SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Socioeconomic Report For Proposed Amendments to Regulation XX—Regional Clean Air Incentive Market (RECLAIM) NOx RECLAIM

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PREFACE

This document presents staff's draft analysis. Staff will still develop and refine the methodologies and results in response to public comments.

EXECUTIVE SUMMARY

A socioeconomic analysis has been conducted to assess the impacts of the proposed amendments to Regulation XX—RECLAIM. The same level of analysis has also been performed on the California Environmental Quality Act (CEQA) alternatives. A summary of the analysis and findings are presented below.

Key Elements of the Proposed Amendments	The proposed amendments would reduce 14 tons of NOx allocations per day by the year 2022, of which 4 tons per day (tpd) would occur in 2016, and the remaining 10 tpd would be distributed evenly over the period of 2018–2022 at the rate of 2 tpd per year. These reductions will help the region attain federal ozone and PM2.5 standards. Based on the Best Available Retrofit Technology (BARCT) analysis, a new level of BARCT is proposed for fluid catalytic cracking units, boilers/heaters >40 mmBtu/hr, gas turbines, coke calciners, and sulfur recovery and tail gas incinerators used in the refinery sector. For the non-refinery sector a new BARCT level is proposed for container glass melting furnaces, cement kilns, sodium silicate furnaces, metal melting furnaces >150 mmBtu/hr, gas turbines and ICEs not located on the outer continental shelf (OCS). To realize the emission reduction potential of the 2015 BARCT analysis and help the Basin achieve the PM2.5 standards by 2019 and 2024 and the ozone standard by 2024 and 2032, staff proposes reductions (or a "shave") of NOx RECLAIM Trading Credits (RTCs) by a total of 14 tpd to be implemented over a seven-year period from 2016 to 2022 and distributed as a 66% shave for 9 refineries and investors, a 47% shave for 30 power plants, a 47% shave for 26 non-major facilities, and no shave for the 210 remaining facilities. The proposed shave of 14 tpd by 2022 would result in 12.5 tpd of remaining RTCs (26.5 tpd – 14 tpd = 12.5 tpd). This amount is expected to sufficiently account for the needs of all RECLAIM facilities, including growth and a compliance margin.
Affected Facilities and Industries	The proposed amendments would only affect the current RTC holdings for 65 out of 275 RECLAIM facilities. The 65 affected facilities would include 9 major refineries, 30 power plants, and 26 other top emitting non-refinery facilities. The nine affected refineries belong to the sector of petroleum product manufacturing (NAICS

	324), the 30 power plants belong to sector of utility (NAICS 221), the remaining 26 facilities belong to the sectors of oil and gas extraction (NAICS 211), utility (NAICS 221), chemical manufacturing (NAICS 325), primary metal manufacturing (NAICS 331), non-metallic mineral manufacturing (NAICS 327), airport operation (NAICS 488), paper manufacturing (NAICS 322), and entertainment (NAICS 713).
Assumptions for the Analysis	The proposed BARCT implementation is assumed to apply to nine refineries and 11 non-refinery facilities. Nine refineries subject to the NOx RECLAIM rules are assumed to install NOx air pollution control equipment in response to the proposed rule amendment. These facilities currently have the following equipment/source categories: Fluid Catalytic Cracking Units (FCCUs), Sulfur Recovery Units/Tail Gas Incinerators (SRU/TGUs), coke calciners, refinery boilers and heaters, and refinery gas turbines. Under the proposed rule amendment, operators of these refineries are assumed to install Selective Catalytic Reduction (SCR) technology, UltraCat filtration units, and Low Temperature Oxidation (LoTOx^{TM}) with Wet Gas Scrubbers (WGS) to reduce NOx emissions. The 11 non-refinery facilities currently have the following equipment/source categories: container glass melting furnaces, glass melting furnace facilities, sodium silicate furnaces, metal heat treating furnaces (rated less than mmBtu/hour), stationary ICEs and non-power plant stationary gas turbines. Under the proposed rule amendment, operators of these facilities are assumed to install SCR technology or UltraCat filtration units to reduce NOx emissions. For the purpose of conducting a worst-case analysis, 34 SCR units and one UltraCat filtration unit are assumed to be installed at the 11 non-refinery affected facilities. It is possible that another UltraCat filtration unit may also be installed in lieu of one of the 34 SCR units. In total, the proposed rule amendment is assumed to result in the installation of the following new NOx air pollution control equipment: 117 SCRs, eight LoTOx^{TM} with WGSs, one LoTOx^{TM} without WGS, and three UltraCat Dry Gas Scrubbers. The annualization factor used for capital costs is based on a discount rate of one or four percent and a 25-year equipment life for SCRs and LoTOx^{TM} technology.
Cost Impacts	The annual compliance cost of implementing full BARCT installation is estimated to be $63 million when evaluated at a 4% discount rate, or $52 million when evaluated at a 1% discount rate between 2018 and 2035. The majority of the compliance cost ($42 to $52 million or 80 to 82 percent) is expected to occur in the refinery sector. The refinery sector FCCU units are estimated to have the highest average annual compliance cost of $22 million (42 percent) among all the

	refinery source categories. The present worth value of full BARCT installation is estimated to be $1.09 billion. The average annualized cost of non-refinery sector is estimated to be $11.5 million when evaluated at a 4% discount rate, or $10 million when evaluated at a 1% discount rate between 2018 and 2035. Among the non-refinery sectors, gas turbines have the highest annual compliance cost of $7.4 million (64%). Under the proposed shave, 15 out of 45 facilities subject to the shave but for which no BARCT has been identified would need to purchase 0.78 tpd of NOx RTCs from the market, up from 0.37 tpd that are currently needed. This cost would add to the total compliance cost for these amendments by up to nine percent (if RTC price rises to just below the ceiling of $15,000). Under the proposed rule amendments, the 210 facilities would not be shaved. If the price of NOx RTCs remains unchanged from the current market price, no additional compliance cost would be incurred. If, however, the RTC price increases after the proposed shave, then these facilities would have to pay additional costs. These potential compliance costs would add to the total annual compliance cost by up to 8 percent (if RTC price rises to just below the ceiling of $15,000).
Job Impacts	Job impacts are only associated with the cost of control installation. It is projected that the proposed amendments would result in net 13 jobs created annually on average (2018-2035), with the majority of jobs created at the beginning of the analysis period. In earlier years, the positive job impact from expenditures made by refineries, container glass, sodium silicate plants, and sulfur acid plants would more than offset the jobs forgone from the additional cost of doing business. The positive job impact would trickle down to the sectors of fabricated metal products (NAICS 332) and machinery manufacturing (NAICS 331) due to purchase of various types of control equipment (SCR, LoTOx™, Catalyst, etc.) by the affected facilities. Likewise, the sector of construction (NAICS 23) would gain jobs in the local economy due to installation of the control equipment. In addition, the sector of professional and technical services (NAICS 541) is projected to gain jobs in earlier years from additional demand for equipment installation and maintenance. Operating and maintenance expenditures will benefit the industries of chemical products (NAICS 325) for additional sales of ammonia and public utilities (NAICS 22) for electricity. Individual sectors may incur jobs forgone.

	The oil and gas extraction sector will incur 33 jobs forgone annually due to additional spending on SCRs required on gas turbines. Despite having a large share of the total compliance cost, the refinery industry is projected to have fewer (10 jobs) forgone relative to other industries with similar magnitude of cost impact due to the fact that the industry is the most capital-intensive. As such, less labor would be required to produce the same amount of products or services.
Health Benefits	The South Coast Air Basin is one of only two "extreme" non-attainment areas in the nation that have not reached the federal eight-hour ozone standards. The amount of pollutants produced by modern urban life and industrial activities, combined with Southern California's year-round sunny weather, all contribute to the high concentrations of ground-level ozone in the area. Ozone exposure can cause immediate, adverse effects on the respiratory system. Long-term impacts of frequent exposure to ozone may lead to permanent lung damage and increase the risk of premature death. In addition, the South Coast Air Basin remains a non-attainment area for the federal 24-hour and annual PM2.5 standards. Exposure to high levels of PM2.5 have been shown to cause and aggravate cardiopulmonary illnesses. NOx is a precursor of PM2.5. These outcomes result in increased absences from school and work, hospitalization, and other medical expenses. Exposure to PM 2.5 is associated with premature deaths. According to recent estimates by the California Air Resources Board, elevated ambient PM 2.5 levels result in approximately 4,100 premature deaths annually in the South Coast Air Basin.
Impact of CEQA Alternatives	Five alternatives to the proposed amendments were developed for the CEQA analysis associated with this proposal: Alternative 1 (Across the Board), Alternative 2 (Most Stringent), Alternative 3 (Industry Approach), Alternative 4 (No Project), and Alternative 5 (Weighted by BARCT Reduction Contribution for all Facilities and Investors). Following analysis, staff determined Alternatives 3 and 4 do not comply with state law. The proposed project has the highest cost but the second to highest positive job impact, due to increased labor demand for the full, instead of partial, installation of control equipment. Alternative 4 would maintain the status quo and serves as a benchmark against which other alternatives were evaluated. Of the four remaining alternatives, Alternative 3, which would not comply with state law, has the lowest cost ($8.20 million) because it is expected to induce the least number of control equipment to be installed; for the same reason, however, it would not create as many jobs and result in an average of 29 jobs

	foregone annually. Alternatives 1 and 2 would cost less than the proposed amendments, yet would experience much more negative job impact (66 and 80 annual jobs forgone, respectively). This is due to less control equipment installation spending in this sector relative to the 11 non-refinery facilities and would result in negative net job impacts.
Market Analysis	The proposed shave of 14 tpd of NOx RTCs for the top 65 emitters is expected to make RECLAIM more efficient in achieving clean air goals by incentivizing 20 facilities (9 refineries and 11 non-refineries) to upgrade to cleaner, cost-effective controls. In addition to the potential compliance cost of control equipment installation and operation for these 20 facilities discussed in the previous sections, the proposed amendments may potentially result in new or additional compliance costs for some of the 45 facilities where no BARCT was identified for installation and some of the 210 facilities that are not shaved but need to purchase RTCs for compliance purposes. New costs would be the result of additional units of RTCs needed to be bought from the market, as well as due to any potential increase in RTC price that would apply to both the additional and existing RTC purchases. A price analysis was conducted to estimate the potential impact of price increases on net buyers (those facilities with a negative emissions balance) using a sensitivity analysis where prices grew from 100 to 300 percent. Under the proposed shave, 15 out of 45 facilities are expected to need to purchase 0.78 tpd of NOx RTCs from the market, up from 0.37 tpd that are currently needed. If RTC price remains constant following the shave, the facilities would incur costs of a little over half a million dollars for the additional 0.41 tpd of NOx RTCs needed (0.78–0.37=0.41). If the price increases by 100 percent, 200 percent, or 300 percent, then these facilities would incur a higher cost of $1.6/$2.7/$3.8 million respectively, not only for the cost of additional RTCs needed due to the shave but also for the higher price of the 0.37 tpd already needed before the shave. Under the proposed rule amendments, 210 facilities would not be shaved. If the price of NOx RTCs remains unchanged from the current market price, no additional compliance cost would be incurred. If, however, the price increases by 100 percent, 200 percent, or 300 percent, then these facilities would have to pay an additional $1.7/$3.4/$5.1 million respectively in order to be compliant. The total compliance costs associated with RTC purchases over the course of 25 years would amount to $14 million to $219 million (expressed in 2014 dollars), depending on the price scenario.

INTRODUCTION

RECLAIM allows facilities to use the most cost-effective approach to meet their emissions limits while helping the region attain clean air goals. This is possible, because unlike command-and-control regulations where every source is controlled to the same emission standard, a RECLAIM facility with more emissions than its actual RTC holdings has the option to install pollution control equipment, change operations, or purchase additional RTCs to offset its total emissions. Facilities are expected to choose whichever option is more economical for their business.

The proposed project consists of applying a shave to the facilities and investors holding the top 90 percent of RTCs, as weighted by a Best Available Retrofit Control Technology (BARCT) reduction contribution to achieve an overall reduction of 14 tons of NOx per day by 2022 according to the following implementation schedule as summarized below:

Table 1: Implementation Schedule for NOx RTC Reductions

Implementation Year	Amount of NOx RTC Reductions (tons/day)
2016	4
2018	2
2019	2
2020	2
2021	2
2022	2
TOTAL	**14**

The proposed shave of 14 tpd of NOx RTCs for the top 65 emitters is expected to make RECLAIM more efficient in achieving clean air goals by incentivizing 20 facilities (9 refineries and 11 non-refineries) to upgrade to cleaner, cost-effective controls at the 2015 BARCT level. Note that, conceptually, the proposed shave would account for emission reductions of 8.79 tpd from installation of controls and remove the unused "excess" RTC holdings of 5.21tpd from the NOx RECLAIM universe.

At the beginning of the RECLAIM program in 1994, a total of 392 NOx facilities were allocated RTC holdings at no cost As a net outcome of facility shutdowns and new facilities joining the universe, there were 275 facilities in the NOx program 2013, with a total of 26.5 tpd RTC holdings. Over the past decade, however, actual emissions have consistently been less than total RTC holdings. Some of these unused "excess" credits can be attributed to facility shutdowns and the subsequent selling of credits. Regardless of why there are excess credits, their existence exerts downward pressure on the RTC market price and may have dis-incentivized RECLAIM facilities to install many of the already identified cost-effective control measures. For example, many facilities didn't

install control equipment that was identified in the 2005 NOx RECLAIM amendments. This outcome is not optimal for achieving clean air goals in the Basin.

These excess RTC holdings are estimated to be between 6-8 tpd[1]. In 2013, the amount of excess credits was 6.5 tpd. Removing at least a portion of these excess credits from the market would relieve the downward pressure on the RTC market price and would be more likely to make control equipment installation a more cost-effective option than purchasing RTCs, particularly for the 20 facilities with newly identified control equipment.

In accordance with the requirements of California Health and Safety Code (H&SC), SCAQMD staff recently conducted a BARCT reassessment of the NOx RECLAIM program to: 1) assess advancements in control technology; 2) to ensure that RECLAIM facilities achieve the same emissions reductions as the implementation of BARCT ; 3) to ensure that emission reductions from the NOx RECLAIM program contribute towards achieving the federal National Ambient Air Quality Standards (NAAQS); and, 4) to assure that the participating facilities will continue to achieve emission reductions as expeditiously as possible to carry out the commitments in the 2012 AQMP.

Based on the BARCT analysis[2], a new level of BARCT is proposed for fluid catalytic cracking units, boilers/heaters >40 mmBtu/hr, gas turbines, coke calciners, and sulfur recovery and tail gas incinerators used in the refinery sector. For the non-refinery sector (except power plants), a new BARCT level is proposed for container glass melting furnaces, cement kilns, sodium silicate furnaces, metal melting furnaces >150 mmBtu/hr, gas turbines and ICEs not located on the outer continental shelf (OCS).

To realize the emission reduction potential of 2015 BARCT and help the Basin achieve the PM2.5 standards by 2019 and 2024 and the ozone standards by 2024 and 2032, staff proposes reductions (or a "shave") of NOx RECLAIM Trading Credits (RTCs) by a total of 14 tpd to be implemented over a seven-year period from 2016 to 2022. This number includes shaving unused RTCs as well as assuming installation of BARCT. Currently, there are 275 RECLAIM facilities holding 26.5 tpd of NOx RTCs in total, among which the refinery sector holds 51% of the RTCs, power plants 21%, investors 4% and other RECLAIM facilities 24%. The proposed shave of 14 tpd would result in 12.5 tpd of remaining RTCs (26.5 tpd – 14 tpd = 12.5 tpd). This amount is expected to sufficiently account for:

[1] For example, RTC Holdings equaled 26.5 tpd for CY 2011 while emissions equaled about 20 tpd. This more than 6 tpd represents excess credits in the market not used by facilities in 2011.

