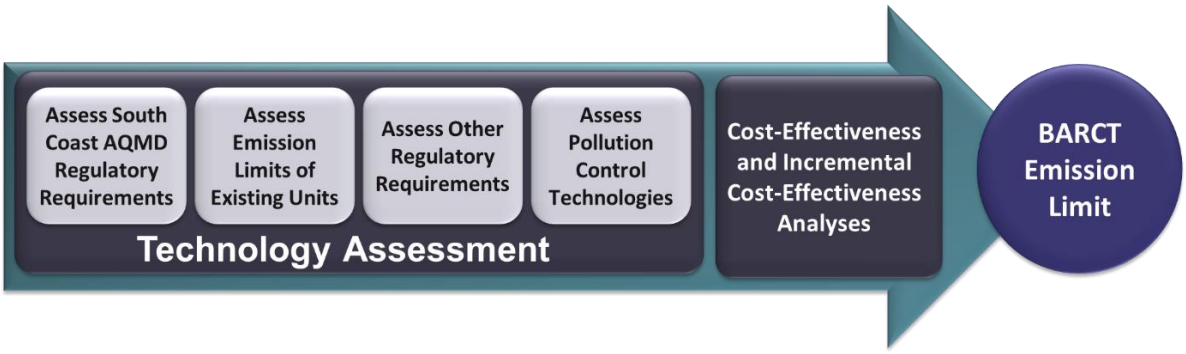

Figure 2-1. BARCT Assessment Approach

PAR 1111 BARCT ASSESSMENT

Assessment of South Coast AQMD Regulatory Requirements

Staff reviewed existing South Coast AQMD NOx regulations for residential heating and small commercial heating. The following table summarizes the South Coast AQMD rules that staff evaluated as part of the BARCT technology assessment.

Table 2-1: South Coast AQMD Regulatory Requirements Similar to PAR 1111

Regulation/Rule Title	Relevant Unit/Equipment Size	Current or Future Effective NOx Emission Limits in ng/J or ppmv at 3 percent O_2, dry
Rule 1146.2 – Emissions of Oxides of Nitrogen (NOx) from Large Water Heaters, Small Boilers and Process Heaters	Large Water Heaters, Small Boilers and Process Heaters (less than or equal to 2,000,000 Btu/hr rated heat input capacity, excluding tank type water heaters subject to Rule 1121)	0 ppmv with compliance dates between 2026-2033: • Type 1 Units • Instantaneous Water Heaters ≤200,000 Btu/hr • Instantaneous Water Heaters >200,000 Btu/hr • Type 1 Pool Heaters • Type 2 Units • Type 1 High Temperature Units, and • Type 2 High Temperature Units
Rule 1147 – NOx Reductions From Miscellaneous Sources	Combustion equipment which require an AQMD permit but are not applicable to other Rules	• 60 ppmv for afterburners, burn-off furnaces, dryers over 1,200°F, kilns, and other units • 30 ppmv for ovens, dryers, kilns and furnaces under 1,200°F, and make-up air heaters, carpet dryers and other units
Rule 1121 – Control of Nitrogen Oxides from Residential-Type, Natural Gas-Fired Water Heaters	Residential-Type, Natural Gas-Fired Water Heaters (less than 75,000 Btu/hr rated heat input capacity)	• 10 ng/J or15 ppmv • 40 ng/J or 55 ppmv for mobile home water heaters

Emission Level of Existing Units

The next step of the BARCT assessment is to evaluate the emission of existing units operating within the South Coast AQMD. Condensing, non-condensing, and weatherized furnaces subject to Rule 1111 are certified to meet the 14 ng/J NOx emission limit; the applicable mobile home furnaces are meeting the 40 ng/J NOx emission limit. PAR 1111 applies to furnaces with a rated heat input capacity of up to 175,000 Btu/hr. Wall furnaces and floor furnaces, which are currently not subject to an emission limit. Staff conducted a review of currently available wall furnace and floor furnace product sheets and found several units with ultra-low NOx burners (14 ng/J) and units that do not state the NOx emission levels. Staff, therefore, assumed a NOx emission of 40 ng/J for wall and floor furnaces to account for units that do not have a stated emission level.

Other Regulatory Requirements

Staff reviewed regulatory requirements from other agencies for identical or similar equipment. The purpose of this step is to determine if there are more stringent regulations in other jurisdictions that should be considered, as NOx reduction rules enforced by the South Coast AQMD cannot be less stringent.

Table 2-2: Other Regulatory Requirements Similar to PAR 1111

Regulatory Entity	Regulation/Rule	Relevant Emission Limits
San Joaquin Valley Air Pollution Control District (Valley Air District)[(2)]	Rule 4905 – Natural Gas-Fired, Fan-Type Central Furnaces (units with a rated heat input capacity less than 175,000 Btu/hr, and for combination heating and cooling units with a rated cooling capacity of less than 65,000 Btu/hr) – Exempts furnaces that are to be installed with a propane conversion kit	14 ng/J (allows mobile home furnaces to meet 40 ng/J if a per unit emission fee is paid)
Bay Area Air Quality Management District (BAAQMD)[(3)]	Rule 9-4 – Nitrogen Oxides Emissions from Natural Gas-Fired Furnaces (units with total rated heat input capacity of less than 175,000 Btu/hr) adopted in March 2023	• Zero-emission limits with implementation in 2029 • Emission standards not applicable to furnaces used in mobile homes
California Air Resources Board (CARB)[(4)]	2022 State Strategy for the State Implementation Plan (adopted September 22, 2022) proposed measures for residential and commercial buildings; Anticipating Board consideration for rule adoption in 2026	Proposed zero-emission limits (GHG, NOx) for new equipment and appliances sold for use in both residential and commercial buildings, with implementation in 2030

[(2)] San Joaquin Valley Air Pollution Control District, Rule 4905, https://ww2.valleyair.org/media/haahtjed/rule-4905.pdf
[(3)] Bay Area Air Quality Management District, Rule 9-4, https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230315_rg0906-pdf.pdf?rev=436fcdb037324b0b8f0c981d869e684d&sc_lang=en
[(4)] California Air Resources Board, 2022 State SIP Strategy, p. 30, https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf

Assessment of Pollution Control Technologies

The next step is to research the commercially available emission control technologies and seek information on any emerging emission control technologies. As part of this assessment, staff met with multiple manufacturers. Rule 1111 is technology and fuel neutral and is focused on achieving the maximum NOx emission reductions possible.

Staff assessed different pollution control technologies as part of the BARCT assessment. Staff presented and discussed the pollution control technology assessment in working group meetings. The objective is to identify and evaluate control technologies, approaches, and potential emission reductions.

Zero-Emission Technology and Emerging Technology

Zero-emission technologies such as heat pumps, electric resistance, and fuel cell technologies were explored as part of the BARCT assessment, all of which are proven technologies that have been in operation for decades. Staff conducted internet searches and met with stakeholders to gather more information on zero-emission technologies and emerging technology.

Heat Pump Technology for Heating, Ventilation, and Air Conditioning

Common zero-emission heating technology includes heat pumps. This technology can be over three times more efficient than conventional appliances and can be used for water heating, space heating, and cooling.

Unlike natural gas fired furnaces that generate heat directly, heat pumps use the principle of energy transfer to transport energy from an outside medium (such as the ground or outside air) to the interior, using a refrigerant cycle. Heat pumps typically consist of an indoor unit and an outdoor unit. Compared to traditional furnaces, heat pumps have the additional benefit of cooling. Different types of heat pumps cater to various HVAC needs, each offering unique advantages. The indoor unit of ducted heat pumps are integrated into a ductwork system, distributing heated or cooled air throughout a building. They are ideal for houses with pre-existing central heating and cooling but require installation of a ducting system for houses that do not. On the other hand, ductless mini-split heat pumps operate without ducts, using individual air handing units mounted inside individual rooms for zonal heating and cooling. These units offer more flexibility in temperature control and installation, making them suitable for spaces lacking ductwork or requiring independent temperature control. Window heat pumps are compact units designed to fit into windows, offering localized heating and cooling for single rooms or small areas. They are easy to install and provide immediate temperature control but are less efficient compared to their ducted or ductless system counterparts.

All air-source heat pumps draw heat from the outside air, which means they will gradually lose performance as the outside temperature drops. Ground-source heat pumps, on the other hand, have refrigerant lines underground to take advantage of the ground's relatively constant temperature. This provides consistent high performance but requires significantly higher installation costs.

Electric Resistance Technology for Space Heating

Electric resistance furnaces use resistance elements, such as heating coils or strips to warm the air, which can then be used in conjunction with air handlers, ductworks, and thermostats to deliver

controlled heat through a residential or commercial space. This technology converts nearly all incoming electricity and converts it to heat directly. Some heat pumps have an electric resistance element used for backup heating since a heat pump's efficiency may decrease due to extreme cold conditions or inadequate spacing.

Electric resistance heaters have fewer requirements for installations compared to natural gas fired heaters, as they do not require a flue or venting system. This allows electric resistance to be installed in a wide range of indoor spaces and is suitable for spaces where natural gas availability is limited or undesirable.

Electric resistance wall heaters are mounted directly onto walls and use electric resistance coils to warm the surrounding air. This warm air then rises naturally, creating convection currents that circulate through the room, gradually raising the ambient temperature. Similarly, electric resistance floor heaters use the same principle, but are generally installed along the baseboards of walls. Both wall and floor heaters are often used in residential and commercial spaces where localized space heating is needed and oftentimes, where a central heating system is not sufficient or not practical.

However, electric resistance furnaces are not as efficient as heat pumps since they convert electricity to heat in a nearly one-to-one ratio.

Solar Technology for Heating, Ventilation, and Air Conditioning

Solar heating technology collects thermal energy from the sun to heat space or water. Active and passive solar heating are the two most common types of solar heating. Active solar air heating systems use solar collectors to heat air, which is then circulated through the home using fans or ducts. This method is often used in conjunction with a traditional heating system to provide supplemental heat. Solar technology is commonly used to generate electricity for storage or to power an existing HVAC system. Due to the reliance on available sunlight, solar HVAC systems may need to have a back-up system when sunlight is not available. Solar HVAC systems are commonly coupled with mini split heat pumps, leveraging the use of a renewable energy source to power the HVAC system. Passive solar heating systems rely on building design elements, such as windows, walls, and floors, to collect, store, and distribute the solar energy naturally.

Mobile Homes

Mobile home furnaces have specific design and size requirements that are different from those of a traditional home furnace. There are various zero emission technologies for mobile home space heating, including solar, electric resistance, and heat pumps. Heat pump technologies include ductless mini-split, package, central air, and geothermal systems that have high energy efficiency and are gaining more popularity. Package heat pump systems do not have the concern of physical design for space and air flow as they do not require a separate indoor unit. Packaged heat pump systems combine the heating and cooling components into one outdoor unit and connect to the home's ductwork to distribute warm or cool air throughout the living space.

PAR 1121 BARCT ASSESSMENT

Assessment of South Coast AQMD Regulatory Requirements

Staff reviewed existing South Coast AQMD NOx regulations for residential water heating. The following table summarizes the South Coast AQMD rules that staff evaluated as part of the BARCT technology assessment.

Table 2-3: South Coast AQMD Regulatory Requirements Similar to PAR 1121

Regulation/Rule Title	Relevant Unit/Equipment Size	Current and Future Effective NOx Emission Limits in ng/J or ppmv at 3 percent O_2, dry
Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (greater than or equal to 5,000,000 Btu/hr rated heat input capacity)	• 7-9 ppm for units burning gaseous fuels 5,000,000 to less than 20,000,000 Btu/hr; • 5-9 ppmv for units burning gaseous fuels greater than 20,000,000 Btu/hr and less than 75,000,000 Btu/hr; • 5 ppmv for units burning natural gas greater than or equal to 75,000,000 Btu/hr; • 12 ppmv for thermal fluid heaters burning gaseous fuels; • 40 ppmv for nongaseous fuels; • 12 ppmv for atmospheric units; • 15 ppmv for units burning digester gas; • 25 ppmv for units burning landfill gas
Rule 1146.1 – Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (greater than 2,000,000 Btu/hr and less than 5,000,000 Btu/hr rated heat input capacity)	• 7-9 ppmv for units greater than 2 MMBtu/hr and less than 5,000,000 Btu/hr burning natural gas; • 12 ppmv for atmospheric units; • 12 ppmv for thermal fluid heaters; • 15 ppmv for units burning digester gas; • 25 ppmv for units burning landfill gas

Regulation/Rule Title	Relevant Unit/Equipment Size	Current and Future Effective NOx Emission Limits in ng/J or ppmv at 3 percent O_2, dry
Rule 1146.2 – Emissions of Oxides of Nitrogen (NOx) from Large Water Heaters, Small Boilers and Process Heaters	Large Water Heaters, Small Boilers and Process Heaters (less than or equal to 2,000,000 Btu/hr rated heat input capacity, excluding tank type water heaters subject to Rule 1121)	0 ppmv with compliance dates between 2026-2033: • Type 1 Units • Instantaneous Water Heaters ≤200,000 Btu/hr • Instantaneous Water Heaters >200,000 Btu/hr • Type 1 Pool Heaters • Type 2 Units • Type 1 High Temperature Units, and • Type 2 High Temperature Units
Rule 1111 – Reduction of NOx Emissions from Natural-Gas-Fired Furnaces	Gas-fired fan-type space heating furnaces with a rated heat input capacity of less than 175,000 Btu/hr or, for combination heating and cooling units, with a cooling rate of less than 65,000 Btu per hour	• 14 ng/J • 40 ng/J before October 1, 2025 with mitigation fee alternative compliance option, and 14 ng/J on and after October 1, 2025, for mobile home furnaces

Emission Level of Existing Units

Currently, Rule 1121 water heaters are required to be certified at the NOx emissions limit of 10 ng/J, whereas mobile home water heaters are required to be certified at an emissions limit of 40 ng/J. The list of units certified for use in the South Coast AQMD can be found on the South Coast AQMD website[(5)].

Other Regulatory Requirements

Staff reviewed regulatory requirements from other agencies for identical or similar equipment. The purpose of this step is to determine if there are more stringent regulations in other jurisdictions that should be considered, as rules

[(5)] South Coast AQMD Certified and Approved Equipment, https://www.aqmd.gov/home/programs/business/business-detail?title=certified-equipment&parent=certified-products

enforced by the South Coast AQMD cannot be less stringent than another air district rule unless compliance is not achievable. .

Table 2-4: Other Regulatory Requirements Similar to PAR 1121

Regulatory Entity	Regulation/Rule	Relevant Emission Limits
San Joaquin Valley Air Pollution Control District (Valley Air District)[6]	Rule 4308 – Boilers, Steam Generators, and Process Heaters (units with a total rated heat input capacity of greater than or equal to 75,000 Btu/hr and less than 2,000,000 Btu/hr) – Exempts units installed in manufactured homes, units installed in recreational vehicles, and hot water pressure washers	20 ppmv (except for pool heaters greater than or equal to 75,000 Btu/hr and less than or equal to 400,000 Btu/hr, which are at 55 ppmv)
Bay Area Air Quality Management District (BAAQMD)[7]	Rule 9-6 – Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters (units with total rated heat input capacity of 75,000 Btu/hr – 2,000,000 Btu/hr) adopted in March 2023	Zero-emission limits with implementation in 2027 for small water heaters with rated heat input capacity greater than or equal to 75,000 Btu/hr and in 2031 for others – Exempts units installed in manufactured homes (40 ng/J limit), units installed in recreational vehicles, and pool/spa heaters with less than 400,000 Btu/hr rated heat input capacity used exclusively to heat swimming pools, hot tubs, or spas
California Air Resources Board (CARB)[8]	2022 State Strategy for the State Implementation Plan (adopted September 22, 2022) proposed measures for residential and commercial buildings; Anticipating Board consideration for rule adoption in 2026	Proposed zero-emission limits (GHG, NOx) for new equipment and appliances sold for use in both residential and commercial buildings, with implementation in 2030

[6] San Joaquin Valley Air Pollution Control District, Rule 4308, https://ww2.valleyair.org/media/o5pdu0oe/rule-4308.pdf

[7] Bay Area Air Quality Management District, Rule 9-6, https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230315_rg0906-pdf.pdf?rev=436fcdb037324b0b8f0c981d869e684d&sc_lang=en

[8] California Air Resources Board, 2022 State SIP Strategy, p. 30, https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf

Assessment of Pollution Control Technologies

The next step is to research the commercially available emission control technologies and seek information on any emerging emission control technologies. As part of this assessment, staff met with multiple manufacturers. South Coast AQMD Rule 1121 is technology and fuel neutral and is focused on achieving the maximum NOx emission reductions possible.

Staff assessed different pollution control technologies as part of the BARCT assessment. Staff presented and discussed the pollution control technology assessment in working group meetings. The objective is to identify and evaluate control technologies, approaches, and potential emission reductions.

Zero-Emission Technology and Emerging Technology

Zero-emission technologies such as heat pumps, electric resistance, and fuel cell technologies were explored as part of the BARCT assessment, all of which are proven technologies that have been in operation for decades. Staff conducted internet searches and met with stakeholders to gather more information on zero-emission technologies and emerging technology.

Heat Pump Technology for Water Heating

Common zero-emission heating technology includes heat pumps. This technology can be over three times more efficient than conventional appliances and can be used for water heating, space heating, and cooling.

Unlike natural gas-fired water heaters that generate heat directly, heat pump water heaters use the principle of energy transfer to transport energy from the surrounding air to the water, using a refrigerant cycle. The most common type of heat pump water heaters are integrated heat pump water heaters, where the heat pump and storage tank are in a single unit. These are ideal for smaller spaces where installation flexibility is limited, as these offer the convenience of a "drop-in" replacement. Additionally, there are split system heat pump water heaters, where the heat pump unit is separated from the water storage tank. This allows the heat pump unit to be installed in a less-obtrusive area, such as outdoors or a basement, whereas the storage tank can be installed in a different location indoors. In split systems, the heat pump takes heat from where the heat pump unit is installed. The split system, however, is not a "drop-in" replacement for a conventional tank-type water heater and may necessitate higher upfront costs for installation.

Two of the most common types of integrated heat pump water heaters, 240-volt (240V) and 120-volt (120V), are differentiated by the power supply required to operate. 240V heat pump water heaters generally are hybrid electric water heaters, where the heat pump water heater can use a back-up heating element to accommodate for high water usage to increase the recovery rate. Compared to 120V heat pump water heaters, 240V heat pump water heaters have a higher efficiency, but require a power supply that may not be available for all installations. 120V heat pump water heaters offer a solution for a wider range of installations, but they do not have a back-up heating element which results in a slower recovery rate.

