APPENDIX A

ARB Staff's Assessment of the South Coast Air Quality Management District's 2015 and 2016 RECLAIM Amendments

Staff Report

on

Assessment of the South Coast Air Quality Management District's 2015 and 2016 RECLAIM Amendments

March 2017

California Environmental Protection Agency

Air Resources Board

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1. EXECUTIVE SUMMARY

As required under State law, this report provides ARB staff's assessment of recent amendments to the South Coast Air Quality Management District's (District) REgional CLean Air Incentives Market (RECLAIM) program. RECLAIM is a market-based regulatory structure that covers the largest emitters of oxides of nitrogen (NOx) and sulfur oxide (SOx) emissions in the South Coast region. The program establishes a declining emissions cap, and businesses within RECLAIM are issued RECLAIM credits that they may trade as part of their overall compliance strategy.

First established in 1993, the District has amended RECLAIM several times since its inception to reflect advances in control technologies as required under State law and establish more stringent caps. This periodic strengthening of the program has been essential to achieve the emission reductions needed to meet increasingly health protective federal air quality standards. Over the 23 year period since its creation, the District estimates that in aggregate NOx emissions from RECLAIM facilities have decreased approximately 70 percent, or 50 tons per day (tpd).

The District first amended RECLAIM in 2001 to address market issues associated with the energy crisis, and then further amended the program in 2005 reflecting a new assessment for Best Available Retrofit Control Technologies (BARCT) for NOx, and in 2010 for SOx. Both the 2005 and 2010 amendments established more stringent BARCT levels and associated reductions in the amount of trading credits allowed over time. Most recently, in December 2015 the District Board adopted amendments to achieve additional NOx emission reductions through 2023 and amended the program again in October 2016 to address how trading credits from facilities that shut down are handled.

The South Coast Board's 2015 and 2016 actions were designed to reduce the number of NOx credits in the RECLAIM market between 2016 and 2023 in order to induce covered businesses to install more efficient control technologies. The District estimates that taken together the 2015 and 2016 amendments should reduce RECLAIM NOx emissions an additional 12 tpd from 2011. Nevertheless, the amount and pace of the reduction in trading credits raised concerns that the amendments do not meet State requirements for minimum control efficiencies and overall emission reduction needs for attaining federal air quality standards. RECLAIM industries represent approximately 40 percent of stationary source emissions within the South Coast, thus securing continuing emission reductions from these sources is a key element of meeting health based federal air quality standards over the next fifteen years.

ARB staff has reviewed the 2015 and 2016 amendments and the overall RECLAIM program focusing on two questions. The first is whether the recent amendments ensure that RECLAIM provides reductions in aggregate from all RECLAIM sources equal to what would be achieved through direct regulation. This is a State law requirement that RECLAIM must meet a BARCT technology threshold. The second issue is whether the timing and magnitude of the emission reductions is supportive of attaining air quality

standards. ARB staff has concluded that the reduction in the amount of trading credits approved by the District Board will not be sufficient to achieve a BARCT level of control as required under State law and that there are additional feasible emission reductions that can be achieved, especially from the refinery sector.

To assess the adequacy of the District's identification of the emission limits that constitute a BARCT level of control, ARB staff first reviewed the District's RECLAIM staff report that documents the District's identification of emission limits and control technologies for equipment operating at covered industries. Staff concluded that the District staff report is a thorough and technically sound analysis and appropriately identifies the BARCT level of emissions control for covered sources. Therefore, the primary focus of ARB staff's assessment was whether the amount of RECLAIM trading credits is being reduced to a level low enough to induce businesses to install additional controls to ensure the program achieves the BARCT level of control identified by the District.

The level of the emissions cap and the mechanism for ensuring market liquidity are critical to meeting the environmental goal of a market program and to buffer against market price spikes. In the RECLAIM market, the number of trading credits available serves as both the emissions cap and the market liquidity/cost containment mechanism. Other market systems use different cost containment mechanisms such as a price containment reserve—usually a set aside pool of trading credits from within the cap. The District's method makes it critical that the number of available trading credits be carefully balanced to meet those two objectives. If too many credits are available in the RECLAIM market then facilities will be incentivized to purchase surplus credits rather than install control technologies. In this situation, the program will not meet the requirement that RECLAIM, in aggregate, is equivalent to BARCT.

For its review of the timing and magnitude of the reduction in the amount of trading credits, ARB staff reviewed the historical record of RECLAIM implementation: the level of control in place at individual facilities, the amount of trading credits held by participants in the market, and the emission reductions achieved over time. These data provided the context for evaluating the timing and magnitude of the adopted reduction in RECLAIM trading credits and the compliance margin provided in the form of additional RECLAIM trading credits allocated in the market above the emissions target to keep the market functioning smoothly. The analysis included a specific emphasis on refineries, which are the largest source of emissions within the RECLAIM program, as well as the largest holder of trading credits. This analysis informed whether, based on historical performance, the level of trading credits the District set was sufficient to ensure that control technologies are installed to meet the aggregate BARCT requirement by 2023.

On December 2, 2016, the District staff released a draft final of its 2016 Air Quality Management Plan (AQMP), which included a measure for further reductions from RECLAIM. In that measure, District staff identified the need to assess the size of the differential between the amount of trading credits available in the market, and actual emissions. District staff also identified a number of potential actions that could achieve

further reductions from RECLAIM sources, including as a primary focus, an assessment of whether more emission reductions could be achieved without the RECLAIM program, and if so, explore how the program could be sunset in an orderly and equitable fashion. The District Board approved the AQMP at their March 3, 2017 District Board meeting. This included an amendment to further strengthen the RECLAIM measure by advancing the 5 tpd in NOx emission reductions from 2031 to 2025. In addition the Board directed staff to transition the program to an individual rule based regulatory structure command-and-control based regulation as soon as practicable.

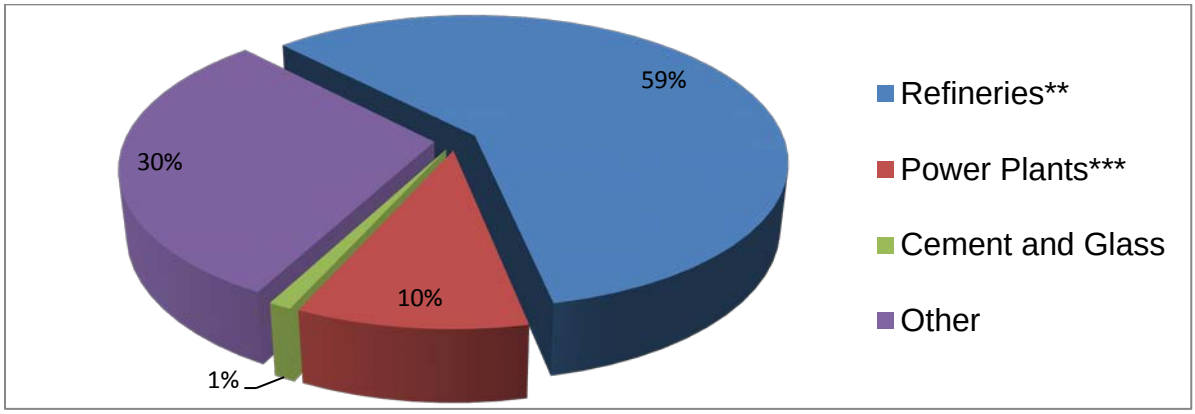
ARB staff believes the adopted actions will resolve the issues raised in ARB's review, and staff will continue to work with the District to develop an approvable program. To support this effort, this report provides ARB staff recommendations to ensure the program meets requirements of State law, and contributes to achieving reductions needed to meet federal air quality standards. In particular, the transition of the RECLAIM program to an individual rule-based regulatory structure will maximize the potential for direct emission reductions to address both regional attainment needs and localized impacts in disadvantaged communities. ARB staff also recommends the District consider transitioning the refinery sector into an individual rule structure first as this sector provides the greatest opportunity for early emission reductions.

Because the 2015/2016 amendments are a strengthening of the 2010 version of the rule, ARB staff proposes to submit these amendments to the United States Environmental Protection Agency (U.S. EPA). Subsequent approval of these amendments into the State Implementation Plan will make the new provisions and associated emission reductions federally enforceable. To support this submittal, the District is developing additional documentation to demonstrate that the 2015/2016 amendments ensure, in the aggregate, NOx emission reductions that meet federal requirements for Reasonably Available Control Measures/Reasonably Available Control Technology (RACM/RACT). RACT is a less stringent level of control than what is required under BARCT, which was the focus of ARB staff's analysis. The 2015/2016 amendments and documentation needed to meet the RACM/RACT requirements must be submitted and approved by U.S. EPA by November 16, 2017. Finally, in addition to revisions to meet BARCT, the District must demonstrate that it is meeting Clean Air Act requirements for Best Available Control Measures/Best Available Control Technology (BACM/BACT) to meet the Serious nonattainment area requirements for PM2.5. ARB staff believe the amendments to the new RECLAIM measure adopted at the March 3 District Board meeting which accelerate the NOx reductions and provide direction to transition the program to a direct regulatory approach as soon as practicable meets BACM/BACT requirements within the timeframes specified within the Clean Air Act.

2. BACKGROUND

RECLAIM was first adopted by the District in October 1993 and was California's first air pollution emissions trading program. The goal of the program was to achieve NOx and SOx reductions from the largest emitting stationary sources in the basin while providing facilities flexibility in determining the most cost-effective means for installing controls. All facilities that emit 4 tons per year (tpy) or more of NOx or SOx are required to participate in the RECLAIM program, excluding those facilities used for certain, essential public services. There are currently 275 facilities included in the RECLAIM market, representing combined emissions of approximately 20 tpd of NOx. This represents approximately 40 percent of the total stationary source facility emissions in the region. RECLAIM facilities include electricity generating facilities (power plants), petroleum refineries, and manufacturers of cement, glass, steel and other energy intensive products. As shown in Figure 1, refineries, the largest stationary source category, account for approximately 60 percent of the RECLAIM NOx emissions.

