Attainment Plan Revision for the 1997 Annual PM2.5 Standard

San Joaquin Valley Air Pollution Control District

July 20, 2021

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VALLEY-WIDE PROGRESS TOWARDS ATTAINMENT OF THE 1997 PM2.5 STANDARDS

The *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan* or Plan) was adopted by the San Joaquin Valley Air Pollution Control District (District) Governing Board on November 15, 2018, and adopted by the California Air Resources Board (CARB) on January 24, 2019. The *2018 PM2.5 Plan* utilized extensive science and research, state of the art air quality modeling, and the best available information in developing a strategy for bringing the Valley into attainment with the 1997, 2006, and 2012 National Ambient Air Quality Standards (NAAQS, or standards) for fine particulate matter (PM2.5) as expeditiously as practicable by the respective deadlines of 2020, 2024, and 2025. The United States Environmental Protection Agency (EPA) proposed and finalized its approval of the 2006 PM2.5 standard portion of the *2018 PM2.5 Plan* in June 2020. EPA has been in the process of reviewing the other portions of the *2018 PM2.5 Plan* related to the 1997 and 2012 PM2.5 standards since May 2019. With regards to the 1997 standard, EPA has defined two components for the standard based on averaging times: a 24-hour average standard of 65 micrograms per cubic meter ($\mu g/m^3$), and an annual average standard of 15 $\mu g/m^3$. The projected attainment date for both standards, as included in the *2018 PM2.5 Plan*, was December 31, 2020.

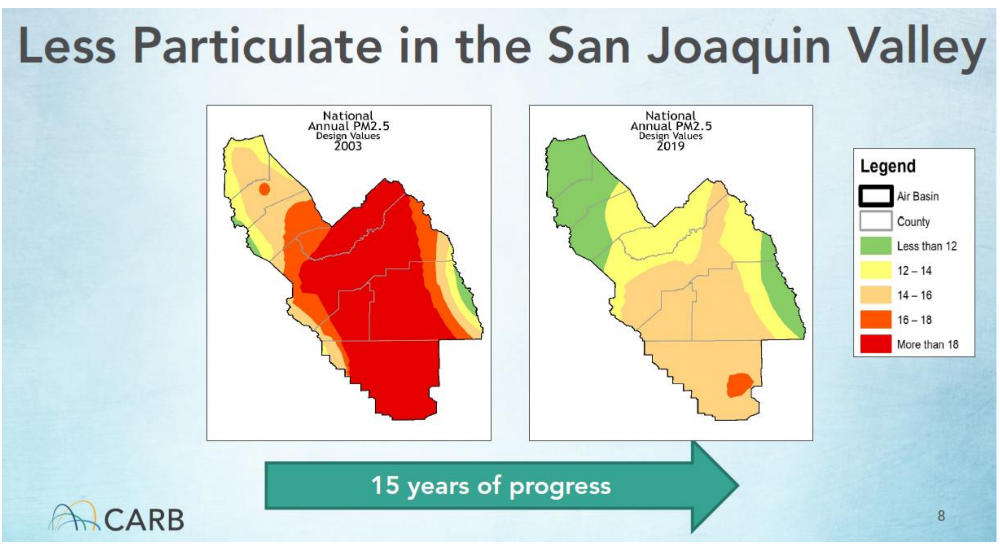
To achieve the significant emissions reductions necessary for expeditious attainment of the PM2.5 standards, the *2018 PM2.5 Plan* includes a comprehensive suite of regulatory and incentive-based measures for both stationary and mobile sources. District and CARB staff have been actively implementing the control strategies detailed in the *2018 PM2.5 Plan*.

The District Governing Board has approved a number of actions in 2019 and 2020 to continue to reduce PM2.5 emissions and fulfill the commitments in the *2018 PM2.5 Plan*. These include amendments to District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters), District Rule 4311 (Flares), and District Rules 4306/4320 (Boilers, Steam Generators, and Process Heaters). Additionally, District staff anticipate bringing a number of recommended actions to the Governing Board for consideration by December 2021 to fulfill *2018 PM2.5 Plan* commitments. These recommended actions will include potential amendments to District Rule 4702 (Internal Combustion Engines), District Rule 4354 (Glass Melting Furnaces), and District Rule 4352 (Solid Fuel-Fired Boilers, Steam Generators and Process Heaters) to achieve additional emissions reductions. Beyond these regulatory development projects, the District is actively implementing incentive programs to further reduce emissions of PM2.5 and key precursor pollutants. The District's Burn Cleaner incentive program was amended per the commitment in the Plan, and has already made significant progress towards meeting the District's emission reduction commitment. Additionally, concurrently with adopting the *2018 PM2.5 Plan*, the District Governing Board adopted three technology advancement incentive programs, including the Low-Dust Nut Harvesting Equipment Incentive Program, the Alternatives to Agricultural Open Burning Incentive Program, and the commercial Clean Green Yard Machine Program. These new programs have been highly successful since their launch in 2019. In June, the District Governing Board adopted a new strategy that establishes the near-complete phase-out of agricultural open burning by the end of 2024.

As a part of the combined strategy in the *2018 PM2.5 Plan*, CARB committed to achieve an aggregate 32 tpd of NOx emission reductions and 1 tpd of PM2.5 emission reductions. Of the measures CARB proposed for that aggregate commitment, some were in progress as the plan was being developed, and by December 2018, CARB's Innovative Clean Transit regulation, amended warranty requirements for heavy-duty vehicles, and lower opacity limits for heavy-duty vehicles were adopted. Since then, CARB has adopted other major rules to meet plan commitments, including the Heavy-Duty Low NOx Omnibus regulation, Advanced Clean Trucks regulation, and the Zero-Emission Airport Shuttle Bus regulation. Further regulatory action is in progress, including the Heavy-Duty Inspection and Maintenance Program, Small Off-Road Engine regulation, and Advanced Clean Cars 2 and CARB has held a number of public workshops and proposed draft regulatory language for public engagement. In addition to the regulatory work, CARB has worked closely with the District to implement essential incentive measures, including submitting the first demonstration report to EPA for accelerated turnover of agricultural equipment, quantifying incentive based emissions reductions from the Moyer Program, FARMER program, and NRCS's agricultural tractor replacements.

These aggressive control measures have achieved significant reductions of PM2.5 and NOx throughout the Valley, leading to measurable progress towards attainment of the health-based PM2.5 standards, with the Valley now in attainment of the 65 µg/m³ standard, and the vast majority of the Valley meeting the 15 µg/m³ standard (see below illustrative figure).

Figure 1: 15 Year Progress in Reducing Annual PM2.5 Design Values

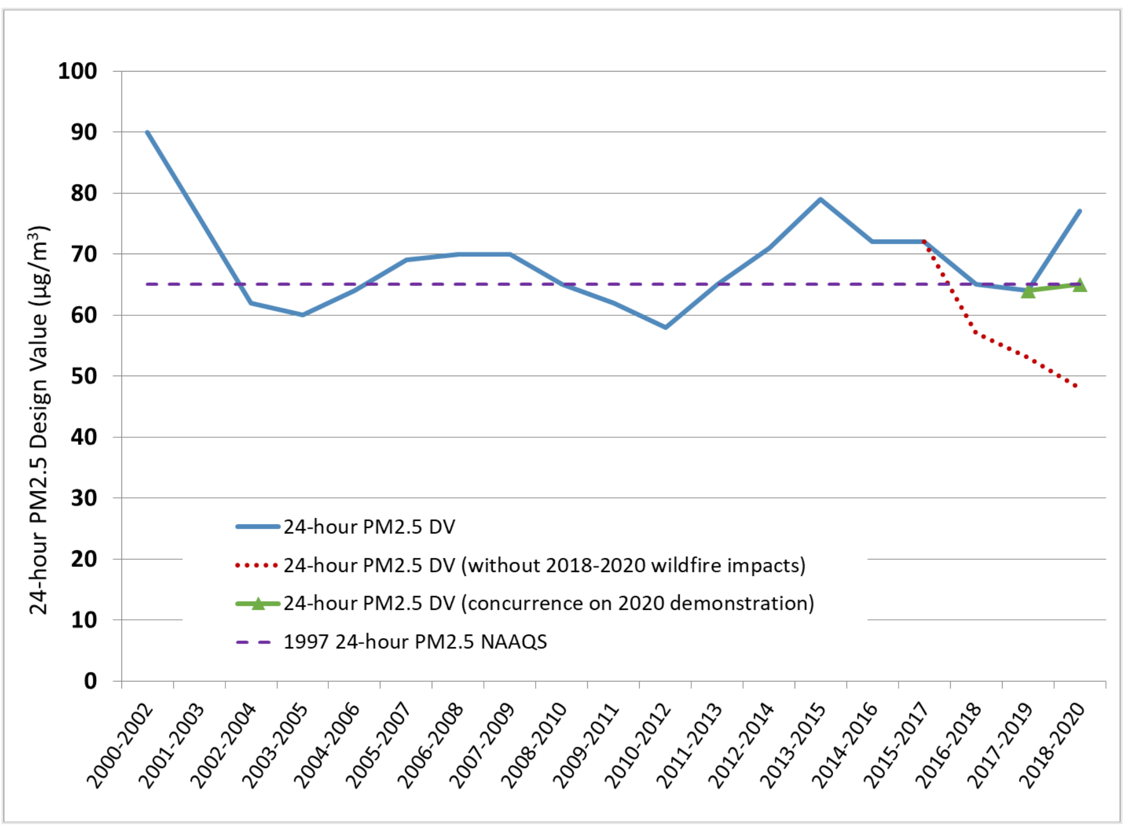


EPA APPROVAL OF WILDFIRE EXCEPTIONAL EVENTS SUPPORTS VALLEY ATTAINMENT DEMONSTRATION OF 65 µG/M³ STANDARD

With respect to the 65 µg/m³ 24-hour portion of the 1997 PM2.5 standard, the District submitted documentation to CARB and EPA demonstrating that this standard has been met by the 2020 attainment target. This demonstration included "exceptional event" documentation of the severe wildfire impacts on the Valley's air quality in the year 2020. In preparing this analysis, the District worked closely with CARB and EPA to ensure that all of the needed documentation had been completed to support a clean data determination of this portion of the 1997 PM2.5 standard. The 24-hour PM2.5 design value is calculated using the 3-year average 98th percentile for the maximum site anywhere in District. Figure 1 shows the trend of the District 24-hour PM2.5 design value through 2020. The solid blue line shows the design value including all exceptional events impacts for each year. The dotted red line represents the design value if all data impacted by wildfire exceptional events were removed from 2016 through 2020 data.

On July 13, 2021, EPA formally approved the District's exceptional event documentation, and the Valley is now able to demonstrate that it meets the 65 µg/m³ standard. This accomplishment is many years in the making, and has only been feasible through the significant investment and effort by Valley residents and businesses to reduce emissions over the past several decades.

Figure 2: Downward Trend in Valley 24-hour PM2.5 Design Value



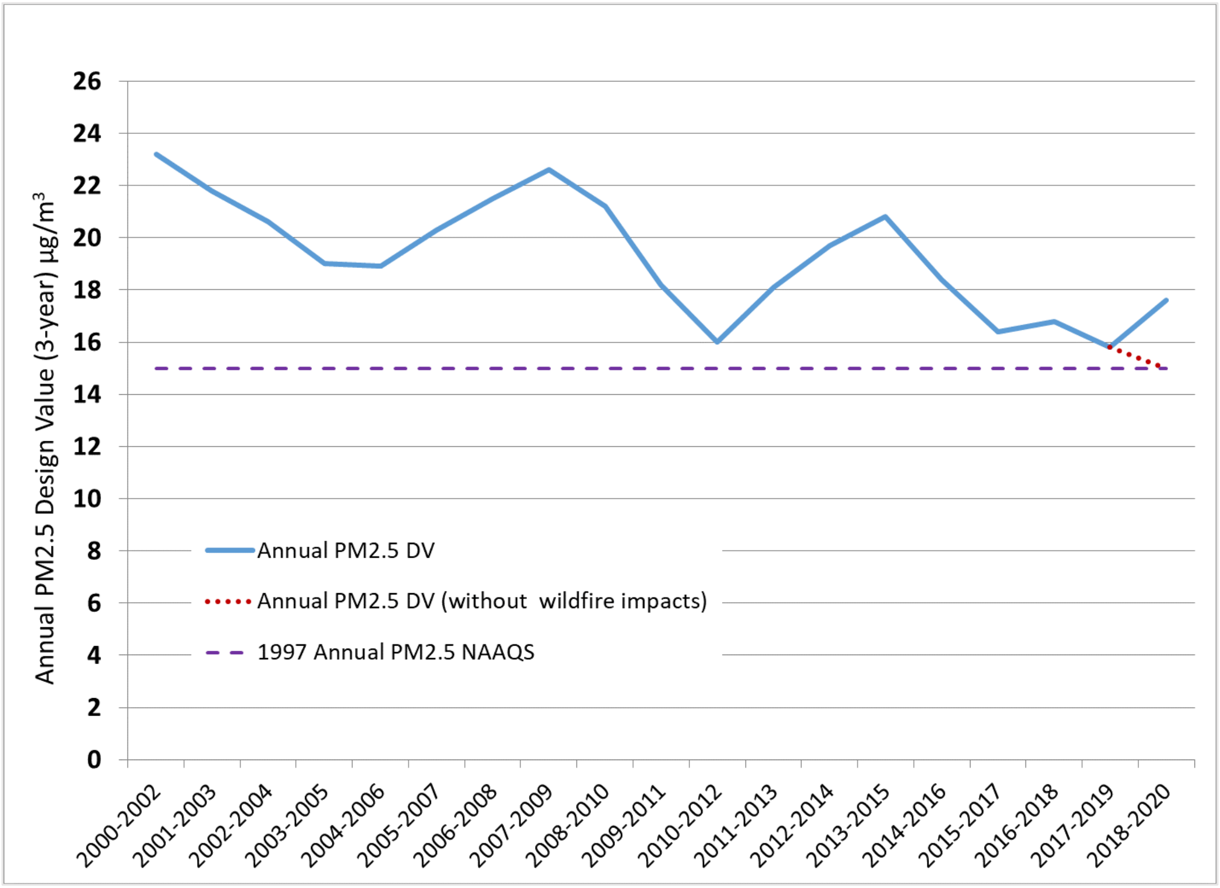
EPA Proposed Disapproval of Plan Elements Pertaining to 15 µg/m³ Standard

Regarding the 15 µg/m³ annual average standard, the Valley would have met this standard by the projected attainment target of 2020, but for significant wildfire impacts, as well as data collection issues at the Valley's peak air monitoring site in Bakersfield (operated by CARB) during the 2018-2020 period. As shown in the figure below, annual PM2.5 levels throughout the Valley have seen a continued steady decline. Fresno has been in attainment of the 15 µg/m³ annual standard since 2016 despite major wildfire impacts. Out of 18 Valley sites, nine of them, generally in the northern part of the Valley, attained in 2020 even without the exceptional events excluded. This is a dramatic improvement compared to ten years ago in 2011, when seven of the nine sites now in attainment exceeded the standard.

