SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Socioeconomic Impact Assessment of Proposed Amended Rule 1110.2 – Emissions from Gaseous and Liquid-fueled Engines and Proposed Amended Rule 1100 – Implementation Schedule for NOx Facilities

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EXECUTIVE SUMMARY

Elements of Proposed Amendments

South Coast AQMD has begun the process of transitioning equipment at NOx Regional Clean Air Incentives Market (RECLAIM) facilities from a facility permit structure to an equipment-based command-and-control regulatory structure per SCAQMD Regulation XI – Source Specific Standards. PAR 1110.2 – Emissions from Gaseous and Liquid-fueled Engines; and PAR 1100 – Implementation Schedule for NOx Facilities, will be amended to transition equipment from the NOx RECLAIM program to a command-and-control regulatory structure while achieving Best Available Retrofit Control Technology (BARCT). The substantive provisions of PAR 1110.2 are: 1) expand the applicability to include internal combustion engines operated at RECLAIM and former-RECLAIM facilities not previously required to comply with BARCT limits in Rule 1110.2; and 2) require engines operated at RECLAIM and former RECLAIM facilities to comply with BARCT in accordance with existing Rule 1110.2 NOx limits. There are other minor and administrative changes that are also proposed for clarity and consistency throughout the rule. Implementation of the proposed project is estimated to reduce NOx emissions by 0.29 tons per day after implementation of BARCT limits. PAR 1100 would: 1) expand the applicability to include owner and operator of RECLAIM or former RECLAIM facility that owns or operates equipment subject to Rule 1110.2; 2) add definitions for additional clarity; and 3) establish the implementation schedule for RECLAIM engines subject to PAR 1110.2.

Affected Facilities and Industries

There are 21 RECLAIM facilities with 76 internal combustion engines that will be subject to PAR 1110.2. Twenty-one of these engines already meet the proposed NOx limit of 11 ppm. Eight portable engines at three facilities will be phased out. Approximately 47 engines across the remaining 10 facilities would need to be replaced, repowered, or retrofitted with air pollution controls in order to meet the NOx limits in PAR 1110.2.

Total Engines Subject to PAR 1110.2	**76**
Already Compliant to 11 ppmv	21
Will be phased out	8
Remaining Engines with Compliance Costs	**47**

Cost impacts for PAR 1110.2 were estimated for five facilities in Los Angeles County, three in Orange County, and one each in Riverside and San Bernardino Counties. The composition of affected engine equipment by county is 25 engines in Los Angeles County, 10 in Orange County, and six each in Riverside and San Bernardino Counties.

County	**Number of Engines**	**Facilities**
Los Angeles	25	5
Orange	10	3
San Bernardino	6	1
Riverside	6	1
Total	**47**	**10**

Cost Assumptions	The Final Socioeconomic Report for the 2005 RECLAIM amendment fully analyzed the socioeconomic impacts of installing selective catalytic reduction (SCR) units that are currently proposed under PAR 1110.2. However, few of the RECLAIM facilities actually installed the control equipment while in RECLAIM, instead obtaining RTCs in lieu of any required emission reductions. Thus, for many of these RECLAIM facilities, they will actually undertake these costs of installation for the first time. Socioeconomic conditions have changed since the 2005 RECLAIM amendment's analysis of SCR equipment and installation costs. As a result, staff conservatively analyzed these socioeconomic impacts using, to the extent data is available, current costs under the current socioeconomic conditions. For facilities with engines requiring retrofit or replacement to meet the BARCT limit of 11 ppm defined in PAR 1110.2, the following cost assumptions were conservatively applied: **SCR Retrofits and New Installation Costs** The cost of SCR equipment varies partially on the size (horsepower) of the engine intended for the emission controls, and the range of engines in the PAR 1110.2 universe is from 131 hp to 5,500 hp. Accordingly, the range of SCR costs assumed for PAR 1110.2 is from $304,000 to $857,000 (rounded to the nearest thousand) across 37 engines. The average SCR cost across all facilities/engines is $382,000, and the SCR equipment life is assumed to be 25 years. **CEMS Equipment and Installation Costs** For control equipment requiring continuous emission monitoring systems (CEMS), approximately $178,000 per system was assumed including equipment and installation. **Catalyst Replacement Costs** For the cost analysis in PAR 1110.2, the catalyst replacement interval assumed was 3 years, and the annual replacement costs range from approximately $28,000 to $231,000, with an average annual cost of $129,000 among 47 engines. **Total Engine Replacement Costs** The proposed emission limits of PAR 1110.2 are achievable with SCR additions and retrofits to existing control equipment. Due to the high cost of total engine replacement, it is assumed that a facility would meet compliance with PAR 1110.2 through the use of available emission control technologies rather than engine replacement. However, for certain smaller and older diesel engines, retrofits are not feasible and engine replacement would be the preferred control option. **Operations & Maintenance Costs** The operations and maintenance (O&M) costs in PAR 1110.2 range between $1,207 and $4,285 annually. The majority of the O&M costs come from electricity required to operate the SCR, and the remaining costs are periodic maintenance of the control

<table>
<tr><td></td><td>equipment. Electrical demand increases as a function of the size of the SCR, which is scaled to the rate of emissions based on engine size.

CEMS Retrofit and New Installation Costs
Some facilities subject to PAR 1110.2 require continuous emission monitoring systems (CEMS) as new installations and/or permit modifications or re-certifications for the existing CEMS equipment. PAR 1110.2 assumes CEMS equipment and installations range between $124,000 and $178,000 for 23 engines, and the associated re-certification and permit modification costs estimated at approximately $4,000. Annual O&M costs of the CEMS equipment range between $10,000 and $20,000, respectively.</td></tr>
<tr><td>Compliance Costs</td><td>PAR 1110.2 Industry-Wide Compliance Costs (2021-2046)
<table><tr><th>Real interest rate scenario</th><th>Total cost if all expenses made in 2019</th><th>Annualized cost</th></tr><tr><td>High-rate scenario (4% interest rate)</td><td>$87,682,000</td><td>$5,404,000</td></tr><tr><td>Low-rate scenario (1% interest rate)</td><td>$113,125,000</td><td>$4,690,000</td></tr></table>Note: A higher real interest rate means future expenses have lower current value. The real interest rate corrects for inflation, and is closely approximated by the nominal interest rate minus inflation.