Figure 1: 2011 Distribution of NOx Emissions by RECLAIM Source Categories[1]



**the vast majority of emissions from refineries comes from 9 facilities
***the majority of emissions from power plants comes from 21 facilities

The RECLAIM program is designed to achieve aggregate emissions goals for NOx and SOx that are equivalent to or better than what would be achieved with a BARCT level of control at individual facilities. The timeframe for achieving these goals is determined by planning horizons for meeting air quality standards. The market currency is RECLAIM trading credits (trading credits or RTCs), with each trading credit representing one pound of NOx or SOx emissions. The cap in the total number of trading credits allowed in the system is set at a level sufficient to reach the emissions target, while providing a compliance margin of additional RECLAIM trading credits above the BARCT level emissions to ensure market liquidity and cost containment. These additional credits provide a safety margin to reconcile potential differences between facilities estimated compliance obligation at the beginning of the compliance period, and actual emissions determined at the end of the compliance period.

[1] Based on District Draft Final Staff Report – NOx RECLAIM, December 4, 2015

When the market was first established in 1993, each RECLAIM facility received an initial allocation of RTCs. The initial allocations accounted for past throughput with a final allocation that accounted for BARCT controls (existing rules and control measures). The allocation decreased over time and represented the facility cap for NOx or SOx emissions from all equipment operating at the facility. The emission level for the first year was based on historic peak production and accounted for effective compliance of rules currently in place. Allocations after 2000 included a "shave" to ensure overall reductions from RECLAIM facilities were consistent with BARCT levels established in the AQMP. These adjustments to a facility's allocation are applied to future allocations. Additional "shaves" have been implemented to adjust initial allocations in 2005 and 2010 to respond to continuing advances in BARCT and the needs of the current AQMP. Facilities with emissions that are above their allocation of RTCs can purchase credits from other facilities. At the end of each annual compliance period, facilities must "hold" sufficient RTCs to cover their actual emissions.

To ensure a more liquid market, as well as protect RECLAIM participants from price fluctuations that may be caused if all RTCs expire at the same time, the RECLAIM program also randomly placed RECLAIM facilities into one of two compliance cycles, either from January 1 to December 31 or from July 1 to June 30. RECLAIM facilities must submit a quarterly report to the District that includes a certification of emissions. Each facility must also submit an Annual Permit Emissions Program report showing any corrections to the quarterly emissions and a final reconciliation of emissions and RTC holdings for the year. To provide an additional cost containment safeguard, the program includes a price threshold for RTCs that when exceeded triggers a review by the Executive Officer and recommendations to the Board to stabilize the market.

3. OVERVIEW OF 2015 AND 2016 RECLAIM AMENDMENTS

a. December 2015 Amendments

To achieve further NOx reductions for meeting the 24-hour PM2.5 standard in 2014 and the 8-hour ozone standard by 2023, the District's 2012 AQMP included a commitment to pursue further amendments to RECLAIM. District staff began a comprehensive rulemaking process in October 2012. The focus of these amendments was on the 37 facilities with the largest emissions, which represent 85 percent of the RECLAIM emissions. The technical evaluation to support the rulemaking included facility surveys and site visits, a comprehensive assessment by District staff of advances in BARCT since the 2005 amendments, as well as an independent BARCT analysis conducted by two consultants.

Based on this analysis, including consideration of control costs and cost-effectiveness, District staff proposed new BARCT levels for equipment in the refinery sector, as well as container glass melting furnaces, cement kilns, sodium silicate furnaces, metal melting furnaces, gas turbines, and internal combustion engines. No new BARCT was proposed for electricity generating facilities (EGUs), as the vast majority of equipment in this sector was already permitted at BARCT. These BARCT levels on individual equipment types provide the basis for determining the aggregate reductions needed to meet a BARCT level of control.

From this analysis, the proposed amendments identified a new emissions level that would represent a BARCT level of control in aggregate, and the associated reduction in trading credits necessary to achieve that level by 2023. Determination of the magnitude of allowable trading credits associated with that goal included additional consideration of growth from new facilities entering the market, accounting for emissions from shut down facilities, and an added compliance margin. In aggregate, a 14 tpd reduction in NOx trading credits was initially proposed by 2023. The proposal also specified the schedule for reducing the trading credits over time, as well as the distribution of the overall reduction in credits amongst industry sectors. The largest portion of the shave was proposed for the refinery sector given this sector is above BARCT and cost-effective control technologies are available to achieve additional reductions and because sources such as power plants were already at BARCT emission levels. The schedule for implementing the shave ran over a seven year period between 2016 and 2022, with the largest increment occurring in the first year to remove surplus trading credits and ensure timely implementation of controls. A number of other modifications were also proposed to improve the functioning of the program, including provisions associated with electricity generation facilities, price triggers, and a methodology to retire trading credits from shut down facilities.

Based on comments from the oil industry regarding the cost and feasibility of further controls, the amendment adopted by the Board resulted in a smaller RTC reduction of 12 tpd and a schedule that implemented these reductions at a slower pace. In addition,

the Board postponed acting on proposed revisions for treatment of shut down emissions, and remanded them back to staff for further consideration.

b. October 2016 Amendments

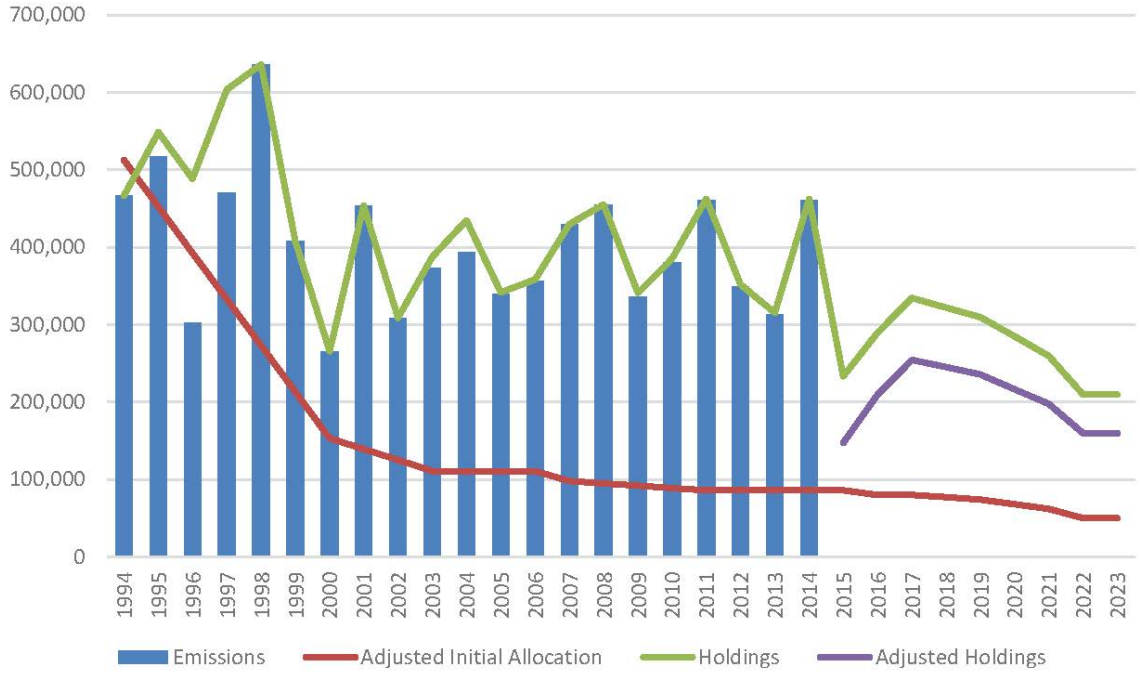
At their October 7, 2016 Board meeting, the District adopted revisions to the RECLAIM shutdown provisions with the intention to "achieve a closer alignment in the treatment of shutdown credits under RECLAIM with emission reduction credits that are used in command-and-control rules".[2] The provisions establish the criteria for determining a facility shut down and the methodology for by which the facility's future holdings will be reduced. Adoption of the shut down provisions will minimize the availability of surplus RTCs in the RECLAIM market from shutdown facilities that in the past has kept the cost of RTCs low and made their purchase less costly than the installation of BARCT controls.

Under the adopted provisions, the NOx RTC holdings of a facility that shuts down will be reduced from all future compliance years by the difference between the average NOx emissions in the two highest emitting years over the last five years, and the facility's average emissions had BARCT been installed in those same two years. This adjustment is not to exceed the facility's adjusted initial allocation which is the amount of RTCs a facility is allocated each year after the shave has been applied. The new shut down provision will reduce the majority of surplus RTCs entering the market in the future by reducing the facility's adjusted initial RTC holdings that can be sold to BARCT. While the shutdown provision does not discount RTCs that were purchased and therefore not included in the adjusted initial RTC holdings, District staff determined that their entry into the RECLAIM market would be minimal and would not impede the installation of BARCT at the largest RECLAIM facilities.

Figure 2 provides an example of how the discounting would work for one facility. The blue bars represent the facility's emissions, while the red line represents the initial allocations, the green line the facility's actual holdings, and the purple line the adjusted holdings that will remain in the market for use by other facilities.