In fact, after excluding data impacted by wildfire exceptional events, the entire Valley is now meeting the standard, with only the Bakersfield-Planz site monitoring site exceeding the 15 µg/m³ annual standard (with a three-year design value of 15.4 µg/m³). This site has historically been the Valley's high site for fine particulate concentrations due in part to its geographic location at the pollution-trapping southern end of the air basin as well as its site location next to an active airport and helicopter landing site. In addition, if it were not for the data collection issues in late 2018, the site's 2020 design value would have been under the 15 µg/m³ standard. CARB has instituted mechanisms to ensure that the Bakersfield air monitoring site is operated appropriately to avoid data completeness issues in the future.

The 1997 annual PM2.5 design value for a given year is the 3-year average (ending in that year) of the annual average PM2.5 concentrations, where the annual average is calculated as the average of the quarterly averages for each calendar quarter (e.g., January-March, April-June, July-September, October-December). Figure 3 shows the trend of the District Annual PM2.5 design value through 2020. The solid blue line shows the design value including all exceptional events impacts for each year. The dotted red line represents the design value if all data impacted by wildfire exceptional events were removed from 2016 through 2020 data.

Figure 3: Downward Trend in Valley Annual PM2.5 Design Value



While significant progress has been made, EPA believes these unprecedented wildfire impacts and data issues prevent it from reaching a finding of attainment of this standard by the 2020 attainment target. Due to these issues, on July 13, 2021, EPA proposed to disapprove the portions of the *2018 PM2.5 Plan* related to the 1997 annual PM2.5 plan.

PROPOSED REVISION TO THE ATTAINMENT PLAN FOR THE 1997 ANNUAL PM2.5 STANDARD

To address EPA's proposed action, the District and CARB have prepared an administrative revision to the *2018 PM2.5 Plan* to establish a new attainment target date for the 1997 annual PM2.5 standard of December 31, 2023. This administrative plan revision has been prepared as a streamlined document that utilizes the existing emissions inventory, air quality analysis and modeling from the *2018 PM2.5 Plan*. Measures achieving additional emissions reductions during the new projected 2023 timeframe include CARB's heavy-duty truck inspection and maintenance program, the agricultural equipment replacement program, amended warranty requirements for heavy-duty vehicles, and lower opacity limits for heavy-duty vehicles, as well as the District's residential woodsmoke reduction strategy. It is important to note that while the District and CARB continue to implement the toughest measures in the nation, the *2018 PM2.5 Plan* also relies on reductions from federal emissions sources. Unfortunately, the federal government has not provided their fair share of emissions reductions, placing pressure on the District and CARB to find additional reductions to make up the shortfall. Based on the continued implementation of the existing control strategy adopted in the *2018 PM2.5 Plan*, District and CARB modeling has shown that the Valley will demonstrate attainment of the 1997 annual PM2.5 standard by the new attainment date of 2023, if not earlier.

HISTORY OF ATTAINMENT PLANNING FOR THE 1997 STANDARD

The EPA 1997 PM2.5 standard has two components: an annual average standard of 15 $\mu g/m^3$, and a 24-hour average standard of 65 $\mu g/m^3$. EPA designated the San Joaquin Valley (Valley) as nonattainment of this standard effective April 2005, and finalized its implementation rule effective May 29, 2007 consistent with federal Clean Air Act (CAA) Subpart 1. On April 30, 2008, the District adopted the *2008 PM2.5 Plan* demonstrating attainment of the 1997 standard by April 2015 and satisfying all federal implementation requirements. EPA approved this plan effective January 9, 2012. Subsequently, on January 4, 2013, the D.C. Circuit Court ruled that EPA erred by solely using CAA Subpart 1 in establishing its PM2.5 implementation rule, without consideration of the PM-specific provisions in Subpart 4.[1]

Subpart 4 differs from Subpart 1 in its attainment plan deadlines, the required level of emissions controls, and its handling of PM precursors. Another key difference is in the classification of nonattainment areas and corresponding attainment deadlines. Under Subpart 1, all areas were designated nonattainment without a corresponding classification. Under Subpart 4, nonattainment areas are initially classified as "Moderate," with six years from its initial nonattainment designation date to reach attainment (though two one-year extensions are available in certain circumstances). An area can request reclassification to "Serious," with ten years from its initial attainment designation date to reach attainment. Subpart 4 allows for an additional extension of up to five years if the area demonstrates that the mandated attainment deadline is infeasible, all requirements and commitments have been met, and the SIP includes the most stringent measures (MSM) possible. If an area fails to attain an applicable attainment deadline, under CAA § 189(d), the area must submit a SIP revision demonstrating expeditious attainment, with PM or PM precursor emissions reduced by at least 5% per year until attainment.

Following the 2013 D.C. Circuit Court ruling, EPA began redirecting all PM2.5 implementation efforts to be consistent with Subpart 4, but under a truncated schedule as compared to what would have occurred had EPA initially designated nonattainment areas under Subpart 4 in 2005. In June 2014, EPA classified the Valley as a Moderate nonattainment area under Subpart 4 with an attainment date of April 5, 2015. In August 2014, the District submitted a formal request to EPA to reclassify the Valley to Serious nonattainment. EPA granted the Valley's Serious reclassification request in April 2015, setting a new attainment date of December 31, 2015.

After implementing the commitments in the *2008 PM2.5 Plan*, the Valley had been on the verge of attaining the 1997 PM2.5 Standard. However, due to the extreme drought, stagnation, strong inversions, and historically dry conditions experienced over the winter of 2013-2014, it was clear in 2014 that attainment by 2015 (based on 2013-2015 data) would not be possible.

[1] *Nat. Res. Def. Council v. E.P.A.*, 706 F.3d 428 (D.C. Cir. 2013)

The District adopted the *2015 PM2.5 Plan for the 1997 PM2.5 Standard* (*2015 PM2.5 Plan*) in April 2015 with an MSM demonstration and an attainment date extension request of 2020, as provided for in Subpart 4. The District had worked closely with EPA for over a year developing this plan to address concerns and ensure CAA requirements were satisfied. The *2015 PM2.5 Plan's* comprehensive control strategy would achieve a 38% reduction in emissions of nitrogen oxides (NOx) between 2012 and 2020, the key precursor to NOx formation in the Valley, as well as significant reductions in directly emitted PM2.5.

EPA formally proposed to approve portions of the *2015 PM2.5 Plan* and the attainment date extension on February 9, 2016. EPA needed to finalize its approval of the Valley's attainment date extension by July 2016, but EPA failed to finalize this action. EPA subsequently denied the District's attainment extension request on the basis that they did not have enough information to act, and found that the Valley failed to attain the 1997 standard by its December 2015 attainment deadline. EPA's action was effective December 23, 2016,[2] just seven days before the new SIP amendment would be due to EPA as a result of EPA's action.

Pursuant to CAA §189(d), EPA's 2016 PM2.5 Implementation Rule,[3] and 40 CFR §51.1003(c), the District was then required to submit a SIP revision that meets the requirements summarized in Table 5-1, commonly called a 5% Plan. Although this 1997 PM2.5 SIP update was technically due by December 2016, this was not feasible given the already-truncated schedule described above. Addressing these requirements as part of this *2018 Plan for the 1997, 2006, and 2012 PM2.5 Plan* (Plan) allowed for better stakeholder involvement and harmonization of SIP elements between the 1997, 2006, and 2012 PM2.5 standards. The Plan was adopted by the District Governing Board on November 15, 2018, and subsequently adopted by CARB on January 24, 2019. CARB and the District have been actively implementing the control strategies outlined in the Plan.

District and CARB recently prepared a clean data determination to confirm the Valley's attainment of the 1997 24-hour PM2.5 standard of 65 µg/m³ by the 2020 attainment target. This analysis included "exceptional event" documentation of the severe wildfire impacts on the Valley's air quality in the year 2020. On July 13, 2021, EPA formally approved the District's exceptional event documentation, and the Valley is now able to demonstrate that it meets the 65 µg/m³ standard.

Due to EPA's proposed disapproval of the portions of the *2018 PM2.5 Plan* that address the 15 µg/m³ annual average standard, as discussed above, the District is amending the State Implementation Plan to update the attainment demonstration for the 15 µg/m³ standard from the original projected attainment date of 2020, to a new demonstrated attainment deadline of 2023.

[2] https://www.gpo.gov/fdsys/pkg/FR-2016-11-23/pdf/2016-28100.pdf
[3] 81 Fed. Reg. 58098-58106, available at https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

PROPOSED SIP REVISION FOR THE 1997 ANNUAL PM2.5 STANDARD

For a Serious PM nonattainment area that fails to attain by the projected attainment date, the CAA requires that a revision to the SIP be submitted to EPA within 12 months after the applicable attainment date. The SIP revision must demonstrate attainment of the standard as expeditiously as possible, but no later than 5 years from the date of EPA's final determination of failure to attain the standard. In addition to the attainment demonstration, the SIP revision must also demonstrate that each year the area will achieve at least a 5 percent reduction in emissions of direct PM2.5 or a 5 percent reduction in emissions of a PM2.5 plan precursor based on the emissions inventory for the area. This proposed attainment demonstration satisfies statutory requirements for a CAA §189(d) plan for a Serious nonattainment area SIP submission, and updates the originally projected attainment date for the 1997 annual PM2.5 standard from December 31, 2020, to December 31, 2023. Updates to address planning requirements for the annual standard based on this new attainment date are being made to the District's *2018 PM2.5 Plan.* Based on the continued implementation of the existing control strategy adopted in the *2018 PM2.5 Plan*, District and CARB modeling has shown that the Valley will demonstrate attainment of the 1997 annual average PM2.5 standard of 15 µg/m³ by the new attainment date of 2023, if not earlier.

5% PLAN DEMONSTRATION

Pursuant to CAA §189(d), EPA's 2016 PM2.5 Implementation Rule,[4] and 40 CFR §51.1003(c), the SIP revision for the 1997 annual PM2.5 NAAQS includes a 5% plan demonstration, showing an annual 5 percent reduction of PM or a PM precursor. This SIP revision demonstrates that the Valley will meet this requirement for all the years required to be addressed in this Plan, which includes 2021 through 2023. The Valley is expected to attain the 1997 annual PM2.5 standard by 2023 at the latest. NOx is used for this demonstration, given that NOx is the key precursor for the formation of both ozone and PM2.5 and the Valley's attainment strategy for PM2.5 and ozone NAAQS heavily depend on NOx reductions.

A CAA §189(d) Plan must include a control strategy satisfying the requirements of 40 CFR §§ 51.1003(c)(1)(iii) and 51.1010(c). This control strategy must be sufficient to achieve the emissions reductions necessary for the 5% demonstration and expeditious attainment. The District's evaluation of emissions sources and emissions controls demonstrates that the most stringent measures, which includes all reasonably available emission reduction opportunities and best available control measures, are in place in the Valley for NOx and directly emitted PM2.5 emissions. This evaluation was approved by EPA in June 2020, as a part of EPA's action related to the 2006 PM2.5 standard.[5] Refer to Appendix C of the *2018 PM2.5 Plan* and the updated Appendix D of the Plan, attached to the report, for these demonstrations.

This updated Plan demonstrates satisfaction of the CAA 5% plan demonstration requirements for the 1997 annual PM2.5 standard through the projected attainment date

[4] 81 Fed. Reg. 58098-58106, available at https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf
[5] 85 Fed. Reg. 27976-27979, available at https://www.regulations.gov/document/EPA-R09-OAR-2019-0318-0194

of 2023. The emissions inventory for baseline and future milestone years are presented in Appendix B of the *2018 PM2.5 Plan*. The updated Chapter 4 of the *2018 PM2.5 Plan,* included as an attachment to this document, includes a new quantification of emission reductions expected to be achieved by 2023 through the ongoing implementation of stationary and mobile source control measures, which will support the emission reductions needed for this updated 5% plan. Please refer to the attached updated Chapter 5 of the Plan for further details on the requirements for attainment planning for this standard, and the 5% plan demonstration.

Attainment Modeling Demonstration

Photochemical modeling plays a crucial role in demonstrating attainment of the national ambient air quality standards based on projected future year emissions. Consistent with U.S. EPA guidance for model attainment demonstrations (U.S. EPA, 2014[6]), photochemical modeling was used to project PM2.5 design values to the future. The findings from the *2018 PM2.5 Plan* model attainment demonstration were retained for the updated modeling demonstration for the 1997 24-hour PM2.5 standards. CARB modeling demonstrates that the Valley will attain the 1997 annual PM2.5 standard in 2023, based on the 2018-2020 baseline design values and anticipated emission reductions in the coming years. Please refer to the updated Appendix K of the *2018 PM2.5 Plan* for a full description and the updated modeling demonstration for this standard.

Motor Vehicle Emission Budgets

Section 93.124(e) of the Federal Conformity Regulation states that nonattainment areas with more than one Metropolitan Planning Organization (MPO) may establish motor vehicle emission budgets for each MPO in the non-attainment area. This SIP revision establishes updated county-level emission budgets for each of the eight MPOs[7] in the Valley. For this revision, CARB has included the year 2026 into the San Joaquin Valley 1997 24-hour and Annual PM2.5 Motor Vehicle Emissions Budgets for the annual average tons per day of NOx and $PM_{2.5}$. The Budgets are based on the most recently amended 2017 Federal Transportation Improvement Plan for each MPO as of January 2018. Please refer to the updated Plan Appendix D for a full description.

Reasonable Further Progress

Pursuant to 40 CFR §§ 51.1003(c)(1)(v) and 51.1012,[8] this SIP revision includes an updated demonstration of Reasonable Further Progress (RFP). Per CAA requirements, each attainment plan for a PM2.5 nonattainment area shall include an RFP plan that demonstrates that sources in the area will achieve such annual incremental reductions

[6] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

[7] The boundary of the Kern Council of Governments encompasses all of Kern County, while the portion of Kern County located within the PM2.5 non-attainment area only includes the portion located within the San Joaquin Valley Air Basin (SJVAB)/San Joaquin Valley Air Pollution Control District (SJVAPCD). Consequently, the motor vehicle emissions budgets for Kern County only include the non-attainment area located within the SJVAB/SJVAPCD.

[8] See also 81 Fed. Reg. 58103-58104.

in emissions of direct PM2.5 and PM2.5 plan precursors as are necessary to ensure attainment of the applicable PM2.5 NAAQS as expeditiously as practicable. This updated Plan demonstrates satisfaction of CAA RFP requirements for all 1997 PM2.5 standard milestone years. Please refer to the updated Plan Appendix H, attached, for a full description and the RFP demonstration.