The majority of compliance costs (61%) for PAR 1110.2 impact Pipeline Transportation (NAICS 4862), where engines are used by utility gas suppliers maintain pipeline systems for distribution of natural gas consumers. Smaller portions of the total costs impact Oil & Gas Extraction (NAICS 2111), Natural Gas Distribution (NAICS 2212), Beverage Manufacturing (NAICS 3121), and Amusement, Gambling and Recreation Industries (NAICS 7139) with 20%, 11%, 5%, and 3%, respectively.

The majority of the one-time costs come from the required purchase and installation of SCR controls or the retrofit of existing SCR equipment. The total cost of SCRs including installation is approximately $33.8 million or approximately $2.1 million average annual cost across the 10 affected facilities. The largest recurring cost is the replacement of catalyst, which totals almost $30.6 million or $1.88 million average annual cost across the 10 affected facilities.</td></tr>
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<tr><td>Cost-Effectiveness</td><td>The cost-effectiveness of the PAR 1110.2 series is estimated to range from $32,000 to $40,000 per ton of NOx reduced based on the Discount Cash Flow (DCF) method, depending on discount and real interest rate (1% or 4%). The rich-burn engine category shows a higher cost-effectiveness figure because PAR 1110.2 requirements affect mainly CEMS equipment for the same catalytic controls. Although this category is subject to emission reductions, the cost is higher as a function of tons of NOx reduced.

<table>
<tr><th></th><th>4% discount and real interest rate DCF cost-effectiveness</th><th>1% discount and real interest rate DCF cost-effectiveness</th></tr>
<tr><td>Lean-burn engines - 2 Stroke</td><td>$28,000</td><td>$24,000</td></tr>
<tr><td>Lean-burn engines - 4 Stroke</td><td>$34,000</td><td>$30,000</td></tr>
<tr><td>Rich-Burn Engines</td><td>$72,000</td><td>$53,000</td></tr>
<tr><td>Average (all types)</td><td>$32,000</td><td>$40,000</td></tr>
</table>
</td></tr>
<tr><td>Jobs and Other Socioeconomic Impacts</td><td>Compliance costs for PAR 1110.2 are expected to result in 76 to 175 jobs foregone annually, on average, between 2021 and 2046. The projected job loss represents about 0.001% of total employment in the four-county region. The Pipeline Transportation industry, which bears more than half of the total expected compliance cost, would have an average of 8 to 13 jobs foregone annually. The industry with the largest job impacts is Construction, where an estimated 12 to 31 jobs would be foregone annually on average.</td></tr>
<tr><td>Competitiveness</td><td>The compliance costs of 1110.2 are expected to impact the relative costs of production at most on any given year during the period of 2021 to 2046 in the following ranges by low-rate (1%) and high rate (4%) scenarios, respectively:

• Oil & Gas Extraction: 0.075-0.081%
• 0.0090%
• Natural Gas Distribution:0.026-0.014%
• Beverage Manufacturing: 0.005-0.006%
• Pipeline Transportation: 2.01-2.21%
• Amusement, Gambling, and Recreation Industries: 0.002-0.002%

The same industries are anticipated to experience an increase in relative delivered price in any given year from 2021 to 2046 of at most by low-rate and high-rate scenarios, respectively:

• Oil & Gas Extraction: 0.009-0.01%
• Natural Gas Distribution: 0.027-0.015%
• Beverage Manufacturing: 0.006-0.006%
• Pipeline Transportation: 0.481-0.521%
• Amusement, Gambling, and Recreation Industries: 0.002-0.002%</td></tr>
</table>

Impacts of CEQA Alternatives

There are four CEQA alternatives associated with PAR 1110.2. Alternative A, the no project alternative, would mean that the current version of Rule 1110.2 would remain in effect. Alternative B (more stringent with distributed generation limits) sets emission limits for non-emergency engines driving electrical generators, with 0.070 lbs/MW-hr NOx, 0.20 lbs/MW-hr CO, and 0.10 lbs/MW-hr VOC. Alternative C (more stringent) sets emission limits for NOx at 7 ppmv (at 15% O_2) and a 5 ppmv ammonia slip limit. Alternative D (less stringent) delays the compliance date for compressor gas two-stroke or four-stroke engines to 2031 instead of the proposed project's 2023 date.

	Average Annual, 2021-2046		
Alternatives	**Cost**	**Job Impacts**	**DCF Cost-Effectiveness, 4%; $ per ton NOx**
Proposed Amendments	$5,464,000	-175	$32,000
Alternative A - No Project	-	-	-
Alternative B – More Stringent, Total Engine Replacement	$23,541,000	-722	$136,000
Alternative C – More Stringent	$13,464,000	-410	$78,000
Alternative D – Less Stringent	$4,237,000	-118	$22,000

INTRODUCTION

The South Coast AQMD's 2016 Air Quality Management Plan established Control Measure CMB-05 – Further NOx Reductions from RECLAIM Assessment, committed to an additional five ton NOx reduction per day to occur by 2025. The South Coast AQMD Governing Board directed staff to implement an orderly sunset of the RECLAIM program and transition to a command-and-control regulatory structure to achieve the additional five ton per day NOx reductions. California State Assembly Bill (AB) 617 promulgated an expedited schedule for Best Available Retrofit Control Technology (BARCT). A programmatic analysis of the RECLAIM concluded that command-and-control rules would need to be adopted and/or amended reflecting current BARCT and provide implementation timeframes for achieving BARCT. South Coast AQMD staff concluded that RECLAIM facilities should not exit unless their equipment is subject to an adopted BARCT rule. Since 2018, South Coast AQMD has amended Rule 1135, Rule 1146, Rule 1146.1, Rule 1146.2, Rule 1118.1, and Rule 1134 with BARCT requirements for facilities exiting RECLAIM. So far only two facilities have exited RECLAIM, and due to EPA concerns about early exiting, South Coast AQMD has stopped allowing facilities to exit RECLAIM with the July 12, 2019 amendment to Rule 2001.

Proposed Amended Rule 1110.2 - Emissions from Gaseous and Liquid-fueled Engines, and Proposed Amended Rule 1100 – Implementation Schedule for NOx Facilities would set new emission limits for Oxides of Nitrogen (NOx), Volatile Organic Compounds (VOCs), and Carbon Monoxide (CO) from all stationary and portable engines over 50 rated brake horsepower (bhp). Implementation of the proposed amendment is estimated to reduce NOx emissions by 0.29 tons per day after implementation of BARCT limits.

The substantive provisions of PAR 1110.2 are:

1) Expand the applicability to include internal combustion engines operated at RECLAIM and former-RECLAIM facilities not previously required to comply with BARCT limits in Rule 1110.2; and
2) Require engines operated at RECLAIM and former RECLAIM facilities to comply with BARCT in accordance with existing Rule 1110.2 NOx limits

PAR 1100 would:

1) Expand the applicability to include owners and operators of a RECLAIM or former RECLAIM facility that owns or operates equipment subject to Rule 1110.2; and
2) Add definitions for additional clarity

LEGISLATIVE MANDATES

The legal mandates directly related to the assessment of the proposed amended rule include South Coast AQMD Governing Board resolutions and various sections of the California Health & Safety Code.

South Coast AQMD Governing Board Resolutions

On March 17, 1989 the South Coast AQMD Governing Board adopted a resolution that calls for an economic analysis of regulatory impacts that includes the following elements:

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

Health & Safety Code Requirements

The state legislature adopted legislation that reinforces and expands the Governing Board resolutions for socioeconomic impact assessments. Health and Safety Code sections 40440.8(a) and (b), which became effective on January 1, 1991, require a socioeconomic analysis be prepared for any proposed rule or rule amendment that "will significantly affect air quality or emissions limitations."

Specifically, the scope of the analysis should include:

- 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
- 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 became effective on January 1, 1992, requires the South Coast AQMD Governing Board to actively consider the socioeconomic impacts of regulations and make a good faith effort to minimize adverse socioeconomic impacts. It also expands socioeconomic impact assessments to include small business impacts, specifically:

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

Finally, Health and Safety Code section 40920.6, which became effective on January 1, 1996, requires incremental cost-effectiveness be performed for a proposed rule or amendment that imposes Best Available Retrofit Control Technology or “all feasible measures” requirements relating to ozone, carbon monoxide (CO), oxides of sulfur (SOx), oxides of nitrogen (NOx), and their precursors.

Incremental cost-effectiveness is defined as the difference in costs divided by the difference in emission reductions between a control alternative and the next more stringent control alternative.

The necessity analysis and the analysis of control alternatives and their incremental cost effectiveness are presented in the Staff Report prepared for the proposed amendments.

REGULATORY HISTORY

Rule 1110.2 was adopted in August 1990, requiring additional reductions for NOx and VOCs from gaseous-fueled combustion engines rated greater than 50-bhp, extending from emission controls for NOx and CO that were previously required in Rule 1110.1, adopted in October 1984.

Administrative changes and clarifications for the rule amendments were adopted in August 1994 and December 1994, with no socioeconomic impacts. In November 1997 requirements for portable engines were revised to be consistent with federal and state regulations. In addition, the continuous emission monitoring requirements for CO were removed and source testing was reduced from annually to every three years.

In June 2005 stationary agricultural engines were required to comply with the rule by replacing their engines with a controlled spark ignition engine and non-selective catalytic reduction system (NSCR) or an electric motor, or adding an NSCR to an existing spark ignition engine. The total annual cost of PAR 1110.2 was estimated at $316,000 per year, but with the available state funding, the cost to agricultural facilities was reduced to $40,000 per year.

The adoption of the February 2008 amendment to 1110.2 lowered NOx, VOC, and CO emission limits for stationary, non-emergency engines. It also established lower emission standards for new, non-emergency electrical generation engines. The amendment also increased monitoring requirements to include more frequent emissions testing and the development of Inspection and Monitoring (I&M) plans. This amendment affected 859 engines at 405 facilities. Overall, costs for all the affected industries ranged from $10.76 million in 2008 to $27.24 million in 2012, with an average annual cost of $22.39 million between 2008 and 2020. 169 jobs were projected to be forgone annually, on average, between 2008 and 2020 in the local economy.

In September 2012, Rule 1110.2 was amended to establish emission limits for biogas/natural gas engines. Included in the amendment was a technology assessment for biogas engine control technology. In December 2015, the compliance deadline for biogas engines was extended by one year. The amendment also addressed concerns raised by the United States Environmental Protection Agency related to State Implementation Plan (SIP) approval issues contained in the rule language regarding excess emissions from startup, shutdown, and malfunction (SSM).

In June 2016, Rule 1110.2 was amended to extend the compliance deadline for one landfill gas facility due to economic concerns related to its power purchase agreement. The facility is required to retire its engines subject to the rule by October 1, 2022.

AFFECTED EQUIPMENT AND FACILTIES

PAR 1110.2 applies to gaseous- and liquid-fueled stationary and portable engines over 50 bhp. There are 21 RECLAIM facilities with 76 internal combustion engines that will be subject to PAR 1110.2. Twenty-one of these engines already meet the proposed NOx limit of 11 ppm. Eight

portable engines at three facilities will be phased out. There are two engines that are limited to 499 operating hours per year that are not required to meet the 11 ppm NOx limit. Approximately 47 engines across the remaining 10 facilities would need to be replaced, repowered, or retrofitted with air pollution controls in order to meet the NOx limits in PAR 1110.2.

Table 1:
PAR 1110.2 Affected Equipment and Facilities by Industry Category

NAICS	Industry Description	Number of Engines	Facilities
312120	Breweries	2	1
211111	Crude Petroleum and Natural Gas Extraction	11	4
221210	Natural Gas Distribution	3	2
486210	Pipeline Transportation of Natural Gas	25	2
713920	Skiing Facilities	6	1
Total		**47**	**10**

Cost impacts for PAR 1110.2 were estimated for four facilities in Los Angeles County, three in Orange County, and one each in Riverside and San Bernardino Counties. The composition of affected engine equipment by county is 25 engines in Los Angeles County, 10 in Orange County, and six each in Riverside and San Bernardino Counties.

Table 2:
PAR 1110.2 Affected Equipment and Facilities by County

County	Number of Engines	Facilities
Los Angeles	25	5
Orange	10	3
San Bernardino	6	1
Riverside	6	1
Total	**47**	**10**

Small Business

South Coast AQMD defines a "small business" in Rule 102 as one which employs 10 or fewer persons and which earns less than $500,000 in gross annual receipts. South Coast AQMD also defines “small business” for the purpose of qualifying for access to services from the South Coast AQMD’s Small Business Assistance Office as a business with an annual receipt of $5 million or less, or with 100 or fewer employees.

In addition to SCAQMD's definition of a small business, the federal Clean Air Act Amendments (CAAA) of 1990 and the federal Small Business Administration (SBA) also provide definitions of a small business. The CAAA classifies a business as a “small business stationary source” if it: (1) is owned or operated by a person who employs 100 or fewer individuals; (2) is a small business as

defined under the federal Small Business Act (15 U.S.C. Sec. 631, et seq.); and (3) emits less than 10 tons per year of any single pollutant and less than 20 tons per year of all pollutants. The SBA definitions of small businesses vary by six-digit North American Industrial Classification System (NAICS) codes. In general terms, a small business must have no more than 500 employees for most manufacturing industries, and no more than $7.0 million in average annual receipts for most nonmanufacturing industries.[1]

Revenue and employee data was available for 5 of the 10 affected facilities in PAR 1110.2 in the Dun and Bradstreet Enterprise Database.[2] Under South Coast AQMD's definition of a small business (Small Business Assistance Office), there are no businesses with available data potentially affected by the requirements of PAR 1110.2 that meet the criteria for a small business. Using the sector-specific SBA definitions, two of the facilities are classified as small businesses. Under the CAAA definition of small business, none of the facilities are considered small businesses.

COMPLIANCE COSTS

Analysis Timeframe

The cost estimate for PAR 1110.2 assumes the first year of costs would be incurred by facilities in 2021, when equipment would be required to meet emission limits defined in the rule. The primary emission control for most engines subject to PAR 1110.2 is selective catalytic reduction (SCR) units, for which the equipment life is assumed to be 25 years before replacement or retrofit is needed. The horizon of the analysis timeline is 2046, which is 25 years after the initial implementation of required controls and emission reductions.

One-time and Recurring Costs

Compliance costs associated with PAR 1110.2 include one-time (capital) costs and recurring costs. The one-time costs include SCR equipment and installation costs, continuous emission monitoring systems (CEMS) equipment and installation costs, as well as one-time permitting fees with South Coast AQMD for SCRs and CEMS with modifications. Recurring costs include annual permit renewal fees for SCR units, operating and maintenance (O&M) costs, triennial catalyst replacement costs, urea usage, annual maintenance and certification for CEMS equipment, and electricity to run SCR equipment.[3] One-time and recurring costs estimates exclude operating costs for existing emission control installations, so the cost estimates account for PAR 1110.2 compliance costs above a facility's current operational baseline.

[1] The latest SBA definition of small businesses by industry can be found at http://www.sba.gov/content/table-smallbusiness-size-standards.

[2] Dun & Bradstreet Enterprise Database, 2019.

[3] For one facility that operates six engines subject to PAR 1110.2, due to the specific nature of the SCR equipment, the catalyst replacement interval is assumed to be 10 years instead of three based on current practice.

One-time Costs

Staff has used the U.S. EPA Air Pollution Control Cost Manual to estimate costs of capital, installation, and operating and maintenance of SCRs.[4] Required modifications (and associated costs) to facilities in order to meet the updated BARCT NOx concentration limits in PAR 1110.2 are detailed below.

Total one-time capital costs for an SCR retrofit include direct and indirect costs associated with purchasing and installing SCR equipment. These costs include the equipment cost for the SCR system itself, the cost of auxiliary equipment, direct and indirect installation costs, and additional costs due to installation such as asbestos removal. The cost of SCR equipment varies partially on the size (horsepower) of the engine intended for the emission controls, and the range of engines in the PAR 1110.2 universe is from 131 hp to 5,500 hp. Accordingly, the range of SCR costs assumed for PAR 1110.2 is from $304,000 to $857,000 (rounded to the nearest thousand) across 37 engines.[5] The average SCR equipment plus installation cost across all facilities/engines is $0.96 million. For the 37 engines across 10 facilities potentially affected by PAR 1110.2, the total capital costs associated with SCR equipment or retrofit of existing equipment, including installation, are approximately $33.8 - $36 million. Per unit equipment costs for SCRs and retrofits range from $0.09 - $0.86 million, and per unit installation costs range from $0.36 - $1.29 million. A smaller subset with 10 engines, rich-burn engines, which require non-selective catalytic reduction (NSCR, also known as 3-way catalyst), are already close to the 11 ppm NOx limit. Compliance with PAR 1110.2 limits for rich-burn engines would likely be achieved through tuning or NSCR retrofit, which have significantly lower costs than a SCR retrofit. One-time permitting fees would apply to 31 of the 47 engines subject to PAR 1110.2, requiring a permit modification at a cost per unit is assumed of $4,659.

Some facilities subject to PAR 1110.2 require continuous emission monitoring systems (CEMS) as new installations and/or permit modifications or re-certifications for the existing CEMS equipment. PAR 1110.2 assumes CEMS equipment and installations range between $124,000 and $178,000 for 23 engines, and the associated re-certification and permit modification costs estimated at approximately $4,000.

Recurring Costs

The largest recurring cost for affected PAR 1110.2 facilities is catalyst replacement. Consumption of catalyst is a function of SCR size and emission reduction requirements, but staff assumed a replacement interval of three years for most SCRs with the exception of one facility whose six engines and SCRs would need catalyst replacement every 10 years.[6] The range of triennial catalyst replacement costs is from $28,000 - $231,000 per SCR unit (average cost per unit is $129,000), while one facility with a 10 year catalyst replacement interval for six engines is $50,000 per unit. Urea costs associated with the operation of each SCRs range from $18,000 to $35,000 annually, and O&M (not including electricity) costs range from $1,207 to $4,285 per unit. Electrical costs

[4] U.S. EPA Air Pollution Control Cost Manual, Selective Catalytic Reduction available at: https://www.epa.gov/sites/production/files/201712/documents/scrcostmanualchapter7thedition_2016revisions2017.pdf

[5] 10 engines subject to PAR 1110.2 categorized as rich-burn engines, will meet rule requirements through modification or installation of CEMS, and thus do not require retrofit or replacement to existing SCR equipment.

[6] Catalyst replacement intervals are based on typical vendor guarantees, but may be longer in actual practice.

per unit is estimated at $1,395 annually. Recurring costs associated with CEMS units include annual service and maintenance. These costs are expected to range from $10,000 - $20,000 annually.

The proposed emission limits of PAR 1110.2 are achievable with SCR additions and retrofits to existing control equipment. Due to the high cost of total engine replacement, it is assumed that a facility would meet compliance with PAR 1110.2 through the use of available emission control technologies rather than engine replacement. However, some smaller and older diesel engines would require engine replacement with Tier IV final engines because retrofitting with SCR controls is not feasible.

The average annual cost of PAR 1110.2 is estimated to be $4.7 – 5.5 million (in 2019 dollars) between 2021 and 2046, for the 1% and 4% real interest rate scenarios, respectively.[7] Table 3 shows a breakdown of both in present worth value of total costs and annualized total costs by industry.

Table 3:
Annual Estimated Costs of PAR 1110.2 by Industry

Industry Description	Number of Facilities	Present Worth Value (2019)		Average Annual Costs (2021-2046)	
		1% Discount Rate	4% Discount Rate	1% Discount Rate	4% Discount Rate
Oil and gas extraction (2111)	4	$22,895,000	$17,386,000	$950,000	$1,084,000
Natural gas distribution (2212)	2	$12,415,000	$9,652,000	$515,000	$603,000
Beverage manufacturing (3121)	1	$5,433,000	$4,120,000	$225,000	$257,000
Pipeline transportation (486)	2	$68,469,000	$53,533,000	$2,839,000	$3,336,000
Amusement, gambling, and recreation industries (7139)	1	$3,914,000	$2,992,000	$162,000	$184,000
Total	**10**	**$113,125,000**	**$87,682,000**	**$4,690,000**	**$5,464,000**

Note: Cost totals shown across all facilities, and costs by category are not evenly distributed among facilities.

Figure 1 illustrates that Pipeline Transportation (NAICS 4862) is expected to incur the largest portion of overall compliance cost with 61%, Oil and Gas Extraction (2111) 21%, Natural Gas Distribution (221210) 11%, Beverage Manufacturing (3121) 5%, and Amusement, Gambling and Recreation Industries (7139) 3%.

[7] SCAQMD uses both 1% and 4% real interest rates to provide a range of potential compliance cost estimates for the proposed amendments.

Figure 1:
Portion of Estimated Annual Compliance Costs by Industry, 2021-2046

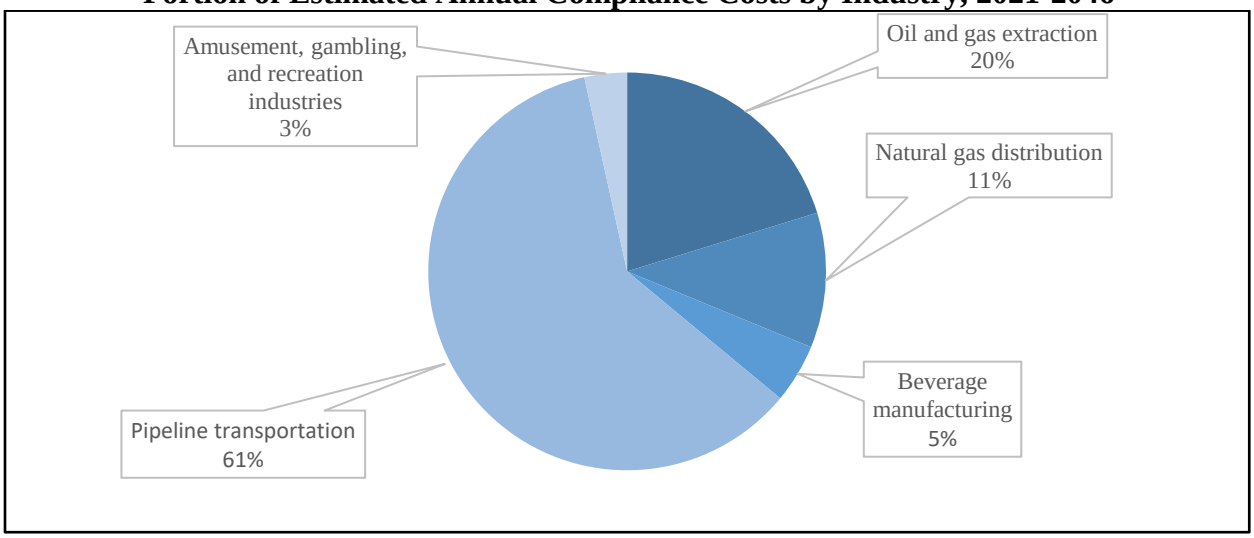


Table 4 shows the distribution of compliance costs by selected cost categories. The majority of capital costs ($2.1 million annually or 39%) are expected to occur from the purchase, installation and/or retrofit of SCR equipment. The remaining one-time costs of CEMS equipment and installation, and permitting total approximately $295,000 annually or 6%.

The largest source of costs is from the recurring cost catalyst replacement, also shown in Table 4, which totals almost $1.9 million annually or 35% across the 47 engines in the PAR 1110.2 universe. Urea consumption accounts for $495,000 (9%) in annual costs of PAR 1110.2, and CEMS service and maintenance costs are approximately $483,000 (9%) annually. Other recurring costs of electricity ($61,000), annual SCR permit renewal ($52,000), and SCR O&M costs ($66,000) each total about 1% each of the annual costs from PAR 1110.2.

Table 4:
Annual Estimated Costs of PAR 1110.2 by Cost Categories

	Present Worth Value (2019)		Annual Average (2021-2046)	
Cost Categories	**1% Discount Rate**	**4% Discount Rate**	**1% Real Interest Rate**	**4% Real Interest Rate**
One-Time Cost				
SCR	$14,336,000	$13,364,000	$596,000	$840,000
SCR (install)	$21,991,000	$20,501,000	$914,000	$1,288,000
SCR (initial permitting fees)	$147,000	$137,000	$6,000	$9,000
CEMS (Equipment/Install)	$3,319,000	$4,607,000	$138,000	$289,000
CEMS (Certification/Modification Fees)	$82,000	$76,000	$3,000	$5,000
One-Time Cost Subtotal	$39,875,000	$38,685,000	$1,657,000	$2,431,000
Recurring Cost				
CEMS Annual Svc. Cost	$11,620,000	$7,684,000	$483,000	$483,000
SCR (permit renewal)	$1,247,000	$824,000	$52,000	$52,000
O&M	$1,579,000	$1,044,000	$66,000	$66,000
Catalyst	$45,438,000	$30,606,000	$1,878,000	$1,878,000
Increased Urea	$11,902,000	$7,870,000	$495,000	$495,000
SCR (electricity)	$1,465,000	$969,000	$61,000	$61,000
Recurring Cost Subtotal	$73,251,000	$48,997,000	$3,035,000	$3,035,000
Total	**$113,125,000**	**$87,682,000**	**$4,690,000**	**$5,464,000**

PAR 1100

Proposed Amended Rule 1100 (PAR 1100) establishes the implementation schedule for PAR 1110.2 for RECLAIM and former RECLAIM facilities. PAR 1100 includes engines regulated under PAR 1110.2 in its applicability for owners or operators of RECLAIM or former RECLAIM facilities. PAR 1100 is an administrative rule and does not impose additional costs to affected facilities, as such, no additional costs or socioeconomic impacts were assumed here.

COST-EFFECTIVENESS

Table 5 shows the cost-effectiveness of the PAR 1110.2 series is estimated to range from $32,000 to $41,000 per ton of NOx reduced based on the Discount Cash Flow (DCF) method, depending on real interest rate used (1% or 4%). DCF utilizes the present value, or a stream of all present and future costs discounted to and summed up in the same initial year, and cost-effectiveness is calculated as a function of present value costs versus emissions reduced during the life of the equipment. The rich-burn engine category shows a higher cost-effectiveness figure because PAR 1110.2 requirements affect mainly CEMS equipment. Although this category is subject to

emission reductions, the cost reduced is higher as a function of the smaller amount of tons of NOx reduced.

Table 5:
PAR 1110.2 Cost-Effectiveness[8]

	4% discount and real interest rate DCF cost-effectiveness	1% discount and real interest rate DCF cost-effectiveness
Lean-burn engines - 2 Stroke	$28,000	$36,000
Lean-burn engines - 4 Stroke	$34,000	$45,000
Rich-Burn Engines	$72,000	$80,000
Average (all types)	**$32,000**	**$41,000**

Note: A higher real interest rate means future expenses have lower current value. The real interest rate corrects for inflation, and is closely approximated by the nominal interest rate minus inflation.

JOBS AND SOCIOECONOMIC IMPACTS

The REMI model (PI+ v2.3.1) was used to assess the total socioeconomic impacts of a regulatory change (i.e., the proposed rule).[9] The model links the economic activities in the counties of Los Angeles, Orange, Riverside, and San Bernardino, and for each county, it is comprised of five interrelated blocks: (1) output and demand, (2) labor and capital, (3) population and labor force, (4) wages, prices and costs, and (5) market shares.[10]

The assessment herein is performed relative to a baseline ("business as usual") where the proposed amendments would not be implemented. The proposed amendments would create a regulatory scenario under which the affected facilities would incur an average annual compliance costs totaling $4.7 - $5.5 million. Direct effects of the proposed amendments have to be estimated and used as inputs to the REMI model in order for the model to assess secondary and induced impacts for all actors in the four-county economy on an annual basis and across a user-defined horizon (2021 - 2046). Direct effects of the proposed amendments include additional costs to the affected entities and additional sales, by local vendors, of equipment, devices, or services that would meet the proposed requirements.

[8] The cost-effectiveness values presented in this analysis differ slightly from that of the SCAQMD Staff report for PAR 1110.2. Cost effectiveness calculations will differ as a function of using DCF costs rather than static costs in the numerator of the equation: *Cost Effectiveness = (cost)/(annual emission reduction potential*years of life of equipment)*

[9] Regional Economic Modeling Inc. (REMI). Policy Insight® for the South Coast Area (160 sector model). Version 2.3.1, 2019.

[10] Within each county, producers are made up of 156 private non-farm industries, 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.)

While compliance expenditures may increase the cost of doing business for affected facilities, the purchase and installation of additional equipment combined with spending on operating and maintenance, may increase sales in other sectors. Table 4 lists the industry sectors modeled in REMI that would either incur a cost or benefit from the compliance expenditures.
Improved public health due to reduced air pollution emissions may also result in a positive effect on worker productivity and other economic factors; however, public health benefit assessment requires the modeling of air quality improvements at a regional scale. The most recent regional analysis was conducted for the 2016 Air Quality Management Plan (AQMP) which found significant health benefits if federal air quality standards are met.

On average, PAR 1110.2 is expected to result in approximately 76 - 175 jobs forgone annually, between 2021 and 2046, depending on the real interest rate assumed (1% - 4%). The projected job loss impacts represent about 0.00065% - 0.0015% of the total employment in the four-county region. Table 7 presents the job impacts across multiple sectors of the regional economy for selected years in the planning horizon.