120V heat pump water heaters can reduce costs and installation complexity that customers may face when retrofitting a heat pump water heater, compared to 240V heat pump water heaters. New Buildings Institute (NBI) worked closely with 120V heat pump water heater manufacturers and utilities in California on a statewide 120-volt heat pump water heater field validation program from

2021 to 2023. NBI installed 120V heat pump water heaters for 32 customers in most climate zones across California.[9] Based on the study findings, they saved between $800 and $15,000 per household compared to 240V heat pump water heater installation, primarily due to the minimal electrical interventions. These are very low amperage draw water heaters, they were pulling 4-6 amps of current during the monitoring period, despite being rated for 15 amps. From the installer feedback, 120V heat pump water heaters were also faster to install, making them ideal for emergency replacements. 120V heat pump water heaters were introduced to the market in 2022. Currently, there are two manufacturers (i.e., Rheem & A. O. Smith) with 120V heat pump water heaters commercially available with sizes ranging from 40 to 80 gallons. More manufacturers are expected to commercialize 120V heat pump water heaters. This type of heat pump water heater can plug into a standard wall outlet (shared circuit ≥ 15 amps) and can be installed like a standard gas water heater. Due to its slower heat recovery rate and lower first hour ratings compared to its gas-fired counterpart, manufacturers recommend upsizing for similar hot water availability, which means a larger footprint is required. For example, for A. O. Smith products, the heat pump water heater replacement typically is 4-6" larger in diameter and 3-8" taller. Another installation consideration is about ventilation. For a small space not meeting the air flow criteria, louvered door and inlet/outlet ducting may be considered.

The split system heat pump water heater offers a solution for small spaces. This technology is widely used in industrial and residential water heating applications in countries like Japan and Australia and are now gaining more adoption in the California market. The SANCO$_2$ heat pump water heater system has been observed in use for multifacility retrofit projects including the South Coast AQMD Multifamily Affordable Housing Electrification Project. [10] [11] Manufacturers are also developing 120V split system heat pump water heaters that minimize the need for electrical upgrades. EmberH2O Heat Pumps also have a 120V split system heat pump water heater [12]. The Hot Water Innovation Prize intends to reward manufacturers that develop innovative split system heat pump water heaters and bring the technology to market.[13]

Multi-function heap pumps are another emerging technology that uses one efficient compressor and outdoor heat exchanger coil to provide space cooling, space heating, and domestic hot water heating. For retrofits in buildings with existing air conditioning, this means that full size capacity air-to-air multi-function heap pumps can utilize existing air conditioning electrical circuits without modification. For buildings that do not have air conditioning, the air-to-air multi-function water heater is less likely to trigger the need for a service breaker panel or service wire upgrade compared to the typical separate heat pump HVAC and standalone heat pump water heater products. Harvest

[9] New Buildings Institute, https://newbuildings.org/resource/plug-in-heat-pump-water-heater-field-study-findings-market-commercialization-recommendations/
[10] Eco2 Systems, SANCO2 Water Heater, https://eco2waterheater.com/product-info/
[11] The South Coast AQMD, Governing Board Meeting January 2019, https://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2019/2019-jan4-002.pdf?sfvrsn=8
[12] Embertec, https://embertec.com/heat-pump(-water-heaters/
[13] Hot Water Solutions, Hot Water Innovation Prize, https://partners.hotwatersolutionsnw.org/hot-water-innovation-prize

Thermal[14] and Villara Aqua ThermAire[15] are market available multi-function water heater products and more developments are underway[16].

Some stakeholders have expressed concerns over how well heat pumps will operate in colder climates, such as the high-altitude locations within the South Coast AQMD. There are heat pump products available in the market that can operate at low temperatures, and the Northwest Energy Efficiency Alliance's Qualified Products List includes heat pump water heater products that are energy efficient in cold climates and products that can produce hot water via heat pump at negative 25 degrees Fahrenheit. Cold climate heat pumps can pull heat from the air even at sub-zero temperatures and are utilized in colder climates in the U.S. and abroad. Maine has one of highest per capita heat-pump adoption rates, outpacing Scandinavian countries, with rebates incentivizing installation of approximately 116,000 heat pumps in a state that has fewer than 600,000 occupied housing units. Heat pump technology is also being adopted in states such as Vermont and Alaska, and according to the International Energy Agency, 60 percent of Norway's buildings are fitted with a heat pump.

Electric Resistance Technology for Water Heating

Electric resistance water heating relies on electric heating elements immersed in a storage water tank to generate heat. These heating elements are submerged in water in the storage water tank and heat the water by converting the incoming electricity to heat. This technology converts nearly all incoming electricity and converts it to heat directly.

Thermostats monitor the water temperature inside the tank and cycle the heating elements on and off, as needed, to maintain a set temperature. Electric resistance water heaters are generally less efficient than heat pump water heaters, as it can only convert electricity to heat at a one-to-one ratio. Some heat pumps have an electric resistance element used for backup heating since a heat pump's efficiency may decrease due to extreme cold conditions or inadequate spacing.

Solar Technology for Water Heating

Solar thermal hot water systems include conventional-sized systems and consist of flat plate collectors, a controller, pump, and storage. The solar thermal collectors absorb sunlight and transfer the heat to the water or heat transfer fluid. Solar water heating can be active, by using pumps to circulate water, or passive, by relying on natural convection. Solar water heating is advantageous in warmer climates, as it depends on the availability of sunlight to function. Because of this, the use of a back-up water heater, be it a gas-fired, electric resistance, or a heat pump water heater, may be required.

Mobile Homes

Mobile home natural gas water heaters generally have lower capacity and are compatible for natural gas and propane use. Similar to mobile home space heating systems, mobile home water heaters need to be approved by HUD for safety standards. Considering the limited space of

[14] Harvest, https://www.harvest-thermal.com/
[15] AquaThermAire by Villara, https://villara.com/wp-content/uploads/2024/03/1.22-AquathermAire-One-Sheet.pdf
[16] CalNEXT, Residential Multi-Function Heat Pumps: Product Search, https://calnext.com/wp-content/uploads/2023/02/ET22SWE0021_Residential-Multi-Function-Heat-Pumps-Product-Search_Final-Report.pdf

manufactured homes, HUD requirements limit the options of water heater replacement in a mobile home. Some common zero-emission mobile home water heaters include electric tankless water heaters and electric storage water heaters. Manufactures are also providing heat pump water heaters that are HUD approved for mobile home installation. For example, Clayton Homes eBuilt shows a Rheem ProTerra heat pump water heater[17]. Some manufacturers have stated that they will continue their heat pump development to further address space constraints for some existing mobile homes as the market grows.

Fuel Cell Technology for Water Heating

Residential fuel cells that provide combined heat and power (referred to as micro-CHPs) are commercially available in Japan and Europe[18]. Most available micro-CHPs use natural gas, which is reformed into hydrogen gas and carbon dioxide (CO_2). The hydrogen is then sent to the fuel cell, which produces electricity and heat as a byproduct, producing zero NOx. This heat can be used to fulfill heating needs, including hot water and space heating. The same unit can use piped or bottled hydrogen gas, which also makes it an option to decarbonize home heating. However, most units also have a natural gas-fueled "top-up boiler" which provides additional needed heat at peak load.

In Japan, micro-CHPs have been heavily subsidized by the government under the Ene-Farm project, which is part of the larger "Hydrogen Society" policy to move Japan's infrastructure to hydrogen as a renewable fuel source. Japan has by far the largest market penetration of micro-CHPs, with 465,000 systems installed by 2022, though this amount was substantially fewer than the Japanese government's target of 1.4 million systems by 2020.

In Europe, adoption has been much lower. Two pilot projects, Ene-field and its successor PACE, have only installed 3,500 micro-CHPs, with the majority installed in Germany.

Staff from South Coast AQMD Technology Advancement Office met with representatives from SoCal Gas and fuel cell manufacturer Aisin to explore funding for a demonstration project to help bring this technology to the United States market.

Fuel cells have a broad range of applications from multi-megawatt systems to small units and continue to expand with emerging technologies[19]. Cost and durability are still critical challenges, and studies have indicated price ranges between $4,000 to $20,000 per kilowatt (kW). Natural gas fuel cells produce some NOx emissions. Fuel cell adoption in California currently is limited; however, fuel cell technology has the potential to replace existing units to meet the zero-emission limits.

COST-EFFECTIVENESS AND INCREMENTAL COST-EFFECTIVENESS

Initial BARCT Emission Limit and Other Considerations

After completing the technology assessment, staff recommends an initial BARCT NOx emission limit established using information gathered from the technology assessment. All provided emission concentration values (i.e., initial and final) in this report refer to concentration in terms of parts per million by volume (ppmv) based on a dry basis. Additionally, staff evaluates other considerations that could affect the emission limits that represent BARCT, including limits for

[17] Clayton Homes eBuilt, https://www.claytonbuilt.com/ebuilt
[18] Aisin, Energy Solutions, https://www.aisin.com/en/product/energy/
[19] U.S. Department of Energy, Multi-Year Research, Development, and Demonstration Plan, https://www.energy.gov/sites/default/files/2017/05/f34/fcto_myrdd_fuel_cells.pdf

those units operating close to the BARCT NOx limits. Heat pump technologies are still the main technologies that can achieve in the nearer term the NOx concentration limits proposed in PAR 1111 and PAR 1121. The summary of the BARCT assessment and staff's recommendations based on feasibility is discussed in the next section.

Method for Cost-Effectiveness and Incremental Cost-Effectiveness Analysis

The South Coast AQMD routinely conducts cost-effectiveness analyses for proposed rules and proposed amended rules and regulations that result in the reduction of criteria pollutants (NOx, sulfur oxides, volatile organic compounds, particulate matter, and carbon monoxide). The analysis is used as a measure of the relative effectiveness of a proposal. It is generally used to compare alternative means of emissions control relating to the cost of purchasing, installing, and operating control equipment to achieve the projected emission reductions. The major components of the cost-effectiveness analysis are capital costs, annual operation and maintenance costs, emission reductions, discount rate, and equipment useful life. The cost-effectiveness for PAR 1111 and PAR 1121 was completed using the discounted cash flow method, which is explained as follows:

Discounted Cash Flow (DCF)

The DCF method converts all costs, including initial capital investments and costs expected in the present and all future years of equipment useful life, to present value. Conceptually, it is as if calculating the number of funds that would be needed at the beginning of the initial year to finance the initial capital investments and to set aside to pay off the annual costs as they occur in the future. The fund that is set aside is assumed to be invested and generates a rate of return at the discount rate chosen. The final cost-effective measure is derived by dividing the present value of total costs by the total emissions reduced over the equipment useful life. The following equation is used for calculating cost-effectiveness with DCF. Note, the "Annual O&M Costs" denoted in the equation include fuel switching costs. The equation was presented in the 2022 AQMP Socioeconomic Report Appendix 2-B (p. 2-B-3):

$$Cost - effectiveness = \frac{Initial\ Capital\ Investments\ +\ (Annual\ O\&M\ Costs\ \times\ PVF)}{Annual\ Emission\ Reductions\ \times\ Years\ of\ Equipment\ Life}$$

Where O&M = Operation and Maintenance; and

PVF = Present Value Factor.

Equation 2-1. Discounted Cash Flow Cost-Effectiveness Equation

The PVF is calculated as follows:

$$PVF = \frac{(1+r)^N - 1}{r * (1+r)}$$

Where r = real interest rate (discount rate); and
N = years of equipment life.

Equation 2-2: PVF Equation

Lastly, Health and Safety Code Section 40920.6 (a)(3) states that an incremental cost-effectiveness assessment should be performed on identified potential control options that meet air quality objectives. To determine the incremental cost-effectiveness under this paragraph, South Coast

AQMD calculates the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option. Once the BARCT assessment is complete and NOx limits are established, staff considers incrementally more stringent options to demonstrate that the NOx limit represents the "maximum degree of reduction achievable by each class or category." The equation for incremental cost-effectiveness is provided as follows:

$$I\text{-}CE\left(\$/_{tons\ NOx\ reduced}\right) = \frac{Incremental\ Difference\ in\ Cost\ (Present\ Worth\ Value)}{Incremental\ Difference\ in\ Emission\ Reductions\ (Lifetime\ Reductions)}$$

Where I-CE = Incremental Cost-Effectiveness

Equation 2-3: Incremental Cost-Effectiveness Equation

The 2022 AQMP's objective is to meet the 2015 federal ozone standard through further emission reductions by transitioning to zero-emission technologies wherever feasible. For PAR 1111 and PAR 1121, staff identified technically feasible, commercially available, zero-emission control technologies for each category of equipment subject to PAR 1111 and PAR 1121. Staff did not identify less stringent control options that would meet the 2022 AQMP's air quality objective.

For the incremental analysis, staff considered a NOx technology that is incrementally more stringent than the current NOx limits. South Coast AQMD funded a project (Request For Proposal #P2018-06) in 2019 – 2023 for Lantec Products to develop prototype residential furnaces with NOx emissions lower than the current PAR 1111 Table 1 NOx limits. However, considering those prototype furnaces currently are not commercially available, and a number of zero-emission technologies are widely commercially available, staff did not consider the prototype low-NOx furnaces to be a feasible option that would achieve the 2022 AQMP's objectives. In conclusion, staff did not identify multiple control technologies for PAR 1111 and PAR 1121 that can achieve the 2022 AQMP's NOx reduction objective other than to transition to zero-emission technologies; therefore, an incremental cost-effectiveness assessment was not conducted.

Although the BARCT assessment only identified zero-emission technologies, there are a variety of control options that one can choose to meet the zero-emission limit. As discussed in earlier sections, heat pump, electric resistance, solar, and fuel cell are the viable zero-emission technologies that are relying on various fuel sources in alignment with the South Coast AQMD fuel neutral policy. In addition, each type of those technologies has multiple features and options for various applications. For example, heat pump water heaters have product lines for 240V and 120V applications to suit different electric and space setting, split systems that separate the tanks and compressor to save indoor space, multi-function systems that combine and streamline the HVAC and water heating to minimize the need of service upgrade. Cost-effectiveness varies depending on the control option selected to meet the zero-emission limit. For example, a heat pump HVAC replacing both space heating and cooling systems is much more cost effective than replacing just a space heating system, with cost saving estimated.

Cost Assumptions

Project Costs

For the purposes of this report, project costs includes equipment, installation, and any electrical service upgrades needed for installation. In order to determine project costs for heat pumps for PAR 1111 and PAR 1121, staff utilized the data published by TECH Clean California. TECH requires contractors who receive the rebates to report a wide variety of information on the project, including cost. Staff used the public data set for December 2024, choosing the median costs in the four-county area for installations of single-family and multifamily from January 2024 to December 2024. The median costs of each county are weighted by county population to generate average project cost for the South Coast AQMD region. For the costs of the natural gas units, staff took capital costs categories by climate zone and building stock from the 2019 E3 "Residential Building Electrification in California"[(20)]. Subsequently, staff determined the costs for each county under the specified climate zones, calculated weighted average costs based on building stock distribution for each county by 2023 Census data, generate average capital cost for the region with the county average costs, and adjusted the cost for inflation to 2024 dollars[(21)]. For homes with air conditioning (AC), combined costs of the heating and cooling systems were considered, as the proposed heat pump replacement provides both heating and cooling. To estimate the percentage of homes with AC and without AC, staff relied on the US Census American Housing Survey[(22)] which for the Los Angeles-Orange-San Bernardino-Riverside area estimates that 87 percent of homes have AC.

Estimating Fuel Switching Cost

The analysis considered the cost impacts of transitions from conventional combustion heating that uses natural gas to zero-emission technologies that use electricity as part of the cost-effectiveness assessment. For this assessment, the analysis relied on fuel price estimates derived from a combination of the California Energy Commission's (CEC) Integrated Energy Policy Reports (IEPR)[(23)] with the 2023 report for natural gas rates and the 2024 updated report for electricity rates, along with national-level forecasts from the Energy Information Administration (EIA). The current CEC forecast extends to 2040. These forecasts are extended into 2050 by applying the growth rates of forecasted electricity and natural gas prices in the EIA national level projections to the final year of forecasted CEC prices. Electricity forecasts are based on the Los Angeles Department of Water and Power (LADWP) and Southern California Edison (SCE) planning areas. Natural gas forecasts are only based on Southern California Gas Company (SoCalGas) forecasts, as SoCalGas is the primary gas utility in the region. Forecasted prices will not match observed electric and natural gas prices in any given year and may differ materially. Current prices are affected by demand and supply shocks, geopolitical factors, and other considerations which are all unforecastable. However, the CEC forecasts are created through a rigorous modeling process and

[(20)] Energy and Environmental Economics, Inc., https://www.ethree.com/e3-quantifies-the-consumer-and-emissions-impacts-of-electrifying-california-homes/
[(21)] United States Census Bureau, American Community Survey, https://data.census.gov/table/ACSDT1Y2022.B25034?q=B25034&g=040XX00US17$1600000
[(22)] United State Census Bureau, American Housing Survey, https://www.census.gov/programs-surveys/ahs.html
[(23)] California Energy Commission, Integrated Energy Policy Report (IEPR), https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report-iepr

reflect the best available expectation for future prices in the region. CEC forecasts are released every two years.

The analysis utilizes the residential utility rate forecast. Since the forecasted prices for LADWP and SCE differ, staff calculated a weighted average price based on the population served by each utility as follows:

LADWP: 4 million ÷ 17.2 million (Population served by LADWP ÷ regional population) = 0.23
SCE: 13.2 million ÷ 17.2 million = 0.77

Staff averaged the utility rates over the equipment lifetime, starting with the first compliance year. For PAR 1111 residential rates, staff used the cost averages for the period of 2027 – 2050, which are $2.45 per therm for natural gas and $0.32 per kWh for electricity. For PAR 1121, staff used the cost average for the period of 2027 – 2041, which are $2.23 per them for natural gas and $0.31 per kWh for electricity.

Using the annual fuel usage for both electricity and gas and the projected utility rates, the fuel switching cost was calculated on a per-year basis using Equation 2-4.

$$Fuel\ switching\ cost\ (\$) = annual\ electricity\ cost\ for\ replacement\ (\$) - annual\ gas\ cost\ (\$)$$

annual gas cost ($) = annual gas use (therm) * projected gas rate ($/therm)

annual electricity cost for replacement ($) = annual electricity use for replacement (kWh) * projected electricity rate ($/kWh)

Equation 2-4: Fuel Switching Cost Equation

The fuel switching costs were calculated over the span of the useful life of the equipment and averaged.

Electrical Panel Upgrade Cost

The TECH dataset for project costs include costs for equipment, installation, any needed panel upsizing and other electrical work for the project. Some projects had panel upsizing or electrical work, while some others did not need it. Therefore, the project costs used for the cost-effectiveness are accounted for the proportion of installations that would require an electrical service upgrade. For more information regarding an analysis of the TECH dataset, please refer to Additional Analysis: Electrical Service Upgrades in a later section of this Chapter. Cost-Effectiveness Screening Threshold

The 2022 AQMP established a cost-effectiveness screening threshold of $325,000 per ton of NOx reduced based on 2021 dollars. The 2022 AQMP stated that this screening threshold will be adjusted based on the annual California Consumer Price Index (CPI). PAR 1111 and PAR 1121 currently considers a $383,000 per ton of NOx reduced cost-effectiveness screening threshold using 2024 dollars. The 2022 AQMP threshold is neither considered a starting point for control costs, nor an absolute cap.

Cost-Effectiveness Analysis

To determine cost-effectiveness for the proposed BARCT limits, cost information and estimates for the control equipment were obtained. Staff utilized the public database of the TECH Clean

California heat pump rebate program[24] to collect information on the project costs, which includes equipment, installation, and electrical service upgrade costs, for heat pumps. After cost information was obtained, a bottom-up approach evaluated each unit category subject to PAR 1111 and PAR 1121 and cost-effectiveness analysis was conducted to estimate cost per ton of NOx emissions reduced over appliance lifetime on a per equipment basis. Baseline emissions for each equipment were calculated using the assumption methodology outlined in Chapter 5.

Cost-Effectiveness Analysis for PAR 1111

Using Equation 2-1-, the cost-effectiveness of Rule 1111 was calculated. For PAR 1111, the annual operating and maintenance cost is the fuel switching costs.

Project Costs for PAR 1111

Staff utilized the public database of the TECH Clean California to determine the cost of a heat pump retrofit. These costs were used for both single-family and multifamily installations. For NOx-emitting project costs, staff used E3 study and adjusted numbers to 2024 to account for inflation, as explained in an earlier section. A summary of the project costs can be found in Table 2-5.

Table 2-5: Summary of Project Costs for PAR 1111

Property Type	Existing NOx-Emitting Appliance	Zero-NOx Emission Replacement	Zero-NOx Emission Project Cost ($)	NOx-Emitting Unit Project Cost ($)	Additional Project Cost for Zero-Emission Units ($)
Single-Family	Furnace + AC	Heat Pump	19,000	20,000	-1,000
	Furnace Only	Heat Pump	19,000	11,000	+8,000
Multifamily (Cost per unit)	Furnace + AC	Heat Pump	5,900	12,000	-6,100
	Furnace Only	Heat Pump	5,900	7,300	-1,400

Operating Costs for PAR 1111

Staff used the annual fuel use by climate zones for heat pumps and natural gas-fired furnaces in the 2019 Residential Appliance Saturation Study (RASS). [25] Five climate zones were identified for four counties in the South Coast AQMD as detailed in Table 2-6. While the South Coast AQMD encompasses more than the five climate zones, such as climate zone 15, fuel use data for other climate zones were not available and therefore excluded from this analysis. Staff calculated the average annual fuel use for each county with the fuel use of all the climate zones under the county and subsequently determined the fuel switch cost of each county. This approach aligns with

[24] TECH Clean California, Heat Pump Data, https://techcleanca.com/public-data/
[25] California Energy Commission, 2019 California Residential Appliance Saturation Study (RASS), https://www.energy.ca.gov/publications/2021/2019-california-residential-appliance-saturation-study-rass

TECH dataset that has a breakdown of project costs by county. The RASS includes information on the energy use of both electrical and natural gas appliances in Californian homes.

Table 2-6: Climate Zones and County Fuel Use

Climate Zone	County Fuel Use
6	Los Angeles and Orange
8	
9	
10	Riverside and San Bernardino
16	

Staff selected the tabulations for the SCE and SoCalGas as the most representative of the South Coast AQMD region. When estimating fuel use in single-family homes, staff used the fuel use tables in the RASS for single-family. Similarly, when estimating fuel use in multifamily homes, staff used tables in the RASS for multifamily.

A summary of the fuel switching costs can be found in Table 2-7. Fuel switching for furnace and AC and furnace only replacements on an annual basis are the same since the fuel switching costs are calculated based on the energy used for strictly for heating.

Table 2-7: Summary of Fuel Switching Costs for PAR 1111

Property Type	Existing NOx-Emitting Appliance	Zero-NOx Emission Replacement	Fuel Switching Cost
Single-Family	Furnace + AC	Heat Pump	-$750
	Furnace	Heat Pump	-$750
Multifamily (Cost per unit)	Furnace + AC	Heat Pump	-$200
	Furnace	Heat Pump	-$200

Present Value Factor for PAR 1111

According to the Air Conditioning, Heating, and Refrigeration Institute (AHRI), air conditioners have an expected lifetime of 12-15 years.[26] In the Department of Energy's 2023 Energy Conservation Standards for Consumer Furnaces[27], it was assumed consumer furnaces not in the north of the country had an expected lifetime of 20.2 years, but noted replacement was likely to be

[26] AHRI, Air-Conditioning and Heat Pump Efficiency 101, https://www.ahrinet.org/certification/cee-directory/air-conditioning-and-heat-pump-efficiency-101

[27] Energy Conservation Program: Energy Conservation Standards for Consumer Furnaces, https://www.federalregister.gov/documents/2023/12/18/2023-25514/energy-conservation-program-energy-conservation-standards-for-consumer-furnaces

linked to the replacement of a central air conditioner. The California Public Utilities Commission (CPUC) proposed a 36-year expected useful lifetime for central and wall furnaces[28]. The most recent amendment to Rule 1111 also assumed a 25-year equipment lifetime. Given the equipment lifetime ranges from 12 – 36 years, staff, assumed a lifetime of 25 years for residential furnaces and a four percent discount rate and thus a PVF of 15.62 as calculated per Equation 2-2: PVF Equation.

Lifetime Emissions Reductions for PAR 1111

Staff evaluated the lifetime emissions reductions, using a bottom-up approach from the annual fuel use from the California RASS. The lifetime emissions reductions is approximately 0.004 tons for single-family and 0.008 for multifamily.

Residential Furnaces: Cost-Effectiveness for PAR 1111

Staff estimated cost-effectiveness for using heat pumps replacing furnaces in homes with AC and without AC.

The project costs and fuel switching costs used for the cost-effectiveness can be found in Table 2-5 and Table 2-7 respectively and are detailed in the following analysis. A summary of cost-effectiveness for zero-NOx emission heat pump replacements in single-family and multifamily housing is provided in Table 2-8.

Table 2-8: PAR 1111 Cost-Effectiveness for Zero-NOx Unit Replacement

Property Type	Scenario	Cost-Effectiveness ($/ton NOx)
Single-Family	Heat Pump Replacing Furnace + AC	-592,000
	Heat Pump Replacing Furnace	+1,730,000
Multifamily (Per Unit)	Heat Pump Replacing Furnace + AC	-785,000
	Heat Pump Replacing Furnace only	-197,000

The cost-effectiveness is below the screening threshold for a heat pump replacing a HVAC system which includes both space heating furnace and air conditioning system; however, staff estimated high cost-effectiveness for heat pump replacing a furnace only. The incremental cost is much higher but the consumer gets the added benefit of space cooling.

The furnace only replacement scenario may be low within the South Coast AQMD as 87 percent of homes in the region have AC. There may also be instances where homes have newer ACs, and the homeowners opt to only replace the furnace, which would be a costly upgrade. Electric resistance furnaces are another option for replacing a NOx-emitting furnace. The upfront cost for NOx-emitting and electric resistance furnaces is similar; however, the cost to operate an electric resistance furnace is high because they are not as efficient as a heat pump. Electric resistance

[28] Residential HVAC and DHW Measure Effective Useful Life Study Final Report, https://www.calmac.org/publications/CPUC_Group_A_2023_Res_HVAC_and_DHW_EUL_Study_Final_Report.pdf

furnaces could be solution for furnace only replacement with low fuel use (e.g., coastal communities).

The 2022 AQMP states "if a proposed BARCT emission standard has a cost-effectiveness that is above the screening threshold, staff will hold a public meeting to discuss other options at or below the proposed screening threshold." Staff presented the ZEM Manufacturer Alternative Compliance Option at Working Group Meeting #8, the Public Consultation held on March 6, 2025, and Stationary Source Committee Meetings held in February 2025 and March 2025. To address the high cost scenario, PAR 1111 is proposing to include the ZEM Alternative Compliance Option that set manufacturer compliance targets for selling both NOx-emitting and zero-NOx emission space heating appliances. For scenarios with high cost-effectiveness to install a zero-NOx emission unit, consumers would likely make the choice to install a NOx-emitting furnace, as the ZEM alternative compliance option allows. There will be circumstances when a consumer does opt to replace their furnace with a heat pump, likely for the added benefit of space cooling, which is becoming more of a necessity as temperature increase in the region. While the furnace only to heat pump scenario is over the cost-effectiveness threshold, the ZEM alternative compliance option addresses the high cost and allows the consumer to choose to install a NOx-emitting appliance in cases where there is a high upfront cost for zero-NOx emission space heating appliances.

Cost-Effectiveness for the ZEM Alternative Compliance Option

Staff estimated the weighted average cost-effectiveness for implementing the ZEM alternative compliance option. For this estimation, staff assumed a range of 10 to 20 percent of consumers would choose to replace their furnace with a heat pump resulting with a range of weighted cost-effectiveness. For any scenario that staff estimated to have cost savings, staff assumed zero cost impact.

A summary of weighed cost-effectiveness for each implementation phase with the proposed ZEM compliance targets is provided in Table 2-9. More details on the estimation for each phase with 10 or 20 percent of furnace only replacement by heat pumps are provided in Table 2-10. Weighted cost-effectiveness for the rule by ZEM alternative compliance option varies depending on what product consumers would choose but is estimated to be lower than the screening threshold using reasonable assumptions on consumer behavior.

Table 2-9: PAR 1111 Cost-Effectiveness for ZEM Alternative Compliance Option

Dates **Phase**	**2027 - 2028** Phase I	**2029 - 2032** Phase II	**2033 - 2035** Phase III	**2036 and after** Phase IV
Targets	70% NO-Emitting 30% Zero-NOx	50% NO-Emitting 50% Zero-NOx	25% NO-Emitting 75% Zero-NOx	10% NO-Emitting 90% Zero-NOx
Weighed Cost-Effectiveness ($/Ton NOx)	$35,000 – $69,000	$69,000 – $140,000	$110,000 – $220,000	$140,000 - $280,000

Table 2-10: PAR 1111 Cost-Effectiveness for ZEM Alternative Compliance Option

Phase 1						
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Overall**	**Number of Units**	**Weighted C/E**
70%	Gas Unit Install	$0	100%	96.0 - 98.0%	192,000 - 196,000	0
10%	New builds	$0	100%			
20%	HVAC to HP	$0	80 - 90%			
	HP to HP	$0				
	Furnace only to HP	$1,730,000	10 - 20 %	2.0 - 4.0%	4,000 - 8,000	34,600 - 69,200
				Totals	200,000	34,600 69,200
Phase II:						
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Overall**	**Number of Units**	**Weighted C/E**
50%	Gas Unit Install	$0	100%	92.0 - 96.0%	184,000 - 192,000	0
10%	New builds	$0	100%			
40%	HVAC to HP	$0	80 - 90%			
	HP to HP	$0				
	Furnace only to HP	$1,730,000	10 - 20%	4.0 - 8.0%	8,000 - 16,000	69,200 - 138,400
				Totals	200,000	69,200 - 138,400
Phase III:						
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Overall**	**Number of Units**	**Weighted C/E**
25%	Gas Unit Install	$0	100%	87.0 - 93.5%	174,000 - 187,000	0
10%	New builds	$0	100%			
65%	HVAC to HP	$0	80 - 90%			
	HP to HP	$0				
	Furnace only to HP	$1,730,000	10 - 20%	6.5 - 13.0%	13,000 - 26,000	112,450 - 224,900
				Totals	200,000	112,450 - 224.900

Phase IV:						
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Overall**	**Number of Units**	**Weighted C/E**
10%	Gas Unit Install	$0	100%	84.0 - 92.0%	168,000 - 184,000	0
10%	New builds	$0	100%			
80%	HVAC to HP	$0	80 - 90%			
	HP to HP	$0				
	Furnace only to HP	$1,730,000	10 - 20%	8.0 - 16.0%	16,000 - 32,000	138,400 - 276,800
				Totals	200,000	138,400 – 276,800

Cost-Effectiveness Analysis for PAR 1121

The cost-effectiveness of PAR 1121 was calculated Using Equation 2-1Equation 2-4, as described in an earlier section.

Project Costs for PAR 1121

Staff utilized the public database of the TECH Clean California to determine the cost of a heat pump retrofit. Since insufficient data was available for all four counties for multifamily, these costs were used for both single-family and multifamily installations. For NOx-emitting project costs, staff used E3 study and adjusted numbers to 2024 to account for inflation, as explained in an earlier section. A summary of the project costs can be found in **Error! Reference source not found.** below.

Table 2-11: Summary of Project Costs for PAR 1121

Property Type	Zero-NOx Emission Project Cost ($)	NOx-Emitting Project Cost	Additional Project Cost for Zero-Emission Units ($)
Single-Family	3,300	5,400	+2,100
Multifamily	3,300	5,400	+2,100

Operating Costs for Rule 1121

While the RASS included information on energy use for natural gas water heaters, no information was provided on electricity use of heat pump water heaters. Therefore, staff relied on annual electricity use estimates provided by EnergyStar[29] for certified products. Using an average of five different heat pump water heaters ranging from 55 gallons to 65 gallons, an average annual

[29] Energy Star, Heat Pump Water Heaters, https://www.energystar.gov/productfinder/product/certified-heat-pump-water-heaters/results

electricity usage was calculated to be 1036 kWh. An annual use of 188 therms/year and 192 therms/year were found from EnergyStar for 45- and 55-gallon water heaters respectively; staff used the average equating to 190 therms/year annual gas usage. Staff did not analyze fuel use costs based on climate zones for PAR 1121. Unlike space heating appliances, water heating fuel use is not significantly impacted by climate zone, and residential type water heater costs for single-family and multifamily are expected to be similar. A summary of the fuel switch costs can be found in Table 2-12.

Table 2-12: Summary of Fuel Switching Costs for PAR 1121

Property Type	Existing NOx-Emitting Appliance	Zero-NOx Emission Replacement	Fuel Switching Cost
Single-Family	Water Heater	Heat Pump	-$1,100
Multifamily (Cost Per Unit)	Water Heater	Heat Pump	-$1,100

Present Value Factor for PAR 1121

For storage water heaters, U.S. DOE estimates a useful life of 10 to 15 years.[30] For the 2024 amendment of Rule 1146.2, Type 1 storage water heaters were assumed to have a 15-year useful life. For this reason, analysis assumes residential water heaters have a 15-year useful life and four percent discount rate and thus a PVF of 11.118 as calculated per Equation 2-2: PVF Equation

Lifetime Emissions Reductions for PAR 1121

Using the annual fuel use for water heating, staff used a bottom-up approach to calculate the lifetime emissions reductions. The lifetime emissions reductions for both single-family and multifamily is approximately 0.0025 tons.

Single Family and Multifamily Water Heaters: Cost-Effectiveness

Since hot water demand is closely correlated to the number of residents in a household, staff assumed the costs of single-family and multifamily replacements would be the same[31].

The analysis considered the replacement of a NOx-emitting residential water heater less than 75,000 Btu/hr with a heat pump. The project costs and fuel switching costs used for the cost-effectiveness can be found in **Error! Reference source not found.** and Table 2-12 respectively.

A summary of cost-effectiveness for zero-NOx emission heat pump replacements in single-family and multifamily housing is provided in Table 2-13.

[30] U.S. Department of Energy, Tankless or Demand-Type Water Heaters, https://www.energy.gov/energysaver/tankless-or-demand-type-water-heaters
[31] U.S. Department of Energy, Sizing a New Water Heater, https://www.energy.gov/energysaver/sizing-new-water-heater

Table 2-13: PAR 1121 Cost-Effectiveness for Zero-NOx Unit Replacement

Property Type	Scenario	Cost-Effectiveness ($/ton NOx)
Single-Family	Heat Pump Water Heater Replacing NOx-Emitting Gas Water Heater	405,000
Multifamily (Per Unit)	Heat Pump Water Heater Replacing NOx-Emitting Gas Water Heater	405,000

Cost-effectiveness for a replacement of a NOx-emitting water heater with a heat pump water heater is $405,000, which is over the cost-effectiveness screening threshold. To address the high cost-effectiveness, PAR 1121 proposes to include a ZEM alternative compliance option that sets manufacturer compliance targets for selling both NOx-emitting and zero-NOx emission water heating appliances. For installations with high cost to install a zero-NOx emission unit, consumers would likely choose to install a NOx-emitting water heater, as the ZEM alternative compliance option allows. New technologies, such as the 120-V heat pump water heaters and incentives, such as the Go Zero program, will help lower upfront costs.

Cost-Effectiveness for the ZEM Alternative Compliance Option

Staff estimated the weighted average cost-effectiveness for implementing the ZEM alternative compliance option. For this estimation, staff assumed zero-cost impacts for new buildings transitioning to zero-NOx emission units and zero-impact for the installation of NOx-emitting unit.

A summary of weighted cost-effectiveness for each implementation phase with proposed manufacturer compliance target is provided in Table 2-14. More details on the estimation for each phase are provided in Table 2-15. Weighted cost-effectiveness for the rule by ZEM alternative compliance option varies depending on what product consumers would choose but is estimated to be lower than the screening threshold using reasonable assumptions.