Quantitative Milestones

Consistent with CAA §189(c)(1), the state must submit in each attainment Plan for a PM2.5 nonattainment area specific quantitative milestones that demonstrate reasonable further progress toward attainment of the applicable PM2.5 NAAQS in the area. Quantitative milestones are designed to track RFP, to track progress in achieving the minimum 5 percent annual emission reductions as well as control measures needed for expeditious attainment. The District and CARB must establish quantitative milestones for milestone years. The quantitative milestone years for this CAA §189(d) Plan are 2017, 2020, 2023, and 2026. This updated Plan demonstrates satisfaction of CAA by establishing quantitative milestones for all milestone years. See the updated Plan Appendix H, attached, for this demonstration.

Contingency Measures

Pursuant to CAA §172(c)(9) and 40 CFR § 51.1014, all PM2.5 attainment plans must contain contingency measures. Contingency measures are additional control measures to be implemented in the event that EPA issues final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure. Contingency measures must be fully adopted rules or control measures that are ready to be implemented quickly upon a determination by the EPA that a failure occurred.

The contingency measures included in the *2018 PM2.5 Plan* continue to satisfy CAA requirements because they:

- Consist of control measures that are not otherwise included in the control strategy or that achieve emissions reductions not otherwise relied upon in the control strategy for the area,
- Specify the timeframe within which its requirements become effective following a determination by EPA,
- Contain a description of any specific trigger mechanisms for the contingency measures and specify a schedule for implementation.

Updates to the District's 2018 PM2.5 Plan

To address EPA's proposed action, the District and CARB have prepared proposed revisions to portions of the *2018 PM2.5 Plan* that relate to the 1997 annual PM2.5 standard, as described above. These updated chapters are attached as appendices to this document for incorporation into the SIP. At this time, the District is proposing no changes to the following sections of the Plan:

- Chapter 1 Introduction
- Chapter 2 Air Quality Challenges and Trends

- Chapter 3 Health Impacts and Health Risk Reduction Strategy
- Chapter 6 Demonstration of Federal Requirements for 2006 PM2.5 Standard
- Chapter 7 Demonstration of Federal Requirements for 2012 PM2.5 Standard
- Appendix A Ambient PM2.5 Data Analysis
- Appendix B Emissions Inventory
- Appendix C Stationary Source Control Measure Analyses
- Appendix E Incentive-Based Strategy
- Appendix F Public Education and Technology Advancement
- Appendix G Precursor Demonstration
- Appendix I New Source Review and Emission Reduction Credits
- Appendix J Modeling Emission Inventory
- Appendix L Modeling Protocol
- Appendix M Summary of Significant Comments and Responses
- Attachment A San Joaquin Valley Supplement to the 2016 State Strategy for the SIP

PUBLIC PROCESS

To ensure that the public has had the opportunity for meaningful participation in the development of the attainment strategy for the federal PM2.5 standards, the District has provided multiple opportunities for the public to learn more about air quality and to provide the District with comments or to request more information. The *2018 PM2.5 Plan* was developed through an extensive public process over a three-year period. The District has presented regular updates about the implementation of the *2018 PM2.5 Plan* at public meetings, such as meetings of District Governing Board, Citizens Advisory Committee (CAC), and Environmental Justice Advisory Group (EJAG), and each update was followed by an opportunity for the public to ask questions or request additional information.

Most recently, District staff provided an update on EPA's review of the *2018 PM2.5 Plan,* including the portions of the plan related to the 1997 PM2.5 standard, at a public hearing held on June 17, 2021. The District was notified of EPA's proposed disapproval of the portions of the SIP related to the 1997 annual PM2.5 standard on July 13, 2021. Subsequent to this notification, the District scheduled a public workshop, with a public notice for the workshop being published on July 20, 2021.

A public workshop to present, discuss and receive public input on the proposed SIP revision for the 1997 annual PM2.5 standard will be held on August 2, 2021. The proposed document was published on July 20, 2021, for thirty-day public review and comment. On August 19, 2021, the District Governing Board will hold a public hearing to consider the proposed administrative update to the SIP. Public comment on the proposed SIP revision is welcomed at any time up to, and at, the scheduled Governing Board meeting.

APPENDIX A

Updated *2018 PM2.5 Plan* Chapter 4: Attainment Strategy for PM2.5

Chapter 4
Attainment Strategy for PM2.5

Updated July 20, 2021

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4. ATTAINMENT STRATEGY FOR PM2.5

This chapter of the *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (Plan) lays out the District and California Air Resources Board (CARB) suite of strategies for attainment of multiple PM2.5 national ambient air quality standards (standards, or NAAQS). Preparing a single plan addressing multiple standards instead of three separate plans allows for development of a more robust and health-protective plan that incorporates stronger control measures on a more expeditious timeframe than may otherwise be required. Furthermore, a focused public process provides greater opportunity for public engagement and participation in the PM2.5 attainment planning process. This Plan addresses the following standards:

1997 PM2.5 Standard (24-hour 65 μg/m³ and Annual 15 μg/m³)

- Plan focus on annual standard – San Joaquin Valley has already attained 24-hour portion of the standard, based on monitoring data from the three year period from 2014 to 2016
- Attainment deadline December 31, 2015
- Serious area 5% Plan with attainment deadline of December 31, 2020, for the 24 hour 65 μg/m³ standard
- Serious area 5% Plan with attainment deadline of December 31, 2023, for the annual 15 μg/m³ standard

2006 PM2.5 Standard (24-hour 35 μg/m³)

- Serious area Plan with attainment deadline of December 31, 2024 with 5-year extension request

2012 PM2.5 Standard (annual 12 μg/m³)

- Attainment deadline under "Serious" classification of December 31, 2025
- This Plan would be submitted three years ahead of 2022 federal submission deadline

This Plan contains a comprehensive suite of regulatory and incentive-based measures to be implemented by the District and CARB to achieve the emissions reductions necessary to attain the PM2.5 standards as expeditiously as practicable. This Plan builds upon comprehensive strategies already in place from previously adopted District plans and CARB State strategies. As such, this attainment strategy relies on existing measures already in place for stationary, area, and mobile sources, as adopted and implemented by the District and CARB. The new regulatory and incentive-based measures proposed by both the District and CARB, combined with existing measures achieving new emissions reductions will achieve the emissions reductions necessary to attain each federal PM2.5 standard as expeditiously as practicable, as evidenced by the photochemical air quality modeling performed by CARB (Appendix K). This Plan demonstrates the District's ongoing efforts to improve air quality in the Valley through a comprehensive strategy as follows:

Regulatory measures that build off existing stringent requirements, including new stationary source measures to further strengthen NOx and/or PM2.5 requirements to achieve greater emissions reductions from flaring activities, internal combustion engines, boilers/steam generators, glass melting furnaces, agricultural operations, and other local sources.

Incentive-based measures that accelerate the deployment of cleaner vehicles and technologies in a variety of sectors, including residential wood combustion, agricultural internal combustion engines, agricultural equipment, heavy duty trucks, off-road equipment, transit buses, school buses, freight equipment, passenger vehicles, locomotives, commercial lawn and garden equipment, and other sources.

State mobile source strategy that reduces emissions from mobile sources under state and federal jurisdiction, including heavy duty trucks, agricultural equipment, locomotives, and off-road equipment.

Targeted "hot-spot" strategy that focuses additional regulatory and incentive-based measures for residential wood burning and commercial charbroiling operations in remaining areas of the Valley that requires further investment and regulatory efforts for attainment of the federal PM2.5 standards. Hot-spot areas include Fresno, Madera, and Kern counties for residential wood combustion and the urban areas of Fresno, Madera, and Kern counties for charbroiling.

Public outreach and education that encourages and empowers the public to understand air quality issues, take advantage of District tools to stay informed regarding local air quality, take actions to protect themselves when necessary, understand the Valley's unique air quality challenges, and take actions to reduce emissions and improve the Valley's air quality.

Technology advancement and demonstration efforts to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable.

Call for action by the state and federal governments to do their part in taking responsibility for regulating, and taking actions, to reduce emissions in the Valley. This includes working together to advocate and secure the significant new funding required to achieve the enormous emissions reductions necessary for attainment under this Plan through incentive-based measures.

4.1 Comprehensive Existing Regulatory Control Strategy

Since 1992, the District has adopted nearly 650 rules to implement an aggressive on-going control strategy to reduce emissions in the Valley. Many current rules are fourth or fifth generation, meaning that they have been revised and emission limits have been lowered, as new emission control technologies become available, technologically feasible, and cost-effective. The District's regulatory authority is limited to stationary sources and some area-wide sources. The District's stringent and innovative rules, such as those for residential fireplaces, glass manufacturing, and agricultural burning, have set benchmarks for California and the nation.

States and the federal government, unlike the District, have the authority to directly regulate tailpipe emissions from mobile sources. CARB has adopted tough regulations for heavy-duty trucks, off-road equipment, and other mobile sources. The District has adopted innovative regulations such as the Indirect Source Review and Employer-based Trip Reduction rules to reduce emissions from mobile sources within the District's limited jurisdiction over these sources. Regulations implemented by the District have reduced emissions from stationary sources by over 80% to date. Air quality improvements in the Valley document the success of the District's innovative and effective rules. The Valley has attained the federal PM10 standard, the revoked one-hour ozone standard, and most recently, the 1997 PM2.5 24-hour standard[1] (65 µg/m^3).

4.1.1 District Rules Contributing to Continued PM2.5 Improvement

The District's current rules and regulations reflect technologies and methods that extend well beyond required control levels. The stringent regulations already adopted under previous attainment plans also serve as control measures for this Plan. These adopted regulations reduce directly emitted PM2.5 and NOx as they are fully implemented. District current rules reducing particulate matter and NOx emissions, contributing to the Valley's progress toward attainment of PM2.5 standards, are identified in Table 4-1 below.

The rules contributing to continued PM2.5 improvements in the Valley and attainment of the federal PM2.5 standards (see Tables 4-1 and 4-2) will reduce approximately 4.2 tons per day of directly emitted PM2.5 emissions and 173.5 tons per day of NOx from the baseline year of this plan of 2013 to the final attainment year of 2025.

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[1] SJVAPCD. Clean Data Finding to EPA for the 1997 24-Hour PM2.5 Standard and Proposed PM2.5 Attainment Strategy. (2017, August 17). http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2017/August/agenda.pdf

Table 4-1 District Rules Reducing PM and NOx Emissions in the Valley

Rule Number	Rule Name	Last Adopted
4103	Open Burning	04/15/2010
4104	Reduction of Animal Matter	12/17/1992
4106	Prescribed Burning and Hazard Reduction Burning	06/21/2001
4203	Particulate Matter Emissions from Incineration of Combustible Refuse	12/17/1992
4204	Cotton Gins	02/17/2005
4301	Fuel Burning Equipment	12/17/1992
4306	Boilers, Steam Generators, and Process Heaters - Phase 3	10/16/2008
4307	Boilers, Steam Generators, and Process Heaters - 2.0 MMBtu/hr TO 5.0 MMBtu/hr	04/21/2016
4308	Boilers, Steam Generators, and Process Heaters - 0.075 MMBtu/hr to Less than 2.0 MMBtu/hr	11/14/2013
4309	Dryers, Dehydrators, and Ovens	12/15/2005
4311	Flares	~~06/18/2009~~ 12/17/2020
4313	Lime Kilns	03/27/2003
4320	Advanced Emission Reduction Options For Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr	~~10/16/2008~~ 12/17/2020
4352	Solid Fuel Fired Boilers, Steam Generators, and Process Heaters	12/15/2011
4354	Glass Melting Furnaces	05/19/2011
4550	Conservation Management Practices	08/19/2004
4692	Commercial Charbroiling	06/21/2018
4702	Internal Combustion Engines	11/14/2013
4703	Stationary Gas Turbines	09/20/2007
4901	Wood Burning Fireplaces and Wood Burning Heaters	~~09/18/2014~~ 06/20/2019
4902	Residential Water Heaters	03/19/2009
4905	Natural Gas-Fired, Fan-Type Central Furnaces	~~06/21/2018~~ 08/15/2020
8011	General Requirements	08/19/2004
8021	Construction, Demolition Excavation, Extraction, and Other Earthmoving Activities	08/19/2004
8031	Bulk Materials	08/19/2004
8041	Carryout and Trackout	08/19/2004
8051	Open Areas	08/19/2004
8061	Paved and Unpaved Roads	08/19/2004
8071	Unpaved Vehicle/Equipment Traffic Areas	09/16/2004
8081	Agricultural Sources	09/16/2004
9310	School Bus Fleets	09/21/2006
9410	Employer Based Trip Reduction	12/17/2009
9510	Indirect Source Review	12/21/2017

In addition to the significant ongoing reductions achieved and maintained through the District's currently adopted air quality regulations, the following table summarizes key District rules achieving new emissions reductions after 2013, the base year for this Plan.

These and other District and CARB rules already guarantee that emissions will continue to be reduced over the coming years. New control measures identified in this plan combined with other control strategies discussed in Appendices C and D will provide necessary emissions reductions to complement those already being achieved and contribute to PM2.5 air quality improvements in the Valley. Even pre-2013 emissions reductions are contributing and will continue to contribute to the Valley's progress toward attaining federal PM2.5 standards.

Table 4-2 District Regulations Achieving New Emissions Reductions after 2013

Rule #	Adopted District Rule	Last Adoption Date
2201	New Source Review Rule	~~2/18/2016~~ 8/15/2019
4307	Boilers, Steam Generators, and Process Heaters—2.0 MMBtu/hr to 5.0 MMBtu/hr	4/21/2016
4308	Boilers, Steam Generators, and Process Heaters—0.075 MMBtu/hr to less than 2.0 MMBtu/hr	11/14/2013
4311	Flares	~~6/18/2009~~ 12/17/2020
4320	Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr	~~10/16/2008~~ 12/17/2020
4354	Glass Melting Furnaces	5/19/2011
4550	Conservation Management Practices	8/18/2004
4702	Internal Combustion Engines	11/14/2013
4901	Wood Burning Fireplaces and Wood Burning Heaters	~~9/18/2014~~ 6/20/2019
4902	Residential Water Heaters	3/19/2009
4905	Natural Gas-Fired, Fan-Type Central Furnaces	~~6/21/2018~~ 8/15/2020
9310	School Bus Fleets	9/21/2006
9410	Employer-based Trip Reduction	12/17/2009
9510	Indirect Source Review	12/21/2017
Reg. VIII	Fugitive PM10 Prohibitions	9/16/2004

Rule 2201 New and Modified Stationary Source Review Rule

Rule 2201 applies to all proposals for new or modified sources of pollution that must obtain a permit from the District. The rule requires that the proposed emissions from any such new or modified equipment be controlled with the Best Available Control Technology (BACT), and that large projects offset their increased emissions by surrendering emission reduction credits that have been generated by companies that have voluntarily reduced their emissions. Compliance with this rule must be demonstrated prior to the District issuing a permit and prior to constructing the new or modified source of pollution.