Table 6:
Industries Incurring vs. Benefitting from Compliance Costs/Spending

Source of Compliance Cost	REMI Industries Incurring Compliance Costs (NAICS)	REMI Industries Benefitting from Compliance Spending (NAICS)
SCR	Oil and gas extraction (211) Natural Gas Extraction (2212) Beverage Manufacturing (3121) Pipeline Transportation (486) Amusement, Gambling, and Recreation Industries (713)	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing (3334)
SCR (installation)		
SCR (initial permitting fees)		Construction (23)
CEMS (Equipment + Install)		State and Local Government (92)
CEMS (Certification/Modification Fees)		Management, scientific, and technical consulting services (5416)

Table 7:
Job Impacts of PAR 1110.2

Industry (NAICS)	2021	2024	2029	2035	2040	2046	Average annual jobs change	Baseline annual jobs (2021-2046)	% Change from average baseline (2021-2046)
Construction (23)	71	-106	-27	-10	-13	-10	-31	496,308	-0.0063%
Retail trade (44-45)	-4	-28	-11	-11	-12	-12	-15	1,015,185	-0.0015%
State and Local Government (92)	-1	-19	-15	-13	-13	-11	-14	902,552	-0.0015%
Pipeline Transportation (486)	-30	-28	-9	-8	-7	-6	-13	957	-1.3994%
Local Government (N/A)	0	-17	-13	-11	-11	-10	-12	755,529	-0.0016%
Management, scientific, and technical consulting services (5415)	-2	-7	-9	-11	-12	-12	-10	212,901	-0.0046%
Food services and drinking places (722)	-1	-13	-8	-8	-8	-8	-9	789,531	-0.0011%
Real Estate (531)	-2	-11	-4	-4	-4	-5	-6	588,763	-0.0010%
Wholesale Trade (42)	1	-10	-4	-4	-4	-4	-5	456,804	-0.0011%
Oil and Gas Extraction (211)	-7	-8	-4	-3	-3	-3	-5	20,161	-0.0230%
Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing (3334)	10	0	0	0	0	0	0	2,117	0.0141%
All Other Industries	1	-122	-50	-51	-57	-58	-68	7,155,021	-0.0009%
Total	**27**	**-351**	**-141**	**-122**	**-133**	**-129**	**-175**	**11,638,182**	**-0.0015%**

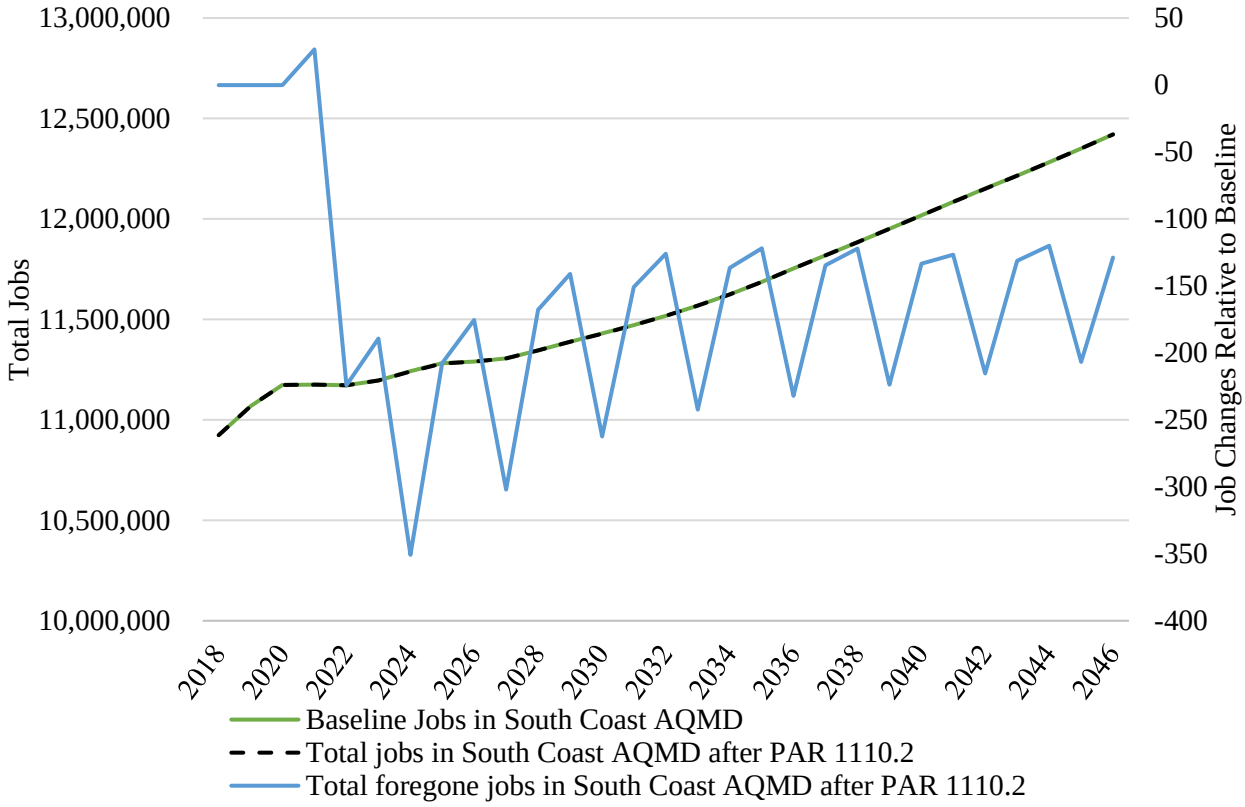
*Assumes a 4% real interest rate

In earlier years of the regional simulation positive job impacts from the expenditures made by the affected facilities would more than offset the jobs forgone from the additional cost of doing business. Construction (NAICS 23) is projected to gain 71 jobs in 2021 from additional demand for equipment installation from the affected facilities on average. Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing (NAICS 3334) also benefits from installations from SCR retrofits and installations in 2021, netting 10 additional jobs in the first year of implementation. Across all industries, the net effect of PAR 1110.2 is a gain of 27 jobs in 2021.

Subsequent years net a decrease in jobs across all industries as a result of direct costs of compliance. Table 7 ranks the most negatively impacted industries over the timeline of the analysis.[11] The remainder of the projected reduction in employment would be across all major sectors of the economy from secondary and induced impacts of the proposed amendments. The reduction in disposable income would dampen the demand for goods and services in the local economy, thus resulting in a relatively large number of jobs forgone projected in sectors such as construction (NAICS 23), retail trade (NAICS 44 - 45), and State and Local Government (NAICS 92). Cyclical job impacts relating to catalyst replacement on a triennial interval are the source of recurring fluctuations in the total job market. Such fluctuations reach a maximum short-term change of 176 jobs foregone in the period from 2024 to 2046, but vary less over time do to predictable market adjustments in demand.

[11] NAICS 3334 is included in Table 4 as an industry benefitting from compliance costs as a result of installations to affected facilities, but does not rank in the top 10 overall from jobs foregone across all industries in the four-county region.

Figure 2:
Projected Regional Job Impact, 2021 – 2046



COMPETITIVENESS

The additional cost brought on by PAR 1110.2 would increase the cost of services rendered by the affected industries in the region. The magnitude of the impact depends on the size, diversification, and infrastructure in a local economy as well as interactions among industries. A large, diversified, and resourceful economy would absorb the impact described above with relative ease.

Changes in production/service costs would affect prices of goods produced locally. The relative delivered price of a good is based on its production cost and the transportation cost of delivering the good to where it is consumed or used. The average price of a good at the place of use reflects prices of the good produced locally and imported elsewhere.

It is projected that the pipeline transportation sector (NAICS 486), which affects 25 engines across four facilities, would experience a rise in its relative cost of production of 1.88% in 2024 for the 4% real interest rate scenario, and on average is projected to see an increase of 2.21% over the period from 2021 to 2046. Oil and Gas Extraction (NAICS 211) is expected to see an increase in its delivered price of 0.07% in 2024, with an overall increase of 0.08% on average over 2021 to 2046.

Table 8:
PAR 1110.2 Projected Relative Cost of Production

Industry	NAICS	1%	4%
Oil and gas extraction	2111	0.0750%	0.0810%
Natural gas distribution	2212	0.0260%	0.0140%
Beverage manufacturing	3121	0.0050%	0.0060%
Pipeline transportation	4862	2.0110%	2.2070%
Amusement, gambling, and recreation industries	7139	0.0020%	0.0020%

Delivered prices that a facility may charge for specific goods or services may increase at a greater rate than predicted, allowing incurred costs to be passed through to downstream industries and end-users. The remaining sectors are likely to experience increases in the relative cost of production and relative delivered price with respect to their counterparts in the rest of the U.S. The natural gas distribution sector (NAICS 2212) is expected to experience an increase in its delivered price by 0.01% in 2024 for the 4% real interest rate scenario, and on average will increase by 0.014% over 2021 to 2046. Smaller impacts to relative cost of production are projected for Amusement, Gambling and Recreation industries (NAICS 713), and Beverage Manufacturing (NAICS 3121), with no estimated increase by 2024 for both, and over time an increase of 0.002% and 0.006%, respectively, over 2021 to 2046.

Table 9:
PAR 1110.2 Projected Relative Delivered Price

Industry	NAICS	1%	4%
Oil and gas extraction	2111	0.0090%	0.0100%
Natural gas distribution	2212	0.0270%	0.0150%
Beverage manufacturing	3121	0.0060%	0.0060%
Pipeline transportation	4862	0.4810%	0.5210%
Amusement, gambling, and recreation industries	7139	0.0020%	0.0020%

CEQA ALTERNATIVES

There are four CEQA alternatives associated with PAR 1110.2. Alternative A, the "no project" alternative, means that the current version of Rule 1110.2 would remain in effect. Alternative B, with distributed generation limits would impose a 0.07 lbs./MW-hr NOx limit, presumed to be achievable in most applications only with a total engine replacement. Alternative C would impose stricter emission limits than the proposed project, with a limit of 7 ppmv NOx at 15% O_2, achieved with greater SCR reductions using additional ammonia and catalyst. Alternative D, the phased-in compliance date, assumes the same reductions as the proposed project but with a later date of required compliance.

Assuming a 4% interest rate, average annual compliance costs for the CEQA alternatives range from $4.2 - $23.5 million between 2021 and 2046, as shown in Table 8. Jobs forgone for the CEQA

alternatives range from 118 to 722 between 2021 and 2046. Alternative B, which aims for more stringent reductions to 2.5 ppmv NOx, could most reasonably be achieved through total engine replacement of a significant number of facilities subject to PAR 1110.2. As explained earlier in the compliance costs section, total engine replacement was seen as a costly path to reductions, and therefore most of the limits proposed in PAR 1110.2 are based on achievable reductions with SCR retrofits and replacements. Cost-effectiveness accordingly increases to $136,000 per ton of NOx reduced for Alternative B. Alternative C, which sets more stringent emission limits for NOx to 7 ppmv (proposed amendments are 11 ppmv NOx), would achieve the reductions with SCR enhancements and additional catalyst layers. The additional capital costs of SCR enhancements as well as the increased recurring cost of catalyst consumption puts Alternative C at a cost-effectiveness level of $78,000 per ton of NOx reduced. Alternative D, which maintains the same emission limits as the proposed amendments, but with a delayed implementation for compressor gas 2-stroke and 4-stroke lean-burn engines (to comply by December 31, 2027).[12]

Table 8:
CEQA Alternatives Comparison to Proposed Amendments

	Average Annual, 2021-2046		
Alternatives	**Cost**	**Job Impacts**	**DCF Cost-Effectiveness, 4%; $ per ton NOx**
Proposed Amendments	$5,464,000	-175	$32,000
Alternative A - No Project	-	-	-
Alternative B – More Stringent, Total Engine Replacement	$23,541,000	-722	$136,000
Alternative C – More Stringent	$13,464,000	-410	$78,000
Alternative D – Less Stringent	$4,237,000	-118	$22,000

[12] The current PAR 1100 provides an extension to the compliance schedule for the compressor gas lean-burn engines. The first compliance deadline is 2023 for retrofits, and facilities can get an extension through a compliance plan for two years from the issuance of a permit to construct. For example, if a facility owner or operator applies by 7/1/2021 and the permit to construct is issued one year later (typical time it takes for South Coast AQMD to process), the first compliance deadline could be 7/1/2024. Proposed rule provisions would allow an additional 2 year extension, so the compliance deadline can be up to 7/1/2026. For replacements, an application received by 7/1/2022 that receives a permit to construct by 7/1/2023, would have 36 months or until 7/1/2026. Another extension of 3 additional years may be requested, with a final compliance date of 7/1/2029.