Table 2-14: PAR 1121 Cost-Effectiveness for Manufacturer Alternative Compliance Option

Dates **Phase**	**2027 - 2028** Phase I	**2029 - 2032** Phase II	**2033 - 2035** Phase III	**2036 and after** Phase IV
Targets	70% NO-Emitting 30% Zero-NOx	50% NO-Emitting 50% Zero-NOx	25% NO-Emitting 75% Zero-NOx	10% NO-Emitting 90% Zero-NOx
Weighed Cost-Effectiveness ($/Ton NOx)	$81,000	$160,000	$260,000	$320,000

Table 2-15: PAR 1121 Cost-Effectiveness for the ZEM Alternative Compliance Option

Phase I:					
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Number of Units**	**Weighted C/E**
70%	Gas Unit Install	$0	70%	233,333	0
10%	New builds	$0	10%	33,333	0
20%	Existing to HP	$405,000	20%	66,667	81,000
			Total	333,333	81,000
Phase II:					
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Number of Units**	**Weighted C/E**
50%	Gas Unit Install	$0	50%	166,667	0
10%	New builds	$0	10%	33,333	0
40%	Existing to HP	$405,000	40%	133,333	162,000
			Total	333,333	162,000
Phase III:					
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Number of Units**	**Weighted C/E**
25%	Gas Unit Install	$0	25%	83,333	0
10%	New builds	$0	10%	33,333	0
65%	Existing to HP	$405,000	65%	216,667	263,250
			Total	333,333	263,250
Phase IV:					
Target Goal	**Action**	**Cost Impact**	**Percent Impact**	**Number of Units**	**Weighted C/E**
10%	Gas Unit Install	$0	10%	33,333	0
10%	New builds	$0	10%	33,333	0
80%	Existing to HP	$405,000	80%	266,667	324,000
			Total	333,333	324,000

PROPOSED BARCT EMISSIONS LIMIT

Health and Safety Code Section Sections 40920.6(a)(1) and 40920.6(a)(2) require that prior to adopting rules to meet the requirement of BARCT, one or more potential control options which achieve the emission reduction objectives of the rule must be identified, and the cost-effectiveness assessment of the potential control option(s) must be conducted. The final proposed BARCT emission limit for each class and category is the emission limit that achieves the maximum degree of emission reductions and is determined to be cost-effective. The following tables summarize the proposed NOx emission limits that represent BARCT for each equipment category.

Table 2-16: PAR 1111 BARCT NOx Emission Limits and Compliance Schedule

Equipment Category	NOx Emission Limit (ng/J)	Building Type	Compliance Date
Residential Fan-Type Central Furnace*	0	New	January 1, 2027
		Existing	January 1, 2029
Mobile Home Furnace	0	New	January 1, 2027
Wall Furnaces and Floor Furnaces	0	New	January 1, 2027
		Existing	January 1, 2029

* Includes Condensing, Non-Condensing, and Weatherized Furnaces.

Table 2-17: PAR 1121 BARCT NOx Emission Limits and Compliance Schedule

Equipment Category	NOx limit (ng/J)	Building Type	Compliance Date
Water Heater*	0	New	January 1, 2027
	0	Existing	January 1, 2029
Mobile Home Water Heater	0	New	January 1, 2027

* Excluding Mobile Home Water Heater

Future implementation dates will allow for an increase in the supply of zero-emission technology in the market. Manufacturers are currently producing heat pumps for both HVAC and water heating and might modify their business strategies in response to policy changes and market dynamics. It is anticipated that the supply chain will adapt to evolving market conditions.

According to the 2022 AQMP, the established cost-effectiveness screening threshold is considered neither a starting point for control costs, nor an absolute cap. During the rulemaking process, if a proposed emission standard has a cost-effectiveness that is above the threshold, staff will hold a public meeting to discuss other emission standards with a cost-effectiveness at or below the proposed screening threshold and/or compliance or implementation options to address an emission standard that is above the proposed screening threshold.

Staff recognized that cost-effectiveness for implementing zero-NOx emission limit is over the 2033-2035 screening threshold for furnace only and water heater replacements. At the Working Group Meeting #8 on February 13, 2024, staff introduced the ZEM alternative compliance option with compliance targets (see Table 2-18) that will allow the sales of both zero-emission electric units and NOx-emitting natural gas-fired units. The discussion of the ZEM alternative compliance option has been conducted in every public meeting since February 13, 2024, including Public Consultation meetings on March 6, 2025, the Stationary Source Committee Meetings held in February 2025 and March 2025, and outreach presentations in public meetings of many cities and various organizations. This alternative compliance option satisfies the direction set forth by 2022 AQMP for rule amendments that exceed the cost-effectiveness screening threshold.

Table 2-18: ZEM Alternative Compliance Option with Compliance Targets

Target Dates	2027-2028	2029-2032	2033-2035	2036 and after
NOx Emitting Units	70%	50%	25%	10%
Zero-NOx Emission Units	30%	50%	75%	90%

The ZEM compliance option also includes a mitigation fee for the sale of all NOx-emitting appliances, with higher over-target mitigation fees for the NOx-emitting appliances sold over the compliance target. The fees will increase by the CPI for each year past the initial ZEM phase in the 2027 calendar year. The mitigation fees, including the over-target mitigation fees, are less than the cost difference between the NOx-emitting units and zero-NOx emissions units with cost-effectiveness above the threshold, e.g., the fees do not exceed the reasonable cost of providing the benefit of not having to sell a zero-emission unit. The ZEM alternative compliance option is detailed in Chapter 3 and Chapter 4.

ADDITIONAL INFORMATION AND CHALLENGES

Additional Analysis: Electrical Service Upgrades

Staff analyzed TECH Clean California data to further understand the frequency of electrical service upgrades needed for retrofit installations. Electrical service upgrade, as defined by the TECH dataset, is "whether the contractor upgraded the amperage capacity of the home's electrical panel as part of the installation."[(32)] Staff also evaluated the percentage of installations in disadvantaged communities, which is defined as, "whether a project occurred in a Census Tract

[(32)] TECH Clean California, Working Data Set, https://techcleanca.com/documents/5564/Data_Dictionary_-_TECH_Working_Data_Set_Single_Family_z3GmSQV.xlsx

labeled as a Disadvantaged Community per CalEnviroScreen 4.0."[32] For this analysis, staff evaluated installations from January 2024 to December 2024 in Los Angeles, Orange, Riverside, and San Bernardino counties.

For single-family space heating, there was a total of 3,074 installations in the AQMD with 3.7 percent needing an electrical service upgrade and 13.6 percent installed in a disadvantaged community.

For multifamily space heating, staff evaluated data from January 2023 to December 2024 since the 2024 dataset did not have installation data from all counties. There were a total of 1,060 installations across 839 properties with 6.7 percent requiring an electrical service upgrade and 25 percent installed in a disadvantaged community. Multifamily space heating had a higher percentage of installations requiring an electrical service upgrade and higher percentage of installations in a disadvantaged community.

For single-family water heating, there were a total of 1,212 installations with 15.8 percent requiring electrical service upgrades and 46.7 percent installed in a disadvantaged community. Since the percentage requiring electrical service upgrades is higher than space heating, staff further evaluated the types of equipment installed. Of the 1,212 installations, 1,006 installations were 240V heat pump water heaters, where 18.6 percent of the 240V installations required an electrical service upgrade. On the other hand, 206 of the 1,212 installations were 120V heat pump water heaters with 2.4 percent requiring an electrical service upgrade. 120V heat pump water heaters offer a solution for an array of installation types, due to its ease of installation only requiring a 120V outlet. Because of this, installation of 120V heat pump water heater may not need an electrical service upgrade as frequently as a 240V heat pump water heater because of the lower electrical demand. Adoption of 120V heat pump water heaters may increase over time since this technology was introduced into the market in 2022, thus making it relatively new compared to 240V heat pump water heaters. Increased market adoption will also likely lead to costs decreasing.

Due to insufficient data for the AQMD for multifamily water heating, staff relied upon the single-family data for this analysis.

Grid Reliability

2023 Integrated Energy Policy Report (IEPR) projects a peak demand increase of 18,000 MW by 2040 due to transport electrification and building electrification. Meanwhile, the Tracking Energy Development (TED) Taskforce, which is comprised of CEC, CPUC, CAISO, and Governor's Office, is tracking[33] 18,000 MW of new energy procurements which will be available by 2028.

In 2021, renewable generation accounted for 33.6 percent of the total California Power Mix, not including solar photovoltaic systems installed on residential and commercial buildings that are less than one megawatt (MW) as they are typically considered distributed generation and not required to report to CEC.[34] The California Power Mix is the percentage of specified fuel types derived from the California Energy Mix, and the California Energy Mix is the total in-state electric generation plus energy imports. There is expected to be more renewables adoption by states in the future, and California Senate Bill 100 called for a Renewables Portfolio Standard of 60 percent by

[33] CPUC, Tracking Energy Development, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/summer-2021-reliability/tracking-energy-development

[34] CEC, 2021 Total System Electric Generation, https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation

2030. Electricity imports account for approximately 30 percent of total system electric generation, with other states pursuing Renewable Portfolio Standards and state energy goals.

The CEC, CPUC, and CARB are working to coordinate across efforts, identify issues not covered by ongoing efforts, and assess needed actions to better align the energy system with the state's climate targets. Related initiatives include the CPUC's proceeding to support decarbonizing buildings in California (R.19-01-011), which eliminated gas line extension subsidies for new gas hookups to homes and commercial buildings effective July 1, 2023.[35] In February 2023, the CPUC ordered load serving entities to procure an additional 4,000 MW of Net Qualifying Capacity for 2026 and 2027, in addition to the mid-term reliability procurement requirements ordered in 2021 (11,500 MW, enough to power approximately 2.5 million homes). The CPUC also approved four energy storage contracts totaling 372 MW for SCE and recommended an electric resource portfolio for use in the California Independent System Operator's (CAISO) 2023-24 Transmission Planning Process. The recommended portfolio includes over 85 gigawatts (GW) of new resources by 2045, including 54,000 MW of renewable resources; over 28,000 MW of batteries; 2,000 MW of long-duration storage; and 1,100 MW of demand response.

The CEC adopts IEPR every two years and an update every other year. The 2022 IEPR has recognized the proposed zero-emission requirements for residential and commercial buildings in California and included recommendations and updates to the energy demand forecast.[36] The IEPR update released on January 1, 2024, provided forecasts for future natural gas and electricity rates, which staff utilized in the cost-effectiveness analysis. Staff used the cost averages for the period of 2024 – 2050, which are $1.71 per therm or 5.84 cents/kWh for natural gas and 24.81 cents/kWh for electricity commercial rates. For residential rates, staff used the cost averages for the period of 2024 – 2050, which are $2.31 per therm or 7.88 cents/kWh for natural gas and 29.85 cents/kWh for electricity.

Under Assembly Bill 3232 (Friedman, Chapter 373, Statutes of 2018), the CEC must assess the feasibility of reducing greenhouse gas emissions in residential and commercial buildings to 40 percent below 1990 levels by January 1, 2030. Statewide electricity consumption was over 280,000 GWh in 2021 and is forecasted to be 358,738 GWh in 2035. The 2022 Planning Scenario peak forecast for CAISO, which manages roughly 80 percent of California's load, reaches 55,117 MW by 2035. CAISO is planning $11 billion in transmission capacity projects over the next 20 years, which covers 80 percent of the entire state service area. The 20-Year Transmission Outlook document from May 2022 considers transmission needs to meet load and renewable energy growth aligned with state policy. The plan describes $11 billion in upgrades to the existing CAISO transmission footprint.[37] In addition, solar photovoltaic generation continues to increase as shown in the following figure .[38] Between 2022 and 2035, behind-the-meter photovoltaic generation is expected to grow on average by about six percent, reaching annual photovoltaic generation of 55,740 GWh by 2035.

[35] CPUC, Press Release, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M496/K979/496979465.PDF
[36] CEC, 2022 Integrated Energy Policy Report Update, https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update
[37] California ISO, 20-Year Transmission Outlook, http://www.caiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf
[38] CEC, 2022 Electric Generation and Capacity, https://www.energy.ca.gov/media/3757

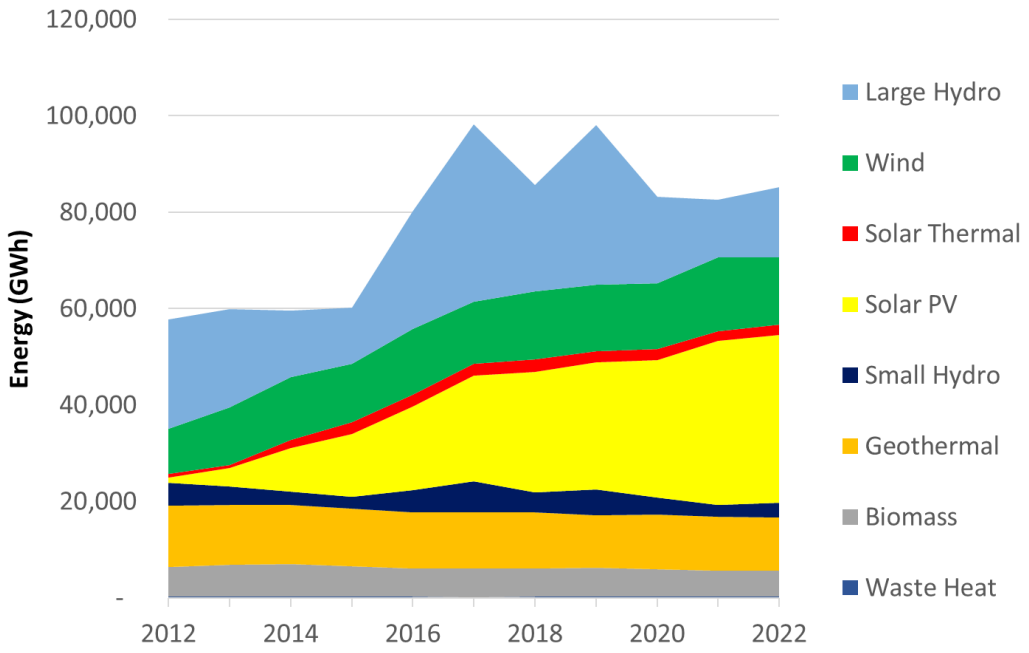

Figure 2-2: In-State Electric Generation – Select Fuel Types, Sourced from CEC Quarterly Fuels and Energy Reporting Regulations

According to SCE's 2021 Sustainability Report, SCE is expected to invest over $5 billion annually in the electric grid, with approximately 3,400 MW of energy storage installed or contracted. In 2021, SCE procured 530 MW of energy storage through three new contracts from third parties and in the same year, entered an engineering, procurement, and construction agreement to construct approximately 535 MW of utility-owned storage. SCE also expected increases in Distributed Energy Resources such as residential solar.[39] In the Pathway to 2045 document, SCE expected a 60 percent increase in electricity load and 40 percent increase in peak load by 2045, with building electrification responsible for 15 percent of load by 2045. SCE noted that the grid will still be summer peaking due to air conditioning.[40]

Staff recognizes the importance of electric grid reliability for electric units, but also for natural gas units, which often require electricity to operate. In 2021, the CPUC created new programs and modified existing programs to reduce energy demand and increase energy supply during critical hours of the day.[41] Per Senate Bill 350 (De León, 2015), the CPUC developed an integrated resource planning process to ensure that California's electric sector meets its greenhouse gas reduction goals while maintaining reliability at the lowest possible costs.[42] Staff recognizes that there are externalities for both electric and natural gas production and distribution. Staff also recognizes the need for regulation of emissions from electricity generation. South Coast AQMD

[39] SCE, Sustainability Report, https://www.edison.com/sustainability/sustainability-report
[40] SCE, Pathway 2045, https://www.edison.com/our-perspective/pathway-2045
[41] California Public Utilities Commission, CPUC Ensures Electricity Reliability During Extreme Weather for Summers 2022 and 2023, https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-ensures-electricity-reliability-during-extreme-weather-for-summers-2022-and-2023
[42] California Public Utilities Commission, CPUC Approves Long Term Plans To Meet Electricity Reliability and Climate Goals, https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-approves-long-term-plans-to-meet-electricity-reliability-and-climate-goals

Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities, is a rule that aims to lower emissions from electricity generation.[43] Regarding the natural gas system, natural gas leaks into the atmosphere from natural gas wells, storage tanks, pipelines, and processing plants. In 2020, methane emissions from natural gas and petroleum systems and from abandoned oil and natural gas wells were source of approximately 33 percent of U.S. methane emissions and approximately four percent of U.S. greenhouse gas emissions. In the South Coast AQMD region, there have been examples of large leaks such as Aliso Canyon, where 109,000 metric tons of methane emissions were released between October 2015 and February 2016.

For this rulemaking, staff did not conduct lifecycle analyses related to the BARCT assessment for either the electricity or natural gas systems as a lifecycle analysis is not required by Health and Safety Code Section 40406 for a BARCT assessment. However, other organizations have conducted lifecycle analyses which show overall NOx reductions when moving to zero-emissions. A 2021 Northeast States for Coordinated Air Use Management (NESCAUM) study estimating NOx reductions for residential scenarios where fossil fuel-burning furnaces are replaced with heat pumps found significant reductions in NOx along with sulfur dioxide and carbon dioxide.[44] A 2023 NESCAUM study also found emission reductions for different scenarios.[45] A 2022 Energy Innovation Policy & Technology study found that switching to heat pumps for industrial processes reduces NOx emissions.[46]

Senate Bill 410: Powering Up Californians Act

Senate Bill 410 (SB 410) was approved on October 7, 2023, and requires the Public Utilities Commission to set targets for how quickly new customers should be connected to the electric grid and create a process for reporting delays. The requirements of SB 410 are effective starting on or before September 30, 2024. Additionally, utility companies must report their current and future staffing needs, including how staff will be trained, to project how future electrical demands will be met. Utility companies may also request cost recovery for cost associated with connecting new customers to the grid with oversight from an independent auditor. SB 410 aims to ensure that the electrical grid is ready for future demand and growth by reducing the time required to connect to the grid, increasing the number of staff and staff training, and allowing for a cost safety net for the utility companies.

Rent Stabilization and Tenant Protections

One of the concerns of stakeholders regarding the adoption of zero-emission technology is that the incremental costs for landlords and property owners to install and operate zero-emission technologies can result in pass-through costs absorbed by tenants. Pass-through costs are fees in addition to base rent, including utilities, property improvements, or renovations. Other agencies have discussed these concerns and solutions regarding rental units, and this is an ongoing topic for

[43] South Coast AQMD, Rule 1135, http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1135.pdf
[44] NESCAUM, Estimating the Emissions Benefits of Switching to Heat Pumps for Residential Heating, https://otcair.org/upload/Documents/Reports/nescaum-otc-emission-reduction-analysis-for-residential-heating-202106.pdf
[45] NESCAUM and OTC, Residential Building Electrification in the Northeast and Mid-Atlantic, https://otcair.org/upload/Documents/Reports/Residential%20Building%20Electrification%20Final%20Report%20August%202023.pdf
[46] Energy Innovation Policy & Technology LLC, https://energyinnovation.org/wp-content/uploads/2022/10/Decarbonizing-Low-Temperature-Industrial-Heat-In-The-U.S.-Report-2.pdf

state and local agencies. According to the U.S. Census, the percentage of renter-occupied households range from 30 to 55 percent in the South Coast AQMD jurisdiction (54 percent in Los Angeles County; 45 percent in Orange County; 28 percent in San Bernardino County; 32 percent in Riverside County).

There are state laws for rent stabilization and tenant protection, such as:

- Costa–Hawkins Rental Housing Act, effective January 1, 1996, which prohibits rent control over certain kinds of residential units (e.g., single-family dwellings and condominiums, and newly constructed apartment units);
- AB 1482 – California Tenant Protection Act of 2019, effective January 1, 2020, which limits annual rent increases to no more than five percent plus local inflation, or 10 percent, whichever is lower; applies to apartments and other multifamily (two units or more) buildings constructed more than 15 years ago; and does not apply to housing regulated by local rent control ordinances;
- SB 567 – Termination of Tenancy, effective April 1, 2024, which requires an owner who displaces a tenant to substantially remodel to provide the tenant with written notice with information regarding description of remodel, expected completion date, and copy of permits required to remodel.

Challenges with state laws involve the ability for landlords to evict tenants to renovate a unit or building for substantial remodels (any modification that requires a permit or abatement of hazardous materials that cannot be safely accomplished within 30 days); the cost of obtaining permits may not deter landlords as costs can be recovered by evictions and relisting with increased rent; and owners can reset rents to market rate at vacancy and then resume conforming to the annual cap of five percent plus inflation.

There are also local regulations for rent stabilization and tenant protection. According to Tenants Together, 39 out of 482 cities in California have "strong" tenant protections.[47] loAt least 13 cities in the South Coast AQMD jurisdiction have rent control, with at least 11 of these cities in Los Angeles County. The maximum allowable increase generally ranges from 2.5 to 5 percent. For the most part, cities in Orange, San Bernardino, and Riverside Counties do not have local rent control ordinances. Some cities that have local regulations include rent control in Santa Ana (Orange County) and Palm Springs (Riverside County). On the local level, some cities might have rent control but no rent board, while other cities might have both. Cities without more stringent rent controls are subject to state laws for rental stabilization and tenant protection.

With building appliances rules by CARB on the state level and rules by local air districts, there is the concern that landlord or property owners may use building appliance upgrades as justification for substantial remodels; utility upgrades could potentially trigger no-fault cause evictions. No-fault causes include: the intent to demolish or substantially remodel the property; compliance with a local ordinance or order issued by a governmental agency. Another concern is that most local and state laws do not directly protect tenants from pass-through expenses; the base cost of rent is controlled, and the allowance of pass-through costs (i.e. costs in addition to base rent) differ across cities.

[47] Tenants Together, Rent Control by City, https://www.tenantstogether.org/resources/list-rent-control-ordinances-city

CARB is considering these state-wide challenges and potential solutions to mitigate the impact of building appliance rules on rental properties. They hired third-party contractor, Strategic Actions for a Just Economy (SAJE), who made the following recommendations[48,49]:

- Prohibit evictions for home modifications that objectively improve quality of housing or help advance climate goals, such as replacing appliances;
- Amend AB 1482 to adjust rent caps to no more than 3 percent, close the substantial remodel loophole, and remove no-fault evictions;
- Amend California Health and Safety code to state heating and cooling must operate with electric (after 2030);
- Provide financial assistance to small landlords in exchange for stronger rent protections (e.g. through the Equitable Building Decarbonization Program);
- Support city-level policy to:
    - Include penalties for illegal construction;
    - Adopt proactive inspection programs;
    - Verify appliance compliance via habitability inspections.

Local agencies can also contribute to solutions for rental protection:

- Support updates to AB 1482 to explicitly limit pass-throughs for decarbonization and zero-NOx retrofits
    - Clarify if upgrading to zero-NOx appliances triggers "substantial repair" clauses in laws;
- Support local agencies (i.e. "rent boards") to consider policies to prohibit or limit pass-through costs for zero-NOx upgrades, especially for low-income tenants;
- Expand education on renter protection laws and resources providing low-cost/free legal support;
- Support local governments to clarify that end-of-life equipment replacements for services already provided (i.e. heat and hot water) qualify as regular operations & maintenance costs, not capital improvements;
- Perform a risk assessment (data-based estimate of the likelihood that impact will occur) to better inform policy and incentive program changes in the long term.
- Rental protection challenges and solutions cannot be addressed in the PAR 1111 and 1121 language or requirements, and staff will continue to meet with different local and state agencies to work on solutions and conduct outreach and education on rent stabilization and tenant protection as part of building appliances rule implementation and Go Zero outreach.

[48] SAJE, Decarbonizing California Equitably, https://www.saje.net/wp-content/uploads/2023/09/Decarbonizing-California-Equitably-Report-1.pdf
[49] The South Coast AQMD, Working Group Meeting #6, https://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1111-and-1121/par-1111-and-1121-wgm6-august-2024.pdf?sfvrsn=18

Mobile Homes

Mobile homes, also known as manufactured homes, must comply with federal construction and safety standards, which are different from those for traditional homes. These standards are enforced by the U.S. Department of Housing and Urban Development (HUD). California Department of Housing and Community Development (HCD) also protects families and individuals who live in mobile homes by inspecting mobile home parks for health and safety violations in areas where the local government has not assumed enforcement. HCD further protects consumers by enforcing regulations for those who build and sell manufactured homes. Mobile home manufacturers also need to meet the energy efficiency standards by the Department of Energy. A manufactured home may be installed under the provisions of Health and Safety Code Section 18551 or the California Code of Regulations, Title 25.

On April 24, 2020, the CPUC approved the Mobile Home Park Utility Conversion Program[(50)]. This program allows mobile home park and manufactured housing communities the opportunity to replace privately owned, master-metered/sub-metered or non-sub metered electric and gas distribution systems with direct service for mobile home residents. Applications for the new program began January 1, 2021, and will continue through 2030 with a goal to convert total of 50 percent of mobile home park spaces in each utility territory to direct gas and/or electric utility service. SCE is targeting 3,300 mobile home conversions per year from list of 72,000 mobile homes. This program will benefit many mobile home residents by providing safer and more reliable utility services.

Mobile home units are currently designed to be certified at 40 ng/J NOx. Mobile home furnaces comply with the 14 ng/J standard by the existing mitigation fee alternative compliance option. Manufacturers have zero-NOx emission units commercially available and installed in new mobile homes.

There are unique challenges to implementing zero-NOx emission appliances for mobile homes. In addition to the issues on special design, additional regulations, and technology readiness for existing mobile homes, stakeholders also expressed the concerns that mobile homeowners may have lower incomes.

Mobile home units for existing buildings will continue to comply with current standard, and the exiting mitigation fee alternative compliance option for mobile home furnaces will continue to be provided. Mobile home units for new buildings, not including new buildings in master-metered park, will start to transition to zero-NOx emission appliances effective in a future date. PAR 1111 and 1121 propose to exempt new and existing mobile homes located in master-metered parks from the zero-NOx emission standards due to the limited electricity available. Mobile homes will be required to transition to zero-NOx appliances once the mobile home parks are converted to direct utility service.

Refrigerants

Another concern highlighted by stakeholders is increasing the number of heat pumps will necessarily increase the amount of refrigerant escaping into the atmosphere. The EPA has updated technologies that may no longer use high global warming potential (GWP) hydrofluorocarbons

[(50)] CPUC Mobile Home Park Utility Conversion Program, https://www.cpuc.ca.gov/regulatory-services/safety/mhp/mobilehome-park-utility-upgrade-program

(HFCs) or HFC blends, which will be effective beginning January 1, 2025[51]. Many refrigerants currently in use, such as R-410A and R-134A, GWP thousands of times higher than CO_2. While the refrigerant circuit in a heat pump is sealed, leaks in the system can result in the refrigerant escaping. When evaluating greenhouse gas emissions from these leaks, it is important to recognize that natural gas fired equipment emit greenhouse gases as a result of normal operations. The E3 Building Electrification in California Study analyzed potential emissions from heat pumps and concluded overall greenhouse gas emissions would be lower for heat pumps than combustion equipment. Furthermore, in 2020 the American Innovation and Manufacturing Act granted the EPA the authority to phasedown production of high GWP refrigerants, encouraging the adoption of lower GWP refrigerants. Several of these low GWP refrigerants also have the co-benefit of increased performance, with R-290 (propane) and R-744 (CO_2) able to operate at much lower temperatures than other refrigerants currently in use.

Table 2-19: Common Refrigerants

Refrigerant	GWP	Notes
R-134a	1,430	Part of EPA phasedown
R-410a	2,087	Part of EPA phasedown
R-32	675	Part of EPA phasedown
R-1234ze	<10	
R-744	1	CO_2, low temperature applications
R-290	3	Propane, low temperature applications

([51]) EPA, Technology Transitions HFC Restrictions by Sector, https://www.epa.gov/climate-hfcs-reduction/technology-transitions-hfc-restrictions-sector

CHAPTER 3: PROPOSED AMENDED RULE 1111

INTRODUCTION

PROPOSED AMENDED RULE 1111

INTRODUCTION

The main objective of PAR 1111 is to propose NOx limits that represent BARCT for the applicable equipment. PAR 1111 also removes obsolete language, reorganizes the rule structure to reflect recently amended and adopted rules, and includes an alternative compliance subdivision.

PROPOSED AMENDED RULE 1111

PAR 1111 reorganizes the rule structure to reflect recently amended and adopted rules and includes new subdivisions. Table 3-1 summarizes the changes to the subdivisions to PAR 1111 from Rule 1111.

Table 3-1: Rule 1111 and PAR 1111 Rule Structure

Subdivision	Rule 1111	PAR 1111
(a)	Purpose and Applicability	Purpose
(b)	Definitions	Applicability
(c)	Requirements	Definitions
(d)	Certification	Requirements
(e)	Identification of Compliant Units	Certification
(f)	Enforcement	Alternative Compliance Options
(g)	Exemptions	Informative Materials, Labeling, Recordkeeping, and Reporting
(h)	(N/A)	Exemptions

PAR 1111 (a) - Purpose

The purpose of PAR 1111 is to reduce NOx emissions from NOx-emitting furnaces used for interior space heating.

PAR 1111 (b) – Applicability

Subdivision (b) is separated into its own subdivision to align with recently amended and adopted rules. PAR 1111 applies to manufacturers, distributors, retailers, resellers, and installers of NOx-emitting furnaces with a rated heat input capacity less than 175,000 Btu/hr used for comfort heating or a cooling rate of 65,000 Btu/hr for combination heating and cooling units. The applicability is expanded from fan-type central furnaces to include floor and wall furnaces.

The provisions of the rule are enforced through the supply chain (i.e. manufacturers, distributors, retailers, etc.). Resellers and retailers are also added to applicability. Sellers were subject to Rule 1111 but have been removed to avoid redundancy.

PAR 1111 (c) – Definitions

Subdivision (c) was previously subdivision (b) in Rule 1111. Subdivision (c) lists the definitions used in PAR 1111. For all definitions, refer to PAR 1111 released with the staff report.

The following definitions have been added to PAR 1111:

- Consumer Price Index (CPI)
- Existing Building
- Floor Furnace
- Furnace
- High-Altitude
- Informative Materials
- Install
- Installer
- Master-Metered Mobile Home Park
- New Building
- Non-Condensing Furnace
- Reseller
- Residential Fan-Type Central Furnace
- Wall Furnace
- Zero-NOx Emission Unit

Install, installer, and reseller are defined to clarify who is subject to the rule. Furnace is defined to include residential fan-type central furnace, floor furnace, and wall furnace. Wall and floor furnaces have not been regulated by Rule 1111 or other rules at the South Coast AQMD. Existing building and new building are defined to differentiate between compliance dates. The term for high-altitude is defined to accommodate the revision and streamlining of the existing high-altitude provisions. Informative materials is defined to clarify the information needed in subdivision (f). Master-metered mobile home parks are defined as installations in master-metered mobile home parks are exempted from Zero-NOx emission standards. Zero-NOx emission unit is defined to clarify what appliances for space heating have zero-NOx emissions, which will be used in the new provision for the manufacturer alternative compliance option. Consumer Price Index (CPI) is defined, and the California annual average increase is used for mitigation fee adjustment as specified in the rule.

The following definitions have been revised in PAR 1111:

- Condensing Furnace
- Downflow Furnace
- Heat Input
- Mobile Home
- Mobile Home Furnace
- NOx Emissions
- Rated Heat Input Capacity
- Weatherized

Condensing furnace, downflow furnace, mobile home furnace, and weatherized are revised to align with the newly added definitions and to clarify which furnaces fall under the different equipment

categories. Heat input, NOx emissions, and rated heat input capacity are revised to align with amended Rule 1146.2 (Adopted June 7, 2024). Mobile home definition is revised to align with the definitions by California Energy Commission and Federal Department of Housing and Urban Development.

The following definitions have been removed from Rule 1111, as they are obsolete or unnecessary definitions:

- Btu
- Dual Fuel System
- Fan Type Central Furnace
- Single Firing Rate
- Variable Firing Rate

PAR 1111 (d) – Requirements

Subdivision (d) was previously subdivision (c) in Rule 1111. Paragraph (c)(5) in Rule 1111 regarding mitigation fees was removed from this section and relevant paragraphs were moved to subdivision (f) under Alternative Compliance Options for a streamlined rule structure. Subdivision (d) outlines the compliance dates for each equipment category.

Paragraph (d)(1) – Current Rule 1111 Emission Limits

Paragraphs (c)(1) to (c)(3) from Rule 1111 were removed and (c)(4) was revised for PAR 1111 paragraph (d)(1) to consolidate the existing requirements. Paragraph (d)(1) specifies the current NOx emission limits for residential fan-type furnaces for each equipment category in PAR 1111 Table 1 (presented in this Staff Report as Table 3-2).

PAR 1111 Table 1 limits are applicable prior to PAR 1111 Table 2 zero-NOx emission limit compliance date, except for mobile home furnaces in existing buildings. PAR 1111 does not propose zero-emission limit for mobile home furnaces in existing buildings, which will remain subject to their Table 1 limit.

Paragraph (d)(1) states that no person shall manufacture, supply, sell, resell, offer for sale, import, or install for use within the South Coast AQMD, any following furnace unless the furnace is certified pursuant to subdivision (e) not to exceed the applicable NOx emission limits in Table 1 that are expressed as nanograms of NOx per joule of useful heat delivered to the heated space (ng/J).

Paragraph (d)(1) includes that no person shall resell or import within the South Coast AQMD in addition to the previous requirements (i.e. manufacture, supply, sell, offer for sale, or install).

Table 3-2: PAR 1111 Table 1 Residential Fan-Type Central Furnace NOx Limits

Equipment Category	NOx Emission Limit (ng/J)
Condensing Furnace	14
Non-Condensing Furnace	14
Weatherized Furnace	14
Mobile Home Furnace	14

Paragraph (d)(2) – PAR 1111 BARCT Emission Limit for New and Existing Buildings

Paragraph (d)(2) sets the updated BARCT emission limits for the applicable equipment categories in PAR 1111 Table 2 (presented in this staff report as Table 3-3). This paragraph states that a person shall only manufacture, supply, sell, resell, offer for sale, import, or install, for use in the South Coast AQMD, a zero-NOx emission unit by the Table 2 compliance dates, unless the NOx-emitting Furnace is included in the ZEM manufacturer alternative compliance option pursuant to paragraph (f)(2) as indicated in the informative materials for the water heater pursuant to subparagraph (g)(1)(C). The applicable Table 2 compliance dates for new buildings shall be determined based on the construction or alteration completion date. The construction or alteration completion means finishing all the installation to ensure the functionality and aesthetics of the space as specified in the approved building permit. Mobile home furnaces for installation in existing buildings are not subject to zero-NOx emission limit.

Table 3-3: PAR 1111 Table 2 Zero-NOx Emission Limit Compliance Schedule

Equipment Category	Building Type	Compliance Date
Residential Fan-Type Central Furnace[1]	New	January 1, 2027
	Existing	January 1, 2029
Mobile Home Furnace	New	January 1, 2027
Wall Furnace and Floor Furnace	New	January 1, 2027
	Existing	January 1, 2029

[1] Includes Condensing, Non-Condensing, and Weatherized Furnaces.

PAR 1111 (e) – Certification

Subdivision (e) provides guidance to manufacturers to certify furnaces. Certification was originally subdivision (d) in Rule 1111.

Paragraph (e)(1) – Testing Requirements

Subdivision (e)(1) was edited for clarity, including the addition of the South Coast AQMD Rule 1111 Nitrogen Oxides Emissions Compliance Testing for Natural Gas-Fired, Fan-Type Central Furnaces certification protocol to the valid operation procedures[(52)].

Paragraph (e)(2) – Determining NOx Emissions

Paragraph (e)(2) was edited to clarify the equations to be used to determine the nanograms of NOx per joule of useful heat to the delivered space. Other edits made are to clarify nomenclature.

Paragraph (e)(3) – Applying for Furnace Certification

Reworded source test requirement to better align with the same section in PAR 1121.

Paragraph (e)(4) – Timeline

Added a requirement for the manufacturer to submit the items identified in paragraph (e)(3) no more than 180 days after the date of source test identified in subparagraph (e)(3)(D). This was added to align with the certification requirements of Rule 1121.

Former PAR 1111 (e) – Identification of Compliant Units

Staff relocated the requirements in existing subdivision (e) and included them in subdivision (g) – Informative Materials, Labeling, Recordkeeping, and Reporting, because the provision were all for labeling requirements.

PAR 1111 (f) – Alternative Compliance Options

Subdivision (f) is a new subdivision to address alternative compliance options that includes existing requirements regarding mitigation fees in Rule 1111 paragraph (c)(5) with revision and proposed new alternative compliance option(s).

Paragraph (f)(1) – Mitigation Fee Alternative Compliance Option for Mobile Home Furnaces

Prior to the applicable Table 2 compliance date, a manufacturer of mobile home furnaces may elect to pay a per unit mitigation fee for selling or enabling distributors, retailers, resellers, or installers to sell mobile home furnaces certified to meet the 40 ng/J NOx emission limit in lieu of the 14 ng/J NOx emission limit. The manufacturer must comply with the following requirements:

- Pay a per unit mitigation fee of $150 for each mobile home furnace distributed or sold into or within the South Coast AQMD until September 30, 2025;
  - On and after October 1, 2025, the per unit mitigation fee is $100 for each mobile home furnace distributed or sold into or within the South Coast AQMD
- Submit an alternative compliance plan, no later than 60 days prior to each 12-month compliance period that begins on October 1st , during which the manufacturer elects to pay the mitigation fee in lieu of meeting the NOx emission limit;
  - Clauses (f)(1)(B)(i) to (f)(1)(B)(iv) detail what should be included with the alternative compliance plan; and
- Submit to the Executive Officer a report signed by the responsible official for the manufacturer no later than 90 days after the end of each 12-month mitigation fee

[(52)] The South Coast AQMD, Protocol, https://www.aqmd.gov/docs/default-source/laboratory-procedures/methods-procedures/r1111_protocol.pdf

alternate compliance period. The report shall, for the applicable 12-month alternate compliance period, identify each model number and the quantity of mobile home furnaces distributed or sold into or within South Coast AQMD; and include the payment of mitigation fees.

Paragraph (f)(2) – Zero-Emission Manufacturer (ZEM) Alternative Compliance Option

In lieu of complying with paragraph (d)(2) a manufacturer of furnaces, other than mobile home furnaces, can elect to comply with the ZEM alternative compliance option. This alternative compliance option allows for the sale of NOx emitting furnaces, including residential fan-type central furnaces certified to emit 14ng/J of NOx or less or wall or floor furnaces, given:

- The manufacturer submits an alternative compliance plan no later than November 1, 2026, detailing the requirements in paragraph (f)(2)(A);
- The manufacturer sells, or enables distributors, retailers, resellers, or installs to sell Zero-NOx emission units into or within the South Coast AQMD at a percentage greater than or equal to the Zero-NOx emission unit sales targets specified in PAR 1111 Table 3 (presented as Table 3-4 in this staff report);
- Equations are provided for calculating zero-NOx emission unit and furnace sales percentages. Each zero-NOx emission unit that utilizes ductwork to distribute heated air through the home or does not utilize ductwork for heat distribution but is a multiple zone system with one outdoor unit will be counted as one unit for the calculation. Each zero-NOx emission unit that does not utilize ductwork to distribute heated air through the home (e.g., a mini-split) shall be counted as a half unit.
- The manufacturer pays a $100 mitigation fee for each furnace sold in 2027 and adjusted by the CPI annual percent increase for each subsequent year after 2027. If the CPI annual percent increase for a calendar year is greater than three percent, a three percent increase will apply to that year; and
- The manufacturer submits a report and mitigation fee payment pursuant to paragraph (g)(2) no later than 90 days after the end of each calendar year utilizing this alternative compliance option.
- The manufacturer complies with the informative material requirements pursuant to paragraph (g)(1)

Table 3-4: PAR 1111 Table 3 ZEM Alternative Compliance Option Targets

Compliance phase	Phase 1	Phase 2	Phase 3	Phase 4
Calendar Years	**2027 - 2028**	**2029 - 2032**	**2033-2035**	**2036 and after**
Zero-NOx Emission Unit Sales Target	30 percent	50 percent	75 percent	**90 percent**
Furnace Sales Target	**70 percent**	**50 percent**	**25 percent**	**10 percent**

Paragraph (f)(3) – ZEM Alternative Compliance Option Sales Target Deviation

Any furnace manufacturer that elects to comply with the ZEM alternative compliance option and sells more NOx-emitting furnaces than furnace sales target in Table 3 in one calendar year

must pay the per unit mitigation fee outlined in Table 3 for each unit sold above the sales target. The mitigation fee for each furnace sold over target is $500 for the calendar year 2027 and adjusted by the CPI annual percent increase for each subsequent year after 2027. If the CPI annual percent increase for a calendar year is greater than three percent, a three percent increase will apply to that year.

Below are two examples for determining the mitigation fee when a manufacturer sold more NOx-emitting furnaces than Furnace Sales Target.

Example 1:

From January 1, 2027, to December 31, 2027, a manufacturer sold 1,000 units with sales for NOx emitting furnaces and zero-NOx emission units 800 (80 percent) and 200 (20 percent) respectively.

Since the 2027 NOx-emitting furnaces sales were over the 70 percent furnace sales target, the mitigation fee should be calculated as below:

- Number of NOx-emitting furnaces within the target = 1,000 x 70% =700
- Mitigation fee for units within the target per PAR 1111 subparagraph (f)(2)(F) = $100 x 700 = $70,000
- Mitigation fee for furnaces sold over target = $500 x (800 -700) = $50,000
- Total mitigation fee this manufacture should pay for 2027 = $70,000 + $50,000 = $120,000

Example 2:
From January 1, 2028, to December 31, 2028, a manufacturer sold 1,000 units with sales for NOx emitting furnaces and zero-NOx emission units 750 (75 percent) and 250 (25 percent) respectively.

Since the 2028 NOx-emitting furnaces sales were over the furnace sales target that is 70 percent, the mitigation fee should be calculated as below:

- Number of NOx-emitting furnaces within the target = 1,000 x 70% =700
- Since it is after 2027, the mitigation fee rates should be CPI adjusted. Assuming California CPI annual percent increase for 2028 is 2.8 percent, within target mitigation fee rate is adjusted to $100 x (1+2.8%) =$102.8; over target mitigation fee rate is adjusted to $500 x (1+2.8%) = $514.0
- Mitigation fee for units within the target per PAR 1111 subparagraph (f)(2)(F) = $102.8 x 700 = $71,960
- Mitigation fee for furnaces sold over target = $514 x (750-700) = $25,700
- Total mitigation fee this manufacture should pay for 2028 = $71,960 + $25,700 = $97,660

Example 3: From January 1, 2029, to December 31, 2029, a manufacturer sold 1,000 units with sales for NOx emitting furnaces and zero-NOx emission units 600 (60 percent) and 400 (40 percent) respectively.

Since the 2029 NOx-emitting furnaces sales were over the furnace sales target that is 50 percent, the mitigation fee should be calculated as below:

- Number of NOx-emitting furnaces within the target = 1,000 x 50% =500
- Since it is after 2027, the mitigation fee rates should be CPI adjusted. Assuming California CPI annual percent increase is 2.8 percent for 2028 and 3.5 percent for 2029, we will use 3.0 percent for 2029 CPI adjustment since it is higher than 3.0 percent. Within target mitigation fee rate is adjusted to \$100 x (1+2.8%)(1+3.0%) =\$105.9; over target mitigation fee rate is adjusted to \$500 x (1+2.8%)(1+3.0%) = \$529.4
- Mitigation fee for units within the target per PAR 1111 subparagraph (f)(2)(F) = \$105.9 x 500 = \$52,950
- Mitigation fee for furnaces sold over target = \$514 x (600-500) = \$51,400
- Total mitigation fee this manufacture should pay for 2028 = \$52,950 + \$51,400 = \$104,350

If the annual percentage of sales of zero-NOx emission units exceeds the Zero-NOx Emission Unit Sales Target in Table 3, a discounted mitigation fee for the reporting year is determined by the following equation:

$$Discounted\ Mitigation\ Fee = F - F \times \frac{(P - T)}{(100 - T)}$$

Where:

F = Annual Mitigation Fee pursuant to subparagraph (f)(2)(F)

P = Reported Percent Zero-NOx Emission Units

T = Zero-NOx Emission Unit Sales Target

Equation 3-2: PAR 1111 Equation 5 Discounted Mitigation Fee

Below is an example for discounted mitigation fee determination.

Example 3: From January 1, 2027, to December 31, 2027, a manufacturer sell 1,000 units with sales for zero-NOx emission units and NOx emitting furnaces 400 (40 percent) and 600 (60 percent) respectively.

Since the 2027 zero-NOx emission unit sales were over the target which is 30 percent, a discounted fee should be calculated as below:

- Annual mitigation fee pursuant to PAR 1111 subparagraph (f)(2)(F) = \$100 x 600 = \$60,000
- Discounted mitigation fee = \$60,000 – (\$60,000 x (40 - 30)/(100 – 30)) = \$51,429
- Total mitigation fee this manufacture should pay for 2027 is \$51,429

PAR 1111 (g) – Informative Materials, Labeling, Recordkeeping, and Reporting

Subdivision (g) is a new subdivision that details the informative materials, labeling, recordkeeping, and reporting requirements. Informative materials and labeling requirements are important tools

for enforcement, especially when some units distributed to the market can only be installed under certain conditions. While manufacturers ship units into many markets, to ensure the labels are only included on units sold into or within the South Coast AQMD, they may elect to send a sticker or label to their distributors so they can be applied at the point of sale.

Paragraph (g)(1) –Informative Materials for Furnaces

Three types of NOx-emitting furnaces are subject to this provision for informative materials, which are:

- Any mobile home furnace that is for distribution or sale inside of the South Coast AQMD that is using an alternative compliance plan in lieu of meeting the 14 ng/J certification limit;
- Any furnace that is for distribution or sale inside of the South Coast AQMD for installation at high-altitude in a downflow configuration persuade to paragraph (h)(3); and
- Any furnace sold under the ZEM alternative compliance option pursuant to paragraph (f)(2) in lieu of complying with paragraph (d)(2).

Those furnaces that are for distribution or sale inside of the South Coast AQMD shall distribute or publish informative materials that clearly display the language outlined in paragraph (h)(1). Informative materials include: the consumer brochure for the furnace, technical specification sheet for the furnace, and the manufacturer's website that promotes, discusses, or lists the furnace. The manufacturer may use alternative language to the language in subparagraph (g)(1)(A), (g)(1)(B), or (g)(1)(C), provided that the language is similar and is approved.

Paragraph (g)(2) – Reporting and Recordkeeping Requirements for ZEM Alternative Compliance Option

The manufacturer of a furnace supplied or offered for use within the South Coast AQMD in accordance with the ZEM alternative compliance option shall submit to the Executive Officer a report, signed by the responsible official for the manufacturer no later than 90 days after the end of each calendar year using the alternative compliance option. The report shall include the information specified in subparagraph (g)(2)(A)for the applicable calendar year.

The manufacturer shall also maintain records for at least five years, including, but not limited to, the information listed in subparagraph (g)(2)(B).

Paragraph (g)(3) –Labeling and Reporting for Propane Conversion Kit Furnace

This provision is an existing requirement. The manufacturer, distributor, or installer of any furnace that elects to use the exemption in paragraph (h)(1) for furnaces to be installed with a propane conversion kit must clearly display on the shipping carton or the name plate of the furnace "This furnace is to be installed for propane firing only. Operating in natural gas mode is in violation of the South Coast AQMD Rule 1111." They must also submit a report by March 1st of the following calendar year to the Executive Officer, which consists of, but is not limited to, the quantity of propane conversion kits for furnaces distributed or sold for use into the South Coast AQMD for the applicable compliance plan period, and the quantity of propane conversion kits for furnaces distributed or sold for use into the South Coast AQMD during the 12-month period of July 1 to June 30, prior to the applicable compliance date.

Paragraph (g)(4) – New and Existing Building Labeling Requirements

A manufacturer can elect to comply with paragraph (d)(2) directly or through alternative compliance option by paragraph (f)(2).

This provision specifies labeling requirement for any manufacturer that is not electing to comply using alternative compliance option by paragraph (f)(2). As specified in paragraph (d)(2), the manufacturer will be subject to the zero-NOx emission compliance date for new buildings on January 1, 2027, for existing buildings on January 1, 2029, except for mobile home furnaces.

PAR 1111 proposes a labeling requirement for the period between the new building compliance date and existing building compliance date for each furnace, except for mobile home furnaces.

Subparagraph (g)(4)(A) specifies the labeling language. Subparagraph (g)(4)(B) allows manufacturers flexibility in the labeling by posting alternative language as long as the language is similar to (g)(4)(A) and approved.

Clause (g)(4)(B)(ii) requires the manufacturer to use the language in (g)(4)(A) if the alternative language is not approved.

Paragraph (g)(5) – Identification of Furnaces Complying with Subdivisions (d) and (e)

This provision is an existing requirement, as paragraph (e)(1) in Rule 1111. It requires manufacturers of NOx emitting furnaces to display the model number, heat input capacity, applicable NOx emission limit, and date of manufacturer or date code.

Paragraph (g)(6) – Identification of Non-Certified Furnaces

This provision is an existing requirement, as paragraph (e)(2) in Rule 1111. It requires any non-certified Furnace shipped to a location in the South Coast AQMD for distribution or sale outside of the South Coast AQMD shall have a label on the shipping container identifying the Furnace as not certified for use in the South Coast AQMD.

PAR 1111 (h) – Exemptions

Subdivision (h) was previously subdivision (g) in Rule 1111. After rule structure streamlining` and removal of obsolete paragraphs, subdivision (h) specifies exemptions for propane-fire furnaces, zero-NOx emission limit, and downflow furnaces for high-altitude installations.

Paragraph (h)(1) – Propane-Fired Furnaces

This is an existing exemption in Rule 1111 paragraph (g)(4). The manufacturer of any natural gas-fired furnace that is not certified to meet the 14 ng/J of NOx emission limit and is to be installed with a propane conversion kit for propane firing only in the South Coast AQMD, is exempt from subdivisions (d) and (e), provided that the labeling and reporting requirements in (g)(3) are met. Its labeling and reporting requirements under the same paragraph have been moved to PAR 1111 paragraph (g)(3) for a streamlined rule structure.

Paragraph (h)(2) – Exemption from Zero-NOx Emission Limit

Three types of NOx-emitting furnaces are subject to this provision for exemption from zero-NOx emission limit, which are:

- Mobile home furnaces in compliance with paragraph (d)(1) for installation in existing buildings;
- Mobile home furnaces in compliance with paragraph (d)(1) for installation or use in new buildings or existing buildings located in master-metered mobile home parks, which are mobile home parks that take electricity through a master meter and then distribute it to park residents through their own system; and
- Furnaces in compliance with paragraph (d)(1) that will be installed or used in new buildings with building permit issued prior to [Date of Adoption] by the appropriate enforcement agency.

Mobile home furnaces in existing mobile homes are exempt from zero-NOx emission requirements due to unique challenges on zero-NOx emission implementation for mobile homes as discussed in Chapter 2.

With the consideration that master-metered mobile homes may currently not have sufficient electrical service to install-emission appliances, subparagraph (h)(2)(B) provides them an exemption from zero-NOx emission requirements. The CPUC Mobile Home Park Utility Conversion Program plans to convert 50 percent of mobile home park spaces to a direct utility service by 2030.[(53)]When mobile homes are converted, they are no longer be exempt by this provision.

Due to potentially long timelines between building permit approval and actual installation of a furnace, subparagraph (h)(2)(C) exempts installations in new buildings if the furnace permit was granted prior to the date of rule adoption. The building permit must be issued by the appropriate enforcing agency according to the California Building Code, either city, county, or state. For example, if a building is in the process of being constructed and the building owner obtains a permit from the city to install a furnace that complies with the current Rule 1111 NOx limit of 14 ng/J, but the furnace is not installed until after the PAR 1111 zero-emission effective date of January 1, 2027, the furnace would be exempt from the zero-emission limit and allowed to be installed.

Paragraph (h)(3) – Downflow furnaces for High-Altitude

Exiting Rule 111 paragraph (i)(3) provides an exemption from 14 ng/J NOx limit for downflow furnaces rated less than 175,000 Btu/hr and condensing or non-condensing furnaces greater than 100,000 Btu/hr installed at high-altitude.

As suggested by stakeholders of high-altitude communities, staff will retain the downflow furnace exemption in PAR 1111 for high-altitude installation. Downflow furnaces certified to meet the 40 ng/J NOx limit are exempted from 14 ng/J NOx and zero-NOx emission standards. Large condensing or non-condensing furnaces greater than 100,000 Btu/hr for high-altitude installation are no longer exempted, effective at the date of rule adoption.

[(53)] CPUC, Mobilehome Park Utility Conversion Program, https://www.cpuc.ca.gov/regulatory-services/safety/mhp/mobilehome-park-utility-upgrade-program

CHAPTER 4: PROPOSED AMENDED RULE 1121

INTRODUCTION

PROPOSED AMENDED RULE 1121

INTRODUCTION

The main objective of PAR 1121 is to propose NOx limits that represent BARCT for the applicable equipment. PAR 1121 also removes obsolete language, reorganizes the rule structure to reflect recently amended and adopted rules, and includes an alternative compliance subdivision.

PROPOSED AMENDED RULE 1121

PAR 1121 reorganizes the rule structure to reflect recently amended and adopted rules and includes new subdivisions. Table 4-1 summarizes the changes to the subdivisions in PAR 1121 from Rule 1121.

Table 4-1: Rule 1121 and PAR 1121 Rule Structure

Subdivision	Rule 1121	PAR 1121
(a)	Applicability	Purpose
(b)	Definitions	Applicability
(c)	Requirements	Definitions
(d)	Certification	Requirements
(e)	Mitigation Fee	Certification
(f)	Enforcement	Alternative Compliance Options
(g)	Exemptions	Informative Materials, Labeling, Recordkeeping, and Reporting
(h)	Final Progress Report	Exemptions
(i)	Program Administration	(N/A)

PAR 1121 (a) – Purpose

The purpose of PAR 1121 is to reduce NOx emission from NOx-emitting water heaters. Subdivision (a) is a new subdivision added to align with recently amended and adopted rules to standardize the rule structure.

PAR 1121 (b) – Applicability

Subdivision (b) was previously subdivision (a) in Rule 1121. PAR 1121 applies to manufacturers, distributors, retailers, resellers, and installers of NOx-emitting water heaters with a rated heat input capacity less than 75,000 Btu/hr.

The provisions of the rule are primarily enforced through the supply chain (i.e. manufacturers, distributors, retailers, installers, etc.). Resellers are also added to applicability since they are part of the supply chain.

PAR 1121 (c) – Definitions

Subdivision (c) was previously subdivision (b) in Rule 1121. Subdivision (c) lists the definitions used in PAR 1121. For all definitions, refer to PAR 1121 released with the staff report.

The following definitions have been added to PAR 1121:

- Consumer Price Index (CPI)
- Existing Building
- Informative Materials
- Install
- Installer
- Master-Metered Mobile Home Parks
- Mobile Home
- New Building
- Parts Per Million by Volume
- Reseller
- Responsible Official
- Standard Conditions
- Zero-NOx Emission Units

Install, installer, and reseller are defined to clarify who is subject to the rule. Existing building, mobile home, and new building are defined to differentiate between compliance dates. The term Informative materials is defined to clarify the information needed in subdivision (g). Master-metered mobile home parks are defined as installations in master-metered mobile home parks are exempted from Zero-NOx emission standards. Zero-NOx emission unit is defined to clarify what appliances for space heating have zero-NOx emissions, which will be used in the new provision for manufacturer alternative compliance option. The term responsible official is also needed for the new provision for manufacturer alternative compliance option. Consumer Price Index (CPI) is defined, and the California annual average is used for mitigation fee adjustment as specified in the rule.

The following definitions have been revised in PAR 1121:

- Heat Input
- Heat Output
- Independent Testing Laboratory
- Mobile Home Water Heater
- NOx Emissions
- Protocol
- Rated Heat Input Capacity
- Recreational Vehicle
- Water Heater

Heat input, heat output, rated heat input capacity, and recreational vehicle are revised to align with their definitions in Rule 1146.2, which was amended on June 7, 2024. Independent testing laboratory, NOx emissions, protocol, and rated heat input capacity are revised for clarity. Water heater is revised to ensure this term includes mobile home water heaters. Mobile home definition

is revised to align with the definitions by California Energy Commission and Federal Department of Housing and Urban Development.

The following definitions are considered obsolete or unnecessary and have been removed from Rule 1121:

- Btu
- Direct Vent Water Heater
- Mitigation Fee
- Power Vent Water Heater
- Power Direct Vent Water Heater

PAR 1121 (d) – Requirements

Subdivision (d) was previously subdivision (c) in Rule 1121. Paragraphs (c)(1) to (c)(8) in Rule 1121 were removed and the relevant equipment and NOx emission limits are summarized in paragraph (d)(1).

Paragraph (d)(1) – Current Rule 1121 Emission Limits

Paragraph (d)(1) specifies the current NOx emission limits for water heaters and mobile home water heaters in PAR 1121 Table 1 (presented in this Staff Report as Table 4-2)

Paragraph (d)(1) states that no person shall manufacture, supply, sell, resell, offer for sale, import, or install, for use in the South Coast AQMD, any water heater unless the water heater is certified pursuant to subdivision (e) and does not exceed the Table 1 NOx limit, expressed by ng/J or ppmv. Paragraph (d)(1) includes that no person shall supply, resell, or import within the South Coast AQMD in addition to the previous requirements (i.e. manufacture, sell, offer for sale, or install).

Table 4-2: PAR 1121 Table 1 Emission Limits

Equipment	NOx Emission Limits	
	ng/J	ppmv
Water Heater*	10	15
Mobile Home Water Heater	40	55

* Excluding Mobile Home Water Heater

Paragraph (d)(2) – PAR 1121 BARCT Emission Limit for New and Existing Buildings

Paragraph (d)(2) sets the updated BARCT emission limits for water heaters and mobile home water heaters as shown in PAR 1121 Table 2 (presented in this Staff Report as Table 4-3). This paragraph specifies that a person shall only manufacture, supply, sell, resell, offer for sale, import, or install for use in the South Coast AQMD a zero-NOx emission unit by the Table 2 compliance dates, unless the NOx-emitting Water Heater is included in the zero-NOx emission manufacturer alternative compliance option pursuant to paragraph (f)(1) as indicated in the Informative Materials for the Water Heater pursuant to paragraph (g)(2). The applicable PAR 1121 Table 2 compliance dates for New Building types shall be determined based on the construction or alteration completion date. Mobile home water heaters for installation in

existing buildings are not subject to zero-NOx emission limit. They will continue to comply with paragraph (d)(1) Table 1 NOx limit.

Table 4-3: PAR 1121 Table 2 Zero-Emission Limits and Compliance Schedule

Equipment Category	Building Type	Compliance Date
Water Heater*	New	January 1, 2027
	Existing	January 1, 2029
Mobile Home Water Heater	New	January 1, 2027

* Excluding Mobile Home Water Heater

PAR 1121 (e) – Certification

Subdivision (e) provides guidance to manufacturers to certify water heaters. Subdivision (e) was originally subdivision (d) in Rule 1121. Obsolete language, which are paragraphs (d)(4), (d)(5), and (d)(6) in Rule 1121, were removed from this subdivision.

Paragraph (e)(1) – Tests by Independent Testing Laboratory

Contains revisions to defined terms and clarification that natural gas-fired water heaters and water heaters designed to be fired with natural gas are subject to certification. Certification is based on emissions tests conducted by independent testing laboratories in accordance to the protocol.

The manufacturer shall obtain confirmation that each model of water heater complies with the applicable requirements of paragraph (d)(1) from an independent testing laboratory, prior to applying for certification for a natural gas-fired water heater or a water heater designed to be fired with natural gas. This confirmation shall be based on emission tests conducted pursuant to the protocol of a randomly selected unit of each model.

Paragraph (e)(2) – Applying for Water Heater Certification

Paragraph (e)(2) remains mostly unchanged with an update to the reference in subparagraph (e)(2)(A).

When applying for certification of water heaters, the manufacturer shall submit to the Executive Officer the following: a statement that the model is in compliance with paragraph (d)(1) signed and dated by the manufacturer, attesting to the accuracy of all statements; general information, including name and address of manufacturer, brand name, trade name, and model number as it appears on the water heater rating plate; a description of each model being certified, and a source test report verifying compliance with paragraph (d)(1) for each model to be certified. The source test report shall be prepared by the confirming independent testing laboratory and contain all elements identified in the protocol for each unit tested.

Paragraph (e)(3) – Timeline

When applying for certification of water heaters, the manufacturer shall submit the items identified in paragraph (e)(2) no more than 180 days after the date of the source test identified in subparagraph (e)(2)(D).

PAR 1121 (f) – Alternative Compliance Options

Subdivision (f) is a new subdivision that details the alternative compliance options.

Paragraph (f)(1) – Zero-Emission Manufacturer (ZEM) Alternative Compliance Option

In lieu of complying with paragraph (d)(2) a manufacturer of water heaters, other than mobile home water heaters, can elect to comply with the ZEM alternative compliance option. This alternative compliance option allows for the sale of NOx emitting water heaters certified to emit 10 ng/J of NOx (or 15 ppmv) or less, given:

- The manufacturer submits an alternative compliance plan no later than November 1, 2026, detailing the requirements in paragraph (f)(1)(A);
- The manufacturer sells, or enables distributors, retailers, resellers, or installs to sell Zero-NOx emission units into or within the South Coast AQMD at a percentage greater than or equal to the Zero-NOx emission unit sales targets specified in PAR 1121 Table 3 (presented as Table 3-4 in this Staff Report);
- The manufacturer pays a $50 mitigation fee for each NOx-emitting water heater sold for the calendar year 2027 and adjusted by the CPI annual percent increase for each subsequent year after 2027. If the CPI annual percent increase for a calendar year is greater than three percent, a three percent increase will apply to that year; and
- The manufacturer submits a report and mitigation fee payment pursuant to paragraph (g)(2) no later than 90 days after the end of each calendar year utilizing this alternative compliance option.

Table 4-4: PAR 1111 Table 3 ZEM Alternative Compliance Option Targets

Compliance phase	Phase 1	Phase 2	Phase 3	Phase 4
Calendar Years	**2027 - 2028**	**2029 - 2032**	**2033-2035**	**2036 and after**
Zero-NOx Emission Unit Sales Target	30 percent	50 percent	75 percent	**90 percent**
NOx-emitting Water Heater Sales Target	**70 percent**	**50 percent**	**25 percent**	**10 percent**

Paragraph (f)(2) – ZEM Alternative Compliance Option Sales Target Deviation

Any water heater manufacturer that elects to comply with the ZEM alternative compliance option and sells more NOx-emitting water heaters than water heater sales target in Table 3 in one calendar year must pay the per unit mitigation fee outlined in Table 3 for each unit sold above the sales target. The mitigation fee for each water heater sold over target is $250 for the

calendar year 2027 and adjusted by the CPI annual percent increase for each subsequent year after 2027. If the CPI annual percent increase for a calendar year is greater than three percent, a three percent increase will apply to that year.

Below are two examples for determining the mitigation fee when a manufacturer sold more NOx-emitting water heaters than water heater sales target.

Example 1: From January 1, 2027, to December 31, 2027, a manufacturer sold 1,000 units with sales for NOx emitting water heaters and zero-NOx emission unit and 800 (80 percent) and 200 (20 percent) respectively.

Since the 2027 NOx-emitting water heater sales were over the water heaters sales target that is 70 percent, the mitigation fee should be calculated as below:

- Number of NOx-emitting water heaters within the target = 1000 x 70%=700
- Mitigation fee per PAR 1121 subparagraph (f)(1)(F) = $50 x 700 = $35,000
- Mitigation fee for water heaters sold over target = $250 x (800-700) = $25,000
- Total mitigation fee this manufacture should pay for 2027 = $35,000 + $25,000 = $60,000

Example 2: From January 1, 2028, to December 31, 2028, a manufacturer sold 1,000 units with sales for NOx emitting water heaters and zero-NOx emission units 750 (75 percent) and 250 (25 percent) respectively.

Since the 2028 NOx-emitting water heater sales were over the water heater sales target that is 70 percent, the mitigation fee should be calculated as below:

- Number of NOx-emitting water heaters within the target = 1,000 x 70% =700
- Since it is after 2027, the mitigation fee rates should be CPI adjusted. Assuming California CPI annual percent increase for 2028 is 2.8 percent
- Mitigation fee rate for water heaters sold within the target is adjusted to $50 x (1+2.8%) =$51.4 per water heater
- Mitigation fee rate for water heaters sold over the target is adjusted to $250 x (1+2.8%) = $257.0 per water heater
- Mitigation fee for water heaters within the target per PAR 1111 subparagraph (f)(1)(F) = $51.4 x 700 = $35,980
- Mitigation fee for water heaters sold over target = $257.0 x (750-700) = $12,850
- Total mitigation fee this manufacture should pay for 2028 = $35,980+ $12,850= $48,830

Example 3: From January 1, 2029, to December 31, 2029, a manufacturer sold 1,000 units with sales for NOx emitting water heaters and zero-NOx emission units 600 (60 percent) and 400 (40 percent) respectively.

Since the 2029 NOx-emitting water heater sales were over the water heater sales target that is 50 percent, the mitigation fee should be calculated as below:

- Number of NOx-emitting water heater within the target = 1,000 x 50% =500
- Since it is after 2027, the mitigation fee rates should be CPI adjusted. Assuming California CPI annual percent increase is 2.8 percent for 2028 and 3.5 percent for 2029, we will use 2.8 percent for 2028 but 3.0 percent for 2029 CPI adjustment since it is higher than 3.0 percent
- Mitigation fee rate for water heaters sold within the target is adjusted to \$50 x (1+2.8%)(1+3.0%) =\$52.9 per water heater
- Mitigation fee rate for water heaters sold within the target is adjusted to \$250 x (1+2.8%)(1+3.0%) = \$264.7 per water heater
- Mitigation fee for units within the target per PAR 1111 subparagraph (f)(1)(F) = \$52.9 x 500 = \$26,450
- Mitigation fee for water heaters sold over target = \$264.7 x (600-500) = \$26,470
- Total mitigation fee this manufacture should pay for 2028 = \$26,450 + \$26,470 = \$52,920

If the annual percentage of sales of zero-NOx emission units exceeds the Zero-NOx Emission Unit Sales Target in Table 3, a discounted mitigation fee for the reporting year is determined by the following equation:

$$Discounted\ Mitigation\ Fee = F - F \times \frac{(P - T)}{(100 - T)}$$

Where:

F = Annual Mitigation Fee pursuant to subparagraph (f)(1)(D)

P = Reported Percent Zero-NOx Emission Units

T = Zero-NOx Emission Unit Sales Target

Equation 4-2: Discounted Mitigation Fee

Below is an example for discounted mitigation fee determinization.

Example 3: From January 1, 2027, to December 31, 2027, a manufacturer's sales for zero-NOx emission unit and NOx emitting water heaters were 400 (40 percent) and 600 (60 percent) respectively.

Since the 2027 zero-NOx emission unit sales were over the target which is 30 percent, a discounted fee should be calculated as below:

- Annual mitigation fee pursuant to PAR 1121 subparagraph (f)(1)(F) = \$50 x 600 = \$30,000
- Discounted mitigation fee = \$30,000 – (\$30,000 x (40 - 30)/(100 – 30)) = \$25,714
- Total mitigation fee this manufacture should pay for 2027 is \$25,714

PAR 1121 (g) – Informative Materials, Labeling, Recordkeeping, and Reporting

Subdivision (g) is a new subdivision that details the informative materials, labeling, recordkeeping, and reporting requirements. Informative materials and Labeling requirements are important tools

for enforcement, especially when some units distributed to the market can only be installed under certain conditions. While manufacturers ship units into many markets, to ensure the labels are only included on units sold into or within the South Coast AQMD, they may elect to send a sticker or label to their distributors so they can be applied at the point of sale.

Paragraph (g)(1) –Informative Materials for Water Heaters

Two types of NOx-emitting water heaters are subject to this provision for informative materials, which are:

- Any mobile home water heater that is for existing building or any mobile homes in a master metered mobile home park; and
- Any water heater sold under the ZEM alternative compliance option pursuant to paragraph (f)(1) in lieu of complying with paragraph (d)(2).

Those water heaters that are for distribution or sale inside of the South Coast AQMD shall distribute or publish informative materials that clearly display the language outlined in paragraph (g)(1). Informative materials include: the consumer brochure for the water heater, technical specification sheet for the water heater, and the manufacturer's website that promotes, discusses, or lists the water heater. The manufacturer may use alternative language to the language in subparagraph (g)(1)(A) or (g)(1)(B), provided that the language is similar and is approved.

Paragraph (g)(2) – Reporting and Recordkeeping Requirements for ZEM Alternative Compliance Option

The manufacturer of a water heater supplied or offered for use within the South Coast AQMD in accordance with the ZEM alternative compliance option shall submit to the Executive Officer a report, signed by the responsible official for the manufacturer no later than 90 days after the end of each calendar year using the alternative compliance option. The report shall include information specified in subparagraph (g)(2)(A) for the applicable calendar year.

The manufacturer shall also maintain records for at least five years, including, but not limited to, the information listed in subparagraph (g)(2)(B).

Paragraph (g)(3) – New and Existing Building Labeling Requirements

A manufacturer can elect to comply with paragraph (d)(2) directly or through alternative compliance option by paragraph (f)(1).

This provision specifies labeling requirement for any manufacturer that is not electing to comply using alternative compliance option by paragraph (f)(1). As specified in paragraph (d)(2), the manufacturer will be subject to the zero-NOx emission compliance date for new buildings on January 1, 2027, for existing buildings on January 1, 2029, except for mobile home water heaters.

PAR 1111 proposes a labeling requirement for the period between the new building compliance date and existing building compliance date for each water heater, except for mobile water heaters.

Subparagraph (g)(3)(A) specifies the labeling language. Subparagraph (g)(3)(B) allows manufacturers flexibility in the labeling by posting alternative language as long as the language is similar to (g)(3)(A) and approved.

Subparagraph (g)(3)(C) requires the manufacturer to use the language in (g)(3)(A) if the alternative language is not approved.

Paragraph (g)(4) – Shipping Carton and Name Plate Labeling

The manufacturer of any water heater manufactured for sale in the South Coast AQMD shall clearly display the following on the shipping carton and name plate of the water heater: model number, date of manufacture, and certification status.

PAR 1121 (h) – Exemptions

Subdivision (h) details the exemptions to the rule. This subdivision was previously subdivision (g) in Rule 1121. While paragraphs (h)(1) and (h)(2) are existing provisions, PAR 1121 proposes new exemptions in paragraphs (h)(3) .

Paragraph (h)(1) – Recreational Vehicle Exemption

PAR 1121 shall not apply to water heaters used in recreational vehicles.

Paragraph (h)(2) – Rule 1146.2 Exemption

PAR 1121 shall not apply to water heaters subject to Rule 1146.2 – Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters.

Paragraph (h)(3) – Exemption from Zero-NOx Emission Limit

Three types of NOx-emitting water heaters are subject to this provision for exemption from zero-NOx emission limit, which are:

- Mobile home water heaters in compliance with paragraph (d)(1) for installation in existing mobile homes;
- Mobile home water heaters in compliance with paragraph (d)(1) for installation or use in new buildings or existing buildings located in master-metered Mobile Home parks, which are Mobile Home parks that take electricity through a master meter and then distribute it to park residents through their own system; and
- Water heaters in compliance with paragraph (d)(1) that will be installed or used in new buildings with building permit issued prior to [Date of Adoption] by the appropriate enforcement agency.

Mobile home water heaters in existing mobile homes are exempt from zero-NOx emission requirements due to unique challenges on zero-NOx emission implementation for mobile homes as discussed in Chapter 2.

With the consideration that master-metered mobile homes may currently not have sufficient electrical service to install-emission appliances, subparagraph (h)(3)(B) provides them an exemption from zero-NOx emission requirements. The CPUC Mobile Home Park Utility Conversion Program plans to convert 50 percent of mobile home park spaces to a direct utility service by 2030.[(54)]When mobile homes are converted, they are no longer be exempt by this provision.

[(54)] https://www.cpuc.ca.gov/regulatory-services/safety/mhp/mobilehome-park-utility-upgrade-program

Due to potentially long timelines between building permit approval and actual installation of a water heater, subparagraph (h)(3)(C) exempts installations in new buildings if the water heater permit was granted prior to the date of rule adoption. The building permit must be issued by the appropriate enforcing agency according to the California Building Code, either city, county, or state. For example, if a building is in the process of being constructed and the building owner obtains a permit from the city to install a water heater that complies with the current Rule 1121 Table 1 NOx emission limit, but the water heater is not installed until after the PAR 1121 zero-emission effective date of January 1, 2027, the water heater would be exempt from the zero-emission limit and allowed to be installed.

CHAPTER 5: IMPACT ASSESSMENT

INTRODUCTION

Both PAR 1111 and PAR 1121 are each expected to impact over 5 million units located in the South Coast AQMD region, for a total of 10 million units.

EMISSIONS INVENTORY AND EMISSION REDUCTIONS

PAR 1111 total NOx emissions inventory is estimated to be 4.5 tpd and the PAR 1121 NOx emissions inventory is estimated to be 2.3 tpd. The 2022 AQMP indicated a total of 351 tpd of NOx emitted from all sources in the region in 2018, the base-year of the emissions inventory and modeling analysis in the plan. Appliances used in residential and commercial buildings, which primarily include space and water heaters, cooking devices, and some other appliances combusting natural gas, emit about 26.8 tpd of NOx[(55)]. Given these data, PAR 1111 and PAR 1121 account for 25.4 percent of NOx emissions from appliances used in residential and commercial buildings.

Estimated Number of Units

PAR 1111 will impact 5,217,000 units, the applicable residential fan-type central furnaces, mobile home furnaces, wall furnaces and floor furnaces. PAR 1121 will impact 5,128,000 units, the applicable small tank type water heaters. To estimate the baseline emissions for both PAR 1111 and PAR 1121, staff evaluated the following information:

- Baseline emissions factor in pounds per million Btu (lbs/MMBtu) from current rule emission limit
- Estimated annual fuel use
- Estimated universe by category
- Useful life (years)

Estimated Emissions Inventory

For all categories, the following equation was used to calculate the emission inventory in tpd:

$$\begin{aligned} &Emission\ Inventory\ (tpd) \\ &\quad = Baseline\ Emissions\ Factor\ \left({}^{lbs}/_{MMBtu}\right) \\ &\quad * Annual\ fuel\ use\ \left({}^{MMBtu}/_{(year * unit)}\right) * Estimated\ Universe\ (units) \\ &\quad * \frac{1\ ton}{2000\ lbs} * \frac{1\ year}{365\ days} \end{aligned}$$

Equation 5-1: Baseline Emissions Calculation

The baseline emissions factor was calculated, using the current NOx emission limits. For PAR 1111, an emission limit of 40 ng/J for wall, and floor furnaces was used and 14 ng/J for residential fan-type central furnaces was used. Similarly, the baseline emissions factor for 1121 was calculated, using the current emission limit of 10 ng/J. An efficiency factor of 75 percent was used, as the efficiency of gas-fired furnaces and water heaters range from 60-95 percent.

[(55)] https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/appendix-iii.pdf

The CEC's RASS in 2019[56] was used for the average annual gas unit energy consumption for primary heat for homes with SoCalGas as a provider, which include resident fan-type central furnaces, wall furnaces, and floor furnaces. For high-altitude homes, fuel use for Climate Zone 16 was used instead. Annual fuel use for residential water heating was taken from EnergyStar.

The total estimated universe for PAR 1111 residential fan-type central furnaces, wall, and floor furnaces was estimated using the American Housing Survey. PAR 1121 estimated universe was also extrapolated from the American Housing Survey. For the total number of commercial units, the CBECS microdata for the Pacific Census Division was used. The number of estimated units and baseline emissions are detailed in **Error! Reference source not found.**. By the ZEM alternative compliance option that sets zero-NOx emission target at 90 percent by 2036, at the full implementation in 2061 the NOx emission reductions would be 6.12 tons per day.

Table 5-1: PAR 1111 and PAR 1121 Baseline Emissions Estimate

Rule	Equipment Category	Estimated Universe	Baseline Emissions (tpd)
PAR 1111	Residential Fan-Type Central Furnace	4,200,000	3.99
	Wall Furnaces and Floor Furnaces	1,037,000	0.52
PAR 1121	Water Heaters	5,128,000	2.32
Total		10,365,000	6.83

COST-EFFECTIVENESS

Health and Safety Code Section 40920.6 requires a cost-effectiveness analysis when establishing BARCT requirements. The cost-effectiveness of a control technology is measured in terms of the control cost in dollars per ton of air pollutant reduced for each class and category of equipment. The costs for the control technology include purchasing, installation, operating, and maintaining the control technology.

As detailed in chapter two, the South Coast AQMD typically relies on the DCF method which converts all costs, including initial capital investments and costs expected in the present and all future years of unit useful age, to a present value.

The following tables summarize the cost-effectiveness estimates for each category of PAR 1111 and PAR 1121, for both zero-NOx emission units replacement and using ZEM alternative compliance option.

[56] California Energy Commission, 2019 California Residential Appliance Saturation Study (RASS), https://www.energy.ca.gov/publications/2021/2019-california-residential-appliance-saturation-study-rass

Table 5-2: PAR 1111 Cost-Effectiveness for Zero-NOx Unit Replacement

Property Type	Scenario	Cost-Effectiveness ($/ton NOx)
Single-Family	Heat Pump Replacing Furnace + AC	-592,000
	Heat Pump Replacing Furnace	+1,730,000
Multifamily (Per Unit)	Heat Pump Replacing Furnace + AC	-785,000
	Heat Pump Replacing Furnace only	-197,000

Table 5-3: PAR 1111 Cost-Effectiveness for ZEM Alternative Compliance Option

Dates **Phase**	**2027 - 2028** Phase I	**2029 - 2032** Phase II	**2033 - 2035** Phase III	**2036 and after** Phase IV
Targets	70% NO-Emitting 30% Zero-NOx	50% NO-Emitting 50% Zero-NOx	25% NO-Emitting 75% Zero-NOx	10% NO-Emitting 90% Zero-NOx
Weighed Cost-Effectiveness ($/Ton NOx)	$35,000 – $69,000	$69,000 – $140,000	$110,000 – $220,000	$140,000 - $280,000

Table 5-4: PAR 1121 Cost-Effectiveness for Zero-NOx Unit Replacement

Property Type	Scenario	Cost-Effectiveness ($/ton NOx)
Single-Family	Heat Pump Water Heater Replacing NOx-Emitting Gas Water Heater	405,000
Multifamily (Per Unit)	Heat Pump Water Heater Replacing NOx-Emitting Gas Water Heater	405,000

Table 5-5: PAR 1121 Cost-Effectiveness for ZEM Alternative Compliance Option

Dates Phase	2027 - 2028 Phase I	2029 - 2032 Phase II	2033 - 2035 Phase III	2036 and after Phase IV
Targets	70% NO-Emitting 30% Zero-NOx	50% NO-Emitting 50% Zero-NOx	25% NO-Emitting 75% Zero-NOx	10% NO-Emitting 90% Zero-NOx
Weighed Cost-Effectiveness ($/Ton NOx)	$80,000	$160,000	$260,000	$320,000

The proposed BARCT emission limits will take effect in future years for installations in new buildings and at the end of the equipment life in existing buildings, and the full implementation will be achieved 25 years for PAR 1111 and 15 years for PAR 1121 after their latest compliance date. The future effective compliance dates, implementation at equipment natural turnover, and the ZEM alternative compliance option will allow for market growth for emerging technologies that typically includes a price decrease.

SOCIOECONOMIC IMPACT ASSESSMENT

A socioeconomic impact assessment has been conducted and released for public review and comment as a separate document at least 30 days prior to the South Coast AQMD Governing Board Hearing for PAR 1111 and PAR 1121, which is scheduled for May 2, 2025 (subject to change).

California Environmental Quality Act (CEQA) Analysis

Pursuant to the California Environmental Quality Act (CEQA) and South Coast AQMD's certified regulatory program (Public Resources Code Section 21080.5 and CEQA Guidelines Section 15251(l); codified in South Coast AQMD Rule 110), the South Coast AQMD, as lead agency for PAR 1111 and PAR 1121, prepared a Subsequent Environmental Assessment (SEA) for the proposed project. The SEA is a substitute CEQA document prepared pursuant to CEQA Guidelines Section 15252 and in lieu of a Subsequent Environmental Impact Report (EIR). The SEA tiers off of the Final Program EIR for the 2022 AQMP, as allowed by CEQA Guidelines Sections 15152, 15162, and 15385. The Draft SEA was released for a 46-day public review and comment period to provide public agencies and the public an opportunity to obtain, review, and comment on the environmental analysis. The South Coast AQMD received three comment letters relative to the analysis in the Draft SEA and responses to the comments will be included in the Final SEA.

Requirements to Make Findings

Health and Safety Code Section 40727 requires that prior to adopting, amending, or repealing a rule or regulation, the South Coast AQMD Governing Board shall make findings of necessity, authority, clarity, consistency, non-duplication, and reference based on relevant information presented at the public hearing, and in the staff report.

Necessity

PAR 1111 and PAR 1121 are needed to establish BARCT requirements and achieve emission reductions proposed by 2022 AQMP Control Measure R-CMB-02 and R-CMB-01 in order to meet the National Ambient Air Quality Standards for ozone.

Authority

The South Coast AQMD Governing Board has authority to adopt amendments to Rule 1111 and Rule 1121 pursuant to the Health and Safety Code Sections 39002, 40000, 40001, 40440, 40702, 40725 through 40728, and 41508.

Clarity

PAR 1111 and PAR 1121 are written or displayed so that their meanings can be easily understood by the persons directly affected by them.

Consistency

PAR 1111 and PAR 1121 are in harmony with and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations.

Non-Duplication

PAR 1111 and PAR 1121 will not impose the same requirements as any existing state or federal regulations. The proposed amended rules are necessary and proper to execute the powers and duties granted to, and imposed upon, the South Coast AQMD.

Reference

In amending Rule 1111 and Rule 1121, the following statutes which the South Coast AQMD hereby implements, interprets or makes specific are referenced: Health and Safety Code Sections 39002, 40000, 40001, 40440, 40702, 40725 through 40728, and 41508.

Comparative Analysis

Under Health and Safety Code Section 40727.2, the South Coast AQMD is required to perform a comparative analysis when adopting, amending, or repealing a rule or regulation. The comparative analysis is relative to existing federal requirements, existing or proposed South Coast AQMD rules and air pollution control requirements and guidelines which are applicable to combustion equipment subject to PAR 1111 and PAR 1121. A comparative analysis has been prepared and is included in the table below.

Table 5-4. Comparative Analysis for PAR 1111

Rule Element	PAR 1111	Bay Area AQMD Rule 9-4	CARB 2022 State Sip Strategy	CARB In-Progress Rulemaking
Unit Applicability	Natural gas-fired Furnaces less than 175 kBtu/hr used for interior space heating	Natural gas-fired furnace	New equipment and appliances sold for use in both residential and commercial buildings	TBD: In an effort to align with PAR 1111 and Bar Area AQMD Rule 9-4
Requirements (All parts per million (ppmv) emission limits are referenced at three percent volume stack gas oxygen on a dry basis averaged over a period of 15 consecutive minutes)	NOx limits: Proposed future limit: 0 ppmv (zero-emission) with a ZEM alternative compliance option that set compliance targets and allows for NOx-emitting furnace sales	NOx limits: Natural gas: 0.0 ppmv (zero-emission)	Zero-emission standards implemented in 2030 for space and water heating	TBD: Anticipated zero-emission (GHG, NOx)
Labeling or Informative Materials	Required for units that use mitigation fee option, propane kits, and alternative compliance options and for units during a specified period that can be installed in existing buildings but not new buildings			
Reporting	Reports for units sold using the ZEM alternative compliance option, for mobile home furnace sales	N/A	To be determined in rulemaking	TBD

Rule Element	PAR 1111	Bay Area AQMD Rule 9-4	CARB 2022 State Sip Strategy	CARB In-Progress Rulemaking
	by mitigation fee option and for quantity of propane conversion kits sold for furnaces distributed or sold for use into South Coast AQMD			
Monitoring	Certification test for non-zero-emission standards	Certification test for units that combust liquid fuels	To be determined in rulemaking	TBD
Recordkeeping	Records for using alternative compliance options and temporary exemptions	N/A	To be determined in rulemaking	TBD

Table 5-5. Comparative Analysis for PAR 1121

Rule Element	PAR 1121	Rule 1146.2	Rule 1146.1	Rule 1146	Bay Area AQMD Rule 9-6	CARB 2022 State Sip Strategy	CARB In-Progress Rulemaking
Unit Applicability	Natural gas-fired water heaters with heat input rates less than 75 kBtu/hr	Large water heaters, small boilers and process heaters less than or equal to 2 MMBtu/hr	Boilers, steam generators, and process heaters with maximum rated heat input capacities greater than 2 MMBtu/hr and less than 5 MMBtu/hr	Boilers, steam generators, and process heaters with maximum rated heat input capacities greater than or equal to 5 MMBtu/hr	Natural gas-fired water heater, rated heat input capacity 75 kBtu/hr – 2 MMBtu/hr	New equipment and appliances sold for use in both residential and commercial buildings	TBD: In an effort to align with PAR 1121 and Bar Area AQMD Rule 9-6
Requirements (All parts per million (ppmv) emission limits are referenced at three percent volume stack gas oxygen on a dry basis averaged over a period of 15 consecutive minutes)	NOx limits: Proposed future limit: 0 ppmv (zero-emission) with a ZEM alternative compliance option that set compliance targets and allows for NOx-emitting furnace sales.	NOx and CO limits: Natural gas: 0 ppmv (zero-emission)	NOx limits: Digester gas: 15 ppmv Landfill gas: 25 ppmv Natural gas: 7 or 9 ppmv, 12 ppmv for atmospheric, and 12 ppmv for thermal fluid heaters All others: 30 ppmv	NOx limits: Digester gas: 15 ppmv Landfill gas: 25 ppmv Natural gas: 5 ppmv for ≥75 MMBtu/hr, 7 or 9 ppmv for 20–75 MMBtu/hr, 12 ppmv for atmospheric, and 12 ppmv for thermal fluid heaters	NOx limits: Natural gas: 0 ppmv (zero-emission)	zero-emission standards implemented in 2030 for space and water heating	TBD: Anticipated zero-emission (GHG, NOx)

Rule Element	PAR 1121	Rule 1146.2	Rule 1146.1	Rule 1146	Bay Area AQMD Rule 9-6	CARB 2022 State Sip Strategy	CARB In-Progress Rulemaking
			CO limit: 400 ppmv	For other types of fuels: 30 ppmv for other gaseous fuels; 40 ppmv for nongaseous fuels CO limit: 400 ppmv			
Labeling or Informative Materials	Required for units that use alternative compliance options and for units during a specified period that can be installed in existing buildings but not new buildings						
Reporting	Annual reporting requirement for units sold	Manufacturers every year after Table 3 compliance	N/A	Every 6 months for units greater than or equal	N/A	To be determined in rulemaking	TBD

Rule Element	PAR 1121	Rule 1146.2	Rule 1146.1	Rule 1146	Bay Area AQMD Rule 9-6	CARB 2022 State Sip Strategy	CARB In-Progress Rulemaking
	using the ZEM alternative compliance option	dates – product models, unit number, rated heat input capacity, applicable equipment category		to 40 MMBtu/hr and an annual heat input greater than 200 x 109 Btu per year (Rule 218)			
Monitoring	Certification test for non-zero-emission units	Source test report Requirements by alternative compliance options	Source testing once every 5 years	A continuous in-stack NOx monitor for units greater than or equal to 40 MMBtu/hr and an annual heat input greater than 200 x 109 Btu per year Source testing once every 3 – 5 years for other units	N/A	To be determined in rulemaking	TBD

Rule Element	PAR 1121	Rule 1146.2	Rule 1146.1	Rule 1146	Bay Area AQMD Rule 9-6	CARB 2022 State Sip Strategy	CARB In-Progress Rulemaking
Recordkeeping	Records for using alternative compliance options and temporary exemptions	Maintenance records = 3 years Rated heat input capacity & modification documentation	Source test records = 2 years (5 years if Title V) Monitoring data = 2 years (5 years if Title V)	Source test records Maintenance & emission records = 2 years Monitoring data = 2 years (5 years if Title V)	N/A	To be determined in rulemaking	TBD

APPENDICES: RESPONSES TO COMMENTS

Throughout the development of PAR 1111 and PAR 1121, staff shared rule concepts and preliminary draft rule language through public meetings such as Working Group Meetings, Public Consultations, and a Public Workshop. Staff shared the preliminary draft PAR 1111 and PAR 1121 with the original rule proposal at the Public Workshop on October 3, 2024. Based on stakeholder comments, staff revised the original rule proposal and proposed a new rule concept in the Working Group Meeting #8 presentation released on February 7, 2025.

Staff has received over 12,000 written comments and many verbal comments since the Public Workshop on October 3, 2024, including over 9,800 comments on the original rule concept and the remaining comments on the new rule concept.

The "Responses to Comments" document consists of five appendices. Appendix A includes general responses to similar comments that were raised by multiple letters. Appendix B includes verbal comments received at the Public Consultation Meeting and written comments received during the public comment period for the new rule concept from February 8, 2025, to March 20, 2025. Appendix C includes verbal comments received at the Public Workshop and written comments received on the original rule concept from October 3, 2024, to February 7, 2025. Appendix D includes all comment letters that were addressed to the South Coast AQMD Governing Board and Stationary Source Committee members by March 20, 2025. Appendix E includes comment letters receive after March 20, 2025, the close of the public comment period for the new rule concept, for which no response is provided.

Table APP-1: Comments Received on the Original and New Concepts

Appendix	Comments	Start Date	End Date	Number of Comments	Comment Number
Appendix A	General responses to similar comments	October 3, 2024	March 20, 2025 (End of the new comment period after Public Consultation)	Eleven general comments	GC-1 to GC-11
Appendix B	Comments addressed to staff after release of new rule concept; many comments still on original rule concept	February 8, 2025	March 20, 2025(End of the new comment period after Public Consultation)	48 written comments and 39 verbal comments at Public Consultation	1 – 48; and PC-01 – PC-39
Appendix C	Comments addressed to staff on original rule concept	October 3, 2024	February 7, 2025	108 written comments and 16 verbal comments at Public Workshop	1-108; and PW-1 – PW-16
Appendix D	Comments addressed to the Board within comment period	October 3, 2024	March 20, 2025 (End of the new comment period after Public Consultation)	11,773 written comments	Table Appendix D-1 1-48; Table Appendix D-2 1-63
Appendix E	Comments received beyond comment period	March 21, 2025	March 28, 2025	122written comments	1-8