Rule 4307 Boilers, Steam Generators, and Process Heaters 2 to 5 MMBtu/hr

Rule 4307 is the most stringent rule in the nation for controlling emissions from fuel combustion-producing heat and energy for manufacturing and processing purposes. Emissions from these units are generally controlled through either combustion modification or exhaust gas treatment.

Rule 4308 Boilers, Steam Generators, and Process Heaters 0.075 to < 2 MMBtu/hr

Adopted in 2005 and amended in 2009 and 2013 to include more stringent NOx limits, Rule 4308 controls emissions from boilers, steam generators, and process heaters in the size range of 0.075 to less than 2 MMBtu/hr. As a point-of-sale rule, emissions are reduced when consumers replace older units with new, low-NOx units as of the January 1, 2015, compliance date.

Rule 4311 Flares

Amended on ~~June 18, 2009~~ December 17, 2020, Rule 4311 controls emissions from flares used in the Valley at industries including oil and gas production facilities, sewage treatment plants, waste incineration and petroleum refining operations. Flare operators are required to submit Flare Minimization Plans (FMPs), perform extensive monitoring and record keeping, submit reports of planned and unplanned flaring activities to the District, and meet petroleum refinery SO2 performance targets. The District ~~has~~ completed two Further Studies reports that analyzed data from FMPs, annual monitoring reports, reportable flaring events reports, and made those reports available on the District web.[2] The District continuously seeks potential opportunities to reduce emissions from these control and safety devices. The District committed in its *2016 Plan for the 2008 8-hour Ozone Standard* to work closely with affected operators to undergo a regulatory amendment process for Rule 4311 to include additional ultra-low NOx flare emission limitations and additional flare minimization requirements to the extent that such controls are determined to be technologically and economically feasible to require in the Valley. ~~The District is undergoing a rule amendment public process concurrently with the development of this attainment plan.~~ As committed to, the District amended Rule 4311 on December 17, 2020, which satisfied the District's control measure commitments in the *2018 PM2.5 Plan* and the *2016 Ozone Plan*.

Rule 4320 Boilers, Steam Generators, and Process Heaters > 5 MMBtu/hr

The District adopted Rule 4320 in 2008, with multiple generations of Rules 4305 and 4306 preceding this rule to regulate this source category. This rule is the most stringent rule in the nation for controlling emissions from boilers, steam generators, and process heaters greater than 5 MMBtu/hr in size. Facilities generally control emissions from these sources through combustion modification or exhaust gas treatment.

[2] http://valleyair.org/Air_Quality_Plans/PM_Plans.htm

Rule 4354 Glass Melting Furnaces

District Rule 4354, adopted in 1994 and subsequently amended six times, is one of the most stringent rules in the nation for controlling NOx, SOx, and PM emissions from industrial glass manufacturing plants that make flat glass (window and automotive windshields), container glass (bottles and jars), and fiberglass (insulation). Subsequent amendments required more stringent NOx emission limits based on Best Available Control Technology (BACT) level controls. The rule gives special consideration to container glass and fiberglass manufacturers who use 30% post-consumer materials under the state glass recycling regulations. The rule also includes a technology forcing limit for flat glass furnaces. As a result of Rule 4354 and continuing efforts on behalf of this industry to reduce emissions, the Valley's glass melting furnaces have significantly reduced NOx, SOx and PM emissions.

Rule 4550 Conservation Management Practices

Rule 4550 is the District's Conservation Management Practices (CMP) rule. Rule 4550 was the first rule of its kind in the nation to reduce fugitive particulate emissions from agricultural operations through the reduction of passes of agricultural equipment and implementation of other conservation practices. Rule 4550 uses a menu approach of control techniques to accommodate the variability of agricultural industries in the Valley. Agricultural operations are required to maintain detailed records verifying use of the approved Conservation Management Practices. Approved CMP plans are enforced through onsite inspections and operators are required to submit applications and modify their plans when changing their conservation management practices. Through this rule, PM10 emissions have been reduced by 35.3 tons per day,[3] which is approximately a 24% reduction for this source category.

Rule 4702 Internal Combustion Engines

Rule 4702 was adopted in 2003, and subsequently amended five times to implement stringent NOx limits for agricultural operations, and to increase the stringency of NOx limits for non-agricultural operations, and extend rule applicability to include units with 25-50 brake horsepower (bhp). With multiple generations of rule amendments, Rule 4702 is the most stringent rule in the nation for this source category. Facilities generally control NOx emissions with advanced technologies, such as selective non-catalytic reduction and selective catalytic reduction.

Rule 4901 Wood-Burning Fireplaces and Wood-Burning Heaters

The District takes a multifaceted and proactive approach to reducing emissions from wood burning fireplaces and wood burning heaters in the Valley. District Rule 4901 reduces emissions from residential burning through stringent curtailment requirements during the wood-burning season. The District ~~most recently~~ amended Rule 4901 in September 2014, two years ahead of the commitment to amend the rule in the *2012 PM2.5 Plan.* Through the District *Check Before You Burn* program, the District has declared and enforced episodic wood burning curtailments, also called "No Burn" days, since 2003. *Check Before You Burn* and District Rule 4901 reduce harmful species of PM2.5 when and where those reductions are most needed, in impacted urbanized

[3] SJVAPCD. *Conservation Management Practices Program Report for 2005.* (2006, January 19). Retrieved from http://www.valleyair.org/farmpermits/updates/cmp_program_report_for_2005.pdf

areas when the local weather is forecast to hamper particulate matter dispersion.

The District's *Burn Cleaner Wood Stove Change-out Program* (*Burn Cleaner Program*) plays a key role in the success of the transition from older more polluting wood burning heaters and open hearth fireplaces to cleaner wood burning heaters and natural gas-fired devices. Since 2006, the *Burn Cleaner Program* has been helping residents overcome some of the financial obstacles in purchasing cleaner alternatives. There are currently more than 30 hearth retailers in the Valley that have partnered with the District to successfully implement the *Burn Cleaner Program*. Additionally, the District has a successful outreach and education program with regards to residential wood burning and educating Valley residents about air quality, the effects of air pollution on the population's health, and on options they can take to reduce emissions. ~~In the latest~~ For the 2017-2018 wood-burning season ~~(2017-2018)~~ the District took part in 82 media interviews about extreme weather and wood burning.

Rule 4902 Residential Water Heaters

District Rule 4902 controls NOx emissions from natural gas-fired residential water heaters with heat input rates less than or equal to 75,000 Btu/hr by enforcing NOx emissions limit of 40 nanograms of NOx per Joule of heat output (ng/J). The District amended Rule 4902 in 2009 to further reduce emissions by lowering the limit to 10 ng/J for new or replacement water heaters and to a limit of 14 ng/J for instantaneous water heaters. As a point-of-sale rule, compliant units will be installed as the older units are replaced through attrition in the years following 2012. The rule has controlled NOx emissions by approximately 88% for this source category.

Rule 4905 Natural Gas-Fired, Fan-Type Residential Central Furnaces

Rule 4905 limits NOx emissions from residential central furnaces supplied, sold, or installed in the Valley with a rated heat input capacity of less than 175,000 Btu/hour. Amendments in 2015 lowered the NOx emission limit for residential units from 40 ng/J to 14 ng/J and expanded rule applicability to include non-residential units and units installed in manufactured homes with compliance deadlines in 2018. Due to the limited number of certified compliant units that will be available by the compliance deadline dates, the rule was amended ~~again~~ on June 21, 2018 and again on August 15, 2020 to extend the emissions fee option period with changes in fee structure to allow additional time necessary to continue technology development and the certification process while providing strong incentive for accelerated deployment of compliant units. As a point-of-sale rule, emissions are reduced when consumers replace older units with newer, low-NOx units through attrition.

Rule 9310 School Bus Fleets

The District adopted Rule 9310 in September 2006 to limit NOx, PM, and diesel toxic air contaminants from school bus fleets. Diesel-fueled school bus fleet operators must replace or retrofit all of their school buses to meet the applicable CARB and U.S. Environmental Protection Agency (EPA) emission standards for engines by 2016. The rule also requires all existing gasoline or alternative-fueled school buses and any diesel school buses manufactured after October 1, 2002 to be operated according to manufacturer specifications and, if replaced, to meet all applicable CARB and EPA current-year emissions standards for the year of delivery of that school bus engine and fuel type.

Rule 9410 Employer-Based Trip Reduction (eTRIP Rule)

The goal of the eTRIP Rule is to reduce single-occupancy-vehicle work commutes. The eTRIP Rule requires the Valley's larger employers, representing a wide range of locales and sectors, to select and implement workplace measures that make it easier for their employees to choose ridesharing and alternative transportation. Because of the diversity of employers covered by the eTRIP Rule, the rule was built with a flexible, menu-based approach. Employers choose from a list of measures, each contributing to a workplace that encourages employees to reduce their dependence on single-occupancy vehicles. Each eTRIP measure has a point value, and employer eTRIPs must reach specified point targets for each strategy over a phased-in compliance schedule (2010 – 2015). The District has continually provided employer assistance through training, guidance materials, promotional information, and online reporting options.

Rule 9510 Indirect Source Review

District Rule 9510 is the only rule of its kind in the State of California and throughout the nation which applies to new development projects, including residential and commercial development projects, and transportation and transit projects. The District's rule is recognized as the benchmark, or best available control, for regulating these indirect sources of emissions. The purpose of this rule is to reduce the growth in emissions from mobile and area sources associated with construction and operation of new development projects in the Valley, by encouraging clean air designs to be incorporated into the development project, or, if insufficient emissions reductions can be designed into the project, by paying a mitigation fee used to fund off-site emissions reduction projects.

Regulation VIII Fugitive PM10 Prohibitions

The Regulation VIII rules were adopted in November 2001, and subsequently amended in 2004 to incorporate more stringent requirements. These rules reduce fugitive dust from construction sites, earthmoving activities, parking and staging areas, open areas, agricultural operations, carryout and trackout, paved and unpaved roads, and material storage sites.

4.1.2 CARB Rules Contributing to Continued PM2.5 Improvement

Mobile source emissions make up over 85% of the Valley's NOx emissions, the primary driver in the formation of particulate and ozone pollution, and therefore reductions in mobile source emissions have become an ever-increasingly important part of the Valley's attainment strategy of federal air quality standards. Local air districts do not have the authority to implement regulations requiring ultra-low tailpipe emissions standards on mobile sources. With authority to regulate mobile source emissions, CARB has adopted and amended a number of regulations aimed at reducing exposure to diesel PM and NOx from fuel sources, freight transport sources like heavy-duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will produce emission reduction benefits in the coming years as the regulated fleets are retrofitted, and as older and dirtier fleet units are replaced with newer and cleaner models at an accelerated pace.

4.2 COMPREHENSIVE INCENTIVE-BASED STRATEGY

In addition to having the toughest air regulations in the nation, the District also operates the most effective and efficient incentive grants program, investing over ~~$2.2 billion~~ $3.5 billion in public/private funding towards clean air projects to date that have achieved over ~~145,000~~ 189,000 tons of emissions reductions. Through strong advocacy at the state and federal levels, the District has appropriated ~~$350~~ $519 million in incentive funding in the ~~2018-2019~~ 2021-2022 District Budget to continue this robust program. Due to the significant investments made by Valley businesses and residents and stringent regulatory programs by the District and CARB, the Valley's ozone and PM2.5 precursor emissions are at historically low levels and air quality over the past few years has been better than any other time on record.

4.2.1 DISTRICT INCENTIVE-BASED STRATEGY CONTRIBUTING TO CONTINUED PM2.5 IMPROVEMENT

The District administers a comprehensive suite of highly successful voluntary incentive programs which are critical to the Valley's attainment of the federal air quality standards, including the following:

- Burn Cleaner Wood Stove and Fireplace Change-out Program
- Heavy Duty Truck Replacement Program
- Proposition 1B Goods Movement Emission Reduction Program
    - Truck Replacement
    - Locomotive Replacement
    - Transport Refrigeration Unit Replacement and Electric Infrastructure
- Tractor Replacement Program
- Tractor Trade-Up Pilot Program
- Off Road Mobile Equipment Repowers
- Agricultural Pump Replacement
- Drive Clean in the San Joaquin
    - Tune In Tune Up Vehicle Repair
    - Passenger Vehicle Replacement
    - New Vehicle Rebate
- Heavy-Duty Engine Program, Locomotive Component
- Restaurant Charbroiler Technology Partnership
- Technology Advancement Program
- Public Benefits Grants Program, New Alternative Fuel Vehicle Purchase component
- Vanpool Voucher Incentive Program
- Electrified Dairy Feed Mixing Program
- School Bus Replacement and Retrofit programs

- Charge Up! Program
- Public Benefit Grants Program, Alternative Fuel Infrastructure Component
- Bicycle Infrastructure
- Alternative-Fuel Mechanics Training
- E-Mobility Commerce
- Public Transportation Subsidy and Park & Ride
- Clean Green Yard Machines Program
- Heavy Duty Waste Haulers
- Public Benefits Grants Program, Enhanced Transportation Strategies Component
- Public Benefits Grants Program, Community Improvement Projects that Reduce Vehicle Use and Emissions Component

In addition, the District is continually working with stakeholders to identify and implement improvements, expansions, and streamlining of the above-mentioned programs to increase accessibility, efficiency, and efficacy of its voluntary incentive programs. As described in Appendix E, some examples of upcoming incentive program enhancements include a new commercial zero-emissions lawn and garden equipment program, expanded agricultural equipment trade-up program, enhanced heavy duty truck replacement program, new incentive program to promote development and deployment of alternatives to agricultural burning, and new lower-emitting almond harvester replacement program.

4.3 New District Emission Reduction Measures For Expeditious Attainment

This Plan includes a comprehensive suite of regulatory and incentive-based measures for both stationary and mobile sources, and also includes a targeted hot-spot strategy that achieves additional reductions from residential wood burning and commercial charbroiling. Through the implementation of this comprehensive strategy, the Valley will experience progressive air quality improvements as the region attains the federal PM2.5 standards as expeditiously as practicable.

Under the federal Clean Air Act (CAA), the entire Valley is designated as not meeting the standard if any area in the Valley is not able to meet the standard. Given the significant additional emission reductions necessary to attain the federal PM2.5 standards, in addition to imposing stringent new measures throughout the Valley, a targeted approach that focuses additional measures and limited resources in remaining “hot-spot” nonattainment areas is needed. Given the innovative nature of this approach, the District has been working with EPA, CARB, and other stakeholders to ensure that the District’s strategy is consistent with all applicable regulations.

The District and CARB are committing in this Plan to aggregate emission reductions of directly emitted PM2.5 and NOx beyond current measures implemented by the District and CARB. The District is committing in this Plan to attain an aggregate amount of emissions reductions from new prohibitory and incentive-based measures, as necessary for expeditious attainment demonstrated through modeling conducted by CARB. While the tables include estimates of the emission reductions from each individual measure, final measures as proposed for adoption into the SIP may provide more or less emission reductions as will be determined through the extensive public rule development process for each regulatory measure. These aggregate commitments will ensure that the total emission reductions will be achieved by the timeframes necessary under this Plan to attain federal standards as expeditiously as practicable.

