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UPDATED 1-HOUR OZONE ATTAINMENT DEMONSTRATION

Executive Summary

This document provides an update to the attainment demonstration for the federal 1979 1-hour ozone standard that was included in the 2016 Air Quality Management Plan (AQMP).

The 1-hour ozone attainment demonstration included in the 2016 AQMP relied on emission reductions from both SCAQMD stationary and mobile source control measures as well as mobile source measures from CARB's State Implementation Plan (SIP) developed primarily for meeting the 8-hour ozone standards in 2023 and 2031. SCAQMD control measures are based on either traditional regulatory or incentive-based strategies while CARB's SIP strategy includes both defined regulatory/incentive measures as well as measures identified as "Further Deployment of Cleaner Technologies" allowed under Clean Air Act Section 182(e)(5). This update is needed because the 1-hour ozone attainment demonstration included in the final 2016 AQMP was based on an emissions inventory that was slightly different than the final inventory used in the 8-hour ozone and PM2.5 attainment demonstrations.

The updated 1-hour ozone attainment demonstration addressed in this document consists of several revisions. First, the emissions inventory is updated to be consistent with the final emissions inventory used for the attainment demonstrations for the 8-hour ozone and PM2.5 standards included in the 2016 AQMP. Second, the air quality modeling is updated to reflect the revised emissions inventory. Third, the updated modeling analysis shows that emission reductions from CARB's SIP strategies including both defined measures and undefined measures (182(e)(5) measures) are not needed for the attainment demonstration. As such, the updated attainment demonstration relies only on SCAQMD measures based on the expectation that anticipated progress in emission reductions targeted toward attainment of the 1997 8-hour ozone standard by 2023 will ensure the attainment of the 1-hour ozone standard by 2022. The updated 1-hour ozone attainment demonstration eliminates the need to submit 182(e)(5) contingency measures for the 1-hour ozone attainment demonstration included in the 2012 AQMP, the latest U.S. EPA approved AQMP.

In summary, the updated analysis successfully demonstrates and reaffirms attainment of the 1-hour ozone standard by 2022.

Introduction

The South Coast Air Basin is currently in non-attainment of the federal 1979 1-hour ozone standard. The 2016 Air Quality Management Plan (AQMP)[1], adopted in March 2017, included control strategies that demonstrated attainment with the 1-hour ozone standard in 2022 as well as other federal ambient air quality standards in the South Coast Air Basin. These other standards included the 2008 8-hour ozone standard (75 ppb), the 1997 8-hour ozone standard (80 ppb), the 2012 annual $PM_{2.5}$ standard (12 $\mu g/m^3$), and the 2006 24-hour PM2.5 standard (35 $\mu g/m^3$).

Attainment of the 1-hour ozone standard in the South Coast Air Basin was demonstrated primarily based on control strategies developed for the 8-hour ozone standards, relying on a fraction of the emission reductions associated with these strategies. The smaller amount of emission reductions needed for attainment is attributed to several factors. First, the 1-hour ozone standard is less stringent than the 8-hour ozone standards, requiring a significantly smaller amount of emission reductions. Second, unlike the 8-hour ozone standards, whose attainment relies on strategies that are heavily focused on NOx reductions, the 1-hour ozone standard can be attained by implementing both NOx and VOC strategies, including NOx strategies that result in concurrent VOC reductions. Finally, since the 1-hour ozone concentrations in 2022 are projected to be very close to the 1979 standard without any additional emission controls beyond existing regulations, only modest NOx and/or VOC emission reductions would be necessary to attain the 1-hour ozone standard by 2022. In summary, anticipated progress toward attainment of the 8-hour standard in 2023 would ensure attainment of the 1-hour standard by 2022.

The 1-hour ozone attainment demonstration included in the 2016 AQMP relied on emission reductions from both SCAQMD stationary and mobile source control measures as well as mobile source measures from CARB's State SIP strategy, which were developed primarily for meeting the 8-hour ozone standards in 2023 and 2031. SCAQMD control measures are based on either traditional regulatory or incentive-based strategies while CARB's SIP strategy includes both defined regulatory/incentive measures as well as measures identified as "Further Deployment of Cleaner Technologies" measures that do not yet have fully-defined implementation strategies (i.e., proposed under Section 182(e)(5)).

During the AQMP process, several versions of the emissions inventory were developed depending on the availability of the most updated data. The modeling for the 1-hour attainment demonstration in the 2016 AQMP was conducted based on the emissions inventory that became available toward the end of the AQMP process, but a final version was developed soon after which was used for the attainment demonstration of the 8-hour ozone and PM2.5 standards.

[1] SCAQMD, 2017, Final 2016 Air Quality Management Plan. Available at: https://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2016-aqmp

However, the 1-hour attainment demonstration was not updated to reflect the final emissions inventory in the 2016 AQMP because of timing constraints.

This document provides an updated 1-hour ozone attainment demonstration based on the final inventory included in the 2016 AQMP and the updated air quality modeling analysis based on the final inventory. The updated analysis shows that the 1-hour ozone standard will be attained in 2022 based on implementation of SCAQMD control measures without any emission reductions from CARB's SIP strategies, including the 182(e)(5) measures. This updated 1-hour ozone attainment demonstration represents an analysis consistent with the 8-hour ozone and PM2.5 attainment demonstrations based on the use of the final emissions inventory in the 2016 AQMP.

A detailed attainment demonstration including updated emissions inventory, emission reductions itemized by control measure, numerical modeling results, spatial distribution of base year and future year design values, and a weight of evidence analysis is presented in this document. A description of control strategies used for the 1-hour attainment demonstration and the Controlled Emissions Processing Algorithm (CEPA) output, which summarizes emission reductions by control measure, are included in Appendix A and B, respectively.

Updated Attainment Demonstration

1. Updated Baseline Emissions Inventory

The emissions inventory for the 2016 AQMP was developed jointly by SCAQMD and CARB. During the process of AQMP development, the emissions inventory was revised multiple times as updated data became available. The 8-hour ozone and PM2.5 attainment demonstrations included in the 2016 AQMP were based on the final emissions inventory made available to the District in November 2016. However, the 1-hour ozone attainment demonstration and modeling were based on an earlier emissions inventory version available in October 2016, which made the 1-hour ozone attainment demonstration inconsistent with the other attainment demonstrations that were based on the final emissions inventory included in the 2016 AQMP. The final November version of the emissions inventory contained updates in the locomotives emission category. Table 1 summarizes the differences between these two emissions inventories. The updated attainment demonstration in this report relies on the inventory consistent with the other attainment demonstrations and emissions analysis included in Chapter 3, Appendix III of the 2016 AQMP. As shown, the updated NOx emissions in years 2012 and 2022 were lower by about 1.6 and 7.5 tons per day, respectively.

TABLE 1

Basin Total Summer Planning NOx and VOC emissions

	Year 2012		Year 2022	
	Oct 2016 Version	*Nov 2016 Version*	*Oct 2016 Version*	*Nov 2016 Version*
Annual Average (tons/day)				
VOC	470.2	470.1	362.7	362.3
NOX	541.4	539.8	297.9	290.4
Summer Planning (tons/day)				
VOC	499.7	499.6	383.1	382.7
NOX	524.0	522.4	294.3	286.8

2. Updated Attainment Strategy for 1-hour Ozone Standard

The South Coast Air Basin is currently in non-attainment of the 1979 1-hour ozone standard and is required to attain the standard by December 31, 2022. This is one year prior to the 1997 8-hour ozone attainment deadline of 2023. The 2016 AQMP concludes that approximately 45% additional NOx emissions reductions beyond the projected 2023 business-as-usual condition, i.e., with no additional control measures beyond those already adopted (baseline), is needed to show attainment of the 8-hour ozone standard in 2023. Comparatively, the 1-hour ozone design value of the Basin is projected to be close to the standard in 2022, such that it requires only modest additional emission reductions beyond currently implemented and adopted regulations to demonstrate attainment. Therefore, anticipated progress toward the 2023 target is expected to ensure the attainment of the 1-hour ozone standard in 2022.

The attainment strategy for the 1-hour ozone standard in the 2016 AQMP relied on SCAQMD's proposed stationary and mobile source measures as well as CARB's SIP strategy, which included both defined (regulatory or incentive) measures and undefined 182(e)(5) measures that are based on further deployment of cleaner mobile source technologies. For SCAQMD's measures, it was assumed that 86% of the 8-hour ozone standard's reductions commitments in 2023 will be achieved in 2022 based on the anticipated rate of reductions for full implementation of these measures in 2023.

Additional reductions were attributed to CARB's measures for several mobile source categories, which included heavy-duty vehicles, locomotives, ocean going vessels and small off-road engines (SORE). While CARB's SIP strategy sets emission reduction targets for 2023 and 2031, it does not define the amount of emission reductions for intermediate years. In addition, these CARB measures (except for SORE) were identified in the SIP Strategy as "Further Deployment of Cleaner

Technologies" measures without having fully-defined implementation strategies (i.e., proposed under Section 182(e)(5)). For the CARB measures, it was assumed that 13% of CARB's total 8-hour ozone standard's reduction commitments in 2023 will be achieved in 2022 based on the level of remaining emission reductions needed for the 1-hour ozone attainment demonstration.

However, based on the updated attainment demonstration outlined in this document, neither reductions from CARB's defined SIP mobile source strategies nor CARB's 182(e)(5) measures are needed for attainment of the 1-hour ozone standard in 2022. Hence, attainment of the 1-hour ozone standard can rely solely on the implementation of the SCAQMD's measures in the 2016 AQMP. Table 2 lists SCAQMD's control measures and associated emission reductions commitments included in the updated 1-hour ozone attainment demonstration. Table 2 is a reprint of Table 4-9 in the 2016 AQMP. The control measures included in the 1-hour ozone demonstration are described in Chapter 4 of the 2016 AQMP with a brief summary of control measures included in Appendix A of this document for completeness.

TABLE 2

1979 1-hour Ozone (120 ppb) SIP Emission Reduction Commitment to be Achieved by 2022 through SCAQMD Stationary and Mobile Source Regulatory Programs[a]

(Summer Planning Inventory, tons per day)

YEAR	VOC		NOx	
	Based on Adoption Date	Based on Implementation Date[b]	Based on Adoption Date	Based on Implementation Date[b]
2016				
2017	CTS-01 (1) **1.0**		MOB-10 (1.9) MOB-11 (2.9) MOB-14 (11) **15.8**	
2018	CMB-01 (1.2) CMB-03 (0.4) ECC-02 (0.07) ECC-03 (0.2) **1.9**		CMB-01 (2.5) CMB-02 (1.1) CMB-03 (1.4) CMB-04 (0.8) ECC-02 (0.3) ECC-03 (1.2) **7.3**	
2019	FUG-01(2) BCM-10 (1.5) **3.5**			
2020		BCM-10 (1.5) CMB-03 (0.4) CTS-01 (1) **2.9**		CMB-02 (1.1) CMB-03 (1.4) **2.5**
2021				
2022		FUG-01 (2) ECC-02 (0.06)^ ECC-03 (0.17)^ CMB-01 (1.0)^ **3.2**		CMB-04 (0.8) MOB-10 (1.9) MOB-11 (2.5) ^ MOB-14 (9.5) ^ ECC-02 (0.26)^ ECC-03 (1.03)^ CMB-01 (2.15)^ **18.1**
TOTAL*	**6.4**	**6.1**	**23**	**21**

[a] Control measures are described in the 2016 AQMP (https://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2016-aqmp) and in Appendix A in this document.

[b] Represents the final, full implementation date; typically a rule contains multiple implementation dates.

* All ozone strategy reductions are adopted by 2022. However, not all adoptions are implemented by 2022. Therefore, totals are not equal.

^ 86 percent of control measures' 2023 reductions. SCAQMD's mobile source control measures would also achieve concurrent VOC emission reductions which would further assist in meeting the 1-hour ozone standard in 2022.

Table 3 summaries the projected NOx and VOC emissions in 2022 with no additional regulations (baseline), reductions associated with SCAQMD measures (Table 2), a set-aside account from the 2016 AQMP (i.e. general conformity, VOC from phase-out of toxics), and the remaining emissions.

Table 3. Total NOx and VOC Emissions for 1-hour Ozone Attainment Strategy

	VOC (Tons/Day)	NOx (Tons/Day)
Baseline*	382.7	286.8
Reductions	6.1	20.6
Set Aside Account	4.5	3.1
Remaining	381.2	269.3

* Summer Planning Inventory

3. Updated Air Quality Modeling

The Weather Research Forecast (WRF) and the Community Multiscale Air Quality (CMAQ) modeling platforms, with an in-house emission processing system, was employed to demonstrate attainment of the 1-hour ozone standard. The modeling platform is identical to the one used in the 8-hour ozone and PM2.5 attainment demonstration included in the 2016 AQMP. Performance evaluation of the 2012 base year ozone modeling, meteorological modeling, ozone episode analysis, 1-hour ozone demonstration methodology, 1-hour ozone isopleths, weight of evidence and uncertainty discussions included in the 2016 AQMP remain unchanged and therefore are not repeated here. Such analysis and discussions are included in Chapter 5 and Appendix V of the 2016 AQMP.

The updated 1-hour ozone design values at the various monitoring stations are presented in Table 4. Modeling results from the 2012 AQMP are also included in this table to be consistent with the format presented in Table 5-3 of the 2016 AQMP. The 2022 predicted baseline ozone values included in the 2012 AQMP are different from the results presented in the 2016 AQMP (e.g., Pasadena site had the maximum 1-hour ozone concentration predicted for 2022 in the 2012 AQMP). This is due to multiple factors including changes in the numerical modeling platform, emissions methodology and Relative Response Factor approaches, year-to-year changes in meteorology and ozone design values as well as additional emission reductions from regulations and expedited mobile source turn-overs (through incentive funding programs) implemented after the adoption of the 2012 AQMP. More details on the updates introduced in the 2016 AQMP attainment demonstration are provided in Appendix V of the 2016 AQMP.

With the updated 1-hour ozone attainment strategy and the emission reductions identified in Table 2, the 1-hour ozone maximum concentration in the Basin is expected to be 123 ppb at the Fontana location in 2022, which is below the 124 ppb level required by the CAA. While the foothill areas in the San Gabriel and San Bernardino mountains including Glendora, Upland and Fontana, are still projected to have high 1-hour ozone levels in 2022 in the updated modeling analysis, Pasadena is expected to have 1-hour ozone levels that are lower than Fontana and other stations located in the foothills. This is due to the 1-hour ozone measurements at Pasadena being lower than Fontana during the five year period (2010-2014) used in the base year design value calculations. Pasadena has consistently shown lower ozone levels than Fontana in the 2015-2017 period as well. Pasadena is not included in Table 4 due to missing data from Dec 2012 to May 2013, a period when the station was shut down for upgrades.

In summary, the updated modeling analysis demonstrates that the 1979 federal 1-hour ozone standard is expected to be attained in 2022 in the South Coast Air Basin without reliance on emission reductions from CARB's SIP strategy, including the 182(e)(5) measures. This eliminates the need to develop contingency for 182(e)(5) measures by January 2019.

TABLE 4

Base-year Design Values and Model-Predicted 1-Hour Ozone Design Values (ppb)

Station	2012 5-Year Weighted Design Value	Final 2012 AQMP		2016 AQMP	
		2022 Baseline	2022 Controlled	2022 Baseline	2022 Controlled
Azusa	112	139	131	104	102
Banning	-	119	102	--	--
Burbank	-	123	111	--	--
Crestline	132	134	116	120	119
Fontana	138	128	110	125	123
Glendora	132	143	133	121	120
Lake Elsinore	108	108	90	93	92
Pasadena	-	141	134	--	--
Perris	114	111	94	108	106
Pomona	117	124	108	103	102
Redlands	133	127	109	120	119
Reseda	125	112	101	105	104
Riverside	124	116	103	109	107
San Bernardino	123	127	110	107	105
Santa Clarita	132	119	105	110	108
Upland	135	135	121	122	120

NOTE: Burbank and Banning do not have 5-year weighted 2012 base-year design values due to incomplete measurement data, and therefore, it was not possible to calculate 2022 design values at these stations. Burbank does not meet U.S. EPA data completeness requirements in 2014, Pasadena does not meet U.S. EPA data completeness requirements in 2013 and Banning does not meet U.S. EPA data completeness requirements in 2013.

4. Spatial Projections of 1-Hour Ozone Design Values

The spatial distribution of 1-hour ozone design values for the 2012 base year is shown in Figure 1. Ozone air quality projections for 2022 without (baseline) and with (controlled) implementation of all proposed control measures in the updated control strategy are presented in Figure 2 and Figure 3, respectively. The predicted ozone concentrations will be significantly reduced in future years in all parts of the Basin with continued implementation of already adopted measures as well as the SCAQMD control measures proposed in the 2016 AQMP. Future design values are predicted from modeled Relative Response Factors (RRFs) and measured base-year design values. Future design values are then interpolated using a natural neighbor interpolation to generate the interpolated fields. With the proposed control measures to reduce ozone precursor emissions, the South Coast Air Basin is expected to meet the 1979 1-hour ozone standard in 2022 (Figure 3).

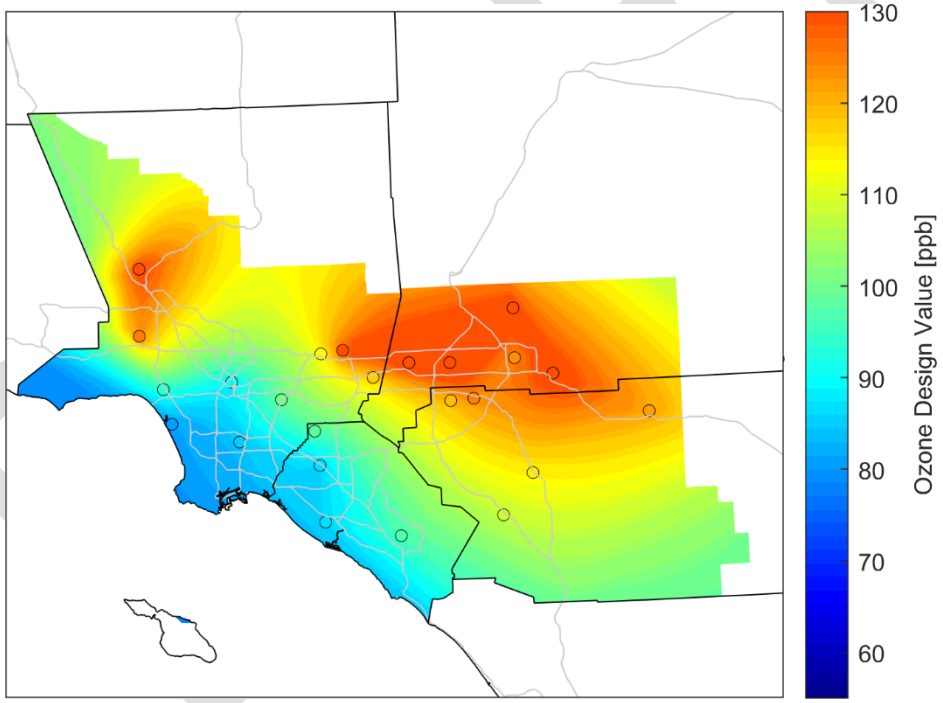

FIGURE 1
2012 OBSERVED 5-YEAR WEIGHTED 1-HOUR OZONE DESIGN VALUES (ppb)

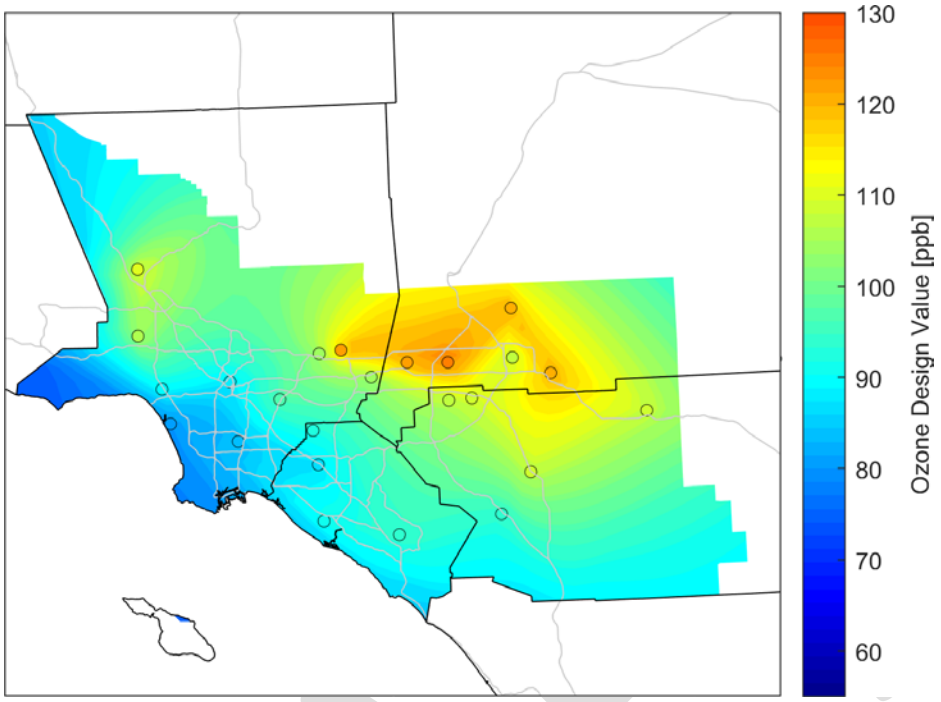

FIGURE 2

MODEL-PREDICTED 2022 BASELINE 1-HOUR OZONE CONCENTRATIONS (ppb)

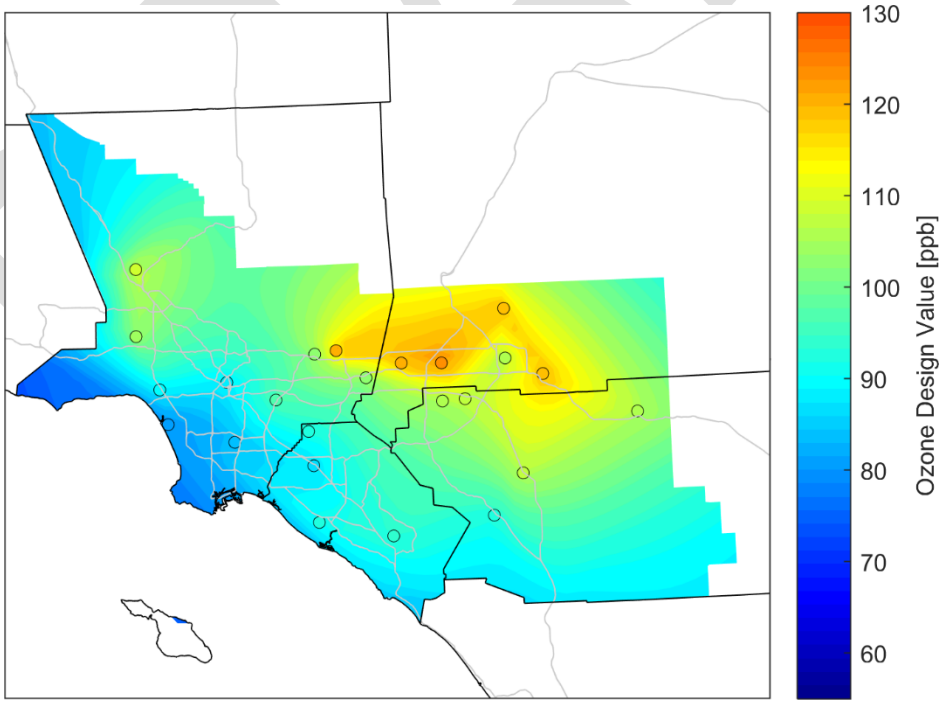

FIGURE 3

MODEL-PREDICTED 2022 CONTROLLED 1-HOUR OZONE CONCENTRATIONS (ppb)

5. Weight of Evidence

Ozone modeling guidance[2] strongly recommends the use of corroborating evidence to support the future year attainment demonstration. The control strategies for the 1-hour ozone standard attainment demonstration are based on emission reductions from SCAQMD control measures and do not include any reductions from CARB measures. Yet, sensitivity tests were conducted to evaluate the efficacy of various emission reduction scenarios including reductions from selected CARB SIP control measures as well as SCAQMD control measures. The results of sensitivity tests are discussed here as weight of evidence to ensure the robustness of model responses to various emissions control strategies.

Different control strategies affect spatial distribution of emission reductions differently, because of the distinct location of the sources affected by those regulations. For example, Control Measure MOB 11 (Expanded Exchange Program for Lawn and Garden Equipment) and CARB's Small Off-Road Engines (SORE) measure targets lawn and garden equipment, which uniformly affect emissions throughout the Basin, whereas control measures affecting ocean-going vessels (OGV) reduce emissions mostly in the immediate vicinity of the ports of Los Angeles and Long Beach. Therefore, the impact of emissions reduction from OGV is larger in coastal areas than inland downwind locations.

Also, in contrast to the 8-hour attainment demonstrations which depend on NOx reductions, VOC emission reductions are as effective, or even slightly more effective than NOx reductions in decreasing the 1-hour ozone design value. The 1-hour ozone isopleth presented in Figure V-8-12 in Appendix V of the 2016 AQMP clearly illustrates the sensitivity of 1-hour ozone to VOC emissions. The contours of the 1-hour ozone isopleths are aligned almost vertically near the upper right corner, indicating VOC reductions can yield ozone improvements as effective or even more effectively than NOx reductions. On the contrary, the 8-hour ozone isopleths (Figure V-5-22 in Appendix V of the 2016 AQMP) show the contours almost parallel to the horizontal axis, indicating 8-hour ozone being less sensitive to VOC emission reductions under future baseline conditions. Thus, control measures promoting VOC emission reductions, like the ones targeting lawn and gardening equipment, tend to be more effective than other measures primarily affecting NOx emissions for the 1-hour attainment demonstration.

The sensitivity tests included in the weight of evidence discussion are summarized in Table 5.

[2] U.S. EPA, 2014, Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, Draft. December 2014

TABLE 5

Description of Attainment Demonstration Sensitivity Scenarios

Scenario	Measures Included
Attainment Demonstration	Measures listed in Table 2
Sensitivity Case 1	Measures listed in Table 2 with the inclusion of concurrent VOC emission reductions from mobile source measures (MOB-10, MOB-11, MOB-14) and residential/commercial combustion measures (CMB-02, CMB-04)
Sensitivity Case 2	Measures listed in Table 2 + CARB's Proposed Measure for Small Off-Road Engines
Sensitivity Case 3	Control Measure MOB-14 (existing mobile source incentive projects only) + Control Measure MOB-11 (extended exchange program for lawn and garden equipment)
Sensitivity Case 4	Measures listed in Sensitivity Case 2 + CARB's control measures for Locomotives and OGV At-Berth

Table 6 shows the VOC and NOx emission reductions and the 1-hour ozone design values resulting from the sensitivity simulations. Ozone response to the change of its precursor emissions varies depending on the level of ozone concentration, the ratio of VOC and NOx emissions, the availability of other chemical species and meteorological conditions. For 2022, the effectiveness of ozone reduction from various scenarios varies between 0.07 and 0.08 ppb per ton of either NOx or VOC emission reductions.

TABLE 6

Emission Reductions and Resulting Effects on 1-hour O_3 Design Values for Attainment Demonstration Sensitivity Scenarios

Scenario	Emission Reductions		Design Value	
	VOC (tpd)	NOX (tpd)	Design Value (ppb)	1-h O_3 Reduction per ton (ppb/ton)
Attainment Demonstration	6.1	20.6	123.5	0.07
Sensitivity case 1	12.2	20.6	123.0	0.07
Sensitivity case 2	15.7	20.9	122.6	0.08

Sensitivity case 3	5.5	7.3	124.5	0.07
Sensitivity case 4	15.9	25.4	122.4	0.07

Sensitivity Case 1 includes concurrent VOC emission reductions associated with SCAQMD's mobile source measures (MOB-10, MOB-11, MOB-14) and SCAQMD's residential and commercial appliances measures rules (CMB-02, CMB-04), which would result in an additional 6.1 TPD of VOC reductions than the attainment demonstration case. The 1-hour design value from this scenario is 123.0 ppb, 0.5 ppb lower than the attainment case. While the Sensitivity Case 1 assumes the VOC reductions from all the sources subject to the SCAQMD's control measures applied to the 1-hour ozone attainment demonstration, it is not used as attainment demonstration due to potential uncertainties to estimate VOC reductions from aforementioned control measures. Still, Sensitivity Case 1 provides additional weight of evidence on the attainment of the 1-hour ozone standard in 2022.

Sensitivity Case 2 appears to be the most effective scenario, which includes additional emission reductions from CARB's proposed Small Off-Road Engine (SORE) measure. These additional reductions from the SORE measure contribute significantly to achieving a reduction in 1-hour ozone design value with the efficiency of 0.08 ppb per ton. The analysis confirms that emissions reductions from SORE are very effective in improving 1-hour ozone concentration due to the spatial spread of the emission reductions as well as substantial amount of concurrent VOC reductions. However, there are uncertainties about the actual level of reductions that will be achieved in 2022 from CARB's proposed SORE measure that will not be adopted until 2020. Therefore, this sensitivity case may not be a dependable option for the 1-hour ozone attainment demonstration, yet, it confirms the sensitivity of 1-hour ozone to VOC reductions.

Sensitivity Case 3 includes the least amount of NOx emission reductions, based on expected reductions from existing mobile source incentive projects (i.e., projects funded already under Carl Moyer and other incentive programs) and reductions expected from lawn and garden equipment under MOB-11. The effectiveness in ozone reduction achieved in this scenario is 0.07 ppb per ton, which is the same as in the attainment demonstration case. The resulting 1-hour ozone design value for Sensitivity Case 3 is 124.5 ppb, which also complies with the 1-hour ozone standard (based on EPA's rounding and truncation notation for the 8-hour ozone design value). While allocating 86% of 2023 emission reduction targets in 2022 may seem to be an ambitious goal, this scenario indicates that the actual amount of emission reductions required to attain the 1-hour ozone standard is significantly less than the 86% target included in the attainment scenario. Therefore, even if there is a marginal shortfall in the emission reductions, the SCAQMD is still expected to attain the 1-hour standard in 2022.

Sensitivity Case 4 includes additional emission reductions from locomotives and OGV at berth (i.e., CARB's 182(e)(5) measures) in addition to the reductions from Sensitivity Case 2. The impact of the additional NOx reductions from locomotives and ships is similar to those of the attainment case and Sensitivity Case 3, but not as effective as the measure targeting SORE. Although this sensitivity case also results in an acceptable 1-hour attainment demonstration, it is not an as reliable option because it depends on undefined 182(e)(5) measures. The modeling results and the sensitivity of 1-hour ozone to its precursor emissions reductions are consistent with the 1-hour ozone attainment demonstration included in the 2016 AQMP, confirming the robustness of the present modeling analysis.

The weight of evidence analysis presented here confirms that the attainment demonstration case (based on SCAQMD control measures) is a viable and robust attainment demonstration path.

APPENDIX A:

CONTROL MEASURES FOR THE 1979 1-HOUR OZONE ATTAINMENT DEMONSTRATION (REPRINTED FROM THE 2016 AQMP)

ECC-02 – CO-BENEFITS FROM EXISTING RESIDENTIAL AND COMMERCIAL BUILDING ENERGY EFFICIENCY MEASURES: This control measure would seek to account for criteria pollutant co-benefits from the implementation of required energy efficiency mandates such as California's Title 24 program and SB 350 (Clean Energy Pollution Reduction Act). The 2020 target for Title 24 will be to achieve zero net energy consumption from new residential buildings by utilizing new building materials and more efficient appliances. SB 350 doubles the additional achievable energy efficiency savings in electricity and natural gas energy uses in existing buildings and increases renewable energy sources as a share of a utility's power sources from 33 to 50 percent by 2030. This control measure will take advantage of the co-benefit emission reductions from implementation of these state regulations.

ECC-03 – ADDITIONAL ENHANCEMENTS IN REDUCING EXISTING RESIDENTIAL BUILDING ENERGY USE: This control measure would seek to provide incentives to go beyond the goals within ECC-02 and CMB-02. Incentive programs would be developed for existing residences that include weatherization, upgrading older appliances with highly efficient technologies and renewable energy sources to reduce energy use for water heating, lighting, cooking and other large residential energy sources. Incorporating newer, efficient appliance technologies, weatherization measures along with renewables such as solar thermal and solar photovoltaics can provide emission reductions within the residential sector above current SCAQMD and state regulations along with reduced energy costs. When implementing this measure the SCAQMD will collaborate with utilities, agencies, and other organizations to help leverage funding and coordinate incentives with similar existing programs. This measure will also track the requirements of the upcoming Title 24 Zero Net Energy for new residential energy building standards. SCAQMD will begin to participate in this development process to advocate for criteria and GHG emission consideration in the new standards.

CMB-01 – TRANSITION TO ZERO AND NEAR-ZERO EMISSION TECHNOLOGIES FOR STATIONARY SOURCES: This proposed control measure would seek corresponding VOC reductions from NOx-focused measures addressing traditional combustion sources by replacement with zero and near-zero emission technologies including low NOx emitting equipment, electrification, battery storage, alternative process changes, efficiency measures, or fuel cells for CHP. Replacing older higher-emitting equipment with newer lower or zero-emitting equipment can apply to a single source or an entire facility. These sources include, but are not limited to, engines, turbines, microturbines, and boilers that generate power for electricity for distributed generation, facility power, process heating, and/or steam production. Another type of combustion source identified for equipment replacement includes ovens, kilns, and furnaces. New businesses can be required or incentivized to install and operate zero-emission equipment, control equipment, technology and processes beyond the current BACT requirements. Fuel cells are also an alternative to traditional combustion methods, resulting in a reduction of NOx emissions with the co-benefit of reducing VOCs and GHGs. Incentives may be used towards alternative process changes, such as

biogas cleanup. This would help modernize a facility towards zero and near-zero technologies. This control measure would also seek energy storage systems and smart grid control technologies that provide a flexible and dispatchable resource with zero emissions. Grid based storage systems can replace the need for new peaking generation, be coupled with renewable energy generation, and reduce the need for additional energy infrastructure. Mechanisms will be explored to incentivize businesses to choose the cleanest technologies as they replace equipment and upgrade facilities, and to provide incentives to encourage businesses to move into these zero and near-zero emission technologies sooner. Over the anticipated timeline of this Plan, as emerging technologies become more widely available and costs decline, the SCAQMD will undergo rulemaking to require zero emission equipment be installed where economically feasible, and require near-zero emissions levels in all other applications.

CMB-02 – EMISSION REDUCTIONS FROM REPLACEMENT WITH ZERO OR NEAR-ZERO NOx APPLIANCES IN COMMERCIAL AND RESIDENTIAL APPLICATIONS: This control measure seeks annual average NOx emission reductions from unregulated commercial space heating furnaces through regulations and incentives that will replace existing older NOx appliances such as boilers, water heaters, and space heating furnaces and other natural gas or LPG equipment with zero emitting or lower NOx technologies. The measure calls for a priority on maximizing emission reductions utilizing zero-emission technologies in all applications that are shown to be cost-effective and feasible. In other applications, near-zero technologies will be incentivized to meet attainment goals. In assessing the cost-effectiveness of these technologies, full life-cycle in-Basin emissions related to energy and fuel production and transmission pathways will be considered, along with GHG emissions, toxic impacts, and anticipated future changes to the energy portfolio in the Basin. This control measure will apply to manufacturers, distributors, sellers, installers and purchasers of commercial and residential appliances and equipment. The control measure has two components. The first component is to continue to implement the Rule 1111 emission limit of NOx for residential space heaters which is 14 ng/J (20 ppm) starting in 2014. The second component is to incentivize the replacement of older boilers, water heaters and space heaters with newer and more efficient low NOx boilers, water heaters and space heaters, and/or "green technologies" such as solar heating or heat pumps. The SCAQMD will also consider potential future regulatory actions to support replacement of older space heating furnaces, water heaters and boilers with lower emissions and zero or near zero emission technologies. The new boilers and water heaters replaced through incentives would comply with current SCAQMD rule emission limits and new space heaters would meet a specified emission limit. If required, the SCAQMD will consider amending Rules 1121 and 1111 to put in place a heat input based emission limit which will result in lower NOx emissions for high efficiency units compared with standard efficiency units. Because of the rules' heat output based limits, high efficiency water heaters and furnaces emit the same amount of NOx per day as standard efficiency units. In addition, the SCAQMD will also consider developing a rule to limit NOx emissions from those commercial and residential heating furnaces which are currently unregulated.

CMB-03 – EMISSION REDUCTIONS FROM NON-REFINERY FLARES: Flare NOx emissions are regulated through NSR and BACT, but there are currently no source-specific rules regulating NOx emissions from existing flares at non-refinery sources, such as organic liquid loading stations, tank farms, and oil and gas production, landfills and wastewater treatment facilities. This control measure proposes that, consistent with the all feasible control measures, all non-refinery flares meet current BACT for NOx emissions and thermal oxidation of VOCs. The preferred method of control would involve capturing the gas that would typically be flared and converting it into an energy source (e.g., transportation fuel, fuel cells, facility power generation). If gas recovery is not cost-effective or feasible, the installation of newer flares utilizing clean enclosed burner systems implementing BACT will be considered.

CMB-04 – EMISSION REDUCTIONS FROM RESTAURANT BURNERS AND RESIDENTIAL COOKING: This control measure applies to retail restaurants and quick service establishments utilizing commercial cooking ovens, ranges and charbroilers by funding development of, promoting and incentivizing the use and installation of low-NOx burner technologies. In addition, the SCAQMD would consider developing a manufacturer based rule to establish emission limits for cooking appliances used by restaurants and residential applications. Finally, co-benefit reductions will be sought through existing or enhanced energy efficiency programs being implemented by other entities.

FUG-01 – IMPROVED LEAK DETECTION AND REPAIR: This control measure seeks to reduce emissions from a variety of VOC emission sources including, but not limited to, oil and gas production facilities, petroleum refining and chemical products processing, storage and transfer facilities, marine terminals, and other sources, where VOC emissions occur from fugitive leaks in piping components, wastewater system components, and process and storage equipment leaks. Most of these facilities are required under SCAQMD and federal rules to maintain a leak detection and repair (LDAR) program that involves individual screening of all of their piping components and periodic inspection programs of equipment to control and minimize VOC emissions. This measure would utilize advanced remote sensing techniques (Smart LDAR), such as Fourier transform infrared spectroscopy (FTIR), Ultraviolet Differential Optical Absorption Spectroscopy (UV-DOAS), Solar Occultation Flux (SOF), and infrared cameras, that can identify, quantify, and locate VOC leaks in real time allowing for faster repair in a manner that is less time consuming and labor intensive than traditional LDAR.

This control measure would pursue two goals. The first is to upgrade a series of SCAQMD's inspection/maintenance rules (Rules 462, 1142, 1148.1, 463, 1178, 1173, and 1176) to require, at a minimum, a self-inspection program, or utilization of an optical gas imaging-assisted LDAR program where feasible. The second is to explore the use of new technologies to detect and verify VOC fugitive emissions in order to supplement existing programs, explore opportunities where Smart LDAR might substitute for existing LDAR programs, and achieve additional emission

reductions. Both goals will be pursued in a public process allowing interested stakeholders to participate in pilot projects and the rule development process.

For new detection technology this control measure will be implemented in two phases: Phase I will be a pilot LDAR program to demonstrate feasibility with the new technology and to establish implementation protocols. The completion of Phase I will result in the identification of facilities/industries currently subject to LDAR programs and identification of those where the new technology is not yet ready to be utilized. Based on the results of Phase I, fugitive VOC rules will be amended as appropriate under the subsequent phase (Phase II) to enhance their applicability and effectiveness, and to further achieve emission reductions.

CTS-01 – FURTHER EMISSION REDUCTIONS FROM COATINGS, SOLVENTS, ADHESIVES, AND SEALANTS: This control measure seeks limited VOC emission reductions by focusing on select coating, adhesive, solvent and sealant categories by further limiting the allowable VOC content in formulations or incentivizing the use of super-compliant technologies. Examples of the categories to be considered include, but are not limited to, coatings used in aerospace applications, adhesives used in a variety of sealing applications, and solvents for graffiti abatement activities. Reductions could be achieved by lowering the VOC content of a few categories within SCAQMD source-specific Rules 1106, 1106.1, 1107, 1124, 1128, 1136, 1143, 1168, and 1171 where possible, especially where the majority of products already meet lower limits. For Rule 1113, where annual quantity and emissions reporting is required under Rule 314, SIP credit for market-driven reductions could be pursued in categories where many coatings are already formulated below current VOC limits. For solvents, reductions could be achieved by promoting the use of alternative low-VOC products or non-VOC product/equipment at industrial facilities. Particular VOC reductions that lead to the increased use of chemicals that are known or suspected to be toxic should be avoided until it can be demonstrated that these replacement products do not lead to increased toxic risk for workers or the general public. The tightening of regulatory exemptions can also lead to reduced emissions across multiple use categories.

BCM-10 – EMISSION REDUCTIONS FROM GREENWASTE COMPOSTING: VOCs and ammonia, which are PM precursor gases, are emitted from composting of organic waste materials including greenwaste and foodwaste and are currently regulated by existing SCAQMD Rule 1133.3. Although Rule 1133.3 covers foodwaste composting, the level of emissions from foodwaste composting has not been fully characterized, mainly due to the lack of related emissions test data. This control measure proposes potential emission minimization through emerging organic waste processing technology and potential emission reductions through restrictions on the direct land application of chipped and ground uncomposted greenwaste and through increased diversion to anaerobic digestion. This proposed control measure includes a 15-day pathogen reduction process of chipped and ground uncomposted greenwaste with composting best

management practices (BMPs) to reduce potential VOC and ammonia emissions from land applied greenwaste.

MOB-10 – EXTENSION OF THE SOON PROVISION FOR CONSTRUCTION/INDUSTRIAL EQUIPMENT: To promote turnover (i.e., retire, replace, retrofit, or repower) of older in-use construction and industrial diesel engines, this proposed measure seeks to continue the SOON provision of the Statewide In-Use Off-Road Fleet Vehicle Regulation beyond 2023 through the 2031 timeframe. Historically, the SCAQMD Governing Board has allocated up to $30 million per year for the program. However, more recently, the Governing Board has allocated up to $10 million per year. This measure proposes to extend the current SOON Program beyond 2023 to 2031 with a minimum allocation of $10 million and potentially higher levels upon the Governing Board's approval. In order to implement the SOON program in this timeframe, funding of up to $30 million per year would be sought to help fund the repower or replacement of older Tier 0 and Tier 1 equipment to Tier 4 or cleaner equipment, with approximately 2 tpd of NOx reductions.

MOB-11 – EXTENDED EXCHANGE PROGRAM: This measure seeks to continue the successful lawnmower and leaf blower exchange programs in order to increase the penetration of electric equipment or new low emission gasoline-powered equipment used in the region. The lawnmower exchange program has resulted in over 55,000 gasoline lawnmowers replaced with zero-emission lawnmowers and over 12,000 older, dirtier gasoline-powered commercial leaf blowers replaced with newer, cleaner leaf blowers. The SCAQMD is currently conducting a lawn and garden equipment loan program with various public entities to demonstrate the feasibility of zero-emission lawn and garden equipment in various public and commercial settings. Such demonstrations will provide valuable information to lawn and garden equipment manufacturers to produce zero-emission products for the commercial environment. A segment of the lawn and garden equipment population comprised of diesel powered equipment represents a significant fraction of the total NOx emissions associated with this category. As such, the proposed extended exchange program will focus on incentives to accelerate the replacement of older equipment with new Tier 4 or cleaner equipment or zero-emission equipment where applicable. In addition, other small off-road equipment (SORE) equipment may also be considered for exchange programs for accelerating the turnover of existing engines.

MOB-14 – EMISSION REDUCTIONS FROM INCENTIVE PROGRAMS: This measure seeks to develop a rule similar to the San Joaquin Valley Air Pollution Control District Rule 9610 to recognize emission reduction benefits associated with incentive programs. The proposed rule would recognize the emission benefits resulting from incentive funding programs such as the Carl Moyer Memorial Air Quality Standards Attainment Program and Proposition 1B such that the emission reductions can be accounted for in the SIP. As previously mentioned, the U.S. EPA indicated that there are six general elements that need to be incorporated in a proposed rule in

order for the reductions to be credited in the SIP. The six necessary elements are the minimal amount of information, documentation, or commitment needed for U.S. EPA to consider approval of emission reduction benefits associated with incentives programs. Additional elements may be identified during the implementation of this measure.

APPENDIX B:

CEPA SOURCE LEVEL EMISSIONS REDUCTION SUMMARY

Run Date: 8/30/2018 11:21:42 AM
(P2016sy CepaV02 SIC / Nov 2014)
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Year 2022 Emission Reductions Excluding Natural Sources by Control Measure in the South Coast Air Basin (Planning Inventory - Tons/Day)

(A) Reductions Without Overlapping/Double-Counting With Other Control Measures (1)

		(Reductions - Tons/Day)			
Measure	Name	VOC	NOx	CO	NO2
BA-01	MOB-14 (Existing Projects) - School Buses - Diesel	0.00	0.15	0.01	0.15
BA-04	MOB-14 (Existing Projects) - Freight Locomotives (Prop1B/Moyer)	0.00	1.01	0.18	1.01
BA-06	MOB-14 (Existing Projects) - Offroad Equipment - Construction/Min	0.00	1.72	2.95	1.10
BA-07	MOB-14 (Existing Projects) - Harborcraft (Fishing Vessels)	0.00	1.96	0.74	1.68
ECC-02	Co-Benefits from Energy Efficiency Measures - Res/Comm Bldg	0.06	0.26	1.87	0.45
ECC-03	Additional Enhancement of Building Energy Efficiency	0.14	1.03	4.31	1.92
CMB-01	Zero and Near-Zero Emission Technologies at Stationary Sources	1.00	2.14	3.78	2.09
CMB-02	Commercial and Multi-Residential Space & Water Heating	0.00	1.10	1.20	1.79
CMB-03	Emission Reductions From Non-Refinery Flares	0.37	1.39	1.01	1.39
CMB-04	Emission Reductions From Restaurant Burners and Residential Cooki	0.00	0.81	0.38	0.81
FUG-01	Improved Leak Detection and Repair	2.03	0.00	0.00	0.00
CTS-01	Further Reduction from Coatings, Solvents, Adhesives & Lubricants	1.01	0.00	0.00	0.00
BCM-01	Further Emission Reductions from Commercial Cooking	0.00	0.00	0.00	0.00
BCM-10	Emission Reduction from Greenwaste Composting	1.50	0.00	0.00	0.00
ARB-LDV	On-Road Light Duty Vehicles	0.00	0.00	0.00	0.00
ARB-HDV	On-Road Heavy Duty Vehicles	0.00	0.00	0.00	0.00
CP	Consumer Products	0.00	0.00	0.00	0.00
FIS-AIRC	Federal/International - Aircrafts	0.00	0.00	0.00	0.00
FIS-LOCO	Federal/International - Locomotives	0.00	0.00	0.00	0.00
MOB-10	Extension of the SOON Provision	0.00	1.91	1.18	1.30
MOB-11	Extended Exchange Program	0.00	2.48	44.71	2.13
MOB-14a	MOB-14 (Future Project Funding) - School Buses	0.00	0.17	0.01	0.18
MOB-14c	MOB-14 (Future Project Funding) - Cargo Handling Equipment	0.00	0.17	2.33	0.16
MOB-14d	MOB-14 (Future Project Funding) - Freight Locomotives - Road Haul	0.00	0.05	0.02	0.05
MOB-14e	MOB-14 (Future Project Funding) - Heavy Duty Diesel Trucks (>1400	0.00	4.24	0.78	4.35
Grand Total (Net)		6.10	20.58	65.44	20.55

Year 2022 Emission Reductions Excluding Natural Sources by Control Measure in the South Coast Air Basin (Planning Inventory - Tons/Day)

(B) Reductions With Overlapping/Double-Counting With Other Control Measures (2)[3]

		(Reductions - Tons/Day)			
Measure	Name	VOC	NOx	CO	NO2
BA-01	MOB-14 (Existing Projects) - School Buses - Diesel	0.00	0.15	0.01	0.15
BA-04	MOB-14 (Existing Projects) - Freight Locomotives (Prop1B/Moyer)	0.00	1.01	0.18	1.01
BA-06	MOB-14 (Existing Projects) - Offroad Equipment - Construction/Min	0.00	1.72	2.95	1.10
BA-07	MOB-14 (Existing Projects) - Harborcraft (Fishing Vessels)	0.00	1.96	0.74	1.68
ECC-02	Co-Benefits from Energy Efficiency Measures - Res/Comm Bldg	0.06	0.26	1.87	0.45
ECC-03	Additional Enhancement of Building Energy Efficiency	0.14	1.06	4.41	1.97
CMB-01	Zero and Near-Zero Emission Technologies at Stationary Sources	1.00	2.14	3.78	2.09
CMB-02	Commercial and Multi-Residential Space & Water Heating	0.00	1.24	1.37	2.04
CMB-03	Emission Reductions From Non-Refinery Flares	0.37	1.39	1.01	1.39
CMB-04	Emission Reductions From Restaurant Burners and Residential Cooki	0.00	0.88	0.41	0.88
FUG-01	Improved Leak Detection and Repair	2.03	0.00	0.00	0.00
CTS-01	Further Reduction from Coatings, Solvents, Adhesives & Lubricants	1.01	0.00	0.00	0.00
BCM-01	Further Emission Reductions from Commercial Cooking	0.00	0.00	0.00	0.00
BCM-10	Emission Reduction from Greenwaste Composting	1.50	0.00	0.00	0.00
ARB-LDV	On-Road Light Duty Vehicles	0.00	0.00	0.00	0.00
ARB-HDV	On-Road Heavy Duty Vehicles	0.00	0.00	0.00	0.00
CP	Consumer Products	0.00	0.00	0.00	0.00
FIS-AIRC	Federal/International - Aircrafts	0.00	0.00	0.00	0.00
FIS-LOCO	Federal/International - Locomotives	0.00	0.00	0.00	0.00
MOB-10	Extension of the SOON Provision	0.00	1.91	1.18	1.30
MOB-11	Extended Exchange Program	0.00	2.48	44.71	2.13
MOB-14a	MOB-14 (Future Project Funding) - School Buses	0.00	0.17	0.01	0.18
MOB-14c	MOB-14 (Future Project Funding) - Cargo Handling Equipment	0.00	0.17	2.33	0.17
MOB-14d	MOB-14 (Future Project Funding) - Freight Locomotives - Road Haul	0.00	0.05	0.02	0.05
MOB-14e	MOB-14 (Future Project Funding) - Heavy Duty Diesel Trucks (>1400	0.00	4.24	0.78	4.35
Grand Total (with potential overlapping)		6.10	20.83	65.75	20.92

[3] This table is included to be consistent with the format presented in the 2016 and previous AQMPs. However, the reductions shown in this table is calculated based on target control efficiency, which was not used to assist the development of control strategy or to demonstrate attainment. The emission reductions listed in table A of the previous page represents the reductions used for attainment.

EMISSION SUMMARY FOR
(POINT, AREA, MOBILE SOURCE, AND OFF-ROAD MV)

BASELINE EMISSIONS

	VOC	NOx	CO	NO2
Point source	31.65	7.19	33.54	7.19
Area source	188.07	27.63	119.03	35.65
RECLAIM	0.00	14.90	0.00	14.90
Total Stationary	219.73	49.72	152.57	57.74
On-road	71.40	116.78	490.38	122.57
Off-road	87.61	103.42	587.59	88.45
Aircraft	3.92	16.91	40.52	16.91
TOTAL	382.66	286.83	1271.06	285.68

EMISSION REDUCTIONS

Point source	0.54	1.80	2.27	1.80
Area source	5.56	4.93	10.27	6.64
RECLAIM	0.00	0.00	0.00	0.00
Total Stationary	6.10	6.73	12.53	8.44
On-road	0.00	4.56	0.80	4.68
Off-road	0.00	9.30	52.11	7.43
Aircraft	0.00	0.00	0.00	0.00
TOTAL	6.10	20.58	65.44	20.55

REMAINING EMISSIONS

Point source	31.12	5.39	31.27	5.39
Area source	182.51	22.70	108.77	29.01
RECLAIM	0.00	14.90	0.00	14.90
Total Stationary	213.63	42.99	140.04	49.29
On-road	71.40	112.22	489.59	117.89
Off-road	87.61	94.12	535.48	81.03
Aircraft	3.92	16.91	40.52	16.91
TOTAL	376.57	266.25	1205.62	265.13
NSR/Set-Aside	4.62	3.08	0.00	3.08
Public Funding	0.00	0.00	0.00	0.00

GRAND TOTAL (T/D)	381.19	269.33	1205.62	268.21
Mobility Adjustments (3)	0.00	0.00	0.00	0.00

(1) Emission reductions for individual measures were estimated based on the sequence of listing contained here. When the sequence changes, reductions from each measure could be affected, but the net total remain the same. The purpose of this table is to estimate total emission reductions without overlapping or double-counting between measures.
(2) Emission reductions for individual measures were estimated in the absence of other measures. Therefore, the sequence of listing does not affect the reduction estimates. The purpose of this table is to provide emission reduction estimates for Appendix IV control measure summary tables as well as cost effectiveness analysis.
(3) Mobility Adjustment includes TCM-01, ATT-01, ATT-02, ATT-05 and adjustments are reflected in the CEPA baseline beyond year 2000.

EMISSION SUMMARY BY AGENCY [4]
EPA, CARB AND SCAQMD

BASELINE EMISSIONS BASE EMISSIONS	VOC	NOx	CO	NO2
EPA	17.76	76.06	204.53	75.67
CARB	242.26	163.26	914.52	154.03
SCAQMD (1)	122.63	47.51	152.01	55.97
TOTAL (2)	382.65	286.83	1271.06	285.67
EMISSION REDUCTIONS				
EPA	0.00	2.33	3.66	2.32
CARB	1.27	11.78	49.29	9.98
SCAQMD	4.82	6.48	12.48	8.24
TOTAL	6.09	20.59	65.43	20.54
REMAINING EMISSIONS				
EPA	17.76	73.73	200.87	73.35
CARB	240.99	151.48	865.23	144.05
SCAQMD (1)	117.81	41.03	139.53	47.73
TOTAL (2)	376.56	266.24	1205.63	265.13

(1) SCAQMD figures include RECLAIM
(2) Totals do not include the line items

[4] The agency responsibility is based on the allocation of regulatory authority, but does not reflect the CARB's 2016 SIP strategy.