[2] Except for power producing facilities, the proposed RTC shave reduction will be based on compliance year 2011 activity levels for all other affected facilities. The 2012 activity levels will be used for RTC reductions from power producing facilities because this activity level better represents this sector's energy consumption.

- The projected 2022 emissions by RECLAIM facilities at the proposed 2015 BARCT levels[3], which would be 10.18 tpd (2.71 tpd for the refinery sector plus 7.47 tpd for the non-refinery sector).
- A 10 percent compliance margin that has been added to the projected 2022 emissions
- An adjustment to account for other uncertainties (e.g. uncertainties in BARCT analysis, and emissions from shut down operations.)

Under the proposed amendments, the 14 tpd of NOx RTC reductions would be distributed as a 66% shave for 9 refineries and investors, a 47% shave for 30 power plants, a 47% shave for 26 non-major facilities, and no shave for the 210 remaining facilities. As a result, the shave would directly affect a total of 65 facilities plus investors that together hold 90 percent of the 26.5 tpd of the NOx RTCs. Other facilities that would not be shaved may also be indirectly impacted by the potential changes in RTC price due to the proposed NOx RTC reductions.

METHODOLOGY FOR SOCIOECONOMIC ASSESSMENT

For the purpose of the socioeconomic analysis of the proposed amendments and CEQA alternatives for the NOx RECLAIM program, staff has assumed three compliance costs categories: (1) costs of full control equipment implementation for nine refineries and 11 non-refineries that would be shaved, (2) costs for a fraction of the remaining 45 shaved facilities to purchase RTCs to remain in compliance, due to both additional credits potentially needed and any potential increase in RTC price, and (3) any potential increase in costs of purchasing RTCs for a fraction of the 210 exempt facilities that need to buy credits from the market to remain in compliance. The costs associated with control equipment implementation are described in the cost section and then used as inputs to simulate and assess the regional macroeconomic impact of the proposed amendments and CEQA alternatives. The costs resulting from the shave for a fraction of the 45 facilities and the 210 exempt facilities are discussed further in the Market Analysis section.

REGULATORY HISTORY

In 1993, the AQMD adopted an emissions trading program (RECLAIM) for stationary sources as a market incentive system to cost-effectively achieve emission reductions. RECLAIM establishes facility mass emission limits for NOx and SOx and allows sources the flexibility to achieve regional prescribed emission reduction targets through process changes, installation of control equipment, and emissions trading. H&SC §39616 (c)(1) and (c)(4) required that findings be made that a market-based incentive program would result in "equivalent or less cost" and "not result in greater loss of jobs or more significant shifts from higher to lower skilled jobs than" the counterpart command-and-control regulation, at the time of adoption and 5 years later.

[3] To account for projected industry growth, the growth factor assumptions are: 1) 1.0 for the refinery sector; 2) 0.89 for power plants; and 3) 1.1 -1.3 for the non-refinery sector.

A socioeconomic analysis of RECLAIM was conducted at the time of its adoption. The cost of RECLAIM was estimated to be $80.8 million annually, on average, compared with the $138.7 million cost of the corresponding command-and-control system (which included rules and control measures in the 1991 AQMP that were subsumed by RECLAIM). RECLAIM was predicted to result in an average of 866 jobs forgone annually, compared with 2,013 jobs forgone under the command-and-control system. Based on the five occupational categories from the lowest-paid to the highest-paid, RECLAIM was projected to result in increased employment opportunities for nearly every category relative to the command-and-control system.

Until the year 2000, prices of NOx RTCs were relatively stable between $1,500 and $3,000 an annual ton per day. In 2000, prices of NOx RTCs rose very quickly to over $45,000 a ton due to the increased demand for RTCs)from power plants in response to the deregulated electrical generation market and limited installation of air pollution controls. In order to address the issues in the RECLAIM market, the Board removed large power plants from the market in May 2001. These power plants were required to file compliance plans for the installation of BARCT and restrictions were placed on the use and trade of their NOx RTCs. Other amendments to RECLAIM in 2001 included filing of compliance plans and forecast reports by large (at least 50 tons of NOx emissions) and medium (between 25 and 50 tons of NOx emissions) non-power plant facilities and the access to RECLAIM AQIP, Mitigation Fee Program, and state Emission Credit Bank by designated facilities. At the time, the Board also adopted several mobile and area source emission reduction credit rules whose credits could be used by RECLAIM facilities to comply with their allocations.

The annualized cost for installing controls on power plants was projected to be $9 million. The annualized cost for the level 1 controls (known technologies at the time) on non-power plant facilities was estimated to be $26 million[4]. It was projected that 640 jobs would be forgone annually from the proposed controls, filing of compliance plans and forecast reports, the access to a reserve of NOx emission reductions, and the creation of mobile and area source credit rules.

In 2005, Regulation XX - RECLAIM was amended to achieve additional NOx reductions pursuant to the 2003 AQMP Control Measure #2003CMB-10. The proposed amendments also address requirements for demonstrating BARCT equivalency in accordance with California Health and Safety Code §40440. In addition, trading restrictions for power producing facilities were removed.

Legislative Mandates

The socioeconomic assessments at the SCAQMD have evolved over time to reflect the benefits and costs of regulations. The legal mandates directly related to the assessment of

[4] Specifically, Level 1 technologies included selective catalytic reduction (SCR) and low-NOx burner (LNB) controls on non-power plant turbines (SCR), internal combustion engines (SCR), boilers (LNB), heaters (ultra LNB), dryers (ultra LNB or LNB), ovens (LNB), furnaces (LNB or oxy-fuel), and afterburners (LNB).

the proposed rule include the SCAQMD Governing Board resolutions and various sections of H&SC.

SCAQMD Governing Board Resolutions

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

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

On October 14, 1994, the Board passed a resolution which directed staff to address whether the rules or amendments brought to the Board for adoption are in the order of cost effectiveness as defined in the AQMP. The intent was to bring forth those rules that are most cost-effective first.

Health & Safety Code Requirements

The state legislature adopted legislation that reinforces and expands the Governing Board resolutions for socioeconomic assessments. H&SC Sections 40440.8(a) and (b), which became effective on January 1, 1991, require that 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 economy of the district
- Range of probable costs, including those to industries
- Emission reduction potential
- Necessity of adopting, amending or repealing the rule in order to attain state and federal ambient air quality standards
- Availability and cost effectiveness of alternatives to the rule

Additionally, the SCAQMD is required to actively consider the socioeconomic impacts of regulations and make a good faith effort to minimize adverse socioeconomic impacts. H&SC Section 40728.5, which became effective on January 1, 1992, requires the SCAQMD to:

- Examine the type of industries affected, including small businesses; and
- Consider socioeconomic impacts in rule adoption

Finally, H&SC Section 40920.6, which became effective on January 1, 1996, requires that incremental cost effectiveness be performed for a proposed rule or amendment that imposes BARCT or “all feasible measures” requirements relating to ozone, carbon monoxide (CO), oxides of sulfur (SOx), oxides of nitrogen (NOx), and their precursors.

Furthermore, H&SC §39616 (c)(1) and (c)(4) require that at adoption a market-based incentive program result in equivalent or less cost and not result in greater job losses or more significant shifts from high- to low-skilled jobs as compared with command-and-control measures. This finding was made in 1993 when RECLAIM was adopted and in 2000 when the findings were ratified.

Finally, H&SC §40440.5 requires that social, economic, and public health analyses of proposed rules be available to the public by at least 30 days prior to the hearing.

SHORT-TERM ECONOMIC OUTLOOK

According to the Wells Fargo Economic Forecast June 03, 2015, "California's economy should continue to outperform the national average over the next couple of years, led by continued gains in the state's technology sector and stronger growth in residential and commercial construction." Despite of whole host of challenges ranging from the drought to labor strikes at its major ports, California's economy has maintained strong momentum through the first part of 2015.

According to the 2015-2016 Economic Forecast and Industry Outlook from Los Angeles Economic Development Corporation (LAEDC), Southern California will continue employment gains and experience a decline in local unemployment rates. The Southern California leading industries are:

- Healthcare and Social Assistance
- Construction
- Professional, Scientific and Technical Services
- Administrative Support
- Waste Services

The lagging industries are other services, nondurable goods manufacturing, and financial activities.

The four-county's economy is composed of a large non-manufacturing sector and a much smaller manufacturing sector. The service sector and the retail and wholesale trade sector combined constituted over 52 percent of the region's employment in 2014 Regional Economic Model (REMI, 2014). Most of the affected RECLAIM facilities belong to manufacturing and utility sectors. For these sectors, the 2015 California State University Fullerton (CSUF) projected steady and positive employment growth in 2015 and 2016 for the counties of Orange, and Riverside and San Bernardino. Table 2 presents the projected annual percentage **e**mployment growth by sector for 2015 and 2016.

Table 2: Annual Percentage Employment Growth by Sector

Sector	Los Angeles			Orange			Riverside & San Bernardino			Southern California		
	2014	2015f	2016f	2014	2015f	2016f	2014	2015f	2016f	2014	2015f	2016f
Mining and logging	3.4%	-1.4%	-0.4%	1.1%	3.2%	2.8%	0.9%	6.0%	3.0%	7.0%	1.1%	-0.6%
Construction	10.5%	7.7%	5.7%	9.6%	6.4%	9.1%	5.3%	0.5%	4.6%	8.6%	5.6%	6.6%
Total Manufacturing	-4.1%	1.1%	-1.0%	-0.3%	2.1%	2.1%	1.6%	10.8%	6.7%	-2.2%	2.9%	1.0%
Durable Manufacturing	-2.1%	5.2%	-0.7%	0.9%	2.6%	2.3%	2.3%	13.8%	8.3%	-0.5%	5.8%	1.7%
Nondurable Manufacturing	-6.6%	-4.3%	-1.6%	-3.5%	0.9%	1.5%	0.4%	4.9%	3.3%	-4.8%	-1.9%	-0.2%
Transportation, Commun. & Utilities	2.2%	4.0%	3.3%	1.0%	1.4%	1.3%	3.8%	4.0%	4.6%	2.3%	3.5%	3.2%
Transportation, Warehousing & Utilit.	0.2%	4.3%	3.6%	1.2%	2.6%	2.9%	3.4%	3.9%	5.3%	1.0%	3.9%	3.9%
Wholesale Trade	3.3%	4.5%	2.7%	1.0%	0.7%	0.3%	3.6%	3.3%	3.3%	2.9%	3.4%	2.3%
Retail Trade	0.7%	4.3%	2.4%	-2.9%	-0.7%	-0.5%	2.2%	2.2%	-2.7%	-0.4%	2.2%	0.6%
Finance, Activities	2.7%	2.2%	2.5%	1.9%	1.9%	2.0%	3.7%	3.9%	4.5%	2.7%	2.4%	2.7%
Services	0.4%	1.8%	0.9%	1.2%	0.2%	0.3%	1.9%	1.8%	2.1%	0.8%	1.4%	1.1%
Total Government	2.3%	2.3%	2.3%	2.0%	2.2%	2.4%	3.7%	4.2%	4.7%	2.5%	2.6%	2.7%
Total Employment	3.4%	-1.4%	-0.4%	1.1%	3.2%	2.8%	0.9%	6.0%	3.0%	7.0%	1.1%	-0.6%

Note: "F" means forecast. Source: California State University, Fullerton.

In addition, the CSUF forecast projects lower unemployment rates in 2015 and 2016 for all the four counties and, Southern California as a whole. Table 3 presents the annual percentage change in unemployment. (CSUF 2015 Economic Forecast).

Table 3: Annual Percentage Unemployment Rate Outlook

	2012	2013	2014	2015F	2016F
Southern California	10.2%	8.6%	7.4%	6.9%	6.5%
Los Angeles	10.9%	9.9%	8.7%	7.6%	7.0%
Orange County	7.6%	6.2%	5.3%	4.8%	4.5%
Riverside & San Bernardino	12.0%	10.2%	8.8%	8.4%	8.3%

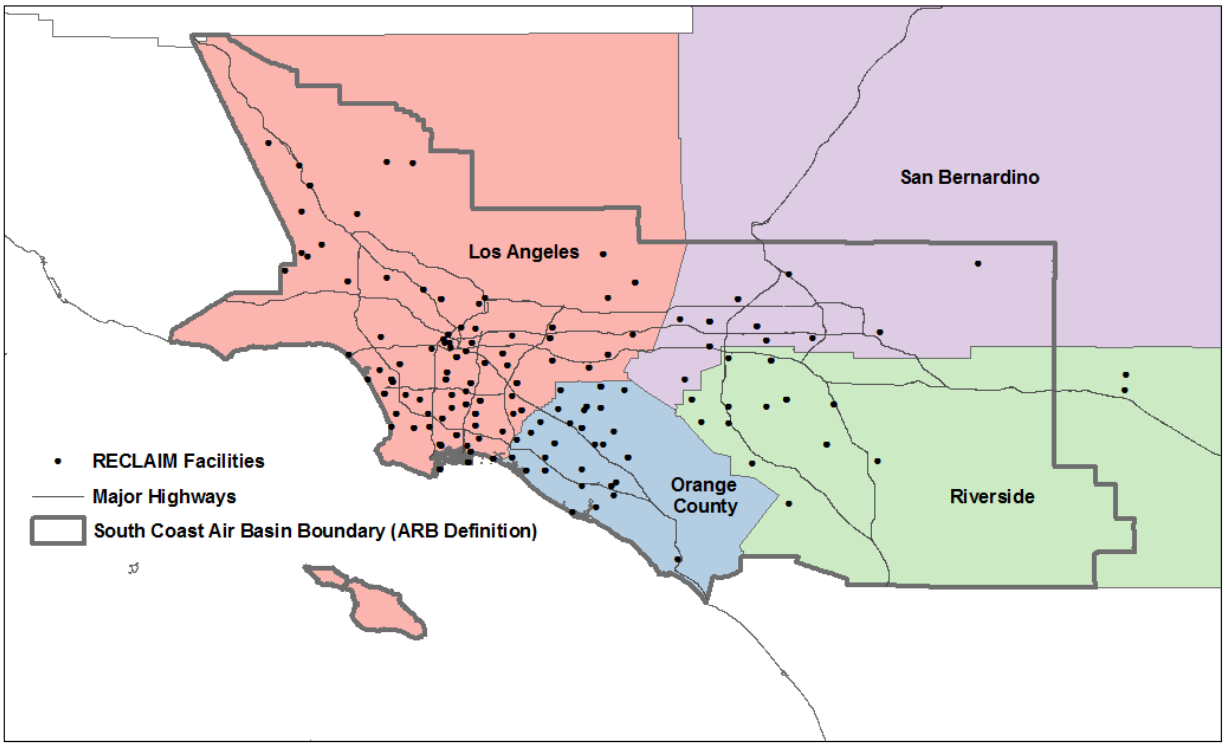
*CSUF 2015 Economic Forecast.

AFFECTED FACILITIES

The RECLAIM universe of facilities evolves constantly due to shutdowns and the entry of new facilities. The RECLAIM program started with 392 NOx facilities in 1994 when RECLAIM went into effect. By the end of compliance year 2013, there were about 275 facilities in the NOx RECLAIM universe. Most of the RECLAIM facilities are relatively large emitting businesses (greater than 4 tons of NOx) with respect to their cohort in the same industry. These facilities are spread across all industries in the four-county economy. Of the 275 facilities, 66 percent were in Los Angeles County, 18 percent in

Orange County, and 8 percent in both Riverside and San Bernardino Counties. Figure 1 shows the location of these facilities within the SCAQMD jurisdiction[5].