Table 4-3 Emission Reductions from District Measures

	2023		2024/2025	
~~2024/2025~~	PM2.5 (tpd)	NOx (tpd)	PM2.5 (tpd)	NOx (tpd)
Flares	–	–	–	0.05
Boilers, Steam Generators, and Process Heaters - Phase 3	–	–	0.03	1.83
Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr	–	–		
Internal Combustion Engines used at Agricultural Operations	–	–		
Glass Plants	–	–		
Solid Fuel-Fired Boilers, Steam Generators And Process Heaters	–	–		
Conservation Management Practices	–	–	0.32	–
Commercial Charbroiling	–	–	0.53	–
Wood Burning Fireplaces and Wood Burning Heaters	0.20	–	0.42	–
Aggregate Emission Reductions Commitment	**0.20**	–	**1.30**	**1.88**

"–" denotes reductions have not been quantified

Table 4-4 Proposed Regulatory Measures

Regulatory Measures	Public Process Begins	Action Date	Implementation Begins
Rule 4311 Flares	2018	2020	2023
Rule 4306 Boilers, Steam Generators, and Process Heaters – Phase 3 **Rule 4320** Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr	2019	2020	2023
Rule 4702 Internal Combustion Engines	2019	2020	2024
Rule 4354 Glass Melting Furnaces	2020	2021	2023
Rule 4352 Solid Fuel-Fired Boilers, Steam Generators And Process Heaters	2020	2021	2023
Rule 4550 Conservation Management Practices	2021	2022	2024
Rule 4692 Commercial Under-fired Charbroiling (Hot-spot Strategy)	2019	2020	2024
Rule 4901 Wood Burning Fireplaces and Wood Burning Heaters (Hot-spot Strategy)	2019	2019	2019

Table 4-5 Proposed Incentive-Based Measures

Incentive-Based Measures	Public Process Begins	Action Date	Implementation Begins
Replacement of Internal Combustion Engines used at Agricultural Operations	2019	2020	ongoing
Installation of Commercial Under-fired Charbroiling Controls (Hot-spot Strategy)	2019	2020	ongoing
Replacement of Residential Wood Burning Devices (Valleywide and Hot-spot Strategy)	2019	2020	ongoing

Given the effectiveness of further reducing residential wood burning emissions, particularly in the remaining “hot spot” areas, this Plan advances the adoption and implementation of proposed enhancements to the District’s residential wood burning strategy. Implementing this proposed measure will require robust public engagement and education efforts to achieve additional reductions well ahead of PM2.5 deadlines and expedite attainment.

The remaining proposed regulatory commitments will require significant investment for the development and deployment of new technology and equipment modifications. The District and CARB are committed to a robust and transparent public rule development process that includes stakeholder, industry, and other-agency input at every step possible to ensure feasibility. After rules are adopted, businesses will need sufficient time to design, finance, and install new controls or modify existing equipment to comply with new requirements.

The District is already implementing highly successful incentive programs in the Valley as discussed above. The District is proposing to enhance multiple incentive programs to further reduce emissions and expedite attainment. Proposed enhancements (Table 4-5) for voluntary incentive-based measures will require additional time to develop the changes, to perform necessary education and outreach, and for the public to utilize. As such, full emission reductions benefits from enhancements will take time to be realized. Proposed incentive measures will include regulatory backstops as needed to encourage utilization of incentive programs, ensuring early emission reductions and expeditious attainment.

4.3.1 Evaluating Control Measures for New Control Strategy Opportunities

The District expended extensive efforts to identify and evaluate potential emission reductions opportunities from each control measure source category. As part of the regulatory evaluation, District rules and source categories were compared to federal and state air quality regulations and standards, and the regulations and standards in other air districts. District rules and regulations were compared to such federal regulations and guidance documents as Control Techniques Guidelines (CTG),[4] Alternative Control Techniques (ACT),[5] New Source Performance Standards (NSPS),[6] National Emission Standards for Hazardous Air Pollutants (NESHAP),[7] and Maximum Achievable Control Technology (MACT)[8] standards. California state regulations, due to regulatory authority, are primarily applicable to mobile sources and consumer products. State regulations also include the California Health and Safety Code (CH&SC) and CARB Airborne Toxic Control Measures (ATCM) requirements which are applicable to stationary and area sources.[9] The District's regulatory evaluation includes state guidelines that are applicable to the source category.

All potential best available control measures (BACM) and most stringent measures (MSM) identified through this regulatory evaluation were thoroughly evaluated using the key factors defined in EPA's 2016 *Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements*, to determine if potential opportunities qualify as BACM/MSM for the Valley.

In addition to evaluating measures adopted by other air quality agencies, the District looked for any control technologies not already required that might be available to further reduce emissions from sources of air pollution in the Valley. This includes new

[4] EPA. Control Techniques Guidelines. Retrieved from http://www.epa.gov/groundlevelozone/SIPToolkit/ctgs.html
[5] EPA. Alternative Control Techniques. Retrieved from http://www.epa.gov/groundlevelozone/SIPToolkit/ctgs.html
[6] EPA. 40 CFR 60 – Standards of Performance for New Stationary Sources (NSPS). Retrieved from http://www.tceq.state.tx.us/permitting/air/rules/federal/60/60hmpg.html
[7] EPA. 40 CFR 61 – National Emission Standards for Hazardous Air Pollutants (NESHAPs). Retrieved from http://www.tceq.state.tx.us/permitting/air/rules/federal/61/61hmpg.html
[8] EPA. 40 CFR 63 – Maximum Achievable Control Technology (MACT). Retrieved from http://www.tceq.state.tx.us/permitting/air/rules/federal/63/63hmpg.html
[9] California Air Resources Board (CARB). Airborne Toxic Control Measures (ATCMs). Retrieved from https://www.arb.ca.gov/toxics/atcm/atcm.htm

technologies and technologies that may not have been cost-effective in the past. The technologies used in BACT guidelines; permits; and other air districts' rules, regulations, guidelines, and studies were reviewed for their feasibility, including how commercially available the technology currently is and whether the technology has been achieved in practice. Cost effectiveness analyses of various control measures include examining the added cost, in dollars per year, of the control technology or technique, divided by the emissions reductions achieved, in tons per year. EPA cautions that the threshold for economic feasibility should be addressed on a case-by-case basis. The District does not have a pre-determined cost-effectiveness threshold, but control options that have extremely high costs per ton of pollutant reduced are generally unreasonable and not feasible for regulation.

Efforts to identify feasible emission reductions opportunities also includes the evaluation of additional control technologies or practices, if any, not already included in previously mentioned BACM/MSM evaluations for the area. This evaluation process considers any emission reduction opportunities that were previously adopted by the District plans that were determined to be beyond RACT at that time and also any new emission reduction opportunities adopted in California state implementation plans (SIP), SIPs in other states, or achieved in practice in other areas. Any potential BACM/MSM identified were then thoroughly evaluated for technological and economic feasibility. In evaluating the technological and economic feasibility of potential BACM/MSM, the District reviews staff reports and studies from other air districts, EPA technical guidance documents, and applicable study data from the scientific community to assist in evaluating. The District has evaluated all sectors and equipment types for additional emission reduction opportunities, as presented in Appendix C.

This Plan demonstrates that all District rules continue to meet or exceed measures identified by the EPA as reasonably available control measures (RACM), BACM, and MSM, as defined above and demonstrated in Appendix C.

4.3.2 New District Control Measure Commitments

The following is a summary of control measure commitments within this Plan.

Rule 4311 Flares

Rule 4311 controls emissions from flares used in the Valley at facilities such as, but not limited to, oil and gas production facilities, sewage treatment plants, waste incineration and petroleum refining operations. Under Rule 4311, flare operators are required to submit flare minimization plans, perform extensive monitoring and record keeping, submit reports of planned and unplanned flaring activities to the District, and meet petroleum refinery SO2 performance targets.

Flaring activities in the Valley emit 0.55 tpd of NOx emissions, representing 0.22% of the annual average NOx emissions in the Valley. Despite this relatively small amount of emissions, in seeking all potential emission reduction opportunities, the District has invested significant resources into evaluating potential emissions reductions opportunities from flares.

As demonstrated in Appendix C, District Rule 4311 satisfies RACM, BACM, and MSM requirements for this source category.[10] Even though flares are not a significant source of PM2.5 and NOx in the Valley, the District has evaluated all potential control technologies and all control technologies achieved in practice in other areas or included in other state implementation plans. As previously stated, Rule 4311 currently has in place the most stringent measures feasible to implement in the Valley.

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, the District will go beyond MSM in this Plan and pursue the following potential opportunities that are projected to provide 0.05 tons per day of additional NOx emissions reductions towards the District's aggregate plan commitment. The District is undergoing a regulatory amendment process for Rule 4311, working closely with affected operators and other stakeholders to include:

- Additional ultra-low NOx flare emission limitations for existing and new flaring activities at Valley facilities to the extent that such controls are technologically achievable and economically feasible,
- Additional flare minimization requirements to the extent that such controls are technologically achievable and economically feasible
- Expand the applicability of the rule by removing the exemption for non-major sources

<u>To satisfy the commitments in the Plan as described above, the District conducted a comprehensive technical rule evaluation, and, on December 17, 2020, adopted amendments to Rule 4311.</u>

Rule 4306 Boilers, Steam Generators, and Process Heaters - Phase 3
Rule 4320 Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr

Valley facilities with units subject to Rules 4306 and 4320 represent a wide range of industries, including but not limited to electrical utilities, cogeneration, oil and gas production, petroleum refining, manufacturing and industrial processes, food and agricultural processing, and service and commercial facilities. NOx emissions from this source category have been reduced by 96% through District regulations.

The District has evaluated all potential control technologies and all control technologies achieved in practice in other areas or included in other state implementation plans for emissions from boilers, steam generators, and process heaters. As demonstrated in Appendix C, Rules 4306 and 4320 currently have in place the most stringent measures feasible to implement in the Valley and therefore meet or exceed RACM, BACM, and MSM requirements for this source category.

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[10] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, the District will go beyond MSM in this Plan and work with affected operators to further reduce NOx emissions from boilers, steam generators, and process heaters to the extent that such controls are technologically and economically feasible. Technologies with the potential to further reduce emissions include the latest generation of ultra-low NOx burners, SCR, and low NOx burners combined with SCR. As demonstrated in Appendix C, some of these technologies may not be cost-effective or feasible at this time. Therefore, the potential measures include lowering the emission limits for the class and category and lowering the more stringent Advanced Emission Reduction Option (AERO) limit further as follows:

- Boilers and process heaters >5.0 MMBtu/hr to ≤ 20 MMBtu/hr
    - Lower current emissions limitations of 6 ppmv (enhanced) and 9 ppmv (standard) to a new limitation as low as 2.5 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Boilers and process heaters > 20 MMBtu/hr
    - Lower current emissions limitations of 5 ppmv (enhanced) and 7 ppmv (standard) to a new limitation as low as 2 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Oil field steam generators >5.0 MMBtu/hr to ≤ 20 MMBtu/hr
    - Lower current emissions limitations of 6 ppmv (enhanced) and 9 ppmv (standard) to a new limitation as low as 3.5 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Oil field steam generators > 20 MMBtu/hr
    - Lower current emissions limitations of 5 ppmv (enhanced) and 7 ppmv (standard) to a new limitation as low as 2 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Oil field steam generators < 50% PUC quality gas
    - Lower current emissions limitations of 12 ppmv (enhanced initial) and 9 ppmv (enhanced final) to a new limitation as low as 3.5 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Petroleum refinery boilers/process heaters >5.0 MMBtu/hr to ≤ 20 MMBtu/hr
    - Lower current emissions limitations of 9 ppmv to a new limitation as low as 3 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Petroleum refinery boilers/process heaters >20 MMBtu/hr to ≤ 110 MMBtu/hr
    - Lower current emissions limitations of 6 ppmv to a new limitation as low as 3 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Petroleum refinery boilers/process heaters >110 MMBtu/hr

    - Lower current emissions limitations of 5 ppmv to a new limitation as low as 3 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment
- Petroleum refinery boilers/process heaters < 50% PUC quality gas
    - Lower current emissions limitations of 9 ppmv to a new limitation as low as 3 ppmv, with Advanced Emission Reduction Option to allow for advanced technology development and deployment

To satisfy the commitments in the Plan as described above, the District conducted a comprehensive technical rule evaluation, and, on December 17, 2020, adopted amendments to Rules 4306 and 4320.

Rule 4352 Solid Fuel-Fired Boilers, Steam Generators and Process Heaters

Rule 4352 limits NOx and carbon monoxide (CO) emissions from any boiler, steam generator or process heater fired on solid fuel. Boilers, steam generators, and process heaters are used in a broad range of industrial, commercial, and institutional settings. Units subject to this rule fire on a variety of solid fuels: coal, petroleum coke, biomass, tire-derived fuel, and municipal solid waste facilities. This rule limits NOx emissions to 165 ppmv for municipal solid waste facilities, 90 ppmv for biomass facilities, and 65 ppmv for all other solid fuel fired units.

The District has evaluated all potential control technologies and all control technologies achieved in practice in other areas or included in other state implementation plans for this category. As demonstrated in Appendix C, Rule 4352 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds RACM, BACM and MSM requirements for this source category. The District's evaluation of potential control technologies has found that the Gore De-NOx and Selective Catalytic Reduction technologies demonstrated in Europe are extremely costly, require additional evaluation for feasibility, and are overall economically infeasible for municipal waste-fired units. The District's evaluation of the Covanta LN NOx technology has found that, while costly, installation of this technology may be cost-effective.

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, the District will go beyond MSM in this Plan and pursue the following potential opportunities to reduce NOx emissions for municipal waste-fired units to the extent that additional NOx controls are technologically and economically feasible:

- Lower NOx limit from 165 ppmv @ 12% CO_2 to 110 ppmv @ 12% CO_2 over 24-hr period and 90 ppmv @ 12% CO_2 over annual period
- Evaluate feasibility of lower NOx emission levels

Rule 4354 Glass Melting Furnaces

District Rule 4354, adopted on September 14, 1994, and subsequently amended six times, is one of the most stringent rules in the nation for controlling NOx, SOx, VOC, CO, and PM emissions from industrial glass manufacturing plants that make flat glass (window and automotive windshields), container glass (bottles and jars), and fiberglass (insulation). The last amendments to the rule included more stringent NOx emission limits based on BACT level controls for container glass, fiberglass, and flat glass. The rule gives special consideration to container glass and fiberglass manufacturers who use 30% post-consumer materials under the state glass recycling regulations. The rule also includes a technology forcing limit for flat glass furnaces. As a result of this stringent prohibitory rule and continuing efforts on behalf of this industry to reduce emissions, the Valley's glass melting furnaces use low-NOx firing technology.

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, the District will go beyond MSM in this Plan and pursue the following potential opportunities to reduce NOx emissions for container glass furnaces to the extent that additional NOx controls are technologically and economically feasible:

- Evaluate feasible ultra low-NOx control technologies (catalytic filtration, oxy-fuel combined with SCR, etc.)
- Lower NOx limit from 1.5 lb/ton to a level ranging from 1.0-1.2 lb-NOx/ton glass pulled or lower, based on a rolling 30-day average

Rule 4550 Conservation Management Practices

Rule 4550 was adopted to help bring the Valley into attainment of federal PM10 standards, and applies to on-field farming and agricultural operation sites located within the Valley. Rule 4550 was the first rule of its kind in the nation to target fugitive particulate emissions from agricultural operations, and it has served as a model for other regions. The District worked extensively with numerous stakeholders, growers, and the Agricultural Technical Committee for the San Joaquin Valleywide Air Pollution Study Agency (AgTech) for two years prior to developing the Conservation Management Practices (CMP) Rule. The District also worked with agricultural stakeholders and other agencies, such as the Natural Resources Conservation Service (NRCS), following rule adoption to ensure affected sources were assisted as much as possible in understanding and complying with the requirements of Rule 4550. Implementation of Rule 4550 by agricultural operations has resulted in the reduction of PM2.5 emissions through the reduction of passes of agricultural equipment and implementation of other conservation practices. Through this rule, PM emissions have been reduced by 35.3 tons per day.

While the attainment modeling process has demonstrated that additional CMPs will not significantly contribute to our attainment efforts, to further develop the District's understanding of the effectiveness of CMP measures on controlling PM2.5 emissions in the Valley, the District is committing to undertaking scientific research on the PM2.5 content, constituents, and stability during wind events of the many soil types found throughout the Valley. This research would be conducted in close coordination with USDA-NRCS, agricultural sources, researchers through established processes including the San Joaquin Valleywide Air Pollution Study Agency, Policy Committee, and Agricultural Technical Subcommittee.

Although Rule 4550 already meets RACM, BACM and MSM for this source category, the District will go beyond MSM in this Plan and is committing to further evaluate ways to promote conservation tillage practices and other potential enhancements to the CMP program to reduce dust from agricultural operations to the extent that they are found to practicably reduce PM2.5. The District will work with the Agricultural Technical Committee (AgTech) to evaluate the feasibility and effectiveness of requiring the selection of additional control measures to achieve additional PM2.5 emissions reductions from tilling and other land preparation activities based on the research discussed above. More widespread implementation of conservation tillage practices such as cover cropping, no till, low till, strip till, and precision agriculture, through additional incentives under Rule 4550, may help to further limit PM2.5 in the Valley. To this end, the District will evaluate measures to promote the selection of conservation tillage as a CMP for croplands.

The District will evaluate the feasibility and effectiveness of CMPs on fallow lands that are tilled or otherwise worked with implements of husbandry to reduce windblown PM2.5 emissions from disturbed fallowed acreage. This evaluation will rely on additional research, in coordination with USDA-NRCS, agricultural sources, and researchers, which recognizes the Valley's unique soil characteristics and agricultural practices to ensure that Valley-specific solutions are considered in this process.

Rule 4692 Commercial Charbroiling

District Rule 4692 reduces PM emissions by requiring catalytic oxidizers for chain-driven charbroilers, including those used in many typical fast-food restaurants. Rule 4692 is among the most stringent rules in the nation for controlling emissions from commercial charbroiling operations. The original rule, adopted in March 2002, reduced PM2.5 emissions from chain-driven charbroilers by 84%. The September 2009 rule amendment expanded rule applicability to more chain-driven charbroilers. Rule 4692 has been fully implemented since 2011.

In addition to the existing emissions reductions already achieved through control requirements for chain-driven commercial charbroilers, this measure would seek to achieve additional emission reductions from commercial underfired charbroilers. While there are ongoing improvements in the technology available for commercial cooking emissions, the costs of installing controls for commercial underfired charbroilers remain high.

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, using new survey and registration information, the District will go beyond MSM in this Plan and pursue reductions in commercial underfired charbroiler emissions through an incentive-based approach to fund the installation of controls for commercial underfired charbroilers within urban boundaries in hot-spot areas of Fresno, Kern, and Madera counties, with a future year regulatory requirement to encourage participation by Valley businesses.

Rule 4702 Internal Combustion Engines

Rule 4702 applies to any internal combustion (IC) engine rated at 25 brake horsepower (bhp) or greater. The purpose of this rule is to limit NOx, CO, VOC, and SOx emissions from units subject to this rule. The rule originally established NOx limits between 25-50 ppmv achieving 90-96% control for non-agricultural rich-burn engines and 65-75 ppmv achieving 85-90% control for non-agricultural lean burn engines. In its continuous effort to improve air quality in the Valley, the District has adopted numerous amendments to Rule 4702 that have resulted in significant reductions of NOx and PM emissions. August 2011 amendments implemented more stringent NOx limits as low as 11 ppmv for non-agricultural operations spark-ignited engines.

Substantial emission reductions from agricultural IC engines have also been achieved through a combination of regulatory efforts and incentive actions. Rule 4702 has effectively reduced emissions from agricultural engines by 84% since 2005.

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, the District will go beyond MSM in this Plan and pursue the following potential opportunities:

- Non-Agricultural IC Engines: Work with affected operators to further reduce NOx emissions from non-agricultural IC engines to the extent that such controls are technologically achievable and economically feasible. Technologies evaluated with the potential to further reduce emissions include the installation of 3-way catalytic reduction for rich-burn IC engines and selective catalytic reduction for lean-burn IC engines. While the analysis in Appendix C shows that many control technologies are not cost-effective, potential emission reduction opportunities for further evaluation include:
  - Rich Burn Engines (“not listed above” category): Lower existing limit of 11 ppmv to as low as 7 ppmv
  - Lean Burn Engines (“not listed above” category): Lower existing limit of 11 ppmv to as low as 5 ppmv
  - Limited Use Rich/Lean Burn: Lower existing limits of 25 and 65 ppmv to as low as 11 ppmv

- Agricultural IC Engines: Work with agricultural sources to further reduce NOx emissions through an incentive-based/regulatory approach as technologically and economically feasible. While the analysis in Appendix C demonstrates that the various control technologies are generally not cost-effective without financial assistance, and may not be technologically feasible for remote agricultural installations, potential emission reduction opportunities for further evaluation include:
  - Replacement of spark-ignited agricultural engines with electric motors where access to electricity is available, or Tier 4-equivalent engine technologies through

incentive-based approach coupled with regulatory backstop to encourage participation.

- Replacement of Tier 3 compression-ignited agricultural engines with electric motors where access to electricity is available, or Tier 4-equivalent engine technologies through incentive-based approach to achieve additional emissions reductions where cost-effective.

Rule 4901 Wood Burning Fireplaces and Wood Burning Heaters

The District takes a multidimensional and proactive approach to reducing emissions in the Valley. This philosophy is especially true for reducing emissions from residential wood burning; with a combination of regulatory controls through Rule 4901, rigorous public outreach and education efforts, *Check Before You Burn* program, and the District's Burn Cleaner Wood Stove Change-out Program (Burn Cleaner Program). The District's approach to reducing emissions from residential wood burning empowers Valley residents to play a major role in reducing emissions at almost no increased cost, and, in many cases, with savings in heating-related energy costs. Control measure analysis in Appendix C confirms this rule implements the most stringent measures feasible in its current form, additional components to the residential wood burning strategy go beyond MSM.

Through the District's *Check Before You Burn* program, the District has declared and enforced episodic wood burning curtailments since 2003. When ambient PM2.5 concentrations in a specific county are forecasted to be at or above 20 $\mu g/m^3$, the District only allows registered or exempt units within that county to burn that day. The tiered compliance thresholds in Rule 4901, which allow additional burn days for District registered EPA-certified devices, encourages the transition from high-polluting devices and open hearth fireplaces to cleaner alternatives. *Check Before You Burn* and District Rule 4901 reduce harmful species of PM2.5 when and where those reductions are most needed - in urbanized areas when the local weather conditions are forecast to inhibit particulate matter dispersion.

While the District meets or exceeds RACM, BACM, and MSM requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, this measure would go beyond MSM to reduce additional emissions by implementing an even more stringent wood burning curtailment program with the following potential enhancements:

- Curtailment Levels
  - Lower curtailment levels in the targeted hot-spot areas of Fresno County, Madera County, and Kern County
    - No burn for non-registered units at or above 12 $\mu g/m^3$
    - No burn for all devices above 35 $\mu g/m^3$
  - Maintain current curtailment levels in rest of Valley
    - No burn for non-registered units at or above 20 $\mu g/m^3$
    - No burn for all devices above 65 $\mu g/m^3$
- Incentive Levels

    - Offer enhanced levels of incentives in hot-spot areas to fund the full replacement of wood burning devices
        - Incentive will only be provided for transition to natural gas devices in areas where natural gas services are available
    - Incentives will be provided for EPA-certified wood burning or pellet fueled devices in areas with no access to natural gas services
    - Continue to offer current level of incentives in rest of Valley
- New Construction
    - Prohibit wood-burning devices in new construction (at higher elevations, only allow EPA-certified devices, subject to density requirements)
- Enhanced outreach and education efforts to increase awareness of residential wood burning health impacts and District's residential wood burning reduction strategy Valleywide
- New visible emissions limitations for residential wood burning
- New requirement for significant remodels of a fireplace or chimney that requires the removal of open-hearth fireplaces
- Only allow seasoned wood to be burned Valleywide
- Enhanced enforcement to assure continued high compliance rate Valleywide under new strategy
- Enhanced enforcement during transfer of real property by requiring verification forms for all house transfers in the Valley
- Enhanced curtailment forecasting through use of new meteorological and air quality models and tools as feasible

To satisfy the commitments in the Plan as described above, the District conducted a comprehensive technical rule evaluation, and, on June 20, 2019, adopted amendments to Rule 4901.

4.3.3 NEW/ENHANCED INCENTIVE-BASED CONTROL MEASURE COMMITMENTS

The District's strategy to reach attainment of the federal PM2.5 standards relies heavily on incentive programs to achieve cost-effective emission reductions of direct PM2.5 and PM2.5 precursors. Given the enormity of emissions reductions necessary to bring the Valley into attainment of the 1997, 2006, and 2012 federal PM2.5 standards, the Valley cannot reach attainment through regulatory measures alone, and significant additional emissions reductions through incentive-based measures are necessary. The incentive programs complement regulatory control measures by providing much needed reductions beyond those feasible through regulation, particularly with respect to mobile sources, which the District has limited direct authority to regulate.

District incentive programs have a positive impact on air quality and are also highly successful due to the fact that participation is voluntary and the emission reductions are both highly cost-effective and surplus to the reductions required by the regulatory control measure commitments in attainment plans. Through a combined public/private investment of more than ~~$2.2~~ $3.5 billion, the District has been able to reduce over ~~145,000~~ 189,000 tons of harmful emissions through a variety of cost-effective, voluntary and often first-of-their-kind incentive programs. Recent audits conducted by CARB and

Department of Finance (DOF) have confirmed that the District's programs are fiscally sound and are "efficiently and effectively achieving their emission reduction objective."

In crafting the new attainment plans, the District explores all feasible opportunities to further reduce stationary sources emissions. The District, CARB, and EPA agree that significant additional emissions reductions from mobile sources are required to reach attainment of the federal standards, primarily through the deployment of incentive-based measures.

Developing these aggressive incentive-based control measures that will require significant funding. While the District has been able to generate significant local funding and successfully advocate for additional state and federal funding, the reductions needed to attain the standards require a significant increase in public and private investment. For example, the necessary transition of the heavy duty trucking fleet to near zero emissions technology in the attainment timeline prescribed in the Clean Air Act can only be achieved with significant investment in infrastructure and fleet turnover.

When given SIP credit, incentive-based emissions reductions can be used alongside regulatory-based emissions reductions to meet federal CAA requirements, such as demonstrating attainment with federal air quality standards at a future date. The District is proposing to use the emission reductions achieved through three incentives programs for the federal PM2.5 standards attainment demonstration. These measures will include the replacement of agricultural engines with electric motors; replacement of woodstoves and fireplaces to cleaner units; and installation of pollution control equipment for commercial underfired charbroilers. In addition, CARB is proposing to adopt SIP-creditable incentive measures for mobile sources in the Valley, including measures to replace significant numbers of heavy duty trucks, agricultural equipment, and off-road equipment.

These proposed aggressive incentive-based control measures that achieve the massive emissions reductions needed to bring the Valley into attainment will require significant funding estimated at $5 billion (table 4-6). Dollars needed are well in excess of current or prospectively scheduled future appropriations. While the District has been able to generate significant local funding and successfully advocate for additional state and federal funding, the reductions needed to attain the PM2.5 federal standards require a significant increase in public incentive funding from the state that can only be secured through sustained action and commitment by the state.

Table 4-6 Incentive Funding Needed for Expeditious Attainment

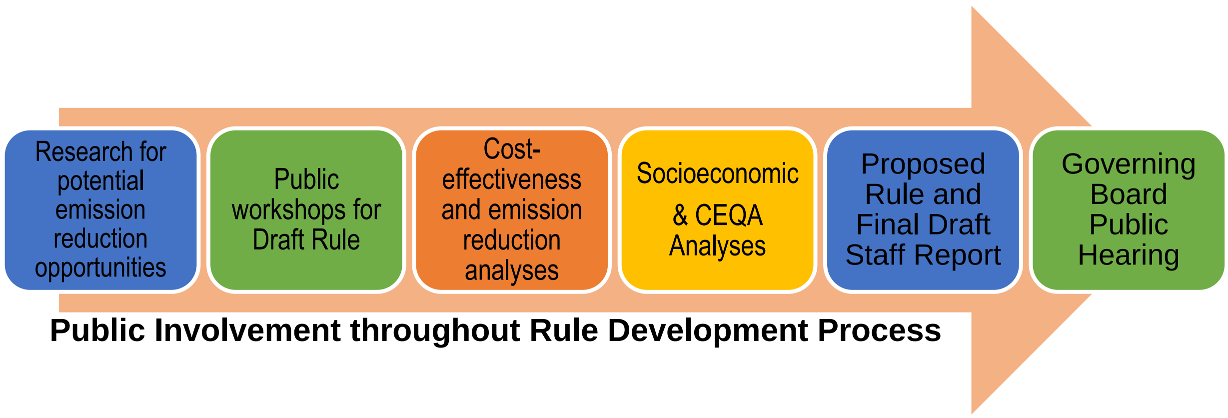
Incentive Measures	Incentive Funding Need ($)
Accelerated Turnover of Trucks and Buses	$3,300,000,000
Accelerated Turnover of Agricultural Equipment	$1,400,000,000
Accelerated Turnover of Off-Road Equipment	$170,000,000
Commercial Under-fired Charbroiling Controls	$45,000,000
Replacement of Residential Wood Burning Devices	$75,000,000

Replacement of Internal Combustion Engines used at Agricultural Operations	$14,000,000
Total	**$5,004,000,000**

4.3.4 IMPLEMENTATION OF REGULATORY MEASURES

After plan adoption, the District adopts or amends rules per the plan's regulatory control measure commitments. In these efforts, the District is committed to a transparent public process that includes stakeholder, industry, and other-agency input at every step possible.

Figure 4-1 Rule Development Process



Contrasting the broader plan development effort, the rule development process allows greater focus on a single sector or technology area. Early in the rule development process, prior to preparing a draft rule, staff researches technologies and explores options for emissions reductions, gathering preliminary data and performing literature reviews of relevant studies. Through a series of public workshops and focus group meetings, staff presents draft rule concepts and receives feedback on specific technology costs, technical insight, and general public comments. Staff uses this information gathering and discussion to refine the rule throughout the rule development process. Using this iterative process of gathering the most up-to-date cost and technical information, staff analyzes cost-effectiveness and potential emissions reductions. These analyses are shared with the public throughout the rule development process.

During the ongoing public workshop process, the District enlists the services of an economic consultant to analyze the proposed rule's socioeconomic impact, pursuant to California Health and Safety Code Section 40728.5. As with draft versions of the rule, the District gives the public and stakeholders the opportunity to review the analysis and provide further feedback. To the extent possible, the District minimizes significant economic and socioeconomic impacts by evaluating viable alternatives, adjusting proposed limits, or extending compliance schedules.

Staff presents the final draft version of the staff report and proposed rule, including the cost-effectiveness analysis, socioeconomic impact report, emissions reductions analysis, RACT analysis, and California Environmental Quality Assessment (CEQA), to the Governing Board during a public hearing. The Governing Board ultimately determines the balance between air quality improvement and rule impacts when adopting proposed rules.

Once adopted, the District forwards the rule through CARB to EPA for inclusion into the SIP, as appropriate. EPA evaluates the rule, determines if the rule meets federal requirements, and provides an opportunity for further public comment. After this review and comment period, EPA will amend the SIP to include the new rule, as appropriate.

Beyond the rule development and adoption process, District staff will continue to engage the public and affected source operators throughout implementation and compliance. Additionally, District staff continues public outreach and education through notifications to stakeholders of the rule adoption, issuance of compliance bulletins, and assistance through the District's Small Business Assistance program.

4.4 CARB Emission Reduction Commitment for the San Joaquin Valley

[*Section 4.4 provided by the California Air Resources Board*]

CARB's existing mobile source control program has achieved substantial reductions in the Valley, and will continue to provide further emission reductions from ongoing implementation. Since 2000, NOx and PM2.5 emissions from mobile sources have been reduced by over 60 percent. Continued implementation of CARB's current mobile source programs will result in significant further reductions by 2025, reducing NOx emissions from 2013 levels by 55 percent and PM2.5 emissions by nearly 40 percent.

The *2016 State Strategy for the State Implementation Plan* (2016 State SIP Strategy),[11] adopted by the CARB Board in March 2017, established Valley emission reductions commitments for ozone in 2031 and acknowledged that more emission reductions would be identified to meet PM2.5 standards in the Valley. CARB staff has further refined the final emission reduction needs and strategies, including funding mechanisms, to accelerate turnover to the technologies identified in the State SIP Strategy. This includes efforts to reflect the benefits of additional transformational efforts underway in the Valley as part of other planning efforts that are anticipated to provide criteria emission reduction co benefits. As an outcome of that process, the *San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan* (Valley State SIP Strategy) includes updates to certain measures in the 2016 State SIP Strategy and proposes additional mobile source measures needed for the Valley's 2018 PM2.5 SIP. Attachment A further describes the updated 2016 State SIP Strategy measures and the Proposed State Measures for the Valley.

[11] CARB (2017) "Revised Proposed 2016 State Strategy for the State Implementation Plan (State SIP Strategy)" https://www.arb.ca.gov/planning/sip/2016sip/2016sip.htm

The measures in the Valley State SIP Strategy build upon the regulatory measures in the 2016 State SIP Strategy and promote accelerated turnover to the next generation of cleaner technologies in the Valley. These additional measures include new requirements that would ensure that on-road, heavy-duty vehicles remain as clean as possible throughout their lifetime, and incentive measures to accelerate the turnover of agricultural equipment, on-road heavy-duty vehicles, and off-road equipment. Given their contribution to ambient PM2.5 levels in the Valley, District measures to achieve additional reductions from local sources of directly emitted PM2.5 will also be critical.

Combined, the actions in the 2016 State SIP Strategy and the Valley State SIP Strategy provide the mobile source emission reductions needed for attainment. Table 4-7 summarizes the combined reductions that will accrue through implementation of the current control program, the measures committed to in the 2016 State SIP Strategy, and the measures in the Valley State SIP Strategy. In aggregate, they will reduce emissions from 2013 levels by 156 tpd NOx and 4.54 tpd PM2.5 in 2023, 189 tpd NOx and 5.5 tpd PM2.5 in 2024, and 194 tpd NOx and 5.6 tpd PM2.5 in 2025.

Table 4-7: Emission Reductions from State Measures

	2023		2024		2025	
	NOx (tpd)	PM2.5 (tpd)	NOx (tpd)	PM2.5 (tpd)	NOx (tpd)	PM2.5 (tpd)
Current Control Program	153	4.5	157	4.6	162	4.7
Measures	3.0	0.04	32	0.9	32	0.9
2016 State SIP Strategy Measures	*3.0*	*0.04*	*9*	*0.1*	*12*	*0.1*
Proposed State Measures for the Valley			*23*	*0.8*	*20*	*0.8*
Total Reductions	156	4.54	189	5.5	194	5.6

Together with the reductions from the current control program and the 2016 State SIP Strategy, the Valley State SIP Strategy is designed to achieve the mobile source NOx reductions necessary for the Valley's PM2.5 attainment needs.

The CARB commitment consists of two components:

1. A commitment to bring to the CARB Board or take action on the Proposed State Measures for the Valley; and

2. A commitment to achieve aggregate emission reductions in 2023, 2024, and 2025.

The commitment for the Valley would be submitted into the California SIP and would become federally enforceable upon approval by U.S. EPA. The comprehensive mobile strategy for the San Joaquin Valley discussed in this document proposes a range of measures and indicates that CARB will undertake various actions; it is subject to CARB's formal approval process. The mobile strategy for the San Joaquin Valley was adopted by the CARB Board on October 25, 2018.

4.4.1 COMMITMENT TO ACT ON PROPOSED STATE MEASURES FOR THE VALLEY

Table 4-8 shows the full list of State measures and schedule for consideration to support attainment of federal PM2.5 standards in the Valley. The CARB Board has already approved the commitment for the 2016 State SIP Strategy measures and CARB is augmenting that commitment with additional State measures for the Valley. CARB staff proposes commit to initiate the public process for all measures as outlined in Table 4-8 by holding a workshop supporting the measure that could include understanding emission inventory changes or releasing draft document for public review. This development process will provide additional opportunity for public and stakeholder input, as well as ongoing technology review, and assessment of costs and environmental impacts. CARB staff also proposes to bring to the Board or take action on the list of Proposed State Measures for the Valley shown in the bottom portion of Table 4-8 by the dates specified.

Table 4-8: State Measures and Schedule for the San Joaquin Valley

Measures	Agency	Public Process Begins	Action	Implementation Begins
2016 State SIP Strategy Measures				
Advanced Clean Cars 2 Reduced ZEV Brake and Tire Wear	CARB	2017	2020 – 2021	2026
Lower In-Use Emission Performance Level:	CARB	2016	2017 – 2020	2018 +
Lower Opacity Limits for Heavy-Duty Vehicles	CARB	2016	2018	2018 – 2024
Amended Warranty Requirements for Heavy-Duty Vehicles	CARB	2016	2018	2022
Heavy-Duty Vehicle Inspection and Maintenance Program	CARB	2019	2020	2022 +
Low-NOx Engine Standard – California Action	CARB	2016	2019	2023
Low-NOx Engine Standard – Federal Action	U.S. EPA	2016	2019	2024
Innovative Clean Transit	CARB	2015	2018 – 2019	2020
Advanced Clean Local Trucks (Last Mile Delivery)	CARB	2016	2019	2020
Zero-Emission Airport Shuttle Buses	CARB	2017	2018	2023
More Stringent National Locomotive Emission Standards	U.S. EPA	2017	2017	2023 +
Zero-Emission Off-Road Forklift Regulation Phase 1	CARB	2020	2020	2023
Zero-Emission Airport Ground Support Equipment	CARB	2018	2019	2023
Small Off-Road Engines	CARB	2016	2018 – 2020	2022
Transport Refrigeration Units Used for Cold Storage	CARB	2016	2018 – 2019	2020 +
Low-Emission Diesel Fuel Requirement	CARB	2019	2021	2023
Proposed State Measures for the Valley				
Accelerated Turnover of Trucks and Buses	CARB / SJVAPCD			Ongoing
Incentive Projects		--	--	
SIP-Creditable Measure*		2018	by 2021	
Accelerated Turnover of Agricultural Equipment	CARB / SJVAPCD			Ongoing
Incentive Projects		--	--	
SIP-Creditable Measure*		2018	by 2020	
Cleaner In-Use Agricultural Equipment	CARB	2019	2025	2030
Accelerated Turnover of Off-Road Equipment	CARB / SJVAPCD			Ongoing
Incentive Projects		--	--	
SIP-Creditable Measure*		2020	by 2021	

*A SIP-creditable measure will be developed to demonstrate that the emission reductions from incentive projects can be credited towards the aggregate commitment

4.4.2 COMMITMENT TO ACHIEVE AGGREGATE EMISSION REDUCTIONS

The 2016 State SIP Strategy included an initial commitment to achieve an aggregate emission reduction of 8 tpd of NOx in the Valley by 2031, which serves as a down payment on the total emission reductions needed for the Valley's attainment of federal standards. This document proposes a commitment to achieve the aggregate emission reductions specified in Table 4-9a by 2023 and in Table 4-9b by 2024 and 2025.

CARB staff proposes to commit to achieve, in aggregate, 3 tpd of NOx emission reductions and 0.04 tpd of PM2.5 emission reductions in 2023, and 32 tpd of NOx emission reductions and 1 tpd of PM2.5 emission reductions in 2024, with the 2024 emission reduction commitments carried through to 2025. These measures, in conjunction with the existing control program, identify all of the reductions required from mobile sources for the Valley's PM2.5 attainment needs. These measures reflect a combination of State actions and petitions for federal action to establish the policy and regulatory mechanisms to bring the needed advanced technologies into the California vehicle and equipment fleet, while pairing these actions with incentive and other programs to strategically accelerate the penetration of the cleanest technologies in each sector.

CARB's aggregate emission reduction commitment may be achieved through a combination of actions including but not limited to: the implementation of control measures; the expenditure of local, State or federal incentive funds; or through the implementation of other enforceable measures. In some cases, actions by federal agencies will be needed. CARB will include these emission reductions in its aggregate commitment to ensure that reductions are achieved regardless of federal action. For example, if a federal heavy-duty low-NOx engine standard is not established, CARB will look to achieve the necessary reductions from other source categories, such as stationary sources. In other cases, programmatic approaches must be developed and funding secured to achieve the reductions outlined.

While Tables 4-9a and 4-9b include estimates of the emission reductions from each of the individual measures, final measures as proposed by staff to the Board or adopted by the Board may provide more or less than the initial emission reduction estimates. CARB's overall commitment is to achieve the total emission reductions necessary to attain the federal air quality standards while reflecting the combined reductions from the existing control strategy and new measures. Therefore, if a particular measure does not get its expected emission reductions, the State is still committed to achieving the total aggregate emission reductions. If actual emission decreases occur that exceed the projections reflected in the current emissions inventory and the Valley State SIP Strategy, CARB will submit an updated emissions inventory to U.S. EPA as part of a SIP revision. The SIP revision would outline the changes that have occurred and provide appropriate tracking to demonstrate that aggregate emission reductions sufficient for attainment are being achieved through enforceable emission reduction measures.

Table 4-9a: San Joaquin Valley Expected Emission Reductions from State Measures (2023)

Reductions shown in tons per day (tpd)

Measure	2023	
	NOx (tpd)	PM2.5 (tpd)
2016 State SIP Strategy Measure		
Heavy-Duty Vehicle Inspection and Maintenance Program	3.0	0.04

Table 4-10b: San Joaquin Valley Expected Emission Reductions from State Measures (2024 and 2025)

Reductions shown in tons per day (tpd)

Measures	2024		2025	
	NOx (tpd)	PM2.5 (tpd)	NOx (tpd)	PM2.5 (tpd)
2016 State SIP Strategy Measures				
Advanced Clean Cars 2	--	--	--	--
Reduced ZEV Brake and Tire Wear	--	NYQ	--	NYQ
Lower In-Use Emission Performance Level:	6.8	<0.1	6.8	<0.1
Lower Opacity Limits for Heavy-Duty Vehicles				
Amended Warranty Requirements for Heavy-Duty Vehicles				
Heavy-Duty Vehicle Inspection and Maintenance Program				
Low-NOx Engine Standard – California Action	0.7	--	2	--
Low-NOx Engine Standard – Federal Action	0.7	--	2	--
Innovative Clean Transit	<0.1	<0.1	<0.1	<0.1
Advanced Clean Local Trucks (Last Mile Delivery)	<0.1	<0.1	<0.1	<0.1
Zero-Emission Airport Shuttle Buses	NYQ	NYQ	NYQ	NYQ
More Stringent National Locomotive Emission Standards	0.1	<0.1	0.3	<0.1
Zero-Emission Off-Road Forklift Regulation Phase 1	--	--	--	--
Zero-Emission Airport Ground Support Equipment	<0.1	<0.1	<0.1	<0.1
Small Off-Road Engines	0.1	<0.1	0.2	<0.1
Transport Refrigeration Units Used for Cold Storage	NYQ	NYQ	NYQ	NYQ
Low-Emission Diesel Fuel Requirement	0.8	0.1	1	0.1
Total Reductions from 2016 State SIP Strategy Measures	**9**	**0.1**	**12**	**0.1**
Proposed State Measures for the Valley				
Accelerated Turnover of Trucks and Buses	10	NYQ	8	NYQ
Existing Incentive Projects				
New Incentive Projects				
Accelerated Turnover of Agricultural Equipment				
Existing Incentive Projects	3	0.2	2	0.2
New Incentive Projects	8	0.6	8	0.6
Cleaner In-Use Agricultural Equipment	NYQ	NYQ	NYQ	NYQ
Accelerated Turnover of Off-Road Equipment				
New Incentive Projects	2	NYQ	1.5	NYQ
Total Reductions from Proposed State Measures for Valley	**23**	**0.8**	**20**	**0.8**
Aggregate Emission Reductions	**32**	**1**	**32**	**1**

"NYQ" denotes emission reductions are Not Yet Quantified
"—" denotes no anticipated reductions
The measures as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

4.4.3 Implementing the State Measures for the Valley

Implementation of the current control program and new regulatory actions to establish requirements for cleaner technologies comprise the core of the overall strategy for the Valley. The remaining increment of reductions will be achieved through the suite of actions to accelerate the penetration of cleaner technologies through incentive programs. These actions will also further California's efforts to meet climate and risk reduction goals and enhance the continuing transformation to a cleaner, more efficient transportation system.

4.4.4 2016 State SIP Strategy Measures

4.4.4.1 Advanced Clean Cars 2

The *Advanced Clean Cars 2* measure is designed to ensure that near-zero and zero-emission technology options continue to be commercially available, with electric driving range improvements to address consumer preferences and maximize electric vehicle miles travelled. The regulation may include lowering fleet emissions further beyond the super-ultra-low-emission vehicle standard for the entire light-duty fleet through at least the 2030 model year, and look at ways to improve real world emissions through implementation programs. Additionally, new standards may be considered to further increase the sales of zero-emission vehicles (ZEV) and plug-in hybrid electric vehicles beyond the levels required in 2025.

4.4.4.2 Reduced ZEV Brake and Tire Wear

As an updated element of the *Advanced Clean Cars 2* measure, *Reduced ZEV Brake and Tire Wear* is designed to evaluate and quantify the benefits that will accrue from the expanded number of zero-emission vehicles and plug-in hybrid electric vehicles operating in California. As these vehicles continue to become more commercially available, the new technologies they employ, including regenerative braking and lower rolling resistance tires, can reduce criteria pollutant emissions from brake and tire wear. CARB staff would quantify these previously unaccounted-for criteria pollutant benefits of the Advanced Clean Cars program for SIP purposes in order to better inform future plans.

4.4.4.3 Lower In-Use Emission Performance Level

Since the adoption of the 2016 State SIP Strategy in March 2017, CARB staff has made substantial progress in refining its approach to controlling the in-use emissions from the on-road heavy-duty truck fleet, as originally described in the *Lower In-Use Emission Performance Level* measure in the 2016 State SIP Strategy. The actions initially proposed in the *Lower In-Use Emission Performance Level* measure are now reflected in this document as three separate, but related elements: *Lower Opacity Limits for Heavy-Duty Vehicles*; *Amended Warranty Requirements for On-Road Heavy-Duty Vehicles*; and *Heavy-Duty Vehicle Inspection and Maintenance Program*.

4.4.4.4 Lower Opacity Limits for Heavy-Duty Vehicles

The *Lower Opacity Limits for Heavy-Duty Vehicles* element is designed to ensure that in-use, heavy-duty vehicles continue to operate at their cleanest possible level. In July 2018, the CARB Board approved for adoption staff's proposal to lower the opacity limits for heavy-duty trucks to limits that better reflect the current emission control technology equipped on today's heavy-duty diesel vehicles. Lowering the opacity limits will help ensure that the opacity limits are more representative of current PM emission control technology and that vehicles operating with malfunctioning PM emission control components are more readily identified and repaired.

4.4.4.5 Amended Warranty Requirements for On-Road Heavy-Duty Vehicles

The *Amended Warranty Requirements for Heavy-Duty Vehicles* element is designed to reduce NOx and PM emissions by encouraging vehicle owners to make emission-related repairs. In June of 2018, the CARB Board approved for adoption staff's proposal to lengthen the current 100,000 mile emissions warranty period up to as high as 350,000 miles, as well as to strengthen maintenance intervals, link warranty to illumination of the on-board diagnostic malfunction indicator light, and clarify regulatory language. The June 2018 rulemaking is a first step, and will help ensure that emission-related parts are warranted throughout a greater portion of the vehicles' service life. A later second step is expected to be proposed within the next few years that could lengthen the mileage warranty periods further, potentially to the useful life or beyond, as applicable, for each classification of heavy duty engine type. Amendment requirements as described could encourage manufacturers to design more durable components.

4.4.4.6 Heavy-Duty Vehicle Inspection and Maintenance Program

The *Heavy-Duty Vehicle Inspection and Maintenance Program* element is designed to ensure that in-use, heavy-duty vehicle emission control components and systems are properly functioning so that these vehicles continue to operate at their cleanest possible levels. CARB staff would develop and propose a regulatory program that reflects the current state of advanced engine and exhaust emission control technologies including on-board diagnostics. <u>Early deployment of next-generation enforcement tools like CARB's Portable Emissions Acquisition System (PEAQS) will be included as part of this measure to help find the dirtiest trucks operating in the Valley, supporting efforts to repair high emitters.</u>

4.4.4.7 Low-NOx Engine Standard

The *Low-NOx Engine Standard* measure is designed to require engine technologies that will substantially lower NOx emissions from on-road heavy-duty vehicles. CARB began development of a new heavy-duty low-NOx emission standard in California in 2016, and Board action is expected in 2019. A California-only low-NOx standard would apply to all vehicles with new heavy-duty engines sold in California starting in 2023. In order to achieve the maximum emission reductions from this measure, CARB included in the 2016 State SIP Strategy a call for U.S. EPA to establish a new federal heavy-duty engine emission standard. Should U.S. EPA fail to initiate a rule development process, CARB would continue with its development and implementation efforts to establish a California-only low-NOx standard. CARB will coordinate its regulatory development efforts with any U.S. EPA regulatory efforts.

4.4.4.8 Innovative Clean Transit

The *Innovative Clean Transit* measure is designed to continue the transition of transit fleets to cleaner technologies to support NOx and GHG emission reduction goals. The measure will consider a variety of approaches to enhance the deployment of advanced clean technology and increase the penetration of the first wave of zero-emission heavy-duty technology into transit applications that are well suited to its use. CARB staff will develop and propose an Innovative Clean Transit measure with a combination of mechanisms, including incentives, which would result in transit fleets purchasing advanced technology buses during normal replacement and using renewable fuels when contracts are renewed.

4.4.4.9 Advanced Clean Local Trucks (Last Mile Delivery)

The *Advanced Clean Local Trucks* measure is designed to increase the penetration of advanced clean technology into applications that are well suited to its use. CARB staff would develop and propose a regulation that would result in the use of low-NOx engines and the purchase of zero-emission trucks for certain class 3-7 last mile delivery trucks in California. This measure would begin in 2020 with a small scale deployment and gradually ramp up to higher percentages of new vehicles sales.

4.4.4.10 Zero-Emission Airport Shuttle Buses

The *Zero-Emission Airport Shuttle Buses* measure is designed to achieve NOx and GHG emission reductions goals through advanced clean technology, and to increase the penetration of the first wave of zero-emission heavy-duty technology into applications that are well suited to its use. Like transit buses, the inclusion of zero-emission airport shuttles would serve as a stepping stone to encourage broader deployment of zero-emission technologies in the on-road sector. CARB staff would develop and propose a regulation or other measures to deploy zero-emission airport shuttles in order to further support market development of zero-emission technologies in the heavy-duty sector.

4.4.4.11 More Stringent National Locomotive Emission Standards

The *More Stringent National Locomotive Emission Standards* measure is designed to reduce emissions from new and remanufactured locomotives. Pursuant to this measure, in 2017, CARB petitioned U.S. EPA for new Tier 5 national locomotive emission standards for new locomotives and more stringent national requirements for remanufactured locomotives. CARB staff estimates that U.S. EPA could require manufacturers to implement the new locomotive emission regulations as early as 2023 for remanufactured locomotives, and 2025 for newly manufactured locomotives. A new federal standard could also facilitate development and deployment of zero-emission track mile locomotives and zero-emission locomotives by building incentives for those technologies into the regulatory structure.

4.4.4.12 Zero-Emission Off-Road Forklift Regulation Phase 1

The *Zero-Emission Off-Road Forklift Regulation Phase 1* measure is designed to increase penetration of ZEVs in off-road applications, advance ZEV commercialization, and to set a market signal to technology manufacturers and investors. CARB staff would develop and propose a regulation with specific focus on forklifts with lift capacities equal to or less than 8,000 pounds for which zero-emission technologies have already gained appreciable customer acceptance and market penetration.

4.4.4.13 Zero-Emission Airport Ground Support Equipment

The *Zero-Emission Airport Ground Support Equipment* measure is designed to increase the penetration of the first wave of zero-emission heavy-duty technology in applications that are well suited to its use, and to facilitate further technology development and infrastructure expansion. A conservative strategy would rely on incentives and natural turnover, along with current in-use requirements, to replace equipment where electric replacements are readily available. A more aggressive turnover and implementation strategy could utilize a memorandum of understanding, regulation, or a combination thereof, along with incentives for demonstration, to ensure an accelerated transition to zero-emission equipment. Under this measure, CARB staff would develop and propose a regulation to accelerate the transition of diesel and large spark ignition airport ground support equipment to zero-emission technology.

4.4.4.14 Small Off-Road Engines

The *Small Off-Road Engines* (SORE) measure is designed to reduce emissions from small off-road engines, and to increase the penetration of zero-emission technology. SORE that are subject to CARB regulations are used in residential and commercial lawn and garden equipment, and other utility applications. CARB will develop and propose tighter exhaust and evaporative emission standards, encourage increased use of zero-emission equipment, and enhance enforcement of current emission standards for SORE. Strategies will be developed for transitioning to zero-emission technologies, including an initial focus on incentives for use of zero-emission equipment, coupled with increasingly stringent emission standards for criteria pollutants and GHGs.

4.4.4.15 Transport Refrigeration Units Used for Cold Storage

The *Transport Refrigeration Units Used for Cold Storage* measure is designed to advance zero and near-zero emission technology commercialization by increasing the early penetration of hybrid electric and electric standby-equipped transport refrigeration units used for cold storage, and supporting the needed infrastructure developments. CARB staff would develop a regulation to reduce NOx, PM, and GHG emissions by reducing the amount of time that transport refrigeration units operate using internal combustion engines while refrigerated trucks, trailers, and shipping containers are parked at certain California facilities and other locations.

4.4.4.16 Low-Emission Diesel Fuel Requirement

The *Low-Emission Diesel Fuel Requirement* measure is designed to reduce emissions from the portion of the heavy-duty fleet that will continue to operate on internal combustion engines. CARB staff would bring to the Board a proposed low-emission diesel standard that would require diesel fuel providers to steadily decrease criteria pollutant emissions from their diesel products until 2031. The standard would complement existing CARB programs that incentivize increased use of renewable fuels as substitutes for conventional fuels, and will focus on more completely transitioning the fuel mix to a cleaner mix of diesel substitute fuels.

4.4.5 PROPOSED STATE MEASURES FOR THE VALLEY

4.4.5.1 Accelerated Turnover of Trucks and Buses

The *Accelerated Turnover of Trucks and Buses* measure is designed to provide incentive funding to accelerate the penetration of near-zero and zero-emission engines beyond the rate of natural turnover achieved through implementation of other measures identified for on-road heavy-duty trucks and buses. Using existing and new funding mechanisms, the measure would target large fleets with significant activity in the Valley for turnover to technologies that meet or exceed CARB's current optional low-NOx standard and the future low-NOx emission standard requirements. Reductions may also be quantified for SIP credit from projects already funded and executed to date.

4.4.5.2 Accelerated Turnover of Agricultural Equipment

The *Accelerated Turnover of Agricultural Equipment* measure is designed to use existing and new incentive funding programs to help accelerate the penetration of cleaner engines used in agricultural equipment beyond the rate of natural turnover. A portion of these SIP-creditable reductions would come from the quantification of reductions from projects already funded and executed to date that will continue to provide SIP-creditable reductions through 2024 and 2025. The remaining reductions correspond to accelerated turnover of additional Tier 0, 1 and 2 agricultural equipment using existing and innovative incentive funding programs.

4.4.5.3 Cleaner In-Use Agricultural Equipment

The *Cleaner In-Use Agricultural Equipment* measure is designed to increase the penetration of cleaner agricultural equipment used in California, including advancing zero-emission technology where feasible. CARB staff would develop a measure with deadlines to serve as an overall emission reduction target and to act as a catalyst for attracting early replacement of agricultural equipment through incentives. In combination with incentive programs and significant lead-time, this measure will ensure that cleaner agricultural equipment will be used in the Valley through 2030.

4.4.5.4 Accelerated Turnover of Off-Road Equipment

The *Accelerated Turnover of Off-Road Equipment* measure is designed to provide incentive funding to accelerate the penetration of near-zero and zero-emission off-road engines beyond the rate of natural turnover achieved through implementation of the other measures identified for off-road equipment. Categories of equipment may include oil drilling workover rigs, construction equipment, transport refrigeration units, and forklifts. CARB staff would use existing and innovative incentive funding programs to help increase the penetration of cleaner engine technology, achieving additional NOx reductions through accelerating the turnover of off-road engines.

APPENDIX B

Updated *2018 PM2.5 Plan* Chapter 5: Demonstration of Federal Requirements for 1997 PM2.5 Standard

Chapter 5

Demonstration of Federal Requirements for 1997 PM2.5 Standards

Updated July 20, 2021

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5 DEMONSTRATION OF FEDERAL REQUIREMENTS FOR 1997 PM2.5 STANDARD

The U.S. Environmental Protection Agency's (EPA) 1997 PM2.5 national ambient air quality standard (NAAQS, or standard) has two components: an annual average standard of 15 micrograms per cubic meter (µg/m³), and a 24-hour average standard of 65 µg/m³. EPA designated the San Joaquin Valley (Valley) as nonattainment of this standard effective April 2005, and finalized its implementation rule effective May 29, 2007 consistent with federal Clean Air Act (CAA) Subpart 1. On April 30, 2008, the District adopted the *2008 PM2.5 Plan* demonstrating attainment of the 1997 standard by April 2015 and satisfying all federal implementation requirements. EPA approved this plan effective January 9, 2012. Subsequently, on January 4, 2013, the D.C. Circuit Court ruled that EPA erred by solely using CAA Subpart 1 in establishing its PM2.5 implementation rule, without consideration of the PM-specific provisions in Subpart 4.[1]

Subpart 4 differs from Subpart 1 in its attainment plan deadlines, the required level of emissions controls, and its handling of PM precursors. Another key difference is in the classification of nonattainment areas and corresponding attainment deadlines. Under Subpart 1, all areas were designated nonattainment without a corresponding classification. Under Subpart 4, nonattainment areas are initially classified as "Moderate," with six years from its initial nonattainment designation date to reach attainment (though two one-year extensions are available in certain circumstances). An area can request reclassification to "Serious," with ten years from its initial attainment designation date to reach attainment. Subpