SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Socioeconomic Impact Assessment 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

On March 17, 1989, the South Coast Air Quality Management District (South Coast AQMD) Governing Board adopted a resolution which requires an analysis of the economic impacts associated with adopting and amending rules and regulations. In addition, Health and Safety Code Section 40440.8 requires a socioeconomic impact assessment for any proposed rule, rule amendment, or rule repeal which "will significantly affect air quality or emissions limitations." Health and Safety Code Section 40728.5 requires the South Coast AQMD Governing Board to actively consider the socioeconomic impacts of regulations, make a good faith effort to minimize adverse socioeconomic impacts and include small business impacts. Lastly, Health and Safety Code Section 40920.6 requires an incremental cost-effectiveness analysis for a proposed rule or amendment which imposes Best Available Retrofit Control Technology (BARCT) or "all feasible measures" requirements relating to emissions of ozone, carbon monoxide (CO), sulfur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (VOC), and their precursors.

Proposed Amended Rule 1111 – Reduction of NOx Emissions from Natural Gas-Fired Furnaces (PAR 1111) aims to further reduce NOx emissions from natural gas-fired furnaces and implement the 2022 Air Quality Management Plan (AQMP) Control Measure R-CMB-02 – Emission Reductions from Replacement with Zero Emission or Low NOx Appliances, targeting emission reductions from the replacement of gas-fired furnaces used for interior space heating with zero-emission options. Similarly, Proposed Amended Rule 1121 – Reduction of NOx Emissions from Residential Type Natural Gas-Fired Water Heaters (PAR 1121) focuses on reducing NOx emissions from residential natural gas-fired water heaters and aims to implement the 2022 AQMP Control Measure R-CMB-01 – Emission Reductions from Replacement with Zero Emissions or Low NOx Appliances – Residential Water Heating.

A socioeconomic impact assessment has been conducted to assess the impacts from implementing PAR 1111 and PAR 1121 (the proposed project) and the following presents a summary of the analysis and findings.

Key Elements of PAR 1111 and 1121

PAR 1111 and PAR 1121 establish zero NOx-emission limits for space and water heating appliances, with separate compliance dates for units installed in new and existing buildings. The proposed project also includes a Zero-NOx Manufacturer (ZEM) alternative compliance option, which sets progressive sales targets for both NOx-emitting and zero-NOx appliances, aiming to transition to zero-NOx technology over time. Manufacturers are required to pay a mitigation fee for each NOx-emitting appliance sold, which is substantially higher for the sales beyond the established compliance targets.

Affected Facilities and Industries

The proposed project is applicable to manufacturers, distributors, retailers, resellers, and installers of space- and water-heating systems, and would affect over 10 million furnaces and water heaters in more than five million buildings, which are mostly residential. Due to the widespread use of space furnaces and water heaters, the proposed project is expected to apply to nearly all the residents in the four-county region. Since the proposed project would mostly apply to residential buildings, a small-business analysis is not conducted.

Analytical Assumptions

This analysis is based on an estimated universe of approximately 10.37 million affected units, including 5.24 million residential furnaces and 5.13 million residential water heaters. Approximately 96% of the affected universe is assumed to be installed in conventional homes, while the remaining 4% is assumed to be installed in mobile homes. Additionally, 90% of the affected units are for existing buildings, with the remaining 10% will be installed in newly constructed buildings. The analysis is based on compliance beginning in 2027 and continuing through year 2060, the latest forecast year available in the Regional Economic Modeling Inc. (REMI) model.

Based on the 2023 United States Census American Housing Survey, 87% of homes in the four-county region are assumed to have both an air conditioner (AC) and a furnace, while the remaining 13% only have a furnace. For the homes with both an AC and a furnace, a heat pump with heating and cooling dual functionality will replace the furnace and AC.

The analysis assumes that manufacturers would choose the ZEM alternative compliance option, which has compliance targets by phases with the last phase having a 90% zero-emission compliance target starting in 2036, resulting in the replacement of 90% of the affected units with zero-emission units by the end of the forecast period. This analysis also assumes that the age of all existing units is uniformly distributed over the full useful life, indicating a linear transition of units to zero-emission. Specifically, each year, an equal number of units are assumed to reach the end of its useful life, with 90% of these units to be replaced with zero-emission units while the remaining 10% will be replaced with NOx-emitting natural gas-fired units. By 2060, 90% of the entire universe of affected units will be zero-NOx emitting. Additionally, the analysis assumes that electrical panel upgrades may be needed for 4% and 16% of existing homes replacing gas-fired furnaces and water heaters with heat pumps, respectively, based on TECH Clean California real-world 2024 installation data[1].

The recurring fuel switching costs/savings have been estimated using data from the 2019 Residential Appliance Saturation Survey[2], combined with utility price forecasts from the California Energy Commission Integrated Energy Policy Report for years 2023 and 2024.[3,4]

The proposed project is expected to yield overall cost savings, mainly due to energy bill savings over the equipment lifetime. For some equipment categories, there will be upfront incremental costs for purchasing and installing zero-

[1] TECH Clean California, Heat Pump Data – Download Data, "TECH Working Data Set – Single-Family", https://techcleanca.com/heat-pump-data/download-data/, accessed March 2025.

[2] Cost data contained in the sheet "Original capital cost from AECOM": https://www.ethree.com/e3-quantifies-the-consumer-and-emissions-impacts-of-electrifying-california-homes/, accessed March 2025.

[3] California Energy Commission, Baseline Demand Forecast File for Natural Gas, https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2023-integrated-energy-policy-report/2023-1, accessed March 2025.

[4] California Energy Commission, 2024 IEPR Electricity Rate Forecast SCE and LADWP https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report-iepr/2024-integrated-energy-policy-report, accessed March 2025.

emission units, which will be offset by an energy-cost saving over time, resulting in overall savings. The present value of cost savings over the forecast period is estimated to be $5.14 billion and $2.68 billion, for a discount rate of 1% and 4%, respectively. The annual average savings are estimated to be $250.34 million and $191.25 million, for a 1% and 4% real interest rate, respectively.

The following table presents the average annual costs/savings of the proposed project by equipment category. Note that the fuel-switching savings outweigh the upfront incremental costs, leading to an overall average annual cost saving.

Cost Categories	Annual Average (2027-2060)	
	1% Interest Rate	4% Interest Rate
Capital Costs		
Furnace Only Replaced by Heat Pump	$52,346,553	$79,253,111
Wall & Floor Furnace Replaced by Heat Pump	$3,196,274	$4,839,185
Water Heater Replaced by Heat Pump	$33,903,189	$51,329,707
Furnace & AC Replaced by New NOx-Emitting Gas Unit	$622,810	$942,939
Furnace only Replaced by New NOx-Emitting Gas Unit	$93,064	$140,899
Wall & Floor Furnace Replaced by New NOx-Emitting Gas Unit	$176,752	$267,605
Water Heater Replaced by New NOx-Emitting Gas Unit	$437,023	$661,657
Electrical Panel upgrade - Furnace & AC Replaced by Heat pump	$3,430,435	$5,193,707
Electrical Panel Upgrade - Furnace Only Replaced by Heat Pump	$512,594	$776,071
Electrical Panel Upgrade - Wall & Floor Furnace Replaced by Heat Pump	$973,553	$1,473,967
Electrical Panel Upgrade - Water Heater Replaced by Heat Pump	$19,257,003	$29,155,260
Recurring Savings		
Furnace & AC Replaced by Heat Pump	($79,093,570)	($79,093,570)
Furnace Only Replaced by Heat Pump	($11,818,580)	($11,818,580)
Wall & Floor Furnace Replaced by Heat Pump	($6,601,954)	($6,601,954)
Water Heater Replaced by Heat Pump	($267,773,180)	($267,773,180)
Total	**($250,338,033)**	**($191,253,176)**

Note: Costs are presented in black text and savings are presented in green text in parentheses.

Job Impacts

The direct effects of the proposed project are used as inputs to the REMI model to assess the secondary induced impacts for all the industries in the four-county economy over the period from 2027 – 2060.

When the costs/savings from compliance are annualized using a 4% real interest rate, the REMI analysis forecasts 580 net jobs gained annually in the four-county economy on average over the forecast period, representing 0.0045% of total jobs in the region.

The largest job impact will occur in 2027, the first assumed compliance year, with a forecast of 1,792 jobs gained, relative to the baseline scenario. Among all the industries, the Retail Trade industry (NAICS 44-45) is projected to have the most jobs gained (319 jobs) over the forecast period, while the Utilities sector (NAICS 22) has the most jobs foregone (172 jobs) over the period.

Sensitivity Analysis

To explore cost- and job-impacts under different assumptions, staff performed a sensitivity analysis, which assumed no savings would occur from fuel-switching when transitioning to zero-emission (ZE) units. The sensitivity analysis estimated the cost of transitioning to ZE units at $174.03 million for a 4% real interest rate, with 500 jobs gained annually forecasted over the 2027 to 2060 period.

Health Benefits

Upon full implementation, PAR 1111 and PAR 1121 are projected to reduce NOx emissions by 4.05 and 2.07 tons per day (tpd), respectively, which would have substantial positive impacts (benefits) on public health. This analysis employs an incidence-per-ton (IPT) and benefit-per-ton (BPT) method based on the results of the health benefit analysis in the 2022 AQMP to estimate benefits from the proposed project. The analysis period spans from 2027 to 2053, as it is based on the first compliance year and the useful life of the affected appliances, which can vary. The last appliances will reach the end of their useful life by 2053, which is the reason why the health benefits analysis extends through that year. NOx emission reductions that may be achieved from implementing PAR 1111 and PAR 1121 are anticipated to prevent approximately 2,490 premature mortalities, 1,170,000 minor restricted activity days, and many other negative health outcomes. The monetized present value of these health benefits is estimated to be $25.43 billion with a 4% discount rate, over the 2027 to 2053 period.

Competitive-ness and Prices

All industries in the region are anticipated to experience a slight increase in relative delivered price and cost of production by 0.0007% and 0.0008%, respectively, over the forecast period.

Impacts of CEQA Alternatives

Four alternatives to the proposed project were developed for the CEQA analysis in the Draft Subsequent Environmental Assessment (SEA): Alternative A – No Project, Alternative B – More Stringent, Alternative C – Less Stringent, and Alternative D – Additional Incentives. The average annual job impacts of these

alternatives range from 369 to 1,025 jobs gained. Additionally, the annual average cost savings range from $139.66 million to $287.35 million, based on a 4% real interest rate, over the forecast period.

INTRODUCTION

Rule 1111 – Reduction of NOx Emissions from Natural Gas-Fired Furnaces reduces nitrogen oxide emissions (NOx) from gas-fired fan-type space heating furnaces with a rated heat input capacity of less than 175,000 British thermal units per hour (Btu/hr) or, for combination heating and cooling units, with a cooling rate of less than 65,000 Btu per hour. Rule 1111 also requires fan-type central furnaces to meet a NOx emission limit of 14 nanograms per Joule (ng/J) but allows the installation of mobile home furnaces that meet a NOx emission limit of 40 ng/J if a mitigation fee is paid by the manufacturer. PAR 1111 proposes zero-NOx emission limits for space heating appliances with compliance dates differentiated for units installed in new or existing buildings.

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. Rule 1121 also requires water heaters to meet a NOx emission limit of 10 ng/J except for mobile home water heaters, which need to meet a NOx emission limit of 40 ng/J. This rule does not apply to water heaters used in recreational vehicles or large water heaters subject to Rule 1146.2.[5] PAR 1121 proposes zero-NOx emission limits for water heating appliances with compliance dates differentiated for units installed in new or existing buildings.

PAR 1111 and PAR 1121 apply to manufacturers, distributors, retailers, resellers, and installers of specified space heating equipment and water heaters. Both PAR 1111 and PAR 1121 exempt space and water heating appliances in existing mobile homes from the zero-NOx emission standards. Mobile home appliances must meet zero-NOx emission standards in new mobile homes or when existing mobile homes are replaced with new mobile homes. PAR 1111 and PAR 1121 provide a ZEM alternative compliance option, which sets targets for the sale of NOx-emitting and zero-NOx appliances that evolve over time to transition the market to zero-NOx appliances. This option also requires manufacturers to pay mitigation fees for all NOx-emitting appliances sold for use within South Coast AQMD jurisdiction, with higher fees applied to those exceeding the established compliance targets. Mitigation fees for NOx-emitting appliances will be adjusted for California CPI after 2027, with the adjustment capped at 3%. Due to the widespread usage of space heating equipment and water heaters, the proposed project is anticipated to affect over five million existing and new buildings in the four-county region.

Upon full implementation, PAR 1111 and PAR 1121 are projected to reduce NOx emissions by 4.05 and 2.07 tons per day (tpd), respectively.

LEGISLATIVE MANDATES

The legal mandates directly related to the assessment of PAR 1111 and PAR 1121 include South Coast AQMD Governing Board resolutions and various sections of the Health and Safety Code.

South Coast AQMD Governing Board Resolution

On March 17, 1989, the South Coast AQMD Governing Board adopted a resolution that calls for an economic analysis associated with adopting and amending rules and regulations that considers all of the following elements:

[5] South Coast AQMD, June 2024, Rule 1146.2, https://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1146-2.pdf, accessed March 2025

- Affected industries
- Range of probable costs
- Cost-effectiveness of control alternatives
- Public health benefits

Health and Safety Code Requirements

The state legislature adopted legislation which reinforces and expands the South Coast AQMD Governing Board resolution requiring socioeconomic impact assessments for rule development projects. Health and Safety Code Section 40440.8, which went into effect on January 1, 1991, requires a socioeconomic impact assessment for any proposed rule, rule amendment, or rule repeal which "will significantly affect air quality or emissions limitations."

To satisfy the requirements in Health and Safety Code Section 40440.8, the scope of the socioeconomic impact assessment should include all of the following information:

- Type of affected industries;
- Impact on employment and the regional economy;
- Range of probable costs, including those to industry;
- Availability and cost-effectiveness of alternatives to the rule;
- Emission reduction potential; and
- Necessity of adopting, amending, or repealing the rule in order to attain state and federal ambient air quality standards.

Health and Safety Code Section 40728.5, which went into effect on January 1, 1992, requires the South Coast AQMD Governing Board to: 1) actively consider the socioeconomic impacts of regulations; 2) make a good faith effort to minimize adverse socioeconomic impacts; and 3) include small business impacts. To satisfy the requirements in Health and Safety Code Section 40728.5, the socioeconomic impact assessment should include the following information:

- Type of industries or business affected, including small businesses; and
- Range of probable costs, including costs to industry or business, including small business.

Finally, Health and Safety Code Section 40920.6, which went into effect on January 1, 1996, requires an incremental cost-effectiveness analysis for a proposed rule or amendment which imposes BARCT or “all feasible measures” requirements relating to emissions of ozone, carbon monoxide (CO), sulfur oxides (SOx), NOx, volatile organic compounds (VOC) and their precursors. The BARCT and cost-effectiveness analyses for the PAR 1111 and PAR 1121 were conducted and are included in Chapters 2 and 5 of the Draft Staff Report, respectively.[6]

[6] South Coast AQMD, Draft Staff Report for Proposed Amended Rule 1111 - Reduction of NOx Emissions from Natural Gas-Fired Furnaces and Proposed Amended Rule 1121 – Reduction of NOx Emissions from Residential Type Natural Gas-Fired Water Heaters, https://www.aqmd.gov/home/rules-compliance/residential-and-commercial-building-appliances, accessed March 2025.

AFFECTED EQUIPMENT

The proposed project would affect furnaces and water heaters primarily used in residential settings. Specifically, PAR 1111 applies to residential furnaces for space heating 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. In addition, PAR 1121 pertains to water heaters with a rated heat input capacity of less than 75,000 Btu/hr, used in residential settings for domestic hot water needs. Thus, the proposed project would directly affect the type of equipment used in residences rather than industrial and commercial facilities in the jurisdiction of South Coast AQMD.

Data from the 2023 United States Census American Community Survey (ACS)[7] was relied upon to estimate the universe of the affected units of furnaces and water heaters. Table 1 shows that the estimated universe includes almost 10.37 million affected units in South Coast AQMD jurisdiction, which are in conventional residential dwellings and mobile homes. This analysis assumed that 96% of all affected units are located in conventional residential dwellings, while the remaining 4% are located in mobile homes. Additionally, 90% of the affected units are assumed to be in existing buildings, while the remaining 10% are projected to be installed in new buildings, for both conventional and mobile homes. Note that existing mobile homes will be exempt from the zero-emission mandates. Therefore, this analysis does not account for existing mobile homes even though the owners may voluntarily replace their units with zero-emission equipment.

Table 1: Estimated Universe of Affected Units

Rule	Equipment Categories	Subcategories	Estimated Universe
PAR 1111	Residential Fan-Type Central Furnace	Residential Fan-Type Central Furnace (Furnace & AC)	3,654,000
		Residential Fan-Type Central Furnace (Furnace only)	546,000
	Wall Furnaces and Floor Furnaces	NA	1,037,000
PAR 1121	Water Heaters	NA	5,128,000
		Total	**10,365,000**

Small Business Analysis

PAR 1111 and PAR 1121 are applicable to furnaces and water heaters in residential settings. Since the proposed project is not applicable to facilities, a small business analysis is not required and thus, was not conducted.

COMPLIANCE COSTS

This section provides estimates of the compliance costs of implementing PAR 1111 and PAR 1121, related to the purchase, installation, and operation of zero-emission space/water heating equipment. Note that some values in this section may not sum due to rounding, and all costs/savings have been adjusted to 2024 dollars.

[7] United States Census Bureau, 2023 American Community Survey, https://www.census.gov/programs-surveys/ahs/data.html, accessed March 2025.

For the cost analysis, the unit costs for equipment purchase and installation of heat pumps were derived from the TECH Clean California incentive program public data set, which tracks real-world project costs for heat pump installations.[8] For natural-gas units, the cost assumptions were derived from the 2019 Energy and Environmental Economics (E3) Residential Building Electrification in California study (E3 study), which contains detailed project-level cost estimates for both gas-fired and electric heating, ventilation, and air conditioning (HVAC) appliances and water heaters.[9] The project-level cost includes the equipment price, ductwork or wiring modifications, and installation costs.[10] The same cost assumptions were applied to both existing and new buildings, and conventional residential dwellings and mobile homes.

This socioeconomic analysis assumes that all the manufacturers of furnaces and water heaters will opt for the ZEM compliance option, such that 90% of the affected units will be gradually replaced with zero-NOx emitting units, with the remaining 10% will be replaced with new NOx-emitting gas-fired units. Specifically, the remaining useful life of the affected units is assumed to be uniformly distributed over their entire useful life. Thus, each year, an equal number of units will need to be replaced. This linear transition to zero-emission units will occur over a forecast period from 2027 to 2060[11]; by the year 2060, 90% of all affected units in each equipment category will have transitioned to zero-emission equipment, while the remaining 10% will continue to be NOx-emitting gas-fired units. Finally, this analysis assumes that the manufacturers will pass through all the mitigation fees for NOx-emitting natural-gas units onto consumers, resulting in an increase in the price of NOx-emitting natural-gas units. Table 2 presents the mitigation fee per unit for different natural gas-fired equipment. Assuming that 100% of the cost will be passed through to consumers, the prices of natural gas-fired furnaces and water heaters will be increased by $100 and $50, respectively, after the proposed project is implemented. The higher prices will constitute incremental costs for the 10% NOx-emitting natural gas-fired units when they expire and need to be replaced with new NOx-emitting natural gas-fired units. Table 2 summarizes the cost assumptions used in this analysis.

Table 2: Mitigation Fee by Rule

Rule	Mitigation Fee
PAR 1111	$100/NOx-emitting furnace in 2027 and CPI adjusted after 2027
PAR 1121	$50/NOx-emitting water heater in 2027 and CPI adjusted after 2027

[8] TECH Clean California, Heat Pump Data – Download Data, "TECH Working Data Set – Single-Family", https://techcleanca.com/heat-pump-data/download-data/, accessed March 2025.

[9] Cost data contained in the sheet "Original capital cost from AECOM": https://www.ethree.com/e3-quantifies-the-consumer-and-emissions-impacts-of-electrifying-california-homes/, accessed March 2025.

[10] The installation costs usually include both labor and design expenses.

[11] Note that 2027 is the first year in which the proposed project will be implemented, and the REMI analysis cannot analyze impacts beyond year 2060.

Capital/One-Time Costs

Residential Fan-Type Central Furnace and AC Replaced with Heat Pump

According to the United States Census American Housing Survey (AHS), approximately 87% of residential buildings in the counties of Los Angeles, Orange, San Bernardino, and Riverside have both a furnace and an AC.[12] Given the dual heating and cooling functionality of heat pumps, this analysis assumes that a heat pump will replace both the existing furnace and AC and bases the incremental capital costs on the difference between a single heat pump unit relative to the combined cost of both furnace and AC replacement. The cost to replace both an AC unit and natural gas furnace is $20,600, while a new heat pump costs $17,200 without including electrical upgrade costs which are considered separately, resulting in an incremental savings of $3,400 per unit. However, considering that heat pump is a relatively new technology and its price in the future is quite uncertain, the analysis takes a conservative approach by assuming that a new heat pump will cost $20,600 – the same cost of replacing an AC and natural gas furnace. As such, the incremental cost of transitioning to zero-emission units is zero for this equipment category.

Residential Fan-Type Central Furnace-Only Replacements with Heat Pumps

According to AHS data, 13% of existing homes in the counties of Los Angeles, Orange, San Bernardino, and Riverside do not have air conditioners. Thus, this analysis assumes that 13% of the Residential Fan-Type Central Furnace equipment category will consist of furnace-only replacements, for both existing and new buildings. The estimated equipment and installation costs for a natural gas furnace and a heat pump are $11,000 and $17,200, respectively. This results in an incremental capital cost of $6,200 for replacing a natural gas furnace with a heat pump, totaling $2.94 billion if 473,928 new heat pumps are installed. The assumption that 473,928 furnace-only units will be replaced by heat pumps is based on an estimated universe of 4.2 million Residential Fan-Type Central Furnaces, with 13% assumed to be furnace-only replacements (546,000 units). Of these, 96% are assumed to be located in conventional homes (524,160), with 90% replaced by heat pumps (471,744), and 4% are assumed to be located in mobile homes (21,840), with 10% replaced by heat pumps (2,184). Table 3 presents the calculation steps.

Table 3: Calculations for Estimating Furnace-only Replacements with Heat Pumps

Total Universe of Fan-Type Central Furnaces	4,200,000
Furnace-Only Replacements (13%)	4,200,000 x 0.13 = 546,000
Units in Conventional Homes (96%)	546,000 x 0.96 = 524,160
Units in Mobile Homes (4%)	546,000 x 0.04 = 21,840
Conventional Homes Transitioning to Heat Pump (90%)	524,160 x 0.90 = 471,744
Mobile Homes Transitioning to Heat Pump (10%)	21,840 x 0.10 = 2,184
Total Number of Furnace-Only Replacements with Heat Pumps	471,744 + 2,184 = **473,928**

[12] United States Census Bureau, 2023 American Housing Survey, https://www.census.gov/programs-surveys/ahs/data.html, accessed March 2025.

The total number of furnace-only replacements with heat pumps is 473,928. After applying the incremental capital cost of $6,200 per unit, the total cost of furnace-only replacements with heat pumps is $2.94 billion, as shown in the following equation:

473,928 (estimated units to be replaced) x $6,200 (incremental cost to transition to heat pump) = $2.94 Billion (total cost)

Wall and Floor Furnace Replacements with Heat Pumps

According to AHS data, approximately 1,037,000 existing residences use wall and floor furnaces for heating. The estimated capital cost for replacing each of these furnaces with a heat pump is $5,900, while replacing them with a natural gas furnace is estimated at $5,700, resulting in an incremental cost of $200 per unit. The total capital costs amount to $180.02 million for roughly 900,116 new heat pumps that will be installed in both existing and new buildings. The assumption that 900,116 units will be replaced with heat pumps is based on an estimated universe of 1,037,000 existing units. Of these, 96% are assumed to be located in conventional residential dwellings (995,520), with 90% replaced by heat pumps (895,968), and 4% are assumed to be located in mobile homes (41,480), with 10% replaced by heat pumps (4,148). The total will be 895,968 replacements in conventional residential dwellings plus 4,148 replacements in mobile homes, which totals 900,116 units. Table 4 presents the calculation steps.

Table 4: Calculations for Estimating Wall and Floor Furnace Replacements with Heat Pumps

Total Universe of Wall and Floor Furnaces	1,037,000
Units in Conventional Homes (96%)	1,037,000 x 0.96 = 995,520
Units in Mobile Homes (4%)	1,037,000 x 0.04 = 41,480
Conventional Homes Transitioning to Heat Pump (90%)	995,520 x 0.90 = 895,968
Mobile Homes Transitioning to Heat Pump (10%)	41,480 x 0.10 = 4,148
Total Number of Wall and Floor Furnace Replacements with Heat Pumps	895,968 + 4,148 = **900,116**

The total number of wall and floor furnace replacements with heat pumps is 900,116. After applying the incremental capital cost of $200 per unit, the total cost of replacing wall and floor furnaces with heat pumps is $180.02 million, as shown in the following equation:

900,116 (estimated units to be replaced) x $200 (incremental cost to transition to heat pump) = $180.02 Million (total cost)

Natural Gas Water Heater Replacements with Heat Pump Water Heaters

Heat pump water heaters are projected to cost an average of $3,700 for equipment and installation, compared to $3,300 for natural gas units. This results in an estimated incremental cost of $400 per unit. When applied to an estimated 4,451,104 water heaters, this translates to a total incremental equipment cost of $1.78 billion. The assumption that 4,451,104 units will be replaced to heat pump water heaters is based on an estimated universe of 5.13 million water heaters. Of these 96% are

assumed to be located in conventional homes (4,922,880), with 90% replaced by heat pump water heaters (4,430,592), and 4% are assumed to be located in mobile homes (205,120), with 10% replaced by heat pump water heaters (20,512). The total will be 4,430,592 replacements in conventional homes plus 20,512 replacements in mobile homes, which totals 4,451,104 units. Table 5 presents the calculation steps.

Table 5: Calculations for Estimating Water Heater Replacements with Heat Pumps

Total Universe of Natural Gas Water Heaters	5,128,000
Units in Conventional Homes (96%)	5,128,000 x 0.96 = 4,922,880
Units in Mobile Homes (4%)	5,128,000 x 0.04 = 205,120
Conventional Homes Transitioning to Heat Pump (90%)	4,922,880 x 0.90 = 4,430,592
Mobile Homes Transitioning to Heat Pump (10%)	205,120 x 0.10 = 20,512
Total Number of Natural Gas Water Heater Replacements with Heat Pump Water Heaters	4,430,592 + 20,512 = **4,451,104**

The total number of natural gas water heater replacements with heat pump water heaters is 4,451,104. After applying the incremental capital cost of $400 per unit, the total cost of replacing natural gas water heaters with heat pump water heaters is $1.78 billion, as shown in the following equation:

4,451,104 (estimated units to be replaced) * $400 (incremental cost to transition to heat pump) = $1.78 Billion (total cost)

Residential Fan-Type Central Furnace and AC Replaced with New NOx -Emitting Gas Furnace and AC Unit, Residential Fan-Type Central Furnace Only Replaced with New NOx-Emitting Gas Furnace, Wall and Floor Furnace Replaced with New NOx-Emitting Gas Wall and Floor Furnace, and Natural Gas Water Heater Replaced with New NOx-Emitting Gas Water Heater

Based on the ZEM compliance option, this analysis assumes that at the end of the forecast period, 10% of the affected units for each equipment category and subcategory will not be expected to transition to zero-NOx emitting units and instead, will be replaced with new NOx-emitting gas units at the end of each unit's useful life. Assuming that 100% of the mitigation fee of $100 per-unit for a gas-fired furnace (e.g., a central furnace and AC unit, a fan-type central furnace only unit, or a gas-fired wall and floor furnace) will be passed through onto the consumer, the incremental cost of replacing an old furnace with a new NOx-emitting gas unit will be exactly $100. Similarly, the mitigation fee of $50 per-unit for a NOx-emitting gas-fired water heater will be passed through onto the consumer such that the incremental cost of replacing an old gas-fired water heater with a new NOx-emitting gas unit will be $50.

Electrical Panel Upgrades

According to the TECH dataset, 4% of existing residences in the region required electrical panel upgrades to add more amperage needed to operate electric space heaters, while 16% needed electrical panel upgrades for operating electric water heaters. This analysis applies these estimates and assumes that 4% of all residences will require electrical panel upgrades for electric space heaters, and 16% for water heaters. The cost of each electrical panel upgrade will be $1,700 with a useful life of 30 years. In total, an estimated 800,897 existing buildings will require electrical panel upgrades, with the total projected cost of approximately $1.36 billion as shown in the following equation:

800,897 (estimated existing residences needing an electrical panel upgrade) * $1,700 (electrical panel upgrade cost) = $1.36 Billion (total cost)

Operation & Maintenance (O&M) Costs

Fuel-Switching Costs or Savings

In addition to incremental upfront costs, the implementation of the proposed project will also result in recurring fuel-switching costs or savings due to the transition from natural gas-fired units to zero-emission electric units. In general, electricity is more expensive on a per-unit basis than natural gas. However, the higher electricity cost is often offset by the increased efficiency of heat pump units which collect heat from the ambient air and produce more heat energy than the electricity used, while natural gas heaters can only produce as much heat energy as is contained in the gas consumed.

To estimate the fuel switching costs and savings of transitioning from natural gas to electric water and air heating, the analysis considered the anticipated energy demand and forecasted prices in the future for both natural gas and electricity. The forecasted electricity rates are sourced from the 2024 California Energy Commission (CEC) Integrated Energy Policy Report (IEPR) and the forecasted natural gas rates are sourced from the 2023 CEC IEPR.[13,14] Note that the CEC has a separate electricity price forecast for both the Los Angeles Department of Water and Power (LADWP) and Southern California Edison (SCE) planning areas. The analysis relied upon an average of the two forecasted rates weighted by population. Specifically, since LADWP serves roughly 23% of the population in the region, it is assigned a weight of 0.23, while the weight of SCE is 0.77. For natural gas, the analysis solely relied on the Southern California Gas (SCG) forecast, since it is the primary gas utility in the South Coast AQMD region. The analysis also relied upon the forecasted residential utility rate forecast for all categories. For each category of units, the steps used to estimate the recurring fuel switching cost/saving are:

[13] California Energy Commission, 2024 IEPR Electricity Rate Forecast SCE and LADWP https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report-iepr/2024-integrated-energy-policy-report, accessed March 2025.

[14] California Energy Commission, Baseline Demand Forecast File for Natural Gas, https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2023-integrated-energy-policy-report/2023-1, accessed March 2025.

1. Estimate the annual electricity demand for heat pump and natural gas units by relying on the 2019 Residential Appliance Saturation Study (RASS)[15] released by the CEC to estimate demand. The RASS includes information on the energy use of both electric and natural gas appliances in homes located throughout California.
2. Calculate the average forecasted utility rates for electricity and natural gas from the CEC IEPR forecast.
3. Calculate the annual average energy cost by multiplying the energy demand for each appliance by its respective forecasted utility rate.
4. Take the difference between the annual average energy cost of the electric unit and natural gas unit.

Table 6 presents average annual demand and price forecasts for natural gas and electricity and the resulting annual fuel switching costs and savings for each category. Note that the average rates are based on the equipment's useful lifespan, which may lead to different forecast rates across equipment types, as shown in Table 6. For a detailed description of the methods used to estimate energy inputs, please refer to Chapter 2 of the PAR 1111 and PAR 1121 Draft Staff Report.[16]

Table 6: Energy Demand, and Fuel Switching Costs (Savings) by Unit Type

Unit Type	Annual Natural Gas Demand (Therms)	Annual Electric Demand Equivalent (kWh)	Natural Gas Rate ($/therm)	Electricity Rate ($/kWh)	Annual Fuel Switching Cost (Savings)
Furnace & AC Replacement by Heat Pump (PAR 1111)	173	1190	$2.55	$0.33	($48.45)
Furnace Replacement by Heat Pump (PAR 1111)	173	1190	$2.55	$0.33	($48.45)
Wall & Floor Furnace Replacement by Heat Pump (PAR1111)	69	490	$2.55	$0.33	($14.25)
Water Heater Replacement by Heat Pump (PAR 1121)	190	1,036	$2.36	$0.32	($116.88)

Note: The average natural gas and electricity rates are based on the useful life of each unit type. PAR 1111 units have a useful life of 25 years, while PAR 1121 units have a useful life of 15 years. As a result, averages are calculated over different time periods, which leads to differing average rates for PAR 1111 and PAR 1121 units.

[15] California Energy Commission, 2019 California Residential Appliance Saturation Study (RASS), https://www.energy.ca.gov/publications/2021/2019-california-residential-appliance-saturation-study-rass, accessed October 2024.

[16] South Coast AQMD, Draft Staff Report for Proposed Amended Rule 1111 - Reduction of NOx Emissions from Natural Gas-Fired Furnaces and Proposed Amended Rule 1121 – Reduction of NOx Emissions from Residential Type Natural Gas-Fired Water Heaters, https://www.aqmd.gov/home/rules-compliance/residential-and-commercial-building-appliances, accessed March 2025.

It is important to note that the forecasted utility rates may 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 which considers population change, electrification of vehicles and buildings, anticipated effects of climate change, and many other variables, thus reflecting the best available expectation for future prices in the region.

Total Compliance Costs of PAR 1111 and PAR 1121

The compliance cost analysis covers the period from 2027, which represents the first year the units are expected to be replaced, to 2060, which is the latest forecast year the REMI model is capable of analyzing. The capital cost for each equipment type is amortized over its useful life and added to the recurring cost or savings in each year. Note that the mitigation fee for each gas unit sold will be adjusted for California CPI after 2027, and the annual adjustment will be capped at 3%.

Due primarily to the savings on recurring energy cost, PAR 1111 and PAR 1121 are anticipated to result in overall net savings. The present value of cost savings over the forecast period is estimated to be $5.14 billion and $2.68 billion, respectively, for a discount rate of 1% and 4%. The annual average savings are estimated to be $250.34 million or $191.25 million for a 1% and 4% real interest rate, respectively. Note that while average savings are anticipated for full implementation of both PAR 1111 and PAR 1121, certain equipment categories and specific circumstances may lead to higher purchase, construction and installation costs for individual consumers. Table 7 presents both the present value and annual average savings for each equipment category of PAR 1111 and PAR 1121.[17] [18]

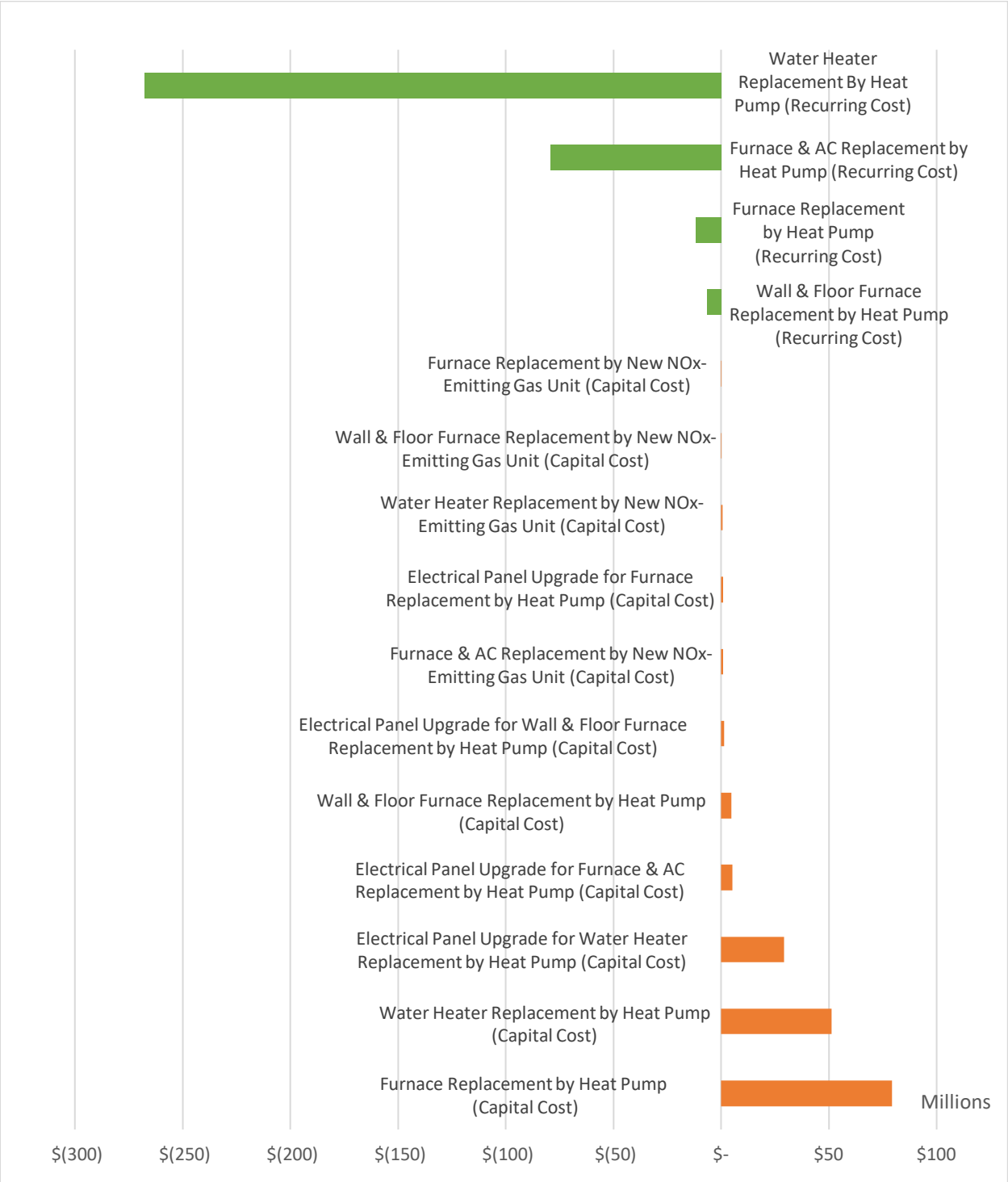
[17] In Table 7, the capital cost for each category includes the equipment price, installation costs (covering contractor labor and design), as well as costs related to ductwork or wiring modifications.

[18] The overall annual net saving implies that tenants' rent is not likely to go up in the region upon the implementation of the proposed project, which alleviates stakeholders' concern about the burden on home renters.

Table 7: Present Value and Average Annual Estimated Costs and Savings of PAR 1111 and PAR 1121

Cost Categories	Present Value (2025)		Annual Average (2027-2060)	
	1% Discount Rate	4% Discount Rate	1% Interest Rate	4% Interest Rate
	Capital Costs			
Furnace Only Replaced by Heat Pump	$2,129,229,077	$1,108,985,584	$52,346,553	$79,253,111
Wall & Floor Furnace Replaced by Heat Pump	$130,010,460	$67,714,521	$3,196,274	$4,839,185
Water Heater Replaced by Heat Pump	$1,379,033,616	$718,254,516	$33,903,189	$51,329,707
Furnace & AC Replaced by New NOx-Emitting Gas Unit	$25,333,173	$13,194,505	$622,810	$942,939
Furnace Only Replaced by New NOx-Emitting Gas Unit	$3,785,417	$1,971,593	$93,064	$140,899
Wall & Floor Furnace Replaced by New NOx-Emitting Gas Unit	$7,189,519	$3,744,582	$176,752	$267,605
Water Heater Replaced by New NOx-Emitting Gas Unit	$17,776,206	$9,258,542	$437,023	$661,657
Electrical Panel upgrade - Furnace & AC Replaced by Heat pump	$139,535,119	$72,675,334	$3,430,435	$5,193,707
Electrical Panel Upgrade - Furnace Only Replaced by Heat Pump	$20,850,075	$10,859,533	$512,594	$776,071
Electrical Panel Upgrade - Wall & Floor Furnace Replaced by Heat Pump	$39,599,868	$20,625,156	$973,553	$1,473,967
Electrical Panel Upgrade - Water Heater Replaced by Heat Pump	$783,290,738	$407,968,380	$19,257,003	$29,155,260
	Recurring Savings			
Furnace & AC Replaced by Heat Pump	($2,124,942,833)	($1,106,753,141)	($79,093,570)	($79,093,570)
Furnace Only Replaced by Heat Pump	($317,520,193)	($165,376,906)	($11,818,580)	($11,818,580)
Wall & Floor Furnace Replaced by Heat Pump	($177,369,339)	($92,380,872)	($6,601,954)	($6,601,954)
Water Heater Replaced by Heat Pump	($7,194,044,931)	($3,746,939,304)	($267,773,180)	($267,773,180)
Total	**($5,138,244,028)**	**($2,676,197,979)**	**($250,338,033)**	**($191,253,176)**

Figure 1: Annual Average Estimated Costs and Savings of PARs 1111 and 1121 by Cost Category



Note: Green bars indicate savings while orange bars indicate costs.

To better understand the distribution of the costs across categories, Figure 1 presents the estimated annual average compliance costs or savings of the proposed project, categorized by equipment type, using a 4% real interest rate. Negative values indicate cost savings, while positive values

indicate costs. The largest cost saving is roughly $267.77 million per year on energy for heat pump water heaters, while the largest capital cost is $79.25 million per year for furnaces replaced by heat pumps.

Sensitivity Analysis

The primary analysis, referred to as the "standard case," estimates fuel-switching savings associated with the transition from natural gas to electric water and space heating. In response to stakeholders' concerns over the uncertainty of future electricity costs, staff conducted a sensitivity analysis which explores an alternate scenario where all the recurring fuel-switching savings will be removed from the calculations. This sensitivity analysis offers a more conservative approach by assuming that no savings will be realized from transitioning to zero-NOx appliances. Table 8 summarizes the estimated costs and savings of the proposed project for both the standard case, which includes the fuel-switching savings, and the sensitivity analysis which excludes the fuel-switching savings. In contrast to the estimated savings for the standard case, the sensitivity analysis estimates an annual average cost of $174.03 million with a 4% real interest rate; and the present value of the costs over the forecast period is estimated at $2.44 billion with a 4% discount rate.

Table 8: Present Value and Annual Average Cost and Savings for Standard and Sensitivity Analyses

	Present Value (2025)		Annual Average (2027-2060)	
Scenario	**1% Discount Rate**	**4% Discount Rate**	**1% Interest Rate**	**4% Interest Rate**
Standard Case	($5,138,244,028)	($2,676,197,979)	($250,338,033)	($191,253,176)
Sensitivity Analysis	**$4,675,633,268**	**$2,435,252,245**	**$114,949,250**	**$174,034,108**

Note: Costs are presented in black text and savings are presented in green text in parentheses.

MACROECONOMIC IMPACTS ON THE REGIONAL ECONOMY

The Regional Economic Modeling Inc. (REMI, PI+ v3) model was used to assess the total socioeconomic impacts of the anticipated implementation of PARs 1111 and 1121.[19, 20] The model, which is comprised of analytical modules with embedded datasets and econometric features, links the economic activities occurring in the counties of Los Angeles, Orange, Riverside, and San Bernardino, and for each county and considers five interrelated blocks: 1) output and demand; 2)

[19] Regional Economic Modeling Inc. (REMI). Policy Insight® for the South Coast Area (70-sector model). Version 3. 2023.

[20] REMI v3 has been updated based on The U.S. Economic Outlook for 2022-2024 from the University of Michigan's Research Seminar in Quantitative Economics (RSQE) release on May 19, 2023, The Long-Term Economic Projections from CBO (supplementing CBO's March 2023 report, The 2023 Long-Term Budget Outlook).

labor and capital; 3) population and labor force; 4) wages, prices and costs; and 5) market shares.[21] It should be noted that the REMI model is not designed to assess impacts on individual operations. The model was used to assess the impacts of the proposed project on various industries that make up the local economy.

Impacts of PAR 1111 and PAR 1121

The assessment herein is performed relative to a baseline ("business as usual") forecast where the PAR 1111 and PAR 1121 would not be implemented. This analysis assumes that the affected households and industries would finance the capital and installation costs of zero-emission appliances at a 4% real interest rate and that these one-time costs are amortized and incurred over the life of the equipment. These amortized capital costs are added to the recurring fuel switching costs or savings, the sum of which are used as inputs to the REMI model.

Compliance costs from the proposed project are used as inputs to the REMI model in order to assess secondary and induced impacts for all the industries in the four-county economy on an annual basis and across a user-defined horizon. This assessment begins in 2027, the earliest date when equipment replacements are expected to occur, and ends in 2060, which is the latest forecast year the REMI model is capable of analyzing. Direct effects of the proposed project that were used as inputs to the model include:

1. Costs from equipment purchase and installation of zero-emission air and water heating equipment, as well as electrical panels. The costs resulting from residential appliances are modeled as changes in disposable income that affect households' consumption.
2. Increase in the revenues of equipment suppliers and electrical panel installers. Incremental upfront costs will be modeled as increases in their revenues. To capture the impacts of spending changes across the supply chain, 50% of total increased spending on equipment is assumed to impact retailers (NAICS 44-45) in South Coast AQMD jurisdiction; 30% is allocated to wholesalers/distributors (NAICS 42), and the remaining 20% to manufacturers (NAICS 332 and 335), based on a discussion with REMI staff. Within the manufacturing sector, 18% of total increased spending is allocated to the electrical equipment, appliance, and component manufacturing industry (NAICS 335), and 2% is allocated to the fabricated metal product manufacturing industry (NAICS 332).
3. Decrease in the revenues of utility companies (NAICS 22) resulting from anticipated energy cost savings due to the shift to electric powered equipment.
4. Increase in the revenues of construction companies (NAICS 23) resulting from increased demand for electrical panel upgrades in 4% and 16% of existing homes replacing gas-fired furnaces and water heaters with heat pumps, respectively.
5. Increase in the revenues of local government (NAICS 92) due to the collection of mitigation fees.

[21] Within each county, the industrial sectors are made up of 156 private non-farm industries and sectors, three government sectors, and a farm sector. Trade flows are captured between sectors as well as across the four counties and the rest of U.S. Market shares of industries are dependent upon their product prices, access to production inputs, and local infrastructure. The demographic/migration component has 160 ages/gender/race/ethnicity cohorts and captures population changes in births, deaths, and migration. For details, please refer to REMI online documentation at http://www.remi.com/products/pi.

Table 9 presents the categories of costs and savings along with the industries and households that will incur the costs or benefit from the savings, and the industries that will be directly affected by the compliance costs and savings due to implementation of the proposed project.

Table 9: Industries Affected by Compliance Costs and Savings of PAR 1111 and PAR 1121

Source of Compliance Costs and Savings	REMI Industries Incurring Costs and Savings	REMI Industries Affected by Costs and Savings (NAICS)
Heat Pump + Install Capital Costs	Private Households	Fabricated Metal Product Manufacturing (332) Electrical Equipment, Appliance, and Component Manufacturing (335) Wholesale Trade (42) Retail Trade (44-45)
New NOx-Emitting Natural-Gas Unit + Install Capital Cost		
Electrical Panel Upgrades		Construction (23)
Fuel Switching		Utilities (22)
Mitigation Fee		State and Local Government (92)

Regional Job Impacts

When the compliance cost is annualized using a 4% real interest rate, the model predicts an annual average of 580 jobs gained over the forecast period 2027-2060, relative to the baseline forecast, which represents 0.0045% of total employment in South Coast AQMD jurisdiction. The sectors with the most jobs gained include Retail Trade (NAICS 44-45) and Wholesale Trade (NAICS 42), which benefit from increased spending on the purchase and installation of zero-emission heat pumps. In addition, households will benefit from the overall savings, and thus consume more, which will lead to increased revenues and jobs gained in other sectors. On the other hand, the sector of Utilities (NAICS 22) will undergo the most jobs foregone, mainly due to lost revenues as a result of massive savings resulting from fuel-switching. Overall, the positive job impacts will outweigh the negative job impacts, and therefore, lead to net jobs gained on average over the forecast period.

Note that the projected job impacts are based on the assumptions and analysis using the REMI model. The actual job impacts may vary depending on various factors in the economy and evolving industry dynamics. Table 10 presents simulated job impacts for selected industries and years and shows that many sectors in the regional economy which are not directly affected by the

implementation of the proposed project will undergo job impacts sooner or later because of the secondary or induced effects of PAR 1111 and PAR 1121.

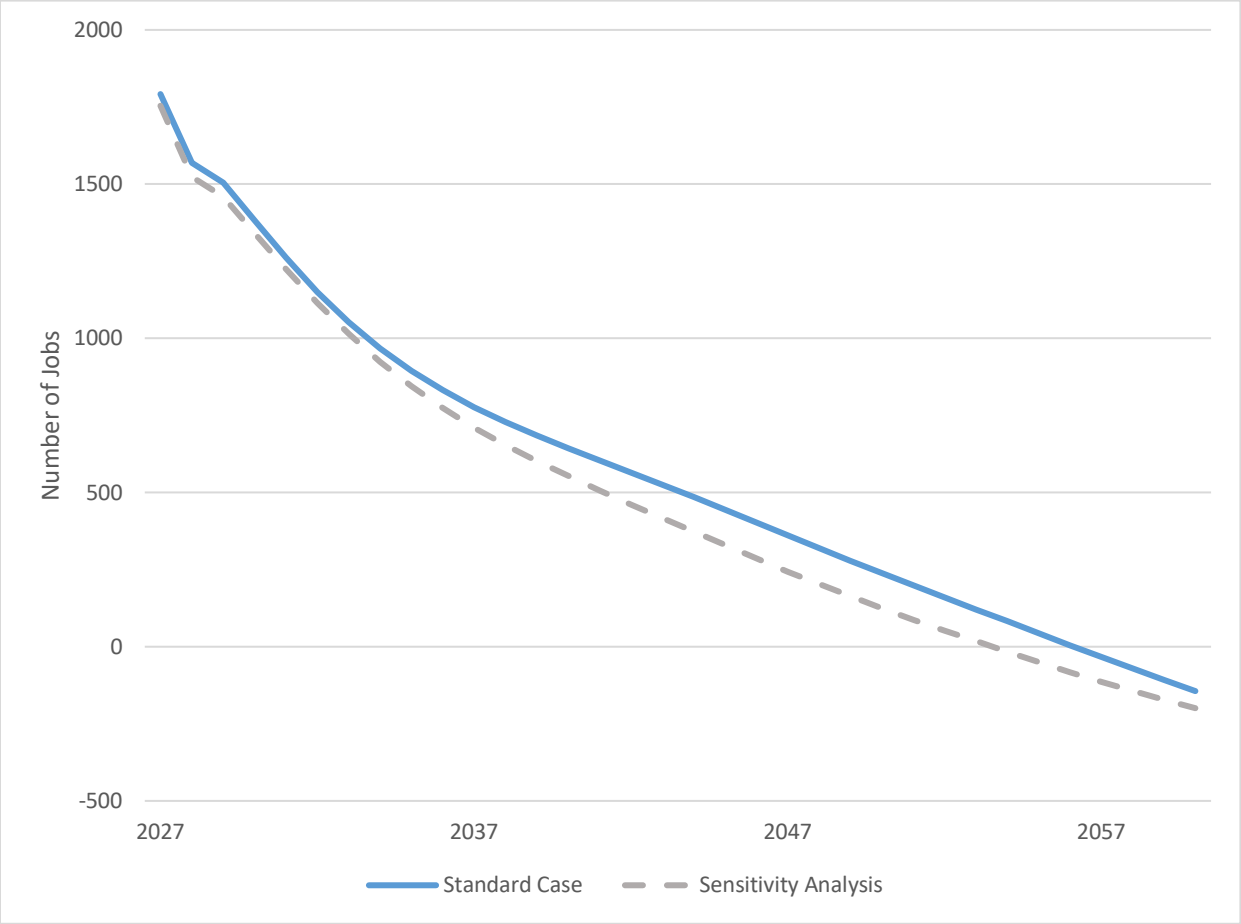
Table 10: Projected Job Impacts of PAR 1111 and PAR 1121 for Selected Industries and Years

Industry	2030	2040	2050	2060	Average (2027 - 2060)	Baseline Number of Jobs	% of Baseline
Utilities (22)	-48	-154	-233	-291	-172	21,163	0.8127
Professional, scientific, and technical services (54)	44	-58	-152	-234	-88	1,083,637	0.0081
Construction (23)	211	-72	-153	-209	-52	588,717	0.0088
Administrative and support services (561)	46	-16	-54	-84	-23	895,295	0.0026
Fabricated metal product manufacturing (332)	11	2	-1	-3	3	68,740	.0044
Electrical equipment, appliance, and component manufacturing (335)	5	4	3	3	4	14,867	.0269
State and Local Government (NA)	92	31	-14	-48	19	985,260	0.0019
Social assistance (624)	22	36	45	45	37	689,252	0.0054
Personal and laundry services (812)	34	53	69	78	57	452,017	0.0126
Wholesale trade (42)	101	72	56	43	70	412,166	0.0170
Ambulatory health care services (621)	62	106	141	153	114	752,937	0.0151
Retail trade (44-45)	456	337	255	188	319	874,680	0.0365
All other industries	345	302	278	215	293	6,186,652	0.0047
Total	**1382**	**644**	**238**	**-144**	**580**	**13,025,381**	**0.0045**

Note: Totals may not sum due to rounding.

For the sensitivity analysis which excludes the savings due to fuel-switching, the REMI analysis resulted in an annual average of approximately 500 jobs gained in the South Coast AQMD jurisdiction over the forecast period, which is about 0.0038% of total jobs in the region. Figure 2 presents a time series of projected job impacts over the 2027 - 2060 period for both the standard case and sensitivity analysis.

Figure 2: Projected Regional Job Impacts, 2027-2060



Health Benefits

The emissions reductions anticipated from PAR 1111 and PAR 1121 would have substantial public health benefits. This assessment estimates these benefits using incidence-per-ton (IPT) and benefit-per-ton (BPT) values derived from estimated health benefits and the projected NOx emission reductions in the Final Socioeconomic Report for the 2022 AQMP.[22] The IPT and BPT method provides robust, reasonable estimates of the magnitude of health benefits and is consistent with previously employed approaches by South Coast AQMD, as well as the United States Environmental Protection Agency (USEPA) and the California Air Resources Board

[22] South Coast AQMD, Final Socioeconomic Report for the 2022 AQMP, https://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/aqmp-2022-socioeconomic-report-main-final.pdf accessed March 2025.

(CARB).[23,24,25] The Final Socioeconomic Impact Report for the 2022 AQMP estimated the health benefits for year 2032 and 2037 based on: 1) modeled reductions in ambient ozone and PM2.5 concentrations across the Basin; and 2) USEPA's Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE) model. This analysis utilizes the projected NOx emissions reductions and associated health benefits attributed to the 2022 AQMP to generate average IPT and BPT estimates. These estimated IPT and BPT factors were then used to generate estimates of the quantity and monetized value of health benefits resulting from anticipated emission reductions from PAR 1111 and PAR 1121. Since NOx is a key precursor to the formation of PM2.5 and ozone, the IPT and BPT estimates for both PM2.5-specific and ozone-specific benefits were developed by dividing the results of the health benefits from the 2022 by the total NOx emission reductions from the 2022 AQMP.

This reduced-form approach relies upon an estimate of the average health impact for each ton of pollutant emissions (and/or its precursors) reduced. This average estimate is based on the benefits derived from the 2022 AQMP air quality modeling, which accounts for potential nonlinearities between NOx emissions and ozone concentrations in the Basin. Thus, although a variable marginal impact of emissions on benefits is not employed, the average IPT and BPT of the 2022 AQMP implementation implicitly reflects the impacts of nonlinear air quality chemistry on the overall expected health benefits. Additional methodological assumptions include:

- Changes in incidence are proportional to ambient PM2.5 or ozone concentrations.
- Changes in primary pollutant concentrations are proportional to changes in directly emitted NOx.
- The IPT and BPT values are specific to the year (2032 and 2037) being evaluated.
- For years prior to 2032, IPT and BPT values are not calculated. Instead, health benefits grow linearly from zero benefits in 2026 to the estimated 2032 total benefits (based upon 2032 IPT and BPT values).
- For intermediate years between 2032 and 2037, IPT and BPT values grow linearly.
- For years beyond 2037, 2037 IPT and BPT values are projected through 2053 based on either future population growth (IPT and cost-of-illness based BPT estimates), or both future population growth and income growth (willingness-to-pay based BPT estimates).

This analysis assesses the public health benefits for which epidemiological studies have demonstrated an association between increases in ambient air pollution exposure and increases in illness and other health effects (morbidity endpoints) or increases in death rates from various causes (mortality endpoints) and are the same health endpoints quantified in the Final

[23] IPT and BPT estimates were used in the health benefits analysis of the South Coast AQMD August 2024 amendment process for Rule 2306 – Freight Rail Yards, http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2024/2024-aug2-026.pdf, accessed March 2025.

[24] USEPA, Technical Support Document: Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors, https://www.epa.gov/sites/default/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf, accessed March 2025.

[25] CARB, Estimating the Community Level Health Benefits from Air Pollution Control Programs, https://ww2.arb.ca.gov/resources/documents/estimating-community-level-health-benefits-air-pollution-control-programs#:~:text=CARB%20uses%20a%20California%20specific,available%20on%20the%20CARB%20website, accessed March 2025.

Socioeconomic Report for the 2022 AQMP. Additional details concerning the selection of quantified health effects, and the generation of health benefits results are available in Chapter 3 and Appendices 3-A and 3-B of the Final Socioeconomic Report for the 2022 AQMP.[26]

Table 11 presents the estimated NOx emissions inventory for PAR 1111 and PAR 1121. In this analysis, NOx emission reductions are assumed to be zero in the year before implementation for each category; and then grow linearly to the year of full implementation, which is 2053. Upon full implementation, PAR 1111 is expected to reduce NOx emissions by 4.05 tpd, while PAR 1121 will reduce NOx emissions by 2.07 tpd, with a total of 6.12 tpd.

Table 11: NOx Emission Reductions for PAR 1111 and PAR 1121

Proposed Amended Rule	NOx Emission Reductions (tpd)
1111	4.05
1121	2.07
Total	**6.12**

The estimated IPT factors were used in conjunction with projected annual NOx emission reductions to estimate the health benefits presented in Table 12. In total, PAR 1111 and PAR 1121 are estimated to prevent approximately 2,490 premature deaths, 10,200 cases of newly onset asthma, 1.17 million minor restricted activity days, and other outcomes, from 2027 to 2053.

[26] South Coast AQMD, Appendices to the Final Socioeconomic Report for the 2022 AQMP, https://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/aqmp-2022-socioeconomic-report-appendices-final.pdf, accessed March 2025.

Table 12: Health Effect Estimates of PAR 1111 and PAR 1121

Health Effects	Annual Average	Total 2027-2053
Premature Deaths Avoided, All Cause		
Long-Term Ozone Exposure	22	590
Long-Term PM2.5 Exposure	69	1,900
Reduced Morbidity Incidence		
Long-Term Ozone Exposure		
Asthma, New Onset	280	7,500
Short-Term Ozone Exposure		
Asthma Symptoms (Chest Tightness, Cough, Shortness of Breath, Wheeze)	51,000	1,400,000
Emergency Room Visits (ED), Asthma	19	510
ED Visits, All Respiratory	44	1,200
HA, Asthma	530	14,000
Minor Restricted Activity Days	21,000	560,000
School Loss Days, All Cause	6,100	170,000
Long-Term PM2.5 Exposure		
Asthma, New Onset	99	2,700
HA, Alzheimer's Disease	7.1	190
HA, Parkinson's Disease	3.0	80
Incidence, Hay Fever/Rhinitis	470	13,000
Incidence, Lung Cancer (non-fatal)	5.7	150
Short-Term PM2.5 Exposure		
Acute Myocardial Infarction, Nonfatal	1.0	28
Asthma Symptoms, Albuterol use	17,000	450,000
ED Visits, Asthma	3.5	94
ED Visits, All Cardiac Outcomes	7.6	210
ED Visits, All Respiratory	17	470
Emergency Hospitalizations (EHA), Asthma	0.18	4.9
HA, All Cardiac Outcomes	2.6	70
HA, All Respiratory	7.3	200
Incidence, Ischemic Stroke	4.1	110
Incidence, Out-of-Hospital Cardiac Arrest	0.69	19
Minor Restricted Activity Days	23,000	610,000
Work Loss Days	3,900	100,000

[1] Health effects of ozone are quantified for the summer planning period only (i.e., May 1 to September 30). There are potentially more premature mortalities and morbidity conditions avoided outside the ozone peak season.
[2] Expressed in person-days. Minor Restricted Activity Days refer to days when some normal activities are avoided due to illness.
[3] Values are rounded to two significant figures.

In addition, Table 13 presents the monetized value of the anticipated health benefits. Roughly 98% of the monetized value of these health benefits are attributable to avoided premature mortalities. The estimates are based on a value of statistical life (VSL) of $12.74 million[27] and the assumption that the willingness-to-pay for mortality risk reductions will increase as per-capita income grows. Specifically, a one percent increase in income is assumed to raise the VSL by 1.1%. These assumptions result in a total undiscounted public health benefit of $59.08 billion dollars over the 2027-2053 implementation period, or a $25.43 billion present value at a 4% discount rate.

Table 13: Monetized Value of Health Benefits from PAR 1111 and PAR 1121 (Billions of 2024 Dollars)

Type of Health Benefit	Total (2027-2053)	Annual Average (2027-2053)	Present Value - 4% Discount Rate
Mortality-related benefits	$57.71	$2.14	$24.80
Long-Term Ozone Exposure	$14.02	$0.52	$5.98
Long-Term PM2.5 Exposure	$43.69	$1.62	$18.82
Morbidity-related benefits	$1.37	$0.05	$0.63
Total	**$59.08**	**$2.19**	**$25.43**

Note: numbers may not sum due to rounding.

Competitiveness and Prices

According to the REMI modeling results, PAR 1111 and PAR 1121 would increase the relative cost of production in the region by 0.0008% on average and raise the relative delivered price of products in the region by 0.0007%. The slight increase in production costs may reduce the region's competitive advantage relative to equipment manufacturers located outside the region. Additionally, this overall increase in prices could negatively impact consumers by reducing their purchasing power. However, these effects are considered minimal.

CEQA ALTERNATIVES

The California Environmental Quality Act (CEQA) requires an evaluation of alternatives when a proposed project may have significant adverse environmental impacts. The implementation of PAR 1111 and PAR 1121 has the potential to result in energy impacts from increased electricity demand that are more severe than was previously analyzed in the Final Program EIR for the 2022 AQMP[28] for Control Measures R-CMB-01 and R-CMB-02. For this reason, four alternatives were developed for the CEQA analysis conducted in the Draft Subsequent Environmental Assessment (SEA): Alternative A – No Project, Alternative B – More Stringent, Alternative C – Less Stringent, and Alternative D – Additional Incentives.[29] This section provides a description of each CEQA

[27] Industrial Economics Inc. and Lisa Robinson, Review of Mortality Risk Reduction Valuation Estimates for 2016 Socioeconomic Assessment, https://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/iecmemos_november2016/scmortalityvaluation_112816.pdf, accessed March 2025.

[28] South Coast AQMD, November 2022, Final Program EIR for the 2022 AQMP, https://www.aqmd.gov/docs/default-source/ceqa/documents/aqmd-projects/2022/2022-aqmp-final-peir.pdf, accessed March 2025.

[29] South Coast AQMD, Draft Subsequent Environmental Assessment for PAR 1111 and PAR 1121,

alternative as well as an assessment of the possible socioeconomic impacts resulting from the event that any of these alternatives are implemented in lieu of the proposed project.

The socioeconomic analysis of the CEQA alternatives assumes that all the affected units will transition to zero-emissions by the specific compliance dates as specified in Table 2 in the rule languages of both PAR 1111 and PAR 1121.

Alternative A – No Project

The No Project Alternative outlines what would happen if PAR 1111 and PAR 1121 were not implemented. In this case, all the affected units in new and existing residential buildings would not need to comply with the proposed zero-emission limit. As a result, the No Project alternative would not involve any new capital or recurring costs and thus would have no socioeconomic impacts.

Alternative B – More Stringent

The More Stringent Alternative would involve imposing earlier compliance dates. Under Alternative B, the deadline for installing compliant equipment in new buildings is 12 months earlier than for the proposed project. Existing equipment in existing buildings would be required to be replaced by the compliance date listed in PAR 1111 and PAR 1121, rather than being replaced at the end of useful life. This rapidly accelerates the installation of zero-emission units relative to the proposed project. This more stringent alternative will begin the phase-in process for existing households in 2026 and will achieve full compliance by 2029. Overall, Alternative B proposes a much more stringent approach by requiring earlier compliance with the proposed zero-emission limits for existing households. These more stringent deadlines would place considerable stress on supply chains for zero-emission units and on equipment installers.

Alternative C – Less Stringent

Under Alternative C, equipment in new buildings would meet the proposed NOx emission limits as specified in PAR 1111 and PAR 1121. Furnaces and water heaters in existing buildings, however, would be allowed to be replaced with low-NOx equipment in situations where alternative compliance options would be necessary. This analysis assumes that 50% of equipment in existing buildings would be replaced with zero-emission equipment, while the remaining 50% would be low NOx.

Alternative D – Additional Incentive Funding

Alternative D considers the effect of providing financial incentives to encourage the early replacement of furnaces and water heaters, while holding all other aspects of the proposed project the same. The standard forecast for the proposed project does not currently evaluate the impact of any incentives. Incentives would help offset any upfront costs and would enable households and to install zero-emission units sooner than they otherwise would. This alternative assumes that a $1,000 incentive will be provided to the units that are replaced early, and 1% of the affected units are assumed to be replaced before the end of their useful life in this alternative.

https://www.aqmd.gov/docs/default-source/ceqa/documents/aqmd-projects/2024/draft-sea---par-1111-amp-1121.pdf , accessed March 2025.

Summary of CEQA Alternatives Analysis

Table 14 summarizes the estimated annual average costs, net present value (NPV) of those costs, and the annual average job impacts for the CEQA alternatives. Alternatives B, C, and D will all result in annual cost savings and job gains, ranging from 369 to 1,025 jobs. One possible reason for the large number of jobs gained in Alternative B is that there is substantial spending occurring at the beginning of the forecast period, which brings about a large number of new jobs in labor-intensive sectors such as retail and wholesale trade.

Table 14: Average Annual Costs and Savings, NPV and Job Impacts For CEQA Alternatives

Comparison of Proposed Project with CEQA Alternatives[1]	NPV (4% Discount Rate)	Average Annual Costs/Savings at 4% Interest Rate	Average Annual Job Impacts
Proposed Project (PAR 1111 and PAR 1121)	($3,728,247,520)	($241,106,932)	677
Alternative A – No Project[1]	$0	$0	0
Alternative B - More Stringent	($5,121,252,536)	($287,353,276)	1,025
Alternative C - Less Stringent	($2,097,479,701)	($139,655,355)	369
Alternative D - Additional Incentives	($3,831,434,444)	($246,468,195)	658

Note: Costs are presented in black text and savings are presented in green text in parentheses.

[1] Analyses of the proposed project and the other CEQA alternatives are based on the assumption that all affected units will transition to zero-emissions by the specific compliance dates as specified in Table 2 – Zero-Emission Limits and Compliance Schedule of both PAR 1111 and PAR 1121.

[2] Alternative A would not result in any compliance expenditure and thus has no costs or job impacts.

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