Figure 1: Location of RECLAIM Facilities as of 2013



For the 275 facilities that are in the NOx RECLAIM program, the 14 tpd of NOx RTC reductions will only directly affect 65 facilities plus the investors that currently hold 90 percent of the NOx RTC holdings. Out of the 65 facilities, 68 percent were in Los Aneles County, 6 percent in Orange County, 12 percent in Riverside County, and 14 percent in San Bernardino County.

They include 9 major refineries, 30 power plants, and 26 other top-emitting non-refinery facilities. The nine affected refineries belong to the sector of petroleum product manufacturing (NAICS 324), the 30 power plants belong to sector of utility (NAICS 221), the remaining 26 facilities belong to the sectors of oil and gas extraction (NAICS 211), utility (NAICS 221), chemical manufacturing (NAICS 325), primary metal

[5] While two facilities located in Desert Hot Springs fall outside the South Coast Air Basin Boundary as defined by the California Air Resources Board, Desert Hot Springs falls within the SCAQMD's jurisdiction for Riverside County. For more information see: http://www.aqmd.gov/home/about/jurisdiction

manufacturing (NAICS 331), non-metallic mineral manufacturing (NAICS 327), airport operation (NAICS 488), paper manufacturing (NAICS 322), and entertainment (NAICS 713).

For the remaining 210 facilities that held 10 percent of the 26.5 tpd of the NOx RTCs in 2011, no NOx RTC shave is proposed.

Small Businesses

The SCAQMD defines a "small business" in Rule 102 for purposes of fees as one which employs 10 or fewer persons and which earns less than $500,000 in gross annual receipts. The SCAQMD also defines “small business” for the purpose of qualifying for access to services from the SCAQMD’s Small Business Assistance Office (SBAO) as a business with an annual receipt of $5 million or less, or with 100 or fewer employees. In addition to the SCAQMD's definition of a small business, the federal Small Business Administration (SBA) and the federal Clean Air Act Amendments (CAAA) of 1990 also provide definitions of a small business.

The CAAA classifies a business as a "small business stationary source" if it: (1) employs 100 or fewer employees, (2) does not emit more than 10 tons per year of either VOC or NOx, and (3) is a small business as defined by SBA.The SBA definitions of small businesses vary by six-digit NAICS codes. In general terms, a small business must have no more than 500 employees for most manufacturing and mining industries, and no more than $7 million in average annual receipts for most nonmanufacturing industries[6]. For instance, the sector of petroleum refineries (NAICS 324110) has 1,500 employees as the threshold below which a business is considered small. The sector of utilities (NAICS 221111) has 500 to 1,000 employees as a threshold and non-metallic mineral products (NAICS 327213) which includes glass plants, has fewer than 750 employees as a threshold below which a business is considered small

The 2015 Dun and Bradstreet data includes employment or gross revenue information for about half of the 275 facilities in the RECLAIM universe. According to the SCAQMD (Rule 102) definition of a small business, 11 facilities would be classified as small businesses. Under the CAAA definition, 26 facilities are considered small businesses. Based on SBA’s definition of a small business, 85 facilities would be small businesses[7]. For the 65 facilities affected by the shave and for which Dun and Bradstreet data is available, none are considered small businesses under either the SCAQMD or CAAA definitions. Twenty-two are considered small businesses under the SBA definition[8].

[6] See the SBA website (http://www.sba.gov/community/blogs/community-blogs/small-business-matters/what-small-business-what-you-need-know-and-wh).The latest SBA definition of small businesses by industry can be found at http://www.sba.gov/content/table-small-business-size-standards.

[7] In order to reconcile discrepancies in Dunn & Bradstreet employment figures, estimates were acquired from SCAQMD Engineering & Compliance (RECLAIM Audit) permit data where applicable.

Compliance Cost of BARCT Installation

Based on the BARCT analysis detailed in the staff report, the total compliance cost of for BARCT installation would be incurred by the nine refineries and 11 non-refineries that have sources/equipment that can be upgraded to the 2015 BARCT level. Table 4 presents the estimated number of upgradable control devices at the 20 facilities per equipment/source category. As will be discussed later, full implementation of BARCT as required by state law requires an additional shave of RTC holdings.

For the nine refineries to remain in compliance under the proposed amendments, they would have the flexibility of changing operations, holding sufficient RTCs, or installing Selective Catalytic Reduction (SCR) technology, UltraCat filtration units, and Low Temperature Oxidation (LoTOx^{TM}) with Wet Gas Scrubbers (WGS) to reduce NOx emissions coming from Fluid Catalytic Cracking Units (FCCUs), Sulfur Recovery Units/Tail Gas Incinerators (SRU/TGUs), coke calciner, refinery boilers and heaters, and refinery gas turbines.

The 11 non-refinery facilities have currently the following equipment/source categories: container glass melting furnaces, glass melting furnace facilities, sodium silicate furnaces, metal heat treating furnaces (rated greater than 150 mmBtu/hour), stationary ICEs and non-power plant stationary gas turbines. For them to remain in compliance under the proposed amendments, operators of these facilities would have the flexibility of changing operations, holding sufficient RTCs, or installing SCR technology or UltraCat filtration units to reduce NOx emissions. For the purpose of conducting a worst-case analysis, 34 SCR units and one UltraCat filtration unit are assumed to be installed at the 11 non-refinery affected facilities. It is possible that another UltraCat filtration unit may also be installed in lieu of one of the 34 SCR units.

In total, the proposed project is expected to result in the installation of the following new NOx air pollution control equipment: 117 SCRs, 8 LoTOx^{TM} with WGSs, one LoTOx^{TM} without WGS, and three UltraCat DGSs.

Table 4: Estimated Number of NOx Control Devices per Sector and Equipment/Source Category

Sector	Equipment/Source Category	Number of Affected Facilities	Estimated Number of Control Devices
Refinery	Fluid Catalytic Cracking Units (FCCUs)	5	3 SCRs 2 LoTOx™ with WGSs 1 LoTOx™ without WGS
Refinery	Refinery Process Heaters and Boilers	8	74 SCRs
Refinery	Refinery Gas Turbines	5	7 SCRs + Add Catalysts to 4 SCRs
Refinery	Sulfur Recovery Unit / Tail Gas Units (SRU/TGUs)	4	5 LoTOx™ with WGSs and 1 SCR**
Refinery	Petroleum Coke Calciner	1	1 UltraCat DGS or LoTOx ***
Non-Refinery	Container Glass Melting Furnaces	1	2 SCR or 1 UltraCat DGS
Non-Refinery	Sodium Silicate Furnaces	1	1 SCR or 1 UltraCat DGS
Non-Refinery	Metal Heat Treating Furnaces	1	1 SCR
Non-Refinery	Internal Combustion Engines (Non-Refinery/Non-Power Plant)	3	16 SCRs
Non-Refinery	Turbines (Non-Refinery/Non-Power Plant)	7	13 SCRs and 1 SCR replacement
		TOTAL	**117 SCRs** **8 LoTOx™ with WGSs** **1 LoTOx™ without WGS** **3 UltraCat DGSs**

* While the total number of affected facilities for the refinery sector is nine, there is an overlap for all of the equipment/source categories except the petroleum coke calciner.

** Even though both SCRs and LoTOx/scrubber are feasible technologies, LoTOx with WGS is considered in the socioeconomic report because they have higher costs for SRU/TGUs

*** Even though both UltraCat DGS and LoTOx with WGS are feasible technologies, UltraCat DGS is analyzed in the socioeconomic report because it has higher costs for petroleum coke calciner

Under the assumption that all BARCT control devices listed above would be installed, an assumed implementation schedule was developed based on the required construction time (Table 5) and cost-effectiveness of control equipment (Table 6), which would ensure the achievement of projected emission reductions in 2018 and 2022. To the extent possible, it was assumed that the most cost-effective NOx control equipment would be installed or modified first taking into account unit turnaround schedule information available to staff at this time. Table 7 summarizes the assumed implementation schedule.

Table 5: Construction Time by Source Category and Control Equipment

Non-Refinery		
Source Category	**Control Equipment**	**Required Time**
Sodium Silicate Furnace	SCR	2 years
ICE Engines	SCR	2 years
Container Glass Furnace	SCR/Ultracat	2 years
Gas Turbines	SCR	2 years
Metal Heat Treating Furnace >150mmBtu/hr	SCR	2 years
Refinery		
Source Category	**Control Equipment**	**Required Time**
Refinery FCCU	SCR/ LoTOx™	3 Years
Coke Calciner	LoTOx™ /Ultracat	3 Years
Boilers/Heaters	SCR	3 Years
Gas Turbines	SCR	2-3 years
SRU/TGs	SCR/ LoTOx™	3 Years

The cost estimates in this analysis are based on the estimates provided by either the consultants or staff for each affected facility, combined with the assumptions applied in the previous CEQA documents which analyzed similar equipment in both the 2005 amendments to NOx RECLAIM and the 2010 amendments to SOx RECLAIM. Further, if a particular technology was identified as having a cost that exceeds $50,000 per ton for a particular facility, staff assumed that facility would not install air pollution controls in response to this project. This is consistent with past practice for proposed RECLAIM amendments.

Table 6: Distribution of Control Equipment by Equipment Category and by Cost-Effectiveness (2018-2022)

Equipment Category	Average DCF $/ton	Average LCF $/ton
Refinery Gas Turbine	$1,900	$3,300
Metal Heat Treating Furnace >150mmBtu/hr	$3,400	$5,500
Sodium Silicate Furnace	$4,800	$7,600
Glass Melting Furnace	$4,900	$7,600
Non-Refinery ICE Engine	$6,000	$9,600
Cement	$8,200	$13,100
Refinery FCCU	$10,500	$18,000
Non-Refinery Gas Turbine	$20,300	$32,500

Coke Calciner	$23,000	$38,000
Refinery Boiler/Heater	$28,000	$45,000
SRU/TG	$34,000	$56,000
Average	**$13,200**	**$21,500**

*DCF stands for Discounted Cash Flow and LCF stands for Levelized Cash Flow

Table 7: Distribution of Control Equipment Categories by Installation Schedules

	2016		2018		2019		2020		2021		2022		Total Equip	Total tpd emi reductions
Categories	**# of Equip**	**tpd emi red**	**# of Equip**	**tpd emi red**	**# of Equip**	**tpd emi red**	**# of Equip**	**tpd emi red**	**# of Equip**	**tpd emi red**	**# of Equip**	**tpd emi red**		
Refinery Sector														
Ref Gas Turbines	0	0.04	add cat	2.4	1 SCR	0.13	1 SCR	0.21	3 SCR	0.96	2 SCR	0.39	7 SCR	4.14
FCCUs					1 SCR	0.07	1 SCR	0.06	1 LoTOxTM	0.06	1 LoTOxTM	0.15	2 SCR 3 LoTOxTM	0.43
					1 LoTOxTM	0.09								
Coke Calciners					1 LoTOxTM Ultracat	0.17							LoTOxTM Ultracat	0.17
Boilers/Heaters							7 SCR	0.10	9 SCR	0.10	9 SCR	0.08	74 SCR	0.96
							14 SCR	0.17	14 SCR	0.14	2 SCR	0.01		
							13 SCR	0.24	6 SCR	0.13				
SRU/TGs							1 LoTOxTM	0.06	1 LoTOxTM	0.06	1 LoTOxTM	0.05	5 LoTOxTM 1 SCR	0.32
									2 LoTOxTM & 1 SCR	0.15				
SubTotal		**0.04**		**2.40**		0.46		0.84		1.60		0.68		6.02
Non-Refinery Sector														
Sodium Silicate Furnace			1 SCR or Ultracat	0.09									1 SCR or Ultracat	0.09
ICE					16 SCR	0.84							16 SCR	0.84
Container Glass Furnace					1 SCR or 2 Ultracat	0.24							1 SCR or 2 Ultracat	0.24
Gas Turbines							14 SCR	1.04					14 SCR	1.04
Metal H. Furnace >150mmBtu/hr					1 SCR	0.56								0.56
SubTotal				**0.09**		**1.64**		**1.04**						**2.77**
Total Emission Red.		**0.04**		**2.49**		**2.10**		**1.88**		**1.60**		**0.68**		**8.79**
Proposed RTC Red.		**4**		**2**		**2**		**2**		**2**		**2**		**14**

Table 8 presents the total average annual compliance cost of the proposed amendments by source/equipment category. The detailed cost assumptions will be discussed in the following subsections. Only estimates using a four percent discount rate will be reported in those subsections.

Table 8: Average Annual Cost Estimates by Equipment Category (Millions of 2014 dollars)

	2018		2019		2022		2035		Average Annual (2018-2035)	
	Discount Rate Applied									
	4%	1%	4%	1%	4%	1%	4%	1%	4%	1%
Source Category Refinery										
Refinery FCCU	0.00	0.00	9.40	7.79	25.24	20.95	25.24	20.95	21.86	18.11
Coke Calciner	0.00	0.00	5.83	4.89	5.83	4.89	5.83	4.89	5.51	4.62
Boilers/Heaters	0.00	0.00	0.00	0.00	17.58	13.12	17.58	13.12	15.12	11.29
Gas Turbines	0.30	0.29	0.76	0.73	3.08	2.95	3.08	2.95	2.70	2.58
SRU/TGs	0.00	0.00	0.00	0.00	7.97	5.84	7.97	5.84	6.50	4.72
Total Refinery	**0.30**	**0.29**	**16.00**	**13.41**	**59.73**	**47.77**	**59.73**	**47.77**	**51.85**	**41.48**
Source Category Non-Refinery										
Sodium Silicate Furnace	0.29	0.25	0.29	0.25	0.29	0.25	0.29	0.25	0.29	0.25
ICE Engines	0.00	0.00	2.38	1.98	2.38	1.98	2.38	1.98	2.25	1.87
Container Glass Furnace	0.00	0.00	1.03	0.82	1.03	0.82	1.03	0.82	0.97	0.78
Gas Turbines	0.00	0.00	0.00	0.00	8.34	7.63	8.34	7.63	7.41	6.78
Metal Heat Furnace >150 mmBtu/hr	0.00	0.00	0.62	0.56	0.62	0.56	0.62	0.56	0.59	0.53
Total Non-Refinery	**0.29**	**0.26**	**4.32**	**3.63**	**12.66**	**11.26**	**12.66**	**11.26**	**11.50**	**10.22**
Grand Total	**0.590**	**0.550**	**20.32**	**17.04**	**72.39**	**59.03**	**72.39**	**59.03**	**63.36**	**51.70**

As shown in Table 8, more expensive controls would not be installed until the 2019-2022 timeframe. Based on this schedule and facility-specific estimates, the average annualized cost of the proposed amendments is estimated to be $63.4 million (at 4 percent discount rate) and $52 million (at 1 percent discount rate) between 2018 and

2035, respectively[9]. The majority of the compliance cost ($41 to $52 million or 80 to 82 percent) is expected to occur in the refinery sector. The refinery sector FCCU units are estimated to have the highest average annual compliance cost of $18 to $22 million (or 44 to 42 percent) among all the refineries source categories. The average annualized cost for the non-refinery sector is estimated to be $10.2 to $11.5 million between 2018 and 2035. Among the non-refinery sectors, gas turbines have the highest annual compliance cost of $7.4 million (64%).

Table 9 presents the annual compliance cost of full BARCT implementation by industry. Refineries (NAICS 324) would incur the majority of the compliance costs. Among the non-refinery sectors, glass melting furnaces, sodium silicate furnaces and metal heat treating furnaces belong to nonmetallic mineral product manufacturing (NAICS 327), chemical manufacturing (NAICS 325), and primary metal manufacturing (NAICS 311) sectors. Gas turbines were used in airport operations (NAICS 488), oil and gas extraction (NAICS 211), and paper manufacturing (NAICS 322) sectors. Internal Combustion Engines (ICE) engines were used in the utility sector (NAICS 221).