[2] District Draft Staff Report Proposed Amendments to Regulation XX – Regional Clean Air Incentives Market, September 6, 2016

Figure 2: Sample Scenario for RTC Holding Reduction upon Shutdown[3]



[3] District Draft Staff Report Proposed Amendments to Regulation XX – Regional Clean Air Incentives Market, September 6, 2016

4. ARB REVIEW

The adopted amendments raised concerns regarding the adequacy of the RECLAIM program to meet minimum requirements of State law regarding market-based trading programs for criteria pollutants. Equally important, the South Coast faces deadlines for meeting health based standards for PM2.5 and ozone over the next fifteen years. ARB is charged with coordinating efforts to meet these standards, and must review District plans to ensure they are approvable under the federal Clean Air Act.

State law establishes specific requirements for RECLAIM and other air district operated market-based trading programs. Districts may adopt alternative market-based trading programs only if the program results in aggregate emission reductions that are equivalent to or greater than command-and-control regulations at individual facilities (HSC 39616(c)(1)). This required level of control is known as BARCT and is defined as an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and cost impacts. Because BARCT level emission limits continuously evolve as new control and process technologies are developed, it must be periodically reassessed to ensure RECLAIM achieves equivalent reductions over time. (HSC 39616, 40440.2, subd. (c); South Coast Air Quality Management District Rule 2015(b)(3)(A), (F), (J).) In addition, under HSC 40920.5 and 40919, BARCT represents the minimum level of control for an extreme nonattainment area such as South Coast.

In addition to ARB's responsibility for ensuring that market-based systems meet requirements outlined in the HSC, ARB is also the lead agency for overseeing all of the State's air quality efforts, including reviewing District rules and development of air quality management plans designed to meet State and federal air quality standards. State law also directs how ARB and the District work together in the development of these plans. District decisions and the air quality management plan are subject to Board approval to ensure they meet State and federal requirements (HSC 40911). State law sets out processes for ARB and the District to follow in developing, reviewing, identifying and correcting any deficiencies with District plans (HSC 40467, 41503). If these processes do not correct the shortcoming in the District plan, then ARB has the responsibility and authority to amend the local plan through a public process (HSC 40469, 41503.2).

These requirements provide the basis for ARB's statutory review of the RECLAIM amendments, as well as recommendations for moving forward with the District to develop effective solutions for rectifying the identified deficiencies.

5. U.S. ENVIRONMENTAL PROTECTION AGENCY REVIEW

On March 15, 2016, subsequent to the South Coast Board's adoption of the 2015 RECLAIM amendments, U.S. EPA disapproved the 2005/2010 RECLAIM amendments previously submitted to U.S. EPA as not meeting Clean Air Act requirements for (RACM/RACT in the District's moderate area plan for the 24-hour 35 ug/m3 PM2.5 standard (PM2.5 Plan). U.S. EPA's disapproval referenced discussion in the District's staff report for the 2015 amendments regarding the availability of surplus trading credits. RACM/RACT is a federal requirement that applies to large sources of air pollutants. It is separate from the State law requirement that RECLAIM must in aggregate meet a BARCT technology threshold.

U.S. EPA, in its action on the PM2.5 Plan, concluded "Given the information in the Plan about "excess" NOx RTCs in the 2010 RECLAIM program and the new information submitted by the commenters indicating that these excess RTCs have artificially depressed NO_X RTC prices during the 2009-2013 period covered by the Plan, thus allowing RECLAIM facilities to avoid installing technically feasible and cost-effective NOx pollution control equipment during this period, and given the absence of a demonstration in the Plan to support a conclusion that the 2010 RECLAIM program ensures, in the aggregate, NOx emission reductions equivalent to RACT-level controls for these sources, we are disapproving the RACM/RACT demonstration in the Plan."[4]

U.S. EPA noted that the District can correct the deficiency in the 2005/2010 amendments by submitting revisions to the NOx RECLAIM program together with documentation sufficient to demonstrate that the revised program ensures, in the aggregate, NOx emission reductions equivalent to RACT-level controls for covered facilities. This revision must be submitted and approved by U.S. EPA by November 16, 2017 or the region will face Clean Air Act sanctions. On November 3, 2016, U.S. EPA also proposed to partially disapprove the District's RACT SIP for the 75 part per billion ozone standard for similar reasons relating to the 2005/2010 RECLAIM program. Consequently, a submittal of revisions and documentation similar to those for the PM2.5 SIP by the District is needed to correct the ozone RACT deficiency.

Finally, as part of the approval for the District's serious area PM2.5 plan, the District will have to demonstrate that it is meeting Clean Air Act requirements for BACM/BACT. BACM/BACT is a more stringent level of control required under the Clean Air Act for serious PM plans than the RACM/RACT level of control required for moderate PM plans.

[4] https://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2015-0204-0212

6. ASSESSMENT OF WHETHER THE ADOPTED AMENDMENTS ACHIEVE STATE LAW REQUIREMENTS FOR BARCT LEVEL CONTROL

ARB staff's evaluation of whether the adopted amendments would ensure that control technologies are installed to meet the aggregate BARCT requirement required under State law focused on three elements:

a. The BARCT emission limits for individual equipment types.
b. The magnitude of the shave in trading credits and its adequacy in meeting the goal of BARCT emissions in aggregate.
c. The timing of the adopted shave with respect to attainment deadlines.

a. BARCT Emission Limits

As noted earlier, District staff conducted a comprehensive assessment of current control technologies to establish BARCT levels for key equipment. This included contracting with two firms - Environmental Technology Services and Norton Engineering Consultants - for an independent BARCT analysis. Norton Engineering's analysis included site visits to six of the nine refineries, and provided the costs of each control option, the size and space needed for control equipment, and the time needed to install the control technologies. District staff then used this information to evaluate control costs and cost-effectiveness. This included assessment of the useful life of equipment, evaluation of several cash flow cost-effectiveness methods, and comparison to the District's cost-effectiveness thresholds. The BARCT control levels, number of affected facilities, and incremental cost-effectiveness are summarized in Table 1, excerpted from the District staff report.

The District's technical assessment was detailed and thoroughly documented, and supported by an independent review of available technologies. The assessment demonstrated these BARCT limits have been achieved in practice and, therefore, concluded that control technologies exist to achieve the identified limits. For example, while each refinery facility is unique, these limits are being achieved at some units in the South Coast, demonstrating the feasibility of more effective controls. In most cases, lower NOx limits could be achieved through installation of selective catalytic reduction (SCR) technology. Although there were small differences in engineering assumptions between District staff and Norton Engineering for boilers, District staff accounted for this uncertainty both in evaluating cost-effectiveness and in setting the shave in trading credits, as will be discussed in later sections. The District calculated the incremental costs and cost effectiveness based on 2011-2012 baseline emissions and the Discounted Cash Flow (DCF) method. District staff used a threshold level of $50,000 per ton to determine whether individual control technologies were cost-effective. This level is consistent with the threshold used in the SOx RECLAIM amendment approved by the District Board in 2010. The proposed BARCT emission limits and the incremental cost effectiveness to install BARCT on equipment at the RECLAIM facilities are shown in the Table 1 below.

Table 1: Summary of Proposed BARCT[5]

	2015 BARCT Level	Number of Affected Facilities	Estimated No of Control Devices	Incremental Cost Effectiveness (1000 dollars/ton)
Refinery Sector				
Fluid Catalytic Cracking Units	2 ppmv at 3% O2	5	5 SCRs (or 2 SCRs + 3 LoTOx/WGS)	3 - 13
Refinery Boilers and Heaters >40 mmbtu/hr	2 ppmv or 0.002 lb/mmbtu	8	73 SCRs	28
Refinery Gas Turbines	2 ppm at 15% O2	5	7 SCRs and adding catalysts to 4 SCRs	1 - 3
Coke Calciner	10 ppmv at 3% O2	1	1 UltraCat (or 1 LoTOx/WGS)	22 - 35
Sulfur Recovery Tail Gas Incinerators	2 ppmv at 3% O2 or 95% reduction	4	6 SCRs (or 1 SCRs + 5 LoTOx/WGS)	28 – 40
Refinery Total			**91 SCRs + 1 UltraCat (or 83 SCRs and 9 LoTOx/WGS) and adding catalysts to SCRs**	**10 - 17**
Non-Refinery Sector				
Container Glass Melting Furnaces	80% reduction	1	2 SCRs (or 1 UltraCat)	3 – 7
Sodium Silicate Furnace	80% reduction	1	1 SCR (or 1 UltraCat)	4 – 8
Metal Heat Treating Furnaces	9 ppmv at 3% O2	1	1 SCR	3 – 4
Gas Turbines (non-OCS)	2 ppmv at 15% O2	3	14 SCRs	5 – 36
Internal Combustion Engines (non-OCS)	11 ppmv at 15% O2	7	16 SCRs	5 – 8
Non-Refinery Total (w/o Cement Kilns)			**34 SCRs (or 31 SCRs and 2 UltraCat)**	**6 - 7**

ARB Staff Conclusion: *ARB staff concludes the District staff report presents a thorough and technically sound analysis and appropriately identified the BARCT control limits for covered sources. The BARCT limits are cost-effective and have been achieved in practice.*

[5] District Draft Final Staff Report – NOx RECLAIM, December 4, 2015

b. Magnitude of Adopted Shave and Adequacy in Achieving BARCT Emissions in Aggregate

Based on these BARCT limits, the District calculated the level of emissions that would be achieved were BARCT implemented on all RECLAIM sources. The District analysis used 2011[6] emissions as a starting point as this reflected full implementation of the shave adopted in the 2005 amendments. District staff estimated that application of updated BARCT emission limits at RECLAIM facilities would reduce 2011 aggregate NOx emissions to 9.5 tpd, a decrease of over 50 percent. District staff then forecast 2011 emissions to 2023 using the latest planning assumptions for the regional economy to account for activity growth. This defined the BARCT level emissions of 10.2 tpd expected in 2023 as shown in Table 2.