Table 9: Average Annual Cost Estimates by Industry (Millions of 2014 dollars)

Industry (NAICS)	2018		2019		2022		2035		Average Annual (2018-2035)	
	Discount Rate Applied									
	4%	1%	4%	1%	4%	1%	4%	1%	4%	1%
Refineries (324)	0.30	0.29	16.00	13.41	59.73	47.77	59.73	47.77	51.85	41.48
Utility (221)	0.00	0.00	2.38	1.98	6.28	5.57	6.28	5.57	5.72	5.00
Air Port Operation (488)	0.00	0.00	0.36	0.30	0.36	0.30	0.36	0.30	0.32	0.27
Paper Manufacturing (322)	0.00	0.00	0.00	0.00	0.73	0.68	0.73	0.68	0.65	0.60
Oil and Gas Extraction (211)	0.00	0.00	0.00	0.00	3.34	3.05	3.34	3.05	2.97	2.71
Nonmetallic Mineral Product Mfg. (327)	0.00	0.00	1.03	0.82	1.03	0.82	1.03	0.82	0.97	0.78
Chemical Manufacturing (325)	0.30	0.26	0.30	0.26	0.30	0.26	0.30	0.26	0.30	0.26
Primary Metal Manufacturing (311)	0.00	0.00	0.62	0.57	0.62	0.57	0.62	0.57	0.59	0.54
Grand Total	**0.59**	**0.55**	**20.32**	**17.04**	**72.39**	**59.03**	**72.39**	**59.03**	**63.36**	**51.70**

[9] In 1987, SCAQMD staff began to calculate cost-effectiveness of control measures and rules using the Discounted Cash Flow method with a discount rate of 4%. Although not formally documented, the discount rate is based on the 1987 real interest rate on 10-year Treasury Notes and Bonds, which was 3.8%. The maturity of 10 years was chosen because a typical control equipment life is 10 years; however, a longer equipment life would not have corresponded to a much higher rate-- the 1987 real interest rate on 30-year Treasury Notes and Bonds was 4.4%. Since 1987, the 4% discount rate has been used by SCAQMD staff for all cost-effectiveness calculations, including in BACT analysis, for the purpose of consistency. The compliance cost reported in this assessment was thus annualized using a real interest rate of 4%. As a sensitivity test, a real interest rate of 1% was also used, which is closer to the prevailing real interest rate (see https://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/).

BARCT Cost Estimates for Refinery Sector

There are nine refinery facilities subject to the NOx RECLAIM rules whose operators may choose to install NOx air pollution control equipment in response to the proposed RTC shave. These facilities include the six refineries owned by five companies operating FCCUs, refinery boilers and heaters, refinery gas turbines, and SRU/TGUs:

As discussed previously, the nine refineries may choose among changing operations, obtaining sufficient RTC holdings, and installing NOx control devices, presumably based on which option would be more economical. The analysis herein assumes that the nine refineries would install BARCT controls under the proposed amendments, a scenario representing the maximum potential cost.

As a conservative approach to cost estimation, the most stringent controls with the high-end cost (worst case scenarios) are assumed for the proposed amendments as well as for CEQA alternatives. In total, 84 SCR units, six LoTOx™ with WGSs, one LoTOx™ without WGS, and one UltraCat DGS are assumed to be installed at the nine refinery sector facilities. In order to operate SCR and UltraCat technology, ammonia is necessary and, as such, tanks to store ammonia would also need to be installed. The size of each ammonia tank needed to operate the SCR units and one UltraCat filtration unit have been estimated to range between 2,000 and 11,000 gallons in capacity. For a full description of the control technologies, please see the CEQA NOx Control Technologies section.

Refinery FCCUs

The purpose of an FCCU at a refinery is to convert or "crack" heavy oils (hydrocarbons), with the assistance of a catalyst, into gasoline and lighter petroleum products. Each FCCU consists of three main components: a reaction chamber, a catalyst regenerator and a fractionator. There are five refineries that operate six FCCUs in the SCAQMD: Chevron, ExxonMobil, Tesoro (Carson and Wilmington), Phillips66, and Valero. The FCCUs are classified as major sources of emissions in RECLAIM, and as such, the NOx emissions from FCCUs are required to be monitored with a continuous emission monitoring system (CEMS), and reported on a daily basis electronically to the SCAQMD.

To further reduce NOx emissions from a FCCU (beyond what is currently being achieved through the use of NOx reducing additives), the potential available control technologies are either: 1) SCR; or, 2) LoTOx™ with WGS.

Two out of the five affected refineries are assumed to install SCRs and the remaining three are assumed to install LoTOx™ with WGS. The total compliance cost of the proposed amendments for refinery FCCUs includes one-time cost and recurring cost. The one-time cost includes the capital cost of SCRs and LoTOx™/WGS and their installations (demolition, concrete, structural, piping, electrical, contractors, contingencies). Total installed cost is assumed to be 4 (or 4.5) times equipment cost. The analysis herein does not include the equipment salvage values mainly due to the fact that

these values will not be realized until after the end of the useful life of the equipment (25 years), which is outside of the model simulation period.

The capital cost and installation of the two SCRs are estimated at $30 and $48.3 million, respectively. Based on the vendor–supplied costs, the capital cost and installation of the three LoTOx^{TM}/WGS are estimated at $33.47, $54.89, and $60.62 million, respectively. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance for the refinery FCCUs would sum up to $14.53 million.

The annual operating costs for the two SCR units include utilities (electricity), ammonia, catalyst replacement (every five years), and other periodic maintenance. The annual operating cost for each SCR unit is estimated at $0.12 and $0.19 million, respectively. The catalyst replacement costs for each SCR unit is estimated at $1.5 million and $2.40 million, respectively. Staff used data provided in the 2005 SOx RECLAIM amendment for the annual costs associated with the WGS and manufacturer's data for the annual costs associated with the LoTOx^{TM}/WGS portion of the system. The annual operating costs for the three LoTOx^{TM}/WGS units include utilities (electricity), ammonia, waste water, and other periodic maintenance. The annual operating cost for each LoTOx^{TM}/WGS unit is estimated at $2.4 and $3.5, and $3.88 million, respectively. The total annual operating and maintenance costs for the two SCRs and three LoTOx^{TM}/WGS units would sum up to about $10.70 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the FCCU units would amount to $25.2 million using a 4-percent discount rate. Table 10 presents these results.

Table 10: Total Capital, Installation, and Annual Operating Cost of SCRs/LoTOx for Refineries FCCUs (Millions of 2014 dollars)

Refinery	Equipment Cost	Installation Cost	Total O&M Cost	Electricity	Ammonia	Catalyst*
5	$7.5	$22.5	$0.12	$0.036	$0.084	$1.5
6	$12.0	$36.0	$0.192	$0.058	$0.134	$2.4
7	$9.6	$23.9	$2.14	$0.64	$1.49	0.0
4	$15.6	$39.0	$3.51	$1.05	$2.45	0.0
9	$17.3	$43.3	$3.88	$1.16	$2.7	0.0
Total	**$62.00**	**$164.70**	**$9.84**	**$2.94**	**$6.86**	**$3.90**

*Total value every five years

Refinery Process Heaters and Boilers

Refinery process heaters and boilers are used extensively throughout various processes in refinery operations such as distillation, hydrotreating, fluid catalytic cracking, alkylation, reforming, and delayed coking. There are 23 boilers and 189 heaters in the refineries classified as major or large NOx sources. The refinery heaters and boilers primarily burn refinery gas which is generated at the refinery. Most of these boilers and heaters use natural gas as back-up or supplemental fuel.

For the purpose of the analysis, controlling NOx emissions from refinery boilers and process heaters was assumed to be accomplished with SCR technology. It was assumed that eight refineries would install 74 SCR units. Total installed cost is assumed to be 4 (or 4.5) times equipment cost. Based on the vendor–supplied costs, the total capital, installation, and operating costs of each SCR is presented in the table below. It should be noted that the annual operating costs were distributed among electricity, ammonia, annual catalyst replacement, and other annual maintenance.

Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of 74 SCR installations for the refinery boilers and heaters is estimated at $15.36 million. The total annual operating and maintenance costs for the 74 SCR units are estimated at $2.4 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the boilers and heaters would amount to $17.8 million using a 4-percent discount rate. Table 11 presents the detailed costs per refinery.

Table 11: Total Capital, Installation, and Annual Operating Cost of SCRs for Refineries Process Heaters and Boilers (Millions of 2014 dollars)

Refinery	Equipment Cost	Installation Cost	Total O&M Cost	Electricity	Ammonia	Catalyst	Other Maintenances
1	$7.36	$25.80	$0.34	$0.10	$0.13	$0.07	$0.03
3	$0.44	$1.54	$0.02	$0.01	$0.01	$0.00	$0.00
4	$4.51	$15.79	$0.21	$0.06	$0.08	$0.04	$0.02
5	$11.98	$41.98	$0.55	$0.16	$0.22	$0.11	$0.06
6	$11.32	$39.67	$0.52	$0.16	$0.21	$0.10	$0.05
7	$7.80	$27.34	$0.36	$0.11	$0.14	$0.07	$0.04
8	$3.85	$13.48	$0.18	$0.05	$0.07	$0.04	$0.02
9	$5.93	$20.80	$0.27	$0.08	$0.11	$0.05	$0.03
Total	**$53.19**	**$186.4**	**$2.45**	**$0.729**	**$0.968**	**$0.484**	**$0.245**

Refinery Gas Turbines

Gas turbines are used in refineries to produce both electricity and steam. Refinery gas turbines are typically combined cycle units that use two work cycles from the same shaft operation. There are a total of 21 gas turbines/duct burners classified as major NOx sources at the refineries in the SCAQMD. Collectively, the 21 gas turbines/duct burners emitted about 1.33 tons per day of NOx in 2011.

For the purpose of the analysis, controlling NOx emissions from refinery gas turbines was assumed to be accomplished with SCR technology. A total of five refineries are affected in this category. Refinery one is assumed to add catalyst to existing SCRs and the remaining four refineries are assumed to install SCRs: Refinery 4 (2 SCRs), Refinery 3 (3 SCRs), Refinery 6 and 7 each to install one SCR.

Based on the vendor–supplied costs, the total capital, installation, and operating costs of each SCR is presented in the table below. It should be noted that the annual operating costs were distributed among electricity, ammonia, annual catalyst replacement, and other annual maintenance. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of the SCRs installations for the refinery gas turbines is estimated at $3.15 million. The total annual operating and maintenance costs of SCR units are estimated at $2.65 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the gas turbines would amount to $3.15 million using a 4-percent discount rate. Table 12 presents the detailed costs per refinery. Staff recently realized that these costs do not match those in the Staff Report. These costs will be edited in the final version of this document to reflect those in the Staff Report. This discrepancy is not expected to change overall results.

Table 12: Total Capital, Installation, and Annual Operating Cost of SCRs for Refineries Gas Turbines (Millions of 2014 dollars)

Refinery	Equipment Cost	Installation Cost	Total O&M Cost	Electricity	Ammonia	Catalyst	Other Maintenances
1	$0.19	$0.58	$0.26	$0.08	$0.10	$0.05	$0.03
4	$0.36	$1.07	$0.48	$0.14	$0.19	$0.10	$0.05
5	$0.50	$1.51	$0.68	$0.20	$0.27	$0.14	$0.07
6	$0.29	$0.86	$0.39	$0.12	$0.15	$0.08	$0.04
7	$0.63	$1.89	$0.85	$0.25	$0.34	$0.17	$0.09
Total	**$1.97**	**$5.91**	**$2.66**	**$0.79**	**$1.05**	**$0.54**	**$0.27**

Sulfur Recovery Units and Tail Gas Units (SRU/TGUs)

Refinery SRU/TGTUs, including their incinerators, are classified as major sources of both NOx and SOx emissions. Because sulfur is a naturally occurring and undesirable component of crude oil, refineries employ a sulfur recovery system to maximize sulfur removal. The type of NOx control option to be utilized in response to this portion of the proposed project is assumed to be LoTOx™ technology with a WGS or SCRs. Three refineries are assumed to install one LoTox™/WGS each and one refinery is assumed to install two LoTOx™/WGS and one SCR.

Based on the vendor–supplied costs, the total capital, installation, and operating costs of LoTOx™/WGS and SCR are presented in the table below. It should be noted that the annual operating costs were distributed among electricity, ammonia, waste water, annual catalyst replacement, and other annual maintenance.

Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of the LoTOx™/WGS and SCR installations for the refinery SRU/TGUS is estimated at $7.33 million. The total annual operating and maintenance costs are estimated at $0.65 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the gas turbines would amount to $7.98 million using a 4-percent discount rate. Table 13 presents the detailed costs per refinery.

Table 13: Total Capital, Installation, and Annual Operating Cost of Sulfur Recovery Units and Tail Gas Units (SRU/TGUs)(Millions of 2014 dollars)

Refinery	Equipment Cost	Installation Cost	Total O&M Cost	Electricity	Ammonia	Waste Water	Other Maintenance
1	$4.52	$15.82	$0.15	$0.07	$0.06	$0.01	$0.01
5	$11.86	$41.52	$0.21	$0.11	$0.08	0.013*	$0.01
6	$4.57	$15.99	$0.13	$0.07	$0.05	$0.01	$0.01
8	$4.52	$15.82	$0.15	$0.07	$0.06	$0.01	$0.01
Total	**$25.47**	**$89.15**	**$0.64**	**$0.32**	**$0.24**	**$0.03**	**$0.04**

*Refinery five cost estimates for annual cost of catalyst.

Petroleum Coke Calciner

Petroleum coke is the heaviest portion of crude oil which cannot be recovered in the normal oil refining process. Instead, it is processed in a delayed coker unit to generate a carbonaceous solid referred to as “green coke,” a commodity. To improve the quality of the product, it is sent to a calciner to make calcined petroleum coke.

There are two commercially available multi-pollutant control technologies for the low temperature removal of NOx emissions from the coke calciner: 1) LoTOx™ with scrubber; and, 2) UltraCat. The type of NOx control option to be utilized for the coke calciner in response to the proposed amendments would depend on the facility's individual operations and the current control technologies and techniques in place. For the purpose of the socioeconomic analysis, one refinery is assumed to control NOx emissions from a coke calciner with UltraCat technology. It should be noted that the annual operating costs were distributed among electricity, ammonia, waste water, annual catalyst replacement, and other annual maintenance.

Based on the vendor–supplied costs, the total capital and installation of LoTOx™ with UltraCat is estimated at $50.84 million. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of one the UltraCat is estimated at $3.25 million. The total annual operating and maintenance costs are estimated at $2.58 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the coke calciner would amount to $5.84 million using a 4-percent discount rate.

BARCT Cost Estimates for Non-Refinery Sector

In addition to the nine refineries, 11 non-refinery facilities also operate with equipment that can be further controlled to meet 2015 BARCT levels. They include one container glass manufacturing plant, one sodium silicate manufacturing plant, one steel plant operating two metal heat treating furnaces rated greater than 150 MMBTU/hr, seven facilities operating gas turbines, and three facilities operating IC Engines. The analysis herein assumes that the 11 non-refinery facilities would choose to install BARCT controls under the proposed amendments, the maximum potential compliance cost scenario.

As a conservative approach to cost estimation, the most stringent controls with the high-end cost (worst case scenarios) are assumed for the proposed amendments as well as for the CEQA alternatives. In total, 34 SCR units and one UltraCat filtration unit are assumed to be installed at these facilities.

Container Glass Melting Furnaces

A container glass melting furnace is the main equipment used for manufacturing glass products, such as bottles, glassware, pressed and blown glass, tempered glass, and safety glass. In the NOx RECLAIM program there is one facility among the top NOx emitting facilities that operates glass melting furnaces. This facility produces container glass from dry, solid raw materials that are melted in the furnaces and then formed into glass container bottles.

To effectively reduce NOx emissions from this category, staff assumed the affected facility would chose to install two Tri Mer Ultra Cat Systems for treating the flue gas of

glass melting furnaces. Based on the vendor–supplied costs, the total capital and installation of two Tri Mer Ultra Cat Systems is estimated at $5.68 million. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of two Tri Mer Ultra Cat Systems is estimated at $0.36 million. The total annual operating and maintenance costs are estimated at $0.67 million. The annual operating costs were distributed among electricity, ammonia and sorbent, waste water, waste disposal, annual catalyst replacement, and other annul maintenance. The total annualized cost of compliance for the container glass melting furnace including capital, operating, and maintenance, is estimated to be $1.03 million.

Sodium Silicate Furnace

In the NOx RECLAIM program, there is only one facility that produces sodium silicate in a melting furnace. NOx emissions are also created from combusting fuel needed to heat the furnace. To effectively achieve the largest reduction of NOx emissions, it was assumed that the affected facility would chose to install one Tri Mer Ultra Cat System.

Based on the vendor–supplied costs, the total capital and installation costs of one Tri Mer Ultra Cat Systems is estimated at $2.00 million. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of one Tri Mer Ultra Cat System is estimated at $0.13 million. The total annual operating and maintenance costs are estimated at $0.166 million. The annual operating costs were distributed among electricity, ammonia, waste water, waste disposal, annual catalyst replacement, and other annual maintenance. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the container glass melting furnace would amount to $0.29 million using a 4-percent discount rate.

Metal Heat Treating Furnaces

A metal melting furnace burns liquid or gaseous fuel to generate enough pre-heated air at a temperature high enough to melt solid metal and into a liquid molten consistency and to maintain the metal in a liquid state until it is ready for later use. Among the top NOx emitting facilities in the NOx RECLAIM program, there is only one facility that processes steel in two metal heat furnaces with individual heat ratings above 150 mm BTU/hr. To effectively achieve a substantial NOx reduction from these metal heat treating furnaces, SCR is the technology that is best suited for the flue gas treatment of NOx. As a result, it was assumed that the operator of the affected facility would chose to install one SCR system.

Based on the vendor–supplied costs, the total capital and installation of one SCR is estimated at $2.80 million. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized compliance cost is estimated at $0.18 million. The total annual operating and maintenance costs are estimated at $0.44 million. The annual operating costs were distributed among electricity, ammonia, annual catalyst replacement, and other annual maintenance. Summing up the

capital, operating, and maintenance costs, total annualized cost of compliance for the metal melting furnace would amount to $0.62 million using a 4-percent discount rate.

Gas Turbines (Non-Refinery/Non-Power Plant)

Stationary gas turbines are used primarily to drive compressors or to generate power. Among the top non-power plant NOx emitting facilities in the RECLAIM universe, there are twenty gas turbines that are either major or large source units. For the purpose of the analysis, controlling NOx emissions from the four non-refinery/non power plant gas turbines is assumed to be accomplished with SCR technology.

Based on the vendor–supplied costs, the total capital, installation, and operating costs of 14 SCRs for the seven affected facilities are presented in the table below. It should be noted that the annual operating costs were distributed among electricity, ammonia and annual catalyst replacement. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of 14 SCRs is estimated at $2.42 million. The total annual operating cost of these 14 SCRs is estimated at $5.92 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the gas turbines would amount to $8.34 million using a 4-percent discount rate. Table 14 presents the detailed costs per facility.

Table 14: Total Capital, Installation, and Annual Operating Cost of SCRs for Non-Power plants Gas Turbines (Millions of 2014 dollars)

Facility	Equipment Cost	Installation Cost	Total O&M Cost	Electricity	Ammonia /Urea	Catalyst
1	$2.81	$5.62	$2.12	$0.41	$1.34	$0.37
2	$2.03	$4.06	$0.27	$0.08	$0.15	$0.03
3	$0.77	$1.55	$0.44	$0.02	$0.32	$0.10
4	$0.96	$1.92	$0.17	$0.04	$0.09	$0.04
5	$0.92	$1.84	$0.56	$0.02	$0.35	$0.19
6	$1.62	$3.25	$0.79	$0.27	$0.29	$0.23
7	$3.48	$6.97	$1.57	$0.55	$0.57	$0.45
Total	**$12.59**	**$25.21**	**$5.92**	**$1.39**	**$3.11**	**$1.41**

Internal Combustion Engines (Non-Refinery/Non-Power Plant)

Stationary Internal Combustion Engines (ICEs) are used primarily to drive pumps, compressors, or to generate power. For the purpose of the analysis, controlling NOx emissions from this category is assumed to be accomplished with SCR technology.

Based on the vendor–supplied costs, the total capital, installation, and operating costs of 16 SCRs for the three affected facilities are presented in the table below. It should be noted that the annual operating costs were distributed among electricity, ammonia and annual catalyst replacement. Assuming a 25-year life for equipment and installation, and a real interest rate of four percent, the total one-time annualized cost of compliance of 16 SCRs is estimated at $1.37 million. The total annual and operating costs of these 16 SCRs is estimated at $0.99 million. Summing up the capital, operating, and maintenance costs, total annualized cost of compliance for the ICE engines would amount to $2.38 million using a 4-percent discount rate. Table 15 presents the detailed costs per facility.

Table 15: Total Capital, Installation, and Annual Operating Cost of SCRs for Non-Power plants ICE Engines (Millions of 2014 dollars)

Facility	Equipment Cost	Installation Cost	Total O&M Cost	Electricity	Ammonia /Urea	Catalyst	Other Maintenances
1	$0.53	$3.93	$0.18	$0.005	$0.08	$0.08	$0.02
2	$0.68	$4.78	$0.31	$0.004	$0.07	$0.22	$0.02
3	$0.80	$10.80	$0.50	$0.01	$0.21	$0.22	$0.06
Total	**$2.01**	**$19.51**	**$0.99**	**$0.02**	**$0.36**	**$0.52**	**$0.10**

MACROECONOMIC IMPACTS ON REGIONAL ECONOMY

The REMI model (PI+ v1.7.2) was used to assess the total socioeconomic impacts of a policy change (i.e., the proposed rule). 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]

[10] Within each county, producers are made up of 66 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 age/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.)

Impact of Proposed Amendments

The assessment herein is performed relative to a baseline ("business as usual") where the proposed amendments would not be implemented. The proposed amendments are assumed to induce full BARCT installation at the nine refineries and 11 non-refinery facilities, which would create a policy scenario under which the affected facilities would incur an annual compliance costs totaling $51.7 million to $63.3 million, depending on the discount rate assumed. It is assumed that the 20 facilities would finance the capital and installation costs of control equipment, or more specifically, these one-time costs are assumed to be amortized and incurred over the equipment life.

Direct effects of the proposed amendments are used as inputs to the REMI model in order for the model 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: 2018 (first year of assumed BARCT implementation) to 2035. Direct effects of the proposed amendments include additional costs to the 20 facilities and additional sales, by local vendors, of equipment, devices, or services that would meet the proposed requirements. Whereas all the compliance expenditures that are incurred by the affected facilities would increase their cost of doing business, the purchase of additional control equipment such as SCR, LoTOx™, Ultra Caltalyst, and equipment installation would increase the spending and sales of businesses in various sectors, some of which may be located in the SCAQMD region. Table 16 lists the industry sectors modeled in REMI that would either incur cost or benefit from the compliance expenditures.

Table 16: Industries Incurring *vs.* Benefitting from Compliance Costs/Spending

Source of Compliance Costs	REMI Industries Incurring Compliance Costs (NAICS)	REMI Industries Benefitting from Compliance Spending (NAICS)
SCR, LoTOx™, Ultra Cat, Catalyst	Refinery (NAICS 324), Manufacturing (NAICS 331), Utility (NAICS 221), Chemical Manufacturing (NAICS 325), Nonmetallic Mineral Product Manufacturing (NAICS 327), Oil and Gas Extraction (NAICS 211), and Support Activities for Transportation (NAICS 488)	*One-time-Capital:* Machinery Manufacturing (NAICS 333)

Source of Compliance Costs	REMI Industries Incurring Compliance Costs (NAICS)	REMI Industries Benefitting from Compliance Spending (NAICS)
Installation of SCR, LoTOx™, Ultra Cat, Catalyst	Refinery (NAICS 324), Manufacturing (NAICS 331), Utility (NAICS 221), Chemical Manufacturing (NAICS 325), Nonmetallic Mineral Product Manufacturing (NAICS 327), Oil and Gas Extraction (NAICS 211), and Support Activities for Transportation (NAICS 488)	*One-time-Capital:* Construction (236)
Operating and Maintenance Cost of SCR, LoTOx™, Ultra Cat, Catalyst	Refinery (NAICS 324), Manufacturing (NAICS 331), Utility (NAICS 221), Chemical Manufacturing (NAICS 325), Nonmetallic Mineral Product Manufacturing (NAICS 327), Oil and Gas Extraction (NAICS 211), and Support Activities for Transportation (NAICS 488)	*Recurring:* Professional, Scientific, and Technical Services (541)
Other Operating and Maintenance Costs: Electricity, Water	Refinery (NAICS 324), Manufacturing (NAICS 331), Utility (NAICS 221), Chemical Manufacturing (NAICS 325), Nonmetallic Mineral Product Manufacturing (NAICS 327), Oil and Gas Extraction (NAICS 211), and Support Activities for Transportation (NAICS 488)	*Recurring:* Utility (221)
Other Operating and Maintenance Costs: Ammonia, Caustic, Oxygen	Refinery (NAICS 324), Manufacturing (NAICS 331), Utility (NAICS 221), Chemical Manufacturing (NAICS 325), Nonmetallic Mineral Product Manufacturing (NAICS 327), Oil and Gas Extraction (NAICS 211), and Support Activities for Transportation (NAICS 488)	*Recurring:* Chemical Manufacturing (NAICS 325)

Source of Compliance Costs	REMI Industries Incurring Compliance Costs (NAICS)	REMI Industries Benefitting from Compliance Spending (NAICS)
Other Operating and Maintenance Costs: Solid Waste Disposal & Waste Water	Refinery (NAICS 324)	*Recurring:* Waste Management (NAICS 562)

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 amendments on various industries that make up the local economy. Cost impacts on individual operations were assessed outside of the REMI model and used as inputs into the REMI model.

It is projected that an average of 13 jobs (net) could be created annually from 2018 to 2035 in the local economy when a 4-percent real interest rate is assumed (approximately 90 jobs created with a 1-percent real interest rate). The majority of job creation would be concentrated at the beginning of the analysis horizon when the purchase and installation of control equipment taking place between 2018 and 2022. After 2022, small numbers of jobs forgone are observed annually. Notice that this analysis only considers the potential compliance cost of full BARCT installation at the 20 facilities, and it does not take into account the monetary benefits for facilities that potentially will have more RTCs available for sale as a result of NOx emission reductions due to BARCT installation. (Please see next section for an RTC market analysis.)

In earlier years of the implementation of these amendments, the positive job impacts from the compliance expenditures made by refineries, container glass, sodium silicate plant, and sulfur acid plants would more than offset the jobs forgone from the additional cost of doing business (Table 17). In 2021, where most of the spending is expected to occur, about 2,300 additional jobs are projected in the regional economy. The positive job impact would trickle down to the sectors of construction, miscellaneous professional services, retail, wholesale, and business services. However, as refineries, glass, sulfur acid plant, and other non-major facilities continue to incur the amortized capital expenditures, reductions in job growth would set in, resulting in jobs forgone in later years.

The oil and gas extraction sector is projected to have 33 average annual jobs forgone, due to additional spending on SCRs required on gas turbines. Despite having a large share of the total compliance cost, the refinery industry is projected to have fewer jobs forgone (10) relative to other industries with a similar magnitude of cost impacts. This is due to the fact that the industry is the most capital-intensive. As such, less labor would be required to produce the same amount of products or services.

In earlier years, positive job impacts are projected in the sectors of fabricated metal products (NAICS 332) and machinery manufacturing (NAICS 331), due to purchase of

various types of control equipment (SCR, LoTOx, Catalyst, etc.) by the affected facilities (as presented in Table 16). Likewise, the sector of construction is projected to gain many jobs during the beginning period, due to the installation of control equipment. In addition, the sector of professional and technical services (NAICS 541) is projected to also gain jobs in earlier years from additional demand for equipment installation and maintenance. Operating and maintenance expenditures would benefit the industries of chemical products (NAICS 325) for additional sales of ammonia and public utilities (NAICS 22) for electricity.

The projected reduction in disposable income from the overall jobs forgone in the later years would dampen the demand for goods and services in the local economy, thus contributing to jobs forgone in sectors such as the rest of manufacturing, retail trade, wholesale, and accommodation and food services. As presented in Table 17, many major sectors of the regional economy would experience negative, albeit minor, job impacts in later years from the secondary and induced effects of BARCT implementation.

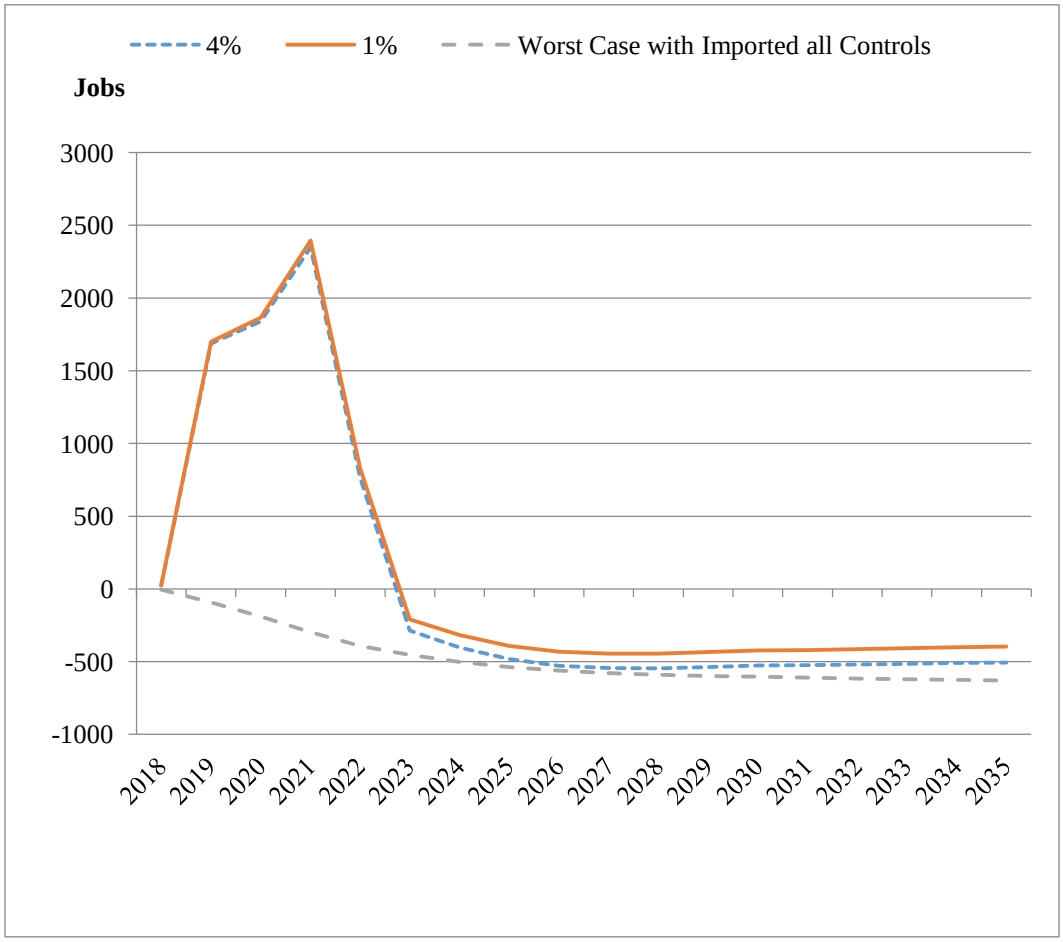
Table 17: Projected Job Impacts of Full BARCT Implementation by Industry and Year

Industry	NAICS	Year					Average Annual (2018-2035)
		2018	2021	2022	2030	2035	
Oil and gas extraction	211	0	-11	-20	-46	-48	-33
Utilities	22	0	5	4	1	0	2
Construction	23	11	1264	468	-120	-88	117
Nonmetallic mineral product mfg.	327	0	10	3	-3	-2	0
Fabricated metal product mfg.	332	0	22	7	-4	-4	1
Machinery mfg	331	1	47	21	2	1	9
Petroleum and coal product mfg.	324	0	-4	-7	-13	-13	-10
Chemical mfg.	325	0	5	3	1	1	2
Rest of Manufacturing	31-33	0	25	-3	-13	-11	-7
Wholesale trade	42	1	61	23	-5	-5	7
Retail trade	44-45	1	101	3	-62	-60	-28
Truck transportation and couriers	484,492	0	14	3	-5	-5	-1
Monetary authorities	521,522,5255	0	15	4	-3	-2	1
Securities, and commodity contracts	523	0	33	4	-7	-4	-1
Insurance carriers and related activities	524	0	10	2	-3	-3	0
Real estate	531	0	45	12	-20	-20	-6
Professional and technical services	54	2	130	52	-2	-44	-1
Management of companies and enterprises	55	0	10	2	-34	-2	-1
Administrative and support services	561	1	92	27	-3	-28	-4
Waste management and remediation services	562	0	3	2	-27	-2	0
Educational services	61	0	26	7	-2	-8	-1
Ambulatory health care services	621	1	68	17	-8	-20	-3
Hospitals	622	0	15	5	-19	-8	-2
Nursing and residential care facilities	623	0	12	3	-6	-5	-1
Social assistance	624	0	38	10	-5	-13	-2
Performing arts and spectator sports	711	0	10	0	-12	0	0
Amusement, gambling, and recreation	713	0	7	2	-2	-1	0
Accommodation	721	0	12	3	-1	-3	0
Food services and drinking places	722	1	63	21	-3	-27	-5
Repair and maintenance	811	0	26	7	-23	-4	1
Personal and laundry services	812	0	38	7	-5	-8	0
Membership associations and organization	813	0	22	5	-9	-4	0
Private households	814	0	11	2	-5	-2	0
Other Industries		0	39	5	-2	-14	-6
Government		1	85	57	-15	-50	-12
Total		**22**	**2347**	**763**	**-527**	**-506**	**13**

*The job impacts are projected for the regional economy, which include jobs at all businesses, whether directly affected by full BARCT implementation or not.

Figure 2 presents a projected time series of job impacts over the 2018-2035 time period. In addition, staff has analyzed an alternative scenario (worst case) where the affected facilities would not purchase any control equipment or services from providers within the Basin. This scenario would result in an annual average of approximately 470 jobs forgone. The 506 jobs forgone in 2035 represents 0.005 percent of total jobs in the region.

Figure 2: Projected Regional Job Impact, 2018-2035



Potential Health Benefits

The South Coast Air Basin is one of only two "extreme" non-attainment areas in the nation that have not reached the federal eight-hour ozone standards. Ground-level ozone, or smog, forms when volatile organic compounds (VOC) photochemically react with nitrogen oxides (NOx) in the presence of sunlight. Encompassing a major swath of Southern California, the South Coast Air Basin is among the most densely populated areas nationwide, with about 13 million cars, trucks, and other vehicles operating on its

extensive network of highways and roads.[11] The amount of pollutants produced by modern urban life and industrial activities, combined with Southern California's year-round sunny weather, all contribute to the high concentrations of ground-level ozone in the area. Ozone exposure can cause immediate, adverse effects on the respiratory system and result in various symptoms such as coughing, throat irritation, chest pain, and shortness of breath. It can also inflame the lining of the lungs, and for asthma patients, it may increase the number and severity of attacks. Long-term impacts of frequent exposure to ozone may lead to permanent lung damage and increase the risk of premature death.

In addition, the South Coast Air Basin remains a non-attainment area for the federal 24-hour and annual PM2.5 standards. NOx is also a precursor to PM2.5 Exposure to high levels of PM2.5 have been shown to cause and aggravate cardiopulmonary illnesses, including heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficult breathing. These outcomes result in increased absences from school and work, hospitalization, and other medical expenses. Exposure to PM 2.5 is associated with premature deaths. According to recent estimates by the California Air Resources Board, elevated ambient PM 2.5 levels result in approximately 4,100 premature deaths annually in the South Coast Air Basin.

The reductions in ozone and PM2.5 associated with the proposed rule amendments have the potential to reduce the mortality and morbidity incidences associated with NOx emissions.

Competitiveness

The additional cost for the proposed rule would increase the cost of services rendered by the affected industries in the region. The magnitude of the impact depends on the size and diversification of, 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.

The proposed amendments are not expected to impose discernable impacts relative to the cost of services or delivered prices of the affected facilities. Based on the 2014 annual financial report, the total gross annual revenue of the corporations which own the nine

[11] According to estimates provided by the California Department of Motor Vehicles, there were a total of 13.7 million registered vehicles in Los Angeles, Orange, Riverside, and San Bernardino counties for the period of January 1 to December 31, 2013. (https://www.dmv.ca.gov/portal/wcm/connect/add5eb07-c676-40b4-98b5-8011b059260a/est_fees_pd_by_county.pdf?MOD=AJPERES, accessed February 18, 2015.) The South Coast Air Basin covers all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino counties; therefore, the total number of vehicles would have been somewhat smaller.

affected refineries was about $963 billion. Based on this estimate, the total annualized cost for the nine refineries ($41 to $52 million) represents approximately 0.004 to 0.005 percent of their estimated corporate gross annual sales. According to the 2014 California State Board of Equalization, total gasoline sales in California were 14.57 billion gallons, of which the South Coast's share is estimated to be 46 percent. The annual compliance cost of refineries due the proposed amendments, if fully passed on to gasoline consumers, would result in a gasoline price increase of up to 0.8 cents per gallon in the four-county area.[12] Gasoline produced by refineries within SCAQMD is also consumed in a larger region including other parts of California and areas in neighboring states (e.g. Nevada and Arizona), therefore, the actual added cost is expected to be lower than the stated amount.

Rule Adoption Relative to the Cost Effectiveness Schedule

On October 14, 1994, the Governing Board adopted a resolution that requires staff to address whether rules being proposed for adoption are considered in the order of cost-effectiveness. The 2012 Air Quality Management Plan (AQMP) ranked, in the order of cost-effectiveness, all of the control measures for which costs were quantified. It is generally recommended that the most cost-effective actions be taken first.

The proposed amended rules implement control measure CMB-01 (Additional Reductions for NOx RECLAIM) in the 2012 AQMP. The cost effectiveness of this measure (Phase II) was estimated to be $16,000 per ton of NOx reduced. This measure was ranked eighth among all the SCAQMD control measures for stationary sources in terms of cost-effectiveness in the 2012 AQMP.

Incremental Cost Effectiveness

Please refer to the Staff Report.

Impact of CEQA Alternatives

Five alternatives to the proposed amendments were developed for the CEQA analysis associated with this proposal. This section provides an assessment of the possible different socioeconomic impacts resulting from these alternatives. Table 18 below summarizes the proposed shave for each affected source category. Alternative 1 (Across the Board), Alternative 2 (Most Stringent), Alternative 3 (Industry Approach which does not comply with state law), Alternative 4 (No Project), and Alternative 5 (Weighted by BARCT Reduction Contribution for all Facilities and Investors). The primary components of the proposed alternatives that have been modified are the source

[12] The rate of 46 percent was applied to the state's total of 14.57 billion gallons sold to get the Basin's share of 6,702 million gallons sold. Dividing the average annual cost of the proposed amendments ($52 million) by 6,702 million gallons will result in $0.008 or (0.8 cents/gallon) increase in gasoline price.

categories that may be affected, and the manner in which compliance with the proposed NOx BARCT emission limits would be achieved.

Table 18: Proposed Amendments and CEQA Alternatives

	Proposed Amendments	Major Refineries/ Investors	Non-Major Facilities	Power Plants	Bottom 10% of RTC Holders
Staff Proposal	**Shave applied to 90% of RTC Holders (Weighted by BARCT Reduction Contribution)** *65 total facilities, plus investors*	**66%** ***(9 Facilities)***	**47%** ***(26 Facilities)***	**47%** ***(30 Facilities)***	**0%** ***(210 Facilities)***
CEQA Alternatives					
CEQA Alternative #1	**Across the Board** *Affects all facilities and investors*	**53%**	**53%**	**53%**	**53%**
CEQA Alternative #2	**Most Stringent Approach** *Across the Board without 10% Compliance Margin*	**60%**	**60%**	**60%**	**60%**
CEQA Alternative #3	**Industry Approach** *Across the Board: Difference between previous BARCT and new BARCT*	**33%**	**33%**	**33%**	**33%**
CEQA Alternative #4	**No Project**	**0%**	**0%**	**0%**	**0%**
CEQA Alternative #5	**Weighted by BARCT Reduction Contribution** *Affects all facilities and investors*	**66%**	**36%**	**36%**	**36%**

To analyze the worst case scenarios, the CEQA analysis assumes that all other components of the project alternatives are identical to the components of the proposed project (i.e., the same control equipment); therefore, the corresponding impacts would

also occur under all the alternatives except the 'no project' alternative. However, for the purpose of conducting socioeconomic analyses and comparing costs and job impacts under different CEQA alternatives, staff assumed that a different set of source categories would be affected under each CEQA alternative.

The analysis conducted in the ensuing subsection focuses on the nine refineries and 11 non-refinery facilities with identified 2015 BARCT. A market analysis is provided in the next section, where the potential cost impact on the remaining NOx RECLAIM facilities is analyzed.

Alternative 1 – Across the Board Shave of NOx RTCs

Alternative 1 consists of an across the board NOx RTC shave of 14 tpd that would affect all NOx RECLAIM facilities and investors. Although the total amount of the shave is identical to the proposed project, the NOx RTC holdings would be shaved by 53 percent overall.

For the purpose of the socioeconomic analysis of the CEQA alternatives, staff assumed fewer control equipment to be installed by refineries since less reduction (53% vs. 66%) is required. To meet the proposed 53% shave, refinery sector needs to only reduce 4.76 out of 6.02 tpd required under the proposed project. To meet the 4.76 tpd reductions and based on the cost-effectiveness schedule, only control costs for the refinery FCCUs, gas turbines, and coke calciners are considered for the cost estimates.

On the other hand, the remaining 11 non-major facilities would need to reduce more of their current holdings relative to the proposed project (53% vs. 47%, or 3.2 vs. 2.77 tpd). Since these facilities will have their holdings reduced by 53% rather than the 47% in the proposed project, these facilities are assumed to need to purchase RTCs to meet the difference. While these facilities may purchase some RTCs, this would not be an additional cost of the program since the sellers would be paid for these RTCs. For the purpose of worst-case analysis, staff assumed these facilities will purchase 0.354 (3.2-2.77) tpd of RTCs at a maximum price of $14,999 per ton, irrespective of the projected demand and supply of NOx RTC and how the market would behave under this alternative shave. The price of $14,999 was assumed the maximum price since Rule 2015 (b) (6) requires a program evaluation if RTC prices rise above this amount.

Alternative 2 – Most Stringent Shave of NOx RTCs

Alternative 2 consists of the most stringent approach by applying an across the board NOx RTC shave of 15.87 tpd. Alternative 2 would affect all RECLAIM facilities and investors, but without including the 10 percent compliance margin or the BARCT adjustment for refinery equipment. Under Alternative 2, the NOx RTC holdings would be shaved by 60 percent overall. Under Alternative 2, the total shave of 15.87 tpd is greater than the 14 tpd shave that is contemplated by the proposed project. In addition, the

distribution of the shave under Alternative 2 would reduce the NOx RTC holdings differently than the proposed project: 60 percent reduction would be applied to all 275 NOx RECLAIM facilities and investors.

For the purpose of the socioeconomic analysis of the CEQA alternatives, staff assumed less control equipment to be installed by refineries since less reduction (60% vs. 66%) is required. To meet the proposed 60% shave, the refinery sector needs to only reduce 5.34 tons out of 6.02 tons required under the proposed project. To meet the 5.34 tons reductions and based on the cost-effectiveness schedule, only control costs for the refinery FCCUs, gas turbines, coke calciners, and boilers/heaters are considered for the cost estimates.

On the other hand, the remaining 11 non-major facilities need to reduce more relative to the proposed project (60% vs. 47% or 3.54 vs. 2.77 tpd). Since these facilities will have their holdings reduced by 60% rather than the 47% in the proposed project, these facilities are assumed to need to purchase RTCs to meet the difference. For the purpose of the worst-case analysis, staff assumed these facilities to purchase 0.77 tpd of RTCs at a maximum price of $14,999 per ton, irrespective of the projected demand and supply of NOx RTC and how the market would behave under this alternative shave.

Alternative 3 – Industry Approach

Alternative 3, an approach that has been proposed by industry representatives does not comply with state law, because it does not meet the definition of BARCT as the maximum degree of reductions achievable, taking into account economic and other impacts (HS&C 40406). This proposal consists of an across the board NOx RTC shave of 8.79 tpd that would affect all RECLAIM facilities and investors. The total amount of shave would be lower than the 14 tpd shave that is contemplated by the proposed project. Under Alternative 3, the NOx RTCs held by all RECLAIM facilities and investors would be shaved by 33 percent. Since there are unused RTCs in the system, it is assumed that facilities would first give up most of their unused credits and install additional controls as needed to reach the total 8.79 tons. However, the analysis assumes that facilities would install controls to reach the required 33% reduction to provide a conservative estimate of costs.

For the purpose of the socioeconomic analysis of the CEQA alternatives, staff assumed less control equipment to be installed by refineries since less reduction (33% vs. 66%) is required. To meet the proposed 33% shave refinery sector needs to only reduce 2.97 tons out of 6.02 tons required under the proposed project. To meet the 2.97 tons reductions and based on the cost-effectiveness schedule, only control costs for the refinery gas turbines are included for the cost estimates. This approach represents a conservative (high) estimate of costs since facilities are expected to give up unused RTCs before installing controls. Since the projects assumes 5.21 tpd of excess RTCs will be given up, it is likely that under this alternative only 3.85 tons (8.7-5.21) of actual BARCT controls

may be installed. As a result, this analysis likely overestimates actual emission reductions for this alternative.

As in the refinery sector, the remaining 11 non-major facilities would have fewer holding reductions relative to the proposed project (36% vs. 47% or 1.94 vs. 2.77 tons/day). To meet the 1.94 tons reductions and based on the cost-effectiveness schedule, only control costs for the sodium silicate furnace, ICE engines, container glass furnace, and metal heat furnaces are considered for the cost estimates.

Alternative 4 - No Project

Alternative 4 is the "No Project" approach such that no NOx RTC reductions would be applied to any RECLAIM facility or investor. CEQA requires the specific alternative of No Project to be evaluated even though it also does not comply with state law for the same reason as Alternative 3. A No Project Alternative consists of what would occur if the proposed project was not approved; in this case, not adopting the proposed project. The net effect of not amending Regulation XX to reduce the available RTCs on the market would be a continuation of the 2005 amendments to the NOx RECLAIM program

Under Alternative 4, existing Regulation XX would remain as currently written. Additional NOx reductions are not anticipated because the current level of NOx allocations is projected to exceed NOx emissions. Consequently, no additional cost is expected from Alternative 4 and no other socioeconomic impacts are foreseen.

Alternative 5 – Weighted by BARCT Reduction Contribution

Alternative 5 consists of an across the board NOx RTC reduction of 14 tpd that would affect all NOx RECLAIM facilities and investors. Although the total amount of shave is identical to the proposed project, the NOx RTC reductions under this alternative would be weighted by the BARCT reduction contribution for major refineries and all other facilities, with investors grouped with the major refineries. As such, NOx RTC holdings for major refineries and investors would be shaved by 66 percent and the NOx RTC holdings for non-major refineries and all other facilities would be shaved by 36 percent.

For the purpose of the socioeconomic analysis of the CEQA alternatives, staff assumed the same control equipment to be installed by refineries as the proposed project since the same reduction (66%) is required. To meet the proposed 36% shave, the remaining 11 non-major facilities need to reduce less relative to the proposed project (36% vs. 47% or 2.12 vs. 2.77 tpd). Based on the cost-effectiveness schedule, only control costs for the sodium silicate furnace, ICE engines, container glass furnace, and gas turbines are considered for the cost estimates.

Table 19 presents a comparison of the alternatives in terms of annual average cost and jobs forgone. This table assumes that under Alternatives 1, 2, and 5 facilities would buy unused RTCs at a greater rate than in the proposed project in lieu of installing more

expensive controls. Therefore, costs are lower but actual emission reductions are also lower than from the proposed project.

Table 19: Average Annual Costs and Job Impacts by CEQA Alternative For 9 Refineries and 11 Non-Major Facilities

CEQA Alternatives	BARCT Cost In $ Millions (annualized using a 4% discount rate)	Jobs	Amount of RTC Credits Removed from Market (Tons/day)
Proposed Amendments	$63.36	+13	14
Alternative 1	$43.52	-66	14
Alternative 2	$52.75	-80	15.87
Alternative 3	$8.20	-29	8.79
Alternative 4	$0	0	0
Alternative 5	$60.78	+21	14

The proposed project has the highest cost but the second to highest positive job impact, due to increased labor demand for the full, instead of partial, installation of BARCT equipment. Alternative 4 serves as a benchmark against which other alternatives were evaluated. Of the four remaining alternatives, Alternative 3, which does not comply with state law, has the lowest cost ($8.20 million) because it is expected to induce the least number of BARCT equipment to be installed; however, it would result in an average of 29 jobs foregone annually. This alternative excludes controls on FCCU and SRUs, boilers/heaters, and coke calciner units at refineries and hence would avoid potential costs, but also the jobs that could be potentially created due to additional expenditure on these controls. In addition, this alternative would achieve fewer emission reductions from the 20 BARCT facilities.

Alternatives 1 and 2 would cost less than the proposed amendments, yet would experience much more negative job impacts (66 and 80 annual jobs forgone, respectively). This is due to less BARCT installation spending in this sector relative to the 11 non-refinery facilities and would result into negative net job impacts.

MARKET ANALYSIS

In addition to the potential compliance cost of control equipment installation and operation for these 20 facilities, the proposed amendments may potentially result in new or additional compliance costs for some of the 45 facilities where no control equipment was identified for installation. New costs would be the result of some facilities finding that their emissions exceed their RTC holdings post-shave. These facilities with negative balances would become net buyers and face the costs of purchasing additional RTCs to

remain compliant. Additional costs would be incurred by facilities that were net buyers before the shave and would see their holdings further reduced under the proposed shave.

Along with the cost of additional credits that would need to be purchased, every unit of traded NOx RTCs could potentially become more expensive as a result of the proposed shave. In the short term, these net buyers are expected to purchase RTCs at a higher price, although RTC costs may go down in the long-term, if some (or all) of the 20 facilities with identified control equipment chose to install controls and offer excess RTCs for sale. In addition to the potential compliance cost that would be incurred by the 45 shaved facilities with no identified control equipment, compliance costs could also be incurred by the net buyers who already exist within the remaining group of 210 facilities that are exempt from the RTC shave under the proposed rule. These facilities are expected to buy RTCs every year and would also face higher RTC prices as the supply decreases. Under CEQA alternatives, these 210 facilities may incur even more costs from varying degrees of RTC shaves.

In order to estimate the magnitude of these market impacts, a price analysis has been conducted. To estimate the potential impact of price increases on the projected net buyers, a sensitivity analysis was conducted where prices grew from 100 to 300 percent. The 300-percent cap approximates the $15,000 per ton price ceiling under Rule 2015. It should be noted that the compliance costs incurred by these projected net buyers would at the same time create monetary benefits to other RECLAIM facilities and/or investors who would be the sellers of these credits. Because this price analysis is speculative, staff did not include it as an input for the regional economic model (REMI) to assess macroeconomic impacts. Note that the analysis is based on the actual 2011 emissions (with growth factors applied to project future emissions) among existing emission sources, including power plants. Potential increases in compliance cost due to higher RTC prices was not directly considered for new and modified sources, nor for the required holdings beyond actual emissions for the power plants. For new and modified sources, however, the projected future emissions by industry-wide growth factors may be able to capture at least a portion of the incremental compliance costs potentially incurred by these facilities.

Finally, the potential monetary value of 5.21 tpd of shaved RTC holdings, which would be removed from the 65 facilities, has also been estimated. However, it should be noted that this estimated value is not considered a compliance cost as RTCs were originally allocated to RECLAIM facilities at zero cost and are not legally considered a facility's property. The results of this "value" analysis are set forth below on page 53.

Assumptions for Price Analysis

Two types of credits exist within the RECLAIM market: Discrete-year credits which must be used within the year of purchase and Infinite-Year Blocks (IYB) which are bundles that extend into perpetuity after the initial purchase year. Given that prices for discrete-year are the most reflective of actual market behavior, they form the basis of this analysis. Over the past five years, prices for discrete RTCs begin at about $3,000 to

$4,000 per ton and eventually drop to around $1,000 per ton as the end of the year approaches. RTCs are much less expensive near the end of the year when the RTC expiration date approaches.

The base price of $3,779 per ton for discrete RTCs from January in compliance year 2015 was used for this analysis.[13] In order to capture a realistic range of increases up to the $15,000 per ton threshold, an increase of 100 percent, 200 percent, and 300 percent was applied to the base price of $3,779 per ton. These values were then aggregated into their yearly totals. Table 20 summarizes the results below.

Table 20: Estimates of RTC price increases

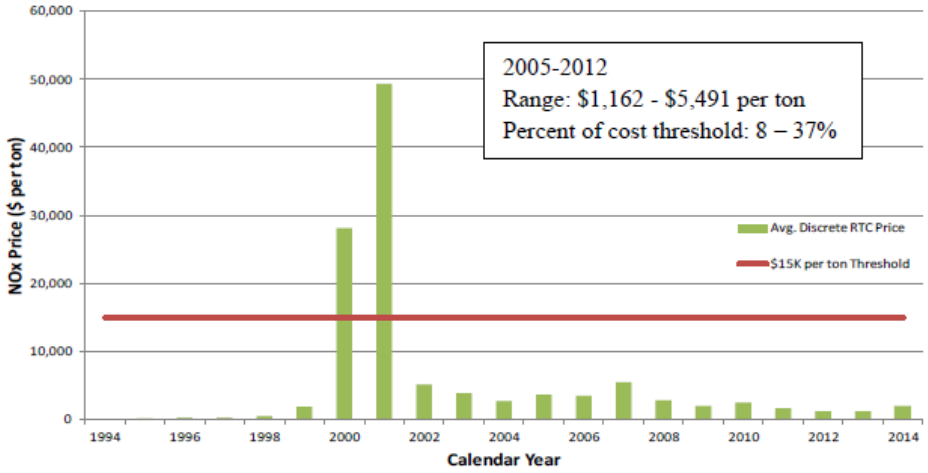
Type	Market price	100 percent Increase	200 percent Increase	300 percent Increase
Discrete Ton	$3,779	$7,558	$11,337	$14,999

*The calculated price increase is $15,116, but was cut off at $14,999 ceiling as identified for program revaluation under Rule 2015.

These cost assumptions are conservative given historical trends in the marketplace. Since the adoption of Regulation XX, there have been a number of amendments to the RECLAIM rules, including BARCT reassessments for NOx in 2005. As a result of the January 2005 amendment, NOx RTCs were reduced by 7.7 tpd (accounting for approximately 22.5 percent of the total RTC holdings at that time) uniformly across the then 281 RECLAIM facilities. This reduction was implemented in phases: 4 tpd in 2007 and an additional 0.925 tpd in each of the following four years. Figure 3 shows discrete RTC prices for compliance years 1994 to 2013, reflecting the fact that the NOx reductions specified by the January 2005 amendment did not cause major RTC price spikes.

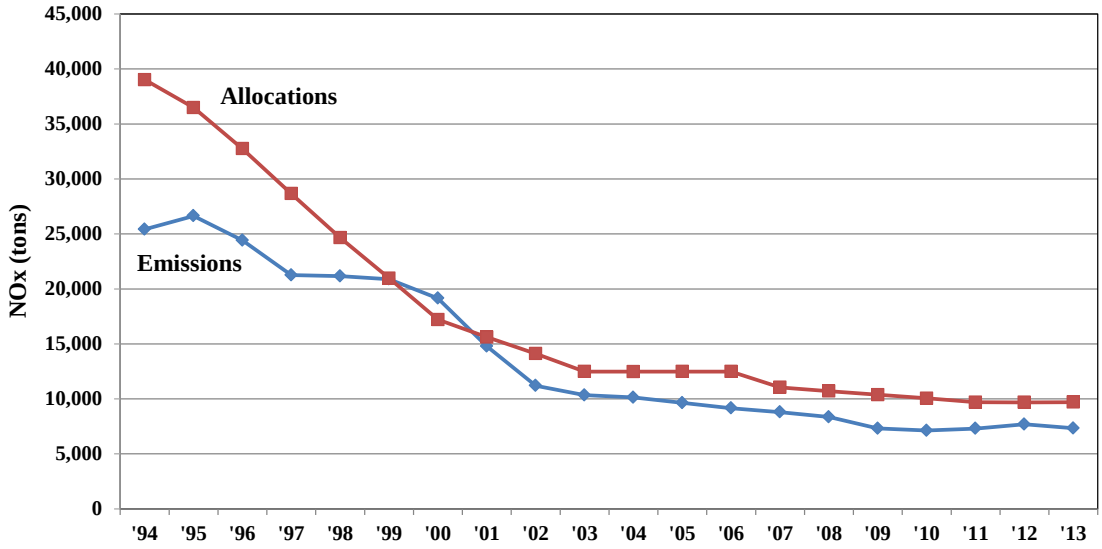
[13] This price represents a 12-month rolling average which is calculated to smooth out short-term fluctuations and present long-term trends. For more information see: http://www.aqmd.gov/docs/default-source/reclaim/nox-rolling-average-reports/12-mo-rolling-avg-price-comp-yrs-2014-15-nox-rtcs---july-2015.pdf?sfvrsn=6

Figure 3: NOx Discrete Prices vs. Threshold



Additionally, since the RECLAIM program began in 1994, actual NOx emissions have consistently been well below total RTC holdings (except during California's energy crisis in 2001). Figure 4 shows how, despite past changes in the market's structure, there were sufficient amounts of NOx RTCs available to allow for expansion and modification by RECLAIM facilities. In drafting the proposed rule, staff added a 10 percent compliance margin to the projected 2022 emissions by RECLAIM facilities at the proposed 2015 BARCT levels and an additional 0.85 tpd to account for uncertainties surrounding the BARCT analysis and facility shutdowns. Additionally, staff also accounted for the proposed Adjustment Account to hold RTCs for power plants to meet their NSR holding obligations which aren't expected to have an economic impact. Given this historical trend and staff's efforts to structure the rule effectively, the remaining NOx RTC holdings after 2022 (12.5 tpd = 26.5 – 14 tpd) is not expected to drop below actual total NOx emissions, even with less than the full implementation of control equipment, and prices are not expected to spike above the $15,000 per ton threshold for program reevaluation.

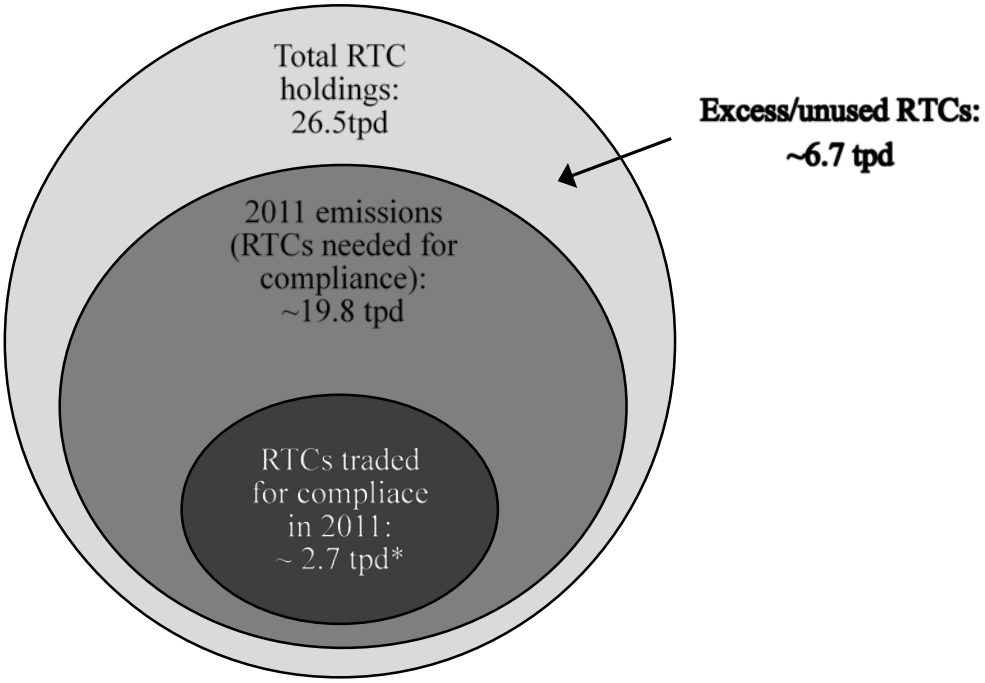
Figure 4: Audited Emissions and RTC Holdings



Understanding the Impact of the First 4 tpd Shave

Under the proposed rule amendments, 4tpd of NOx RTCs would be removed from the NOx RECLAIM program in 2016, before any facility is expected to have installed new BARCT control equipment. Based on 2011 data, there existed a wide margin between the overall NOx RTC holdings and actual emissions. As illustrated in Figure 5, a total of about 6.7 tpd were unused and considered as excess NOx RTC credits. Moreover, in 2011, only 2.7 tpd of NOx RTCs were traded in the market directly for the purpose of regulation compliance, while 6.7 tpd of excess RTCs remained unused. Therefore, even with no expected BARCT installation in 2016 (thus, no additional credits expected to be released into the market for trading), it would be unlikely that NOx RTC prices would rise to the $15,000 ceiling after the first 4 tpd of NOx RTCs are shaved. To be conservative, however, the following analysis will examine different price scenarios to evaluate the potential cost impact in the first year of the proposed shave.

Figure 5: Distribution of RTCs in NOx RECLAIM Market, 2011



*RTCs traded for compliance was calculated for each NOx RECLAIM facility by: 1) substracting 2011 RTC holdings from 2011 NOx emissions and 2) summing up the negative balance, which is equivalent to the amount of facility emissions that a facility did not have RTC holdings for. Among the approximatly 2.7 tpd RTCs traded for compliance in 2011, close to 60 percent was purchased by the nine refineries and 11 non-refinery facilities with identified control equipment.

Potential Compliance Cost for Net Buyers: 45 Affected Facilities

For the first shave of 4 tpd in 2016, 15 facilities (6 existing net buyers and 9 new net buyers) could have their emissions exceed their RTC holdings, based on 2011 emission data. These 15 facilities are expected to purchase 0.46 tpd of NOx RTCs from the market, up from 0.39 that are currently needed. If RTC price remains constant following the shave, the facilities would incur costs of about $100,000 for the additional 0.07 tpd of NOx credits needed (0.46-0.39=0.07). If the price increases by 100 percent, 200 percent, or 300 percent, then these facilities would incur a higher cost of $740,000/$1.4 million/$2 million respectively, not only for the cost of additional RTCs needed due to the initial 4 tpd shave but also for the higher price of the 0.39 tpd already needed before the shave. [14]

As a result of the 14 tpd shave fully phased-in in 2022, 15 of the 45 facilities are expected to have their 2022 emissions exceed their 2022 RTC holdings, unless they make changes

[14] The formula used for calculating this cost is: [pre-shave RTC purchase necessary for compliance*(post-shave RTC price – pre-shave RTC price) + (post-shave RTC purchase necessary for compliance - pre-shave RTC purchase necessary for compliance)*post-shave price]*365 days.

at their facility or purchase RTCs (7 existing net buyers plus 8 new net buyers).[15] When CEQA alternatives are considered, the number of facilities that fall into this group of net buyers ranges from 11 to 20.

Under the proposed shave, these 15 facilities are expected to need to purchase 0.78 tpd of NOx RTCs from the market, up from 0.37 tpd that are currently needed. If RTC price remains constant following the shave, the facilities would incur costs of a little over half a million dollars for the additional 0.41 tpd of NOx RTCs needed (0.78–0.37=0.41). If the price increases by 100 percent, 200 percent, or 300 percent, then these facilities would incur a higher cost of $1.6/$2.7/$3.8 million respectively, not only for the cost of additional RTCs needed due to the shave but also for the higher price of 0.37 tpd already needed before the shave.

Under the proposed shave, these compliance costs that could be potentially incurred by some of these 45 facilities would add to the total compliance cost of full control equipment installation by up to nine percent[16]. Under the CEQA alternatives, these 45 facilities would be subject to different shaves and result in different projected amounts of RTCs that would needed to be purchased. Under the CEQA alternatives, the potential compliance costs for some of these 45 facilities would range between over $300,000 to about $5 million, depending on the price differential assumed. It is assumed these funds would remain in the local economy as they flow to other RECLAIM holders who are selling RTCs. The table below summarizes the potential compliance cost for the proposed rule amendment and the CEQA alternatives for this group of facilities under different price scenarios.

Table 21: Annual Price Increases for Net Buyers for 45 Facilities

45 Facilities	Number of Net Buyers	Amount of RTCs to be purchased (TPD)	Current Market Price (Thousands)	Estimated Increases in Cost		
				100 percent differential (Thousands)	200 percent differential (Thousands)	300 percent differential (Thousands)
Proposed Rule Amendments	15	0.78	$570	$1,650	$2,730	$3,770
Alternative 1	18	0.88	$700	$1,920	$3,130	$4,310
Alternative 2	20	1.06	$950	$2,410	$3,870	$5,280
Alternative 3	11	0.61	$330	$1,170	$2,000	$2,820
Alternative 4	11	0.64	$370	$1,240	$2,120	$2,970

[15] 2022 emissions are calculated by applying a growth factor of 0.87 to the 30 power plants' 2011 actual emissions and 1.10 growth factor to the remaining 15 facilities' 2011 actual emissions.
[16] To arrive at this percent increase, the total compliance cost of full BARCT installation was concerted to 2015Q1 dollars using the Marshall & Swift Indices.

Potential Compliance Cost for Net Buyers: 210 Facilities Not Subject to Shave

Among the 210 facilities that would be exempt from the proposed shave, approximately 100 facilities purchase NOx RTCs to remain in compliance according to the 2011 audited emissions and RTC holdings data. These 100 facilities represent 13 different industries with half belonging to the manufacturing sector (NAICS 31-33). In 2011, this group's NOx RTC holdings fell short of its actual NOx emissions by roughly 1 tpd, and this gap is expected to widen to 1.24 tpd in 2022 due to industry growth.[17] Therefore, some facilities needed to purchase RTCs from the market to retain their level of compliance.

Under the proposed rule amendments, the 210 facilities would not be shaved. If the price of NOx RTCs remains unchanged from the current market price, no additional compliance cost would be incurred. If, however, the price increases by 100 percent, 200 percent, or 300 percent, then these facilities would have to pay an additional $1.7/$3.4/$5.1 million respectively in order to be compliant. These potential compliance costs would add to the total annual compliance cost by up to 8 percent.[18]

Under the CEQA alternatives, these 210 facilities would be subject to different shaves and the projected amount of RTCs needed to be purchased would increase as a result. The potential compliance cost under these alternatives would range between $600,000 and $10.4 million annually, depending on the price differential assumed. It is assumed these funds would remain in the local economy as they flow to other RECLAIM holders who are selling RTCs. Table 22 below summarizes the potential compliance cost for the proposed rule amendment and the CEQA alternatives for this group of facilities, under different price scenarios.

Table 22: Annual Price Increases for Net Buyers in 210 Facilities Group

210 Facilities	Number of Net Buyers	Amount of RTCs to be purchased (TPD)	Current Market Price	Estimated Increases in Cost		
				100 percent differential	200 percent differential	300 percent differential
Proposed Rule Amendments	103	1.24	$0	$1,720	$3,430	$5,100
Alternative 1	149	2.08	$1,150	$4,020	$6,890	$9,670
Alternative 2	153	2.22	$1,340	$4,400	$7,470	$10,430
Alternative 3	128	1.70	$630	$2,980	$5,330	$7,600
Alternative 4	132	1.75	$700	$3,120	$5,540	$7,880

[17] 2022 emissions are calculated by applying a growth factor of 1.3 to each of the 210 facilities' 2011 actual emissions.
[18] See Footnote 6.

Value of Shaved Excess RTCs

SCAQMD staff believes the shave of 5.21 tons is necessary in order to induce the 20 facilities with identified control equipment to upgrade their control equipment. This is especially likely given that about 60 percent of the 2.7 tpd of RTCs traded in CY 2011 were made by the 20 affected facilities.

In response to stakeholder comments, the value of the remaining 5.21 shave (14 tpd – 8.79 tpd control equipment reductions from installing controls = 5.21) is estimated here. Applying the base price of $3,779, the current market value for 5.21 tpd for shaved credits is $7 million annually.

However, the market value of the shaved excess credits should not be taken as an investment loss. Except for the credits that would be removed from the investors' accounts, at least a portion of the remaining proposed shave would be applied to an affected facility's initial RTC holdings that were allocated by SCAQMD at no cost. Therefore, staff considers that there is no investment loss associated with shaving these original allocations.

Staff does acknowledge that the shaved facilities and investors would potentially face an investment loss on the IYBs purchased from the market. However, this loss could be possibly made up for if, after the proposed shave and/or after control equipment installation, a facility still has surplus RTC holdings that can be traded at a higher RTC price.[19]

Costs of Command and Control (CAC) versus the Proposed Amendments to NOx RECLAIM

RECLAIM allows facilities to use the least cost option to comply with their allocations. Unlike the command-and-control regulations where every source has to be controlled to the same emission standard, RECLAIM facilities can purchase RTCs from others in lieu of control equipment installation. Under this principle and based on the perspective of the entire RECLAIM market, as long as there is a positive supply of RTCs on the market, RECLAIM facilities may purchase RTCs to meet their compliance requirements. If the market supply of RTCs decreases and RTC prices increase, it becomes more and more economical to for a facility to install cost-effective control equipment. Assuming the least cost compliance option is chosen and there is an availability of RTCs, the cost of implementing RECLAIM must therefore always be less than CAC for a facility with the option to install control equipment. For facilities with no cost-effective equipment identified by the BARCT analysis, there is no incremental cost due to RECLAIM as long as the affected facility does not produce emissions exceeding its originally allocated holdings.

[19] The costs of shaved RTCs and increased RTC prices have not been considered as costs in the past and may not be required to consider.

As discussed in the Draft Staff Report (DSR), staff has identified and demonstrated that technologically feasible and cost-effective control equipment are commercially available to support the proposed 14 tpd shave from the NOx RECLAIM universe. Table 23 shows, by industry group, the 2022 remaining emissions, the current RTC holdings, the percentage shave, the RTCs holdings after the shave, and the surplus or deficit of RTCs after the shave. After the shave and after control equipment is installed, the refineries as a whole are projected to have 1.81 tpd surplus RTCs on the net. The power plants, the investors, and the 26 other major facilities would have 0.86, 0.39 and 0.16 tpd surplus RTCs on the net, respectively. The 210 remaining facilities would not be subject to any shave; however, their emissions would grow above the RTC holdings that they currently have, and they would have to buy RTCs from other sectors to reconcile their projected emissions.

Table 23: Estimated Surplus RTCs after 14 tpd Shave by Industry Group

	9 Refineries	14 Investors	30 Power Plants	26 Major Facilities	210 Other Facilities	Total
A. 2022 Remaining Emissions (tpd)	2.71	0	2.04	1.93 (note)	3.50 (note)	10.2
B. Current RTC Holdings (tpd)	13.28	1.16	5.47	3.94	2.65	26.5
C. % Shave	66%	66%	47%	47%	0%	-
D. RTCs After Shave = B x (1-C)	4.52	0.39	2.90	2.09	2.65	12.5
E. Surplus RTCs After Shave and Installing Control = D – A	1.81	0.39	0.86	0.16	(0.85)	2.3

Note: The 2011 emissions from 210 facilities = 20 tpd – (11.35 (refineries) – 1.92 (power plants) – 4.04 (26 other major facilities)) = 2.69 tpd. The 2022 remaining emissions for 210 facilities using a composite growth factor of 1.3 = 2.69 x 1.3 = 3.50 tpd. The 2022 remaining emissions for 26 major facilities including process units' emissions = Total 2022 remaining emissions for entire universe – (2022 remaining emissions for refineries + 2022 remaining emissions from power plants + 2022 remaining emissions from 210 facilities) = 10.18 – (2.71+2.04+3.50) = 1.93 tpd

Based on the market analysis of projected net buyers, the proposed shave is estimated to increase the annual RTC purchase cost for the 45 shaved facilities with no identified control equipment (30 power plans and 15 non-refinery major facilities) by approximately $569,000-$3,770,000, depending on the price scenario. For the 210 facilities whose RTC holdings would not be shaved, the increased RTC cost annually was estimated at $0-$5,090,000, also depending on the price scenario. Therefore, the total incremental cost associated with RTC purchase would fall in the range of $569,000-$8,860,000 annually. Converting this cost to 2014 dollars and multiplying it by 25 years, the typical BARCT control equipment life, the overall incremental compliance cost associated with RTC purchase over the course of 25 years would be approximately $14 million (in 2014 dollars) if RTC price stays constant, and approximately $219 million (in 2014 dollars) if RTC price increases to $14,999.

However, it should again be noted that the amount that the projected net buyers paying to purchase RTCs would benefit other RECLAIM facilities with surplus credits to trade.

They include the RECLAIM facilities that install control equipment and generate surplus RTCs for sale and thus reduce the costs of installing and operating control.

The costs of installing control equipment over the equipment life of 25 years that would be incurred under the command-and-control regulations as shown in Table 4.3 and Table 4.4 of the DSR (expressed in 2014 dollars):

Low end of range: $570 million (refinery) + $53 million (non-refinery) = $623 million
High end of range: $928 million (refinery) + $160 million (non-refinery) = $1.09 billion

Under the RECLAIM program, under the scenario where the RTC price rises to $14,999 and control equipment is fully installed by the nine refineries and 11 non-refinery facilities, the overall net cost would be:

Low end of range: ($623 million + $219 million) - $219 million = $623 million
High end of range: ($1.09 billion + $219 million) - $219 million = $1.09 billion

The last two terms on the left-hand-side of the equation above represent the incremental cost of RTC purchase for the net buyers and the corresponding benefits accrued to the credit seller, respectively. Note that the credit sellers may not only include facilities that install control equipment, but also the facilities with surplus NOx RTCs for sale. Overall, the net compliance costs of implementing control due to the proposed amendments to the RECLAIM program would be equivalent to the compliance costs of implementing command-and-control regulations to achieve the same level of NOx emission reductions.

Based on projections reported in Table 23, the net amount of RTCs available to trade due to full BARCT implementation could be as high as 2.3 tpd, or $314 million at $14,999 per ton, assuming that the facilities do not need to use the excess for any compliance purposes. In addition, since trading in the RECLAIM market is dynamic, there could be additional benefits due to multiple tradings, trading across cycles, or trading as "Infinite Year Block" (IYB) RTCs in lieu of discrete RTC credits.[20]

Since its inception, the RECLAIM program has provided many monetary benefits to its participants relative to CAC. For example, under the RECLAIM program, refineries have saved approximately $205 million since 2007 by delaying installation of about 47 SCRs from 2007 to 2015. This number was estimated as follows:

The total capital and installation of the 47 SCR was estimated to be $460 million in the 2005 amendments (not counting the operating and maintenance cost). If the facilities

[20] The price for discrete RTC is much lower than the price for IYB RTCs. For example, during the 12-month period from August 2014 to July 2015, the rolling average price for discrete RTCs was $2,734 per ton whereas the rolling average price for IYB RTCs was $181,035 per ton.

invested this money at a 5 % rate of return over the 8 years, they would have saved a total of $220 million, i.e., ($460*(1.05)^8-$460).

The affected facilities purchased 1.7 tons/day in lieu of not installing these 47 SCRs. The cost of purchasing these credits over the past 8 years is estimated to be about $15 million, (i.e., 1.7 tons *365*$3,000 per ton of RTCs * 8 years). The total net cumulative benefits of the program for these facilities only would have been about $205 million.

Additional factors under RECLAIM that could lower the cost of RECLAIM as compared with the CAC but cannot be quantified for inclusion into the analysis herein are:

- The control technologies that can help reduce emissions from RECLAIM sources are commercially available and some are achieved-in-practice.
- Sources subject to Rule 2005—New Source Review for RECLAIM—are not subject to the 1.2 offset factor that is applied to new and modified sources for non-RECLAIM facilities when purchasing or using emission reduction credits (ERCs).21

- Rule 2005 facilities can sell excess RTC offset holdings at the end of each compliance year resulting from the new and modified sources. This option is not available under CAC.

- RTCs resulting from shutdowns are not subject to the best available control technology (BACT) discount that is applicable to non-RECLAIM sources.

- RECLAIM facilities can take advantage of facility or program emission averaging to implement the least cost controls. Cross-cycle trading under RECLAIM provides additional compliance flexibility.

- The non-RECLAIM facilities are subject to source specific standards (e.g. concentration limits or mass emission limits) that cannot be exceeded at any time whereas, for the most part, RECLAIM facilities can operate their equipment with flexibility and reconcile the emissions with the facility caps at the end of the compliance quarter and year;

- In addition, the RECLAIM facilities have received monetary benefits from trading their RTCs through the past 22-year life of the RECLAIM program to reduce the costs of compliance.

Because of the above reasons, staff believes that the RECLAIM facilities are not being disproportionately impacted by participating in the RECLAIM program, and costs are equivalent to or less than what would have occurred under CAC.

[21] Rule 2005—New Source Review for RECLAIM.

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