To then determine the proposed level of trading credits associated with this more stringent level of control, the District staff included a number of adjustments as shown in Table 3. These adjustments included accounting for the potential for new facilities to enter the market, emissions from shut down facilities, and uncertainty in the BARCT analysis. Lastly, the District staff included a 10 percent compliance margin. The South Coast first introduced a compliance margin in the 2005 RECLAIM amendments to address uncertainty in market behavior. This provided a safety margin to reconcile potential differences between facilities' estimated compliance obligations at the beginning of the compliance period and actual emissions determined at the end of the compliance period. The compliance margin was determined by looking at historical data showing that approximately 10 percent of RTCs were held back by facilities as a safety margin or due to unfavorable market conditions.

Finally, in addition to the adjustments above, the amendments adopted by the Board in 2015 also included an additional 2 tpd of extra trading credits. All the adjustments together totaled 4.3 tpd, resulting in an overall shave in trading credits of 12 tpd. As a result, the total available trading credits in 2023 will be 14.5 tpd, compared to the BARCT emissions target of 10.2 tpd.

A graphical representation of the information contained in Tables 2 and 3 is also presented in Figure 3, comparing the BARCT level of emissions required in 2023, to the supply of trading credits adopted by the Board. To provide context for the appropriateness of this margin in trading credits, ARB staff looked at a number of metrics. First, at the time of the 2015 amendments, there were approximately 6 tpd of surplus trading credits held by regulated parties, representing a supply approximately 25 percent above actual emissions. A key objective of the 2015 amendments was to remove these surplus credits to stimulate the installation of controls. However, the adopted amendments result in a supply of credits more than 40 percent above BARCT-level emissions in 2023. Looking at this another way, the extra RTCs included in the adopted amendments effectively triple the compliance margin, increasing it from 10 percent to 30 percent. In addition, while the adopted shave represents a 45 percent

[6] 2012 emissions were used for power plants to better reflect the closure of San Onofre and the commissioning of new power plant facilities.

reduction in trading credits, this is less than the 50 percent reduction in emissions necessary to achieve a BARCT level of control. These metrics all indicate that although the adopted shave is expected to reduce overall emissions, it is unlikely to result in sufficient reductions in the volume of RECLAIM credits to achieve BARCT level emissions by 2023.

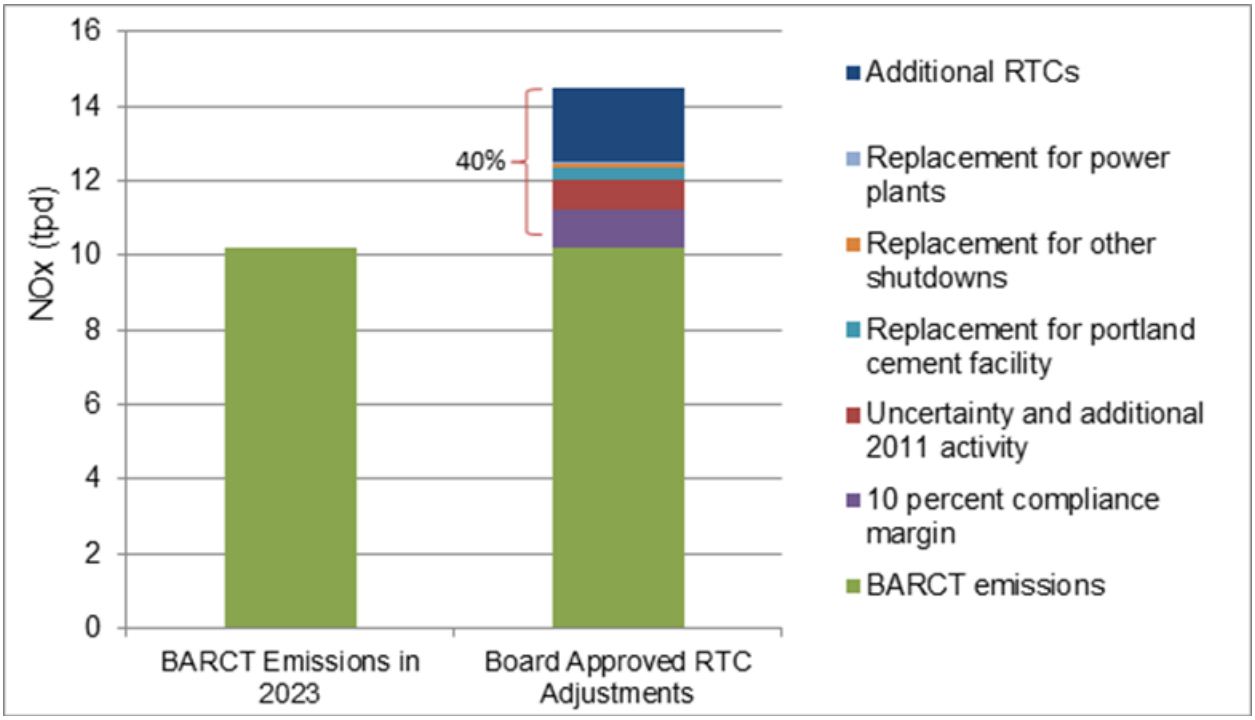
Table 2: Determination of BARCT level emissions

		Notes:
2011 Actual Emissions for RECLAIM facilities	20.7 tpd	
2015 BARCT applied to 2011 emissions	9.5 tpd	Estimated 2011 emissions reflecting implementation of 2015 BARCT limits
Growth adjustment to 2023	0.7 tpd	Growth adjustment to reflect BARCT emissions in 2023 at facilities currently in RECLAIM. This growth adjustment is consistent with past RECLAIM amendments
2023 BARCT level emissions	**10.2 tpd**	

Table 3: Determination of Associated Trading Credits

		Notes:
2023 BARCT level emissions	10.2 tpd	
Emissions from new RECLAIM facilities	+0.1 tpd	Emissions for new RECLAIM facilities entering the market (includes growth to 2023). This potential set aside for new power plants was added to make up for the loss of production from shutdown of the San Onofre Nuclear Generation Station.
Emissions from shutdown facilities	+0.4 tpd	Remaining emissions from shutdown glass and cement facilities adjusted for BARCT to allow for new replacement facilities.
BARCT uncertainty adjustment	+0.8 tpd	BARCT analysis uncertainty adjustment. This accounts for uncertainties that arose in the BARCT analysis and for additional 2011 activity level adjustments.
10% compliance margin	+1.0 tpd	This is consistent with past RECLAIM amendments.
Additional RTCs	+2 tpd	Board adopted amendments
2023 RTC Cap	**14.5 tpd**	
Difference between RTC cap and BARCT emissions	**+4.3 tpd**	

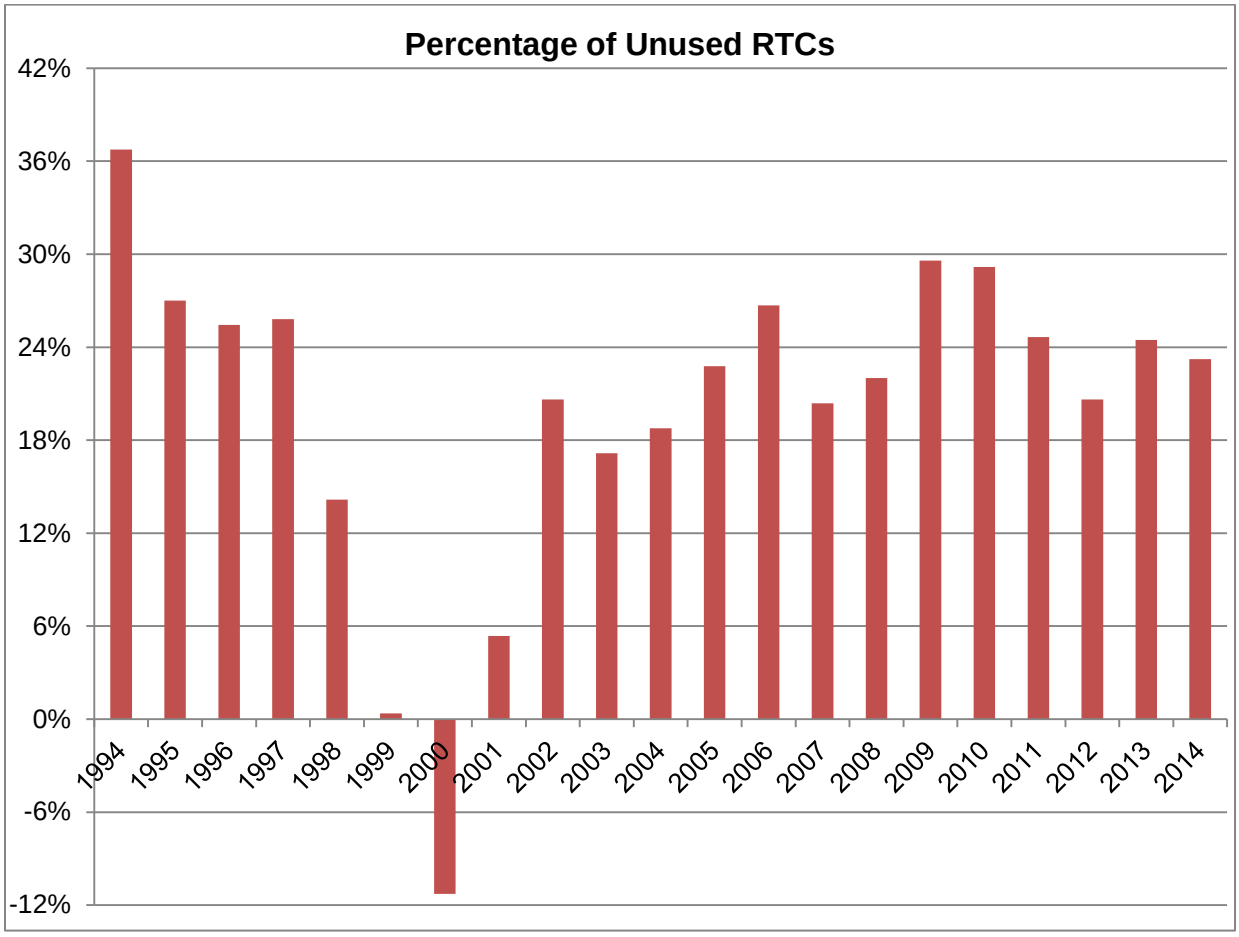
Figure 3: Comparison of BARCT Emissions with Adopted Trading Credits in 2023



To further assess the adequacy of the shave adopted by the District Board, ARB staff also looked at historic trends in both the magnitude and price of trading credits, and the impact on emission reductions achieved to date. The primary driver for whether the adopted shave will induce covered facilities to install controls is the availability of trading credits in relation to the BARCT emissions target, and the pricing of those credits compared to the cost of control. A surplus of credits relative to the demand will result in lower prices for those credits. Too large of a surplus can depress the price of trading credits and incentivize facilities to purchase available credits in lieu of installing controls.

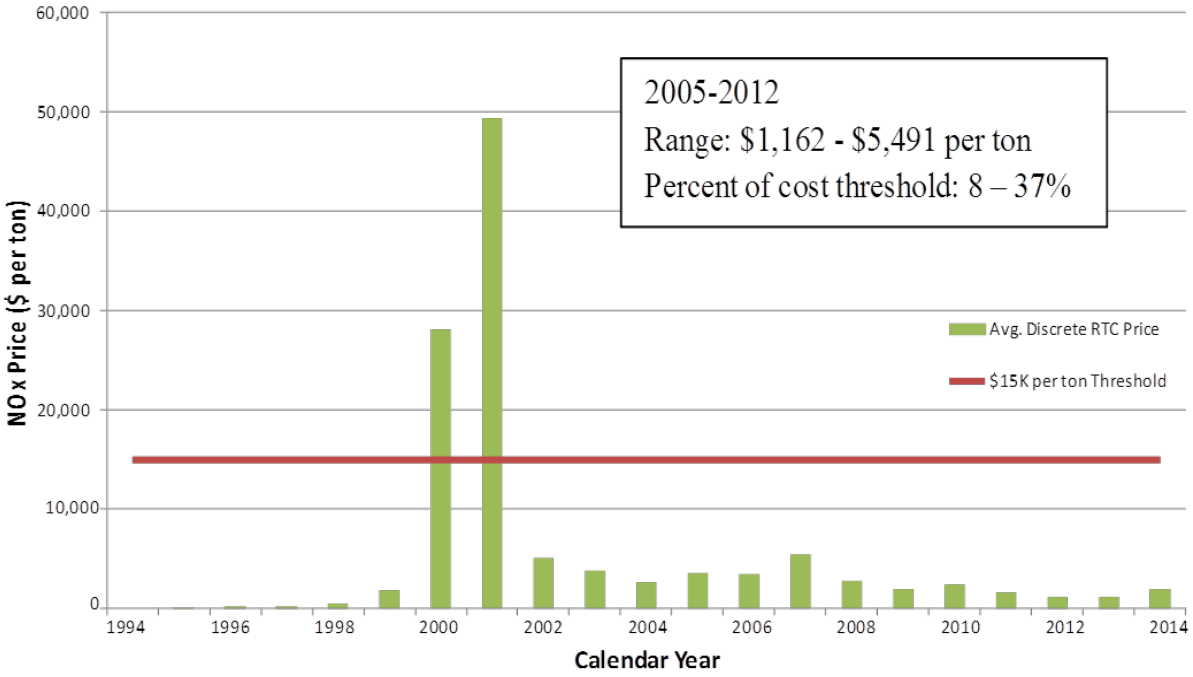
Figure 4 shows the percent of yearly unused trading credits between 1994 and 2013. With the exception of the energy crisis in 2000 and 2001, this percentage has generally remained between 20 to 30 percent. By comparison, the shave approved by the District Board would result in the largest credit volume margin since the program's inception at 40 percent.

Figure 4: Percent of Total RTCs above Total NOx Emissions by Year



ARB staff also examined the cost of trading credits, which are directly related to their availability in the market. Figure 5 depicts the range of RTC prices between 1994 and 2014. The red line reflects the historical price trigger of $15,000 per ton based on a 12-month rolling average contained in the RECLAIM rule. If the trigger is exceeded, the Executive Officer reports to the Governing Board with recommendations to stabilize the market. During the energy crisis of 2000 and 2001, emissions from RECLAIM facilities rose above available credits, resulting in the cost of credits spiking over 40 times the normal price and substantially exceeding the price trigger. However, with the exception of the energy crisis, the volume of credits has been high and therefore their cost has remained low. Between 2009 and 2013, the average price of trading credits ranged from $1,200 to $5,500 per ton as shown in Figure 5. This is well below the average cost-effectiveness of controls ($8,300-$13,000 per ton). As noted in the District's staff report for the 2015 amendments, credit prices in a well-functioning RECLAIM market should lie between the upper and lower bounds of the cost-effectiveness of emission reductions among all market participants.

Figure 5: NOx RECLAIM Trading Credit Prices between 1994 and 2014[7]



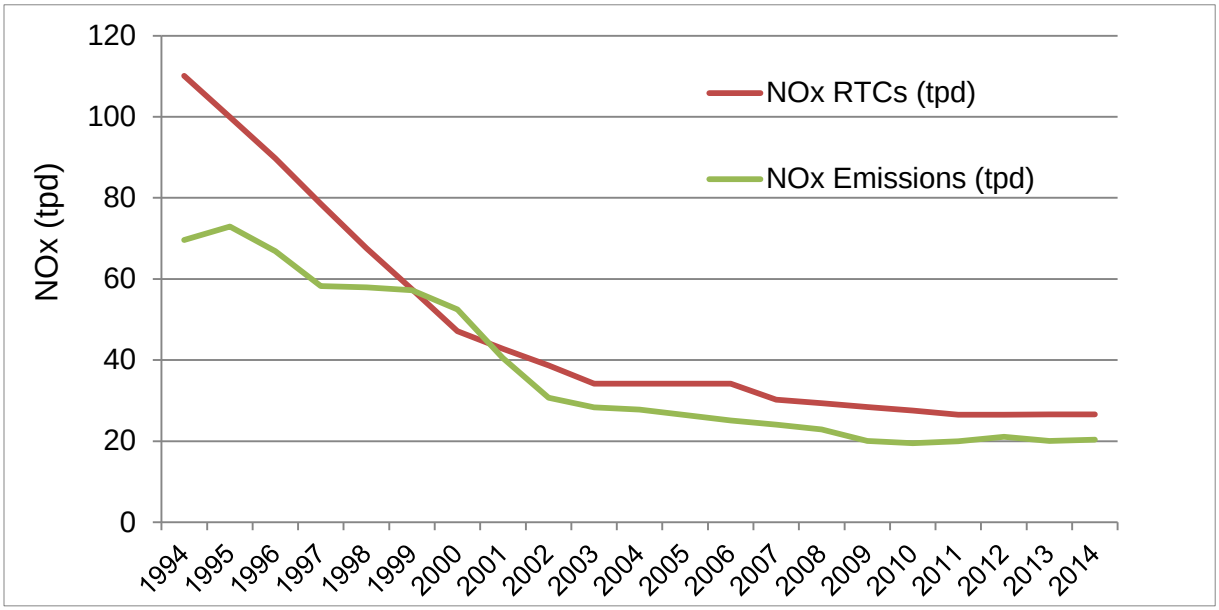
The resulting overall performance of the RECLAIM system is shown in Figure 6, which compares the historical trend in RTCs with emission reductions and illustrates that RECLAIM NOx emissions in aggregate have remained relatively constant since 2009. As discussed above, with the exception of the period during the energy crisis, the amount of RTCs has remained well above emission levels, and also well above the intended 10 percent compliance margin. These surplus RTCs have been artificially depressing RTC prices and have induced RECLAIM facilities to delay installation of cost-effective controls.

The availability of low cost credits played a significant role in the effectiveness of 2005 amendments. Similar to the 2015 amendments, at the time of the 2005 amendments, over 6 tpd of surplus RTCs were available in the market. The goal of the 2005 amendments was therefore to reduce the magnitude of the surplus credits from 6 tpd to approximately 2.5 tpd, representing a 10 percent compliance margin. However, although the 2005 amendments established a 7.7 tpd shave in NOx emissions (a 22 percent reduction), it did not result in a corresponding decrease in actual emissions, which dropped only 4 tpd (a 16 percent reduction). Two thirds of these reductions (2.6 tpd) were due to closure of facilities rather than installation of controls. Under a command and control regulatory structure, emission reduction credits generated when a facility shuts down are discounted to a BACT level and can only be used to offset emissions from new or modified facilities. However, RECLAIM facilities that permanently shut down were able to sell their RTCs back into the RECLAIM

[7] District Draft Final Staff Report – NOx RECLAIM, December 4, 2015

market. Allowing the full value to remain in the market resulted in additional surplus credits and further delayed or eliminated the need for many facilities to install equipment to reduce their NOx emissions.

Figure 6: Trends in NOx Emissions and RECLAIM Trading Credits

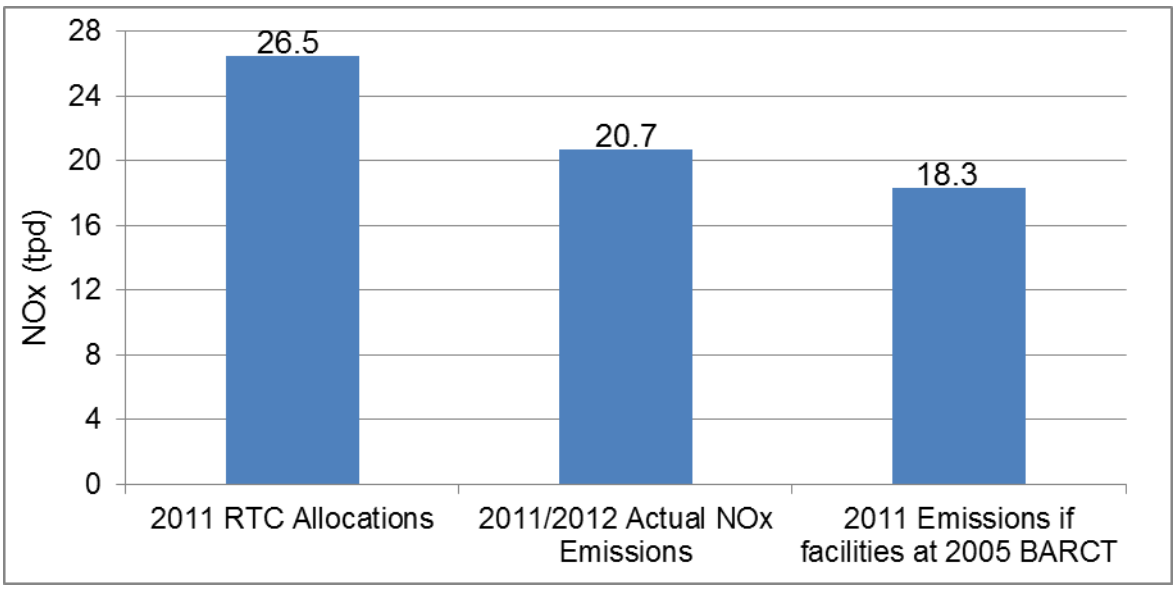


As a result, the amendments did not result in any change in the amount of surplus trading credits, with 6 tpd still remaining in the market in 2011. Therefore, while application of the 2005 BARCT limits should have resulted in NOx emissions of 18.3 tpd in 2011, actual emissions were 20.7 tpd. This shortfall is illustrated in Figure 7.

The District sought to rectify these deficiencies as part of the 2015 RECLAIM amendment. This included establishing a shave that would reduce the surplus trading credits and provisions that would require retirement of RTCs from larger facilities that have shut down. Permits associated with the equipment or facility being shut down would be surrendered, and the RTCs for future years would be retired from the RECLAIM program.

While the District Board deferred action on provisions to limit surplus credits from facility shutdowns in the December 2015 amendments, it did subsequently approve revised shut down provisions in October 2016 that will reduce the availability of surplus credits from facility shut downs in the future. Nevertheless, the District adopted shave results in an overall margin in surplus trading credits of 4.3 tpd above the aggregate BARCT emissions target. This is well above the 2.5 tpd margin determined to be sufficient in the 2005 amendments.

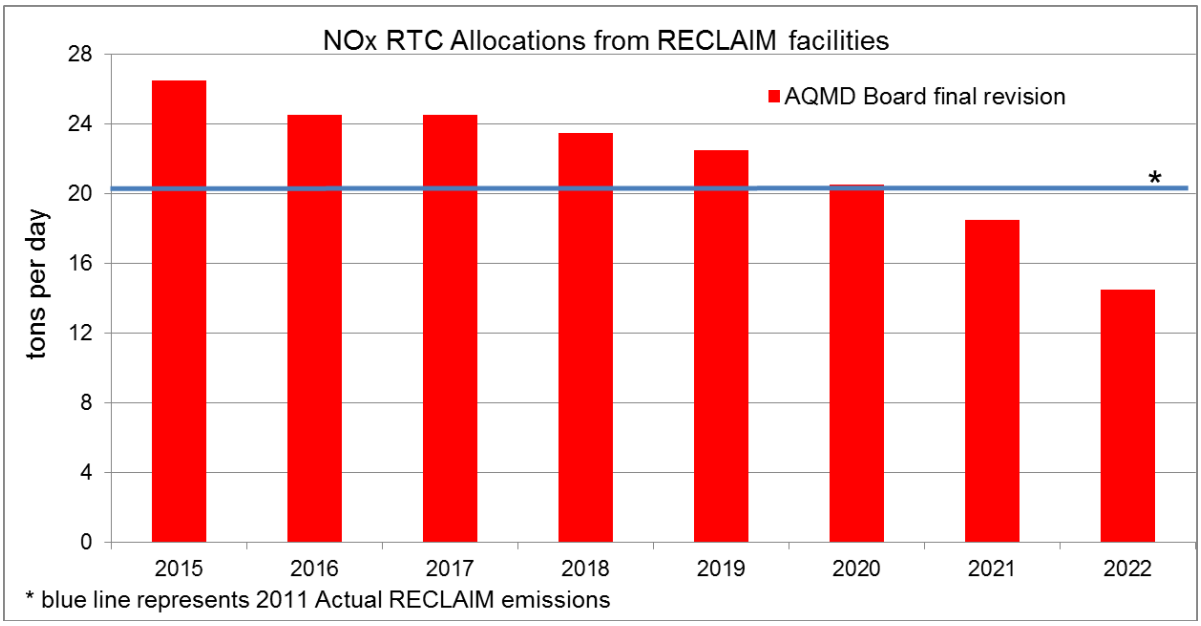
Figure 7: Comparison of 2011 Actual Emissions and BARCT-level Emissions Under 2005 Amendments



c. Timing of Adopted Shave with Respect to Attainment Deadlines

The adopted amendments implement the 12 tpd NOx shave over a seven year period starting in 2016 and ending in 2022. During this time period, the District faces a number of critical attainment deadlines. This includes the 2019 Serious area attainment deadline for the 35 ug/m3 24-hour PM2.5 standard, the 2021 Moderate area deadline for the 12 ug/m3 annual PM2.5 standard, and the 2022 deadline for meeting the 1-hour ozone standard. Under the schedule approved by the Board, smaller annual reductions occur in the early years of the shave with the largest annual reductions not implemented until the final year of the shave. As shown in Figure 8, the amount of trading credits will not drop below current emissions until 2021. As a result, real emission reductions and progress toward meeting air quality standards, will also be delayed.

Figure 8: Adopted RECLAIM Shave Schedule



ARB Staff Conclusion: *ARB staff concludes that the shave approved by the District Board will not achieve NOx emissions that are consistent with a BARCT level of control as required under State law. Inclusion of surplus trading credits above the emissions target will likely keep trading prices below the cost of installing controls as occurred with the 2005 amendments that led to a shortfall in achieving the required BARCT level of emissions. The shave approved by the District Board exacerbates the current situation by increasing the amount of surplus credits from 20 percent to 40 percent. Based on historical performance, ARB staff believes this margin will continue to provide a market structure that incentivizes the purchase of trading credits and results in an insufficient level of aggregate control. Further, ARB staff concludes the implementation schedule will slow progress toward meeting the air quality needs of the region in addition to HSC 40910 and 40913 requirements for expeditious attainment. The adopted schedule delays the removal of surplus trading credits and the amount of allowable credits will not drop below the current level of emissions until 2021.*

7. ASSESSMENT OF ADDITIONAL OPPORTUNITIES TO MEET THE REGION'S EMISSION REDUCTIONS NEEDS

a. Sectors Not Achieving BARCT Level Emissions

The structure of the RECLAIM program allows for some sources to be above BARCT, and others below, as long as the system achieves a BARCT level of control in aggregate. Because ARB staff has concluded that the 2015 and 2016 RECLAIM amendments will not achieve an aggregate level of BARCT control, staff further examined the emissions and RTCs holdings by sector to determine the causes. This analysis helps identify where there are opportunities for feasible further emission reductions as part of the broader AQMP planning process. Table 4 highlights 2011 actual emissions in key sectors, compared to 2011 emissions that were expected through implementation of BARCT limits identified by the District in 2005 and further expected through implementation of 2015 BARCT limits.

Table 4: BARCT Emissions by Sector

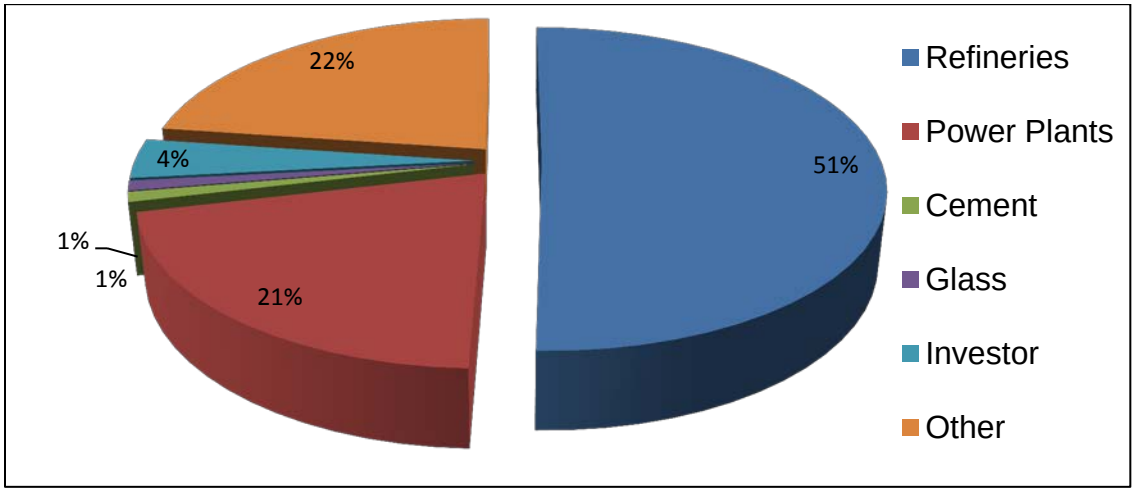
	2011 Actual Emissions	2011 Emissions expected with 2005 BARCT	2011 Emissions expected with 2015 BARCT
Refineries	11.5	8.8	2.8
EGUs	1.5	2.6	2.0
Other Sources	3.6	4.0	1.3

As Table 4 demonstrates, 2011 emissions for EGUs and other non-refinery sources were below 2005 BARCT emission levels, indicating these sources had installed BARCT or better controls.

The emissions reduction success of the EGU sector is in part due to their unique history within the RECLAIM program. In 2000, California experienced an energy crisis and electric power generation could not meet demand. Southern California EGUs increased production by bringing older, uncontrolled and high-emitting equipment into service. As available RTCs were purchased to cover the higher emissions, the cost of RTCs quickly increased from $1,500 to $3,000 per ton in the period between 1993 and 1998, to over $45,000 per ton in 2000. In response, to limit price spikes in the cost of RTCs, RECLAIM was amended in 2001. While the original RECLAIM program required the District to reevaluate the program if RTC prices exceed $15,000 per ton, the 2001 amendments added new requirements on EGUs to develop a compliance plan to install BARCT at the earliest feasible date. The EGUs were temporarily restricted from participation in the RECLAIM market until they could demonstrate that their facilities met BARCT requirements. As a result, South Coast staff's 2011 BARCT assessment showed that EGUs in aggregate achieved BARCT levels of emission control.

In contrast, Table 4 demonstrates that 2011 refinery sector emissions were approximately 30 percent above 2005 BARCT-level emissions, and significant further reductions can be achieved from installation of more stringent 2015 BARCT limits. Since the nine refineries included in RECLAIM represent approximately 60 percent of the total emissions and hold nearly 50 percent of the available RTCs in 2011 as shown in Figure 9 there is a significant opportunity available to further reduce emissions.

Figure 9: 2011 Distribution of RTCs by Source Category[8]



b. BARCT Limits for Specific Refinery Equipment

Table 5, as excerpted from District's RECLAIM staff report, summarizes 2005 BARCT limits and compares 2011 actual NOx emissions with emissions expected with BARCT for specific refinery equipment. In total, 2011 actual emissions were 2.74 tpd, or 31 percent greater than a BARCT level of control. Boilers account for the majority of excess emissions, especially large boilers, greater than 110 million British Thermal Units per hour (mmbtu/hr). Fluid catalytic cracking units (FCCUs) and coke calciners also had emissions above BARCT limits, while turbines achieved levels well below BARCT.

[8] District Draft Final Staff Report – NOx RECLAIM, December 4, 2015

Table 5: 2005 BARCT Levels and Emissions in 2011

Emissions for Refinery Sector	2011 Emissions (tpd)	2005 BARCT	2011 Emissions at 2000/2005 BARCT (tpd)	Actual 2011 Emissions above 2000/2005 BARCT
Fluid Catalytic Cracking units (FCCUs)/ Carbon Monoxide Boilers	1.08	85% control	0.6	0.48
Turbines/Duct Burners	1.33	62.27 lb/mmcft	4.86	-3.53
Coke Calciner	0.55	30 parts per million by volume	0.25	0.3
SRU/TG Incinerators	0.43	no change from prior BARCT	0.43	0 0
Boilers/Heaters > 110 mmbtu/hr	4.88		0.82	4.06
Boilers/Heaters >40-110 mmbtu/hr	2	25 ppmv	0.97	1.03
Boilers/Heaters 20-40 mmbtu/hr	0.45	9 ppmv	0.1	0.35
Boilers/Heaters <20 mmbtu/hr	0.06	12 ppmv	0.02	0.04
Other Major/Large Sources	0.11	n/a	0.1	0.01
Total	**11.5**		**8.76**	**2.74**

Based on these limits, District staff expected the 2005 amendments would result in refineries installing a number of control devices by 2011 to meet the declining cap in trading credits. However, the 2015 staff report noted that refineries instead relied heavily on the purchase of RTCs in lieu of installing control equipment. Of the 51 refinery boilers that the District expected would install SCR to meet BARCT, only 4 units were installed. All 4 installations were due to U.S. EPA consent decrees or orders of abatement, thus from requirements external to RECLAIM. Other refinery equipment that the District expected to be controlled include 6 FCCUs of which only 3 had SCR controls installed by 2011, and a single coke calciner that in 2011 had NOx emissions of 65 ppmv, approximately twice BARCT levels. As a result, the lack of BARCT level of control at refineries was a significant cause of the shortfall in emission reductions achieved through the 2005 amendments.

Table 6 summarizes the additional emission reductions that would result from installation of 2015 BARCT technologies for specific types of refinery equipment, demonstrating the substantial further reductions that could be achieved. The largest reductions could occur through installation of more stringent controls on gas turbines, followed by boilers and heaters. In aggregate, these incremental reductions could achieve an additional 6 tpd of NOx beyond the 2.74 tpd that could be achieved in meeting 2005 BARCT limits.

Table 6: Additional Reductions from Implementation of 2015 BARCT Limits

	2015 BARCT Level	Incremental NOx Reductions beyond 2005 BARCT (tpd)
Fluid Catalytic Cracking Units	2 ppmv	0.43
Refinery Boilers and Heaters >40 mmbtu/hr	2 ppmv	0.94
Refinery Gas Turbines	2 ppmv	4.14
Coke Calciner	10 ppmv	0.17
Sulfur Recovery Tail Gas Incinerators	2 ppmv	0.32
Refinery Total		**6.00**

c. Refinery Sector Shave

In addition to the adequacy of the overall shave, the apportionment of the shave amongst individual sectors can influence the likelihood that additional controls will be installed. Table 7 below summarizes how the shave adopted as part of the 2015 amendments will be apportioned between the sectors included in the RECLAIM market. The largest shave was applied to refineries and investors in consideration of the availability of control equipment and the potential for feasible, cost-effective further reductions. However, although RTC allocations for the refinery sector will be reduced by over 50 percent, they will remain more than 50 percent above what emissions levels would be were BARCT-level technologies installed for this sector in 2023. This difference demonstrates that opportunities exist to achieve greater reductions with a larger proportional shave for refineries.

Table 7: Apportionment of 2015 Adopted Shave to RECLAIM sectors

Number of entities	9	15	21	26	219	
	Refinery Facilities	Investors	Electricity Generating Facilities	Non-Electricity Generating Facilities	Other Facilities	Total
Current RTC Holdings (tpd)	14.15	0.42	5.63	3.45	2.86	26.5
Adopted Shave applied to each Sector	56%	56%	42%	42%	0%	
2023 RTC Holdings After Shave (tpd)	6.23	0.24	3.33	2.00	2.86	14.5
2023 Emissions After BARCT	2.76	0	2.04	1.93	3.5	10.2
2023 % Surplus or Deficit RTCs	55%	100%	37%	3%	-22%	

d. Refinery Emission Trends

This limited progress in installing BARCT control at refineries is reflected in recent emission trends. Sector level refinery NOx emissions have dropped only slightly since 2000, and have remained essentially flat since 2009, as shown in Figure 10. This has occurred at the same time that the RTC allocation for the refinery sector has been reduced by 38 percent.

Figure 10: Refinery NOx Trends from 1990 to 2014[9]

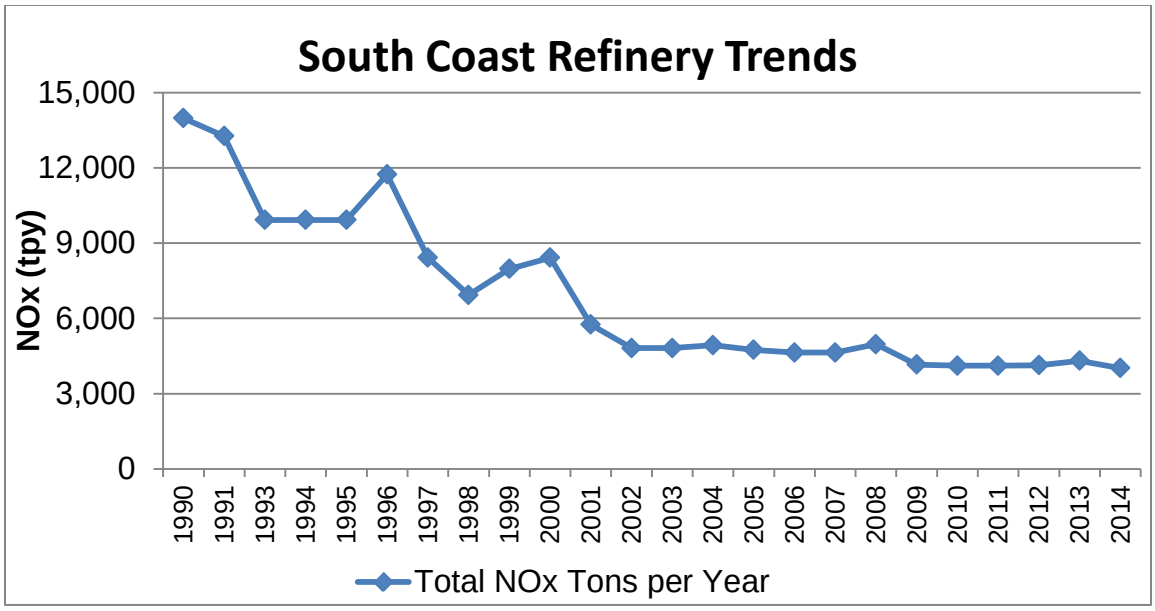
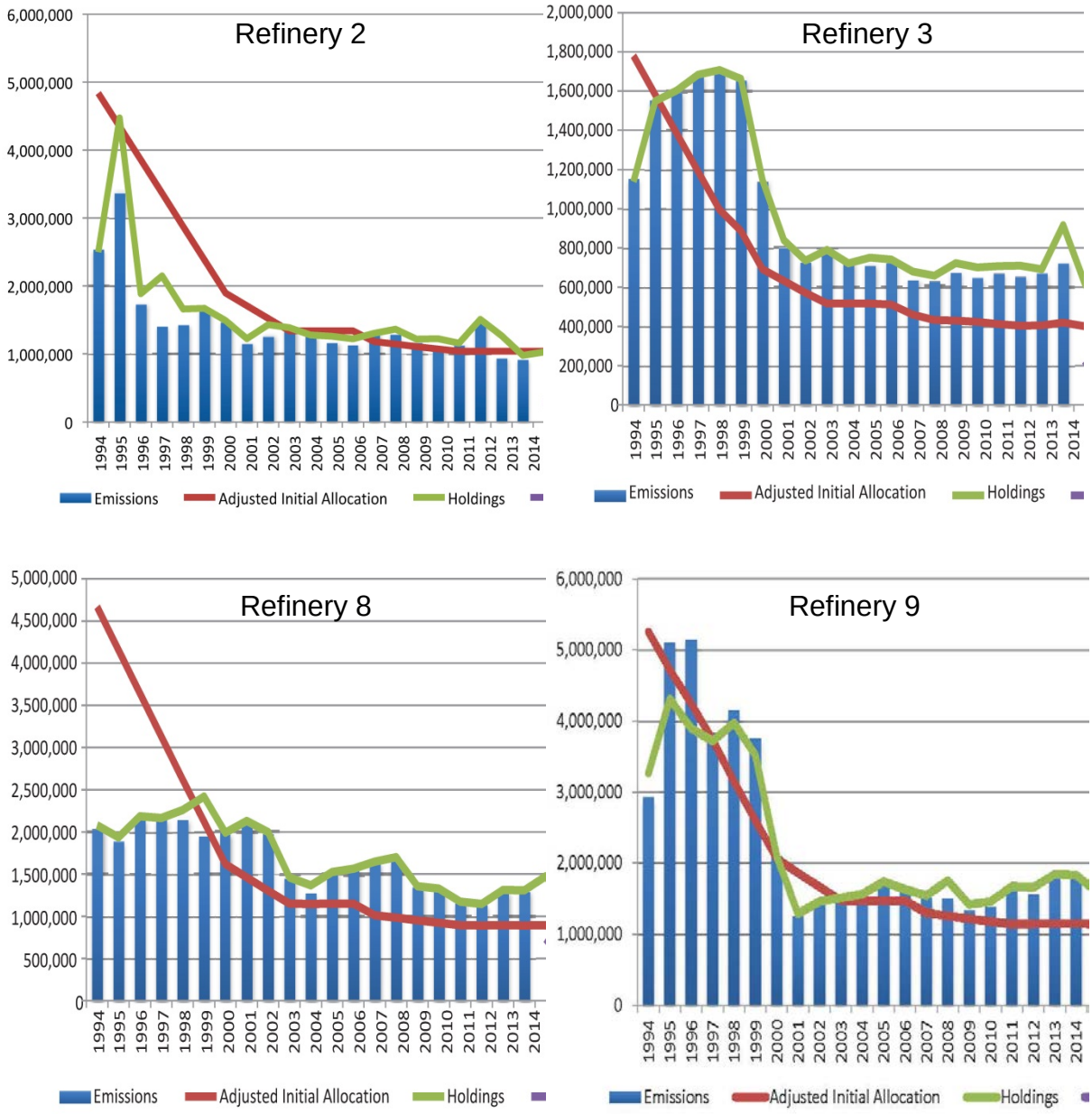


Figure 11 compares trends in actual emissions at four of the South Coast refineries to the current amount of RTC holdings, as well as the initial adjusted allocations representing the refinery sector shave applied over this time period. The graphs highlight that although the initial adjusted allocations have decreased (red line), emissions (blue bars) at most of the refineries have remained relatively constant since 2001 as the refineries have purchased a corresponding amount of credits to maintain their holdings (green line). While the trading aspect of the RECLAIM program provides flexibility for facilities to operate above BARCT levels by purchasing credits, it must be accompanied by an equivalent number of credits from facilities that are operating below BARCT. Currently, EGUs and other facilities are operating at BARCT, while refineries have purchased surplus credits to allow them to operate above BARCT. This again highlights that the program as a whole is not achieving an aggregate BARCT level of control due to a supply of trading credits that is too far above intended emission levels.

[9]Data downloaded from the ARB CEIDARS database in March of 2016

Figure 11: Several refineries now emit NOx (blue bars) well above their original adjusted allocations (red line).)[10]



ARB Staff Conclusion: *The control limits, NOx emission trends, and amount of RTCs owned by refineries compared to their initial allocations demonstrates that these facilities have purchased trading credits rather than install controls based on the availability of low cost, surplus RTCs. Installation of BARCT level controls at all affected units could reduce NOx emissions by 75 percent. However, the shave adopted by the*

[10] District Draft Staff Report Proposed Amendments to Regulation XX – Regional Clean Air Incentives Market, September 6, 2016

Board for the refinery sector will only reduce allocations by 56 percent. Therefore, ARB staff expects that the refinery sector will continue to purchase surplus RTC rather than install more efficient control and reduce emissions. Removal of surplus RTCs and establishment of a larger shave for the refinery sector would drive the installation of controls and help meet the region's attainment needs.

8. CONCLUSIONS AND RECOMMENDATIONS

Based on the assessment contained in this report, ARB staff has concluded that the RECLAIM program as amended in 2015 and 2016 does not meet State law requirements for a market-based program to achieve aggregate emissions reductions equal to direct control. The reductions in RTCs and the new provisions for handling trading credits for shutdown facilities do strengthen the program. However, ARB staff's analysis indicates that even with these changes, the amount of trading credits remains too high compared to the BARCT level of emissions in aggregate. As a result, facilities, and refineries in particular, will likely continue to purchase credits in lieu of installing controls. Evaluation of control limits achieved by individual units at refineries in the South Coast demonstrates that feasible and cost-effective controls are available that can provide significant further reductions in the refinery sector.

ARB staff has worked closely with South Coast District staff to develop the AQMP and the necessary control strategy. Actions at the federal, State, and local levels have resulted in a decrease of over 75 percent in both mobile and stationary source NOx emissions between 1990 and today. The District has continued to develop measures to reduce emissions from stationary sources and is currently exploring approaches to make the RECLAIM program more effective. The draft final 2016 AQMP released in December of this year contained a proposed measure to achieve a further 5 tpd NOx shave under the RECLAIM program by 2031. The AQMP control measure CMB-05 included a list of RECLAIM amendment concepts that could help achieve these further reductions. The eight concepts in the proposed measure included:

1. Assessment of whether more SIP creditable and/or actual emission reductions could be achieved without the RECLAIM program, and if so, explore how the program could be sunset.

2. Assessment of options for facilities at BACT or BARCT to exit the program and become subject to command and control regulations.

3. Consideration of the overlay of command-and-control regulations for certain RECLAIM facilities.

4. Consider BARCT-based individual facility emission caps for some or all RECLAIM facilities.

5. Assess the need for and the size of the differential between RTC holdings and actual emissions.

6. Assess the need for more frequent BARCT assessments and adjustment to allocations as technology advances.

7. Reexamination of the level of price thresholds in the RECLAIM program.

8. Reevaluate the benefits of investors holding RTCs.

The District Board approved the AQMP at their March 3, 2017 District Board meeting. This included an amendment to further strengthen the RECLAIM measure by advancing the 5 tpd of NOx reductions from 2031 to 2025. In addition the District Board directed staff to identify a path to transition the program to an individual rule based regulatory structure as soon as practicable.

ARB staff believes the adopted actions will resolve the issues raised in ARB's review, and staff will continue to work with the District to develop an approvable program. To support this effort, this report provides ARB staff recommendations to ensure the program meets requirements of State law, and contributes to achieving reductions needed to meet federal air quality standards. The recently adopted amendments for shut down provisions will provide a mechanism similar to procedures used for facilities and equipment that shut down under a command and control system. The transition of the RECLAIM program to an individual rule-based regulatory structure will maximize the potential for direct emission reductions to address both regional attainment needs and localized impacts in disadvantaged communities. And since the refinery sector is not yet at BARCT, we also recommend that the District consider transitioning refineries into a command and control structure first. This would provide an opportunity to ensure early reductions during the transition.

The 2015/2016 RECLAIM amendments, with a reduced number of RTCs and new provisions for handling facility shut downs, is a strengthening of the 2010 version of the rule previously submitted to U.S. EPA. Thus, ARB staff proposes to submit the 2015/2016 amendments to U.S. EPA. Subsequent approval of the 2015/2016 amendments into the State Implementation Plan will make the new provisions and associated emission reductions federally enforceable. To support this submittal, the District is developing additional documentation to demonstrate that the 2015/2016 amendments ensure, in the aggregate, NOx emission reductions equivalent to RACM/RACT-level controls for covered facilities. RACM/RACT is a less stringent level of control than what is required under BARCT, which was the focus of ARB staff's analysis. The 2015/2016 amendments and documentation needed to meet the RACM/RACT requirements must be submitted and approved by U.S. EPA by November 16, 2017. Finally, in addition to revisions to meet BARCT, the District must demonstrate that it is meeting Clean Air Act requirements for BACM/BACT to meet the Serious nonattainment area requirements for PM2.5. ARB staff believe the amendments to the new RECLAIM measure adopted at the March 3 District Board meeting which accelerate the NOx reductions and provide direction to transition the program to a direct regulatory approach as soon as practicable meets BACM/BACT requirements within the timeframes specified within the Clean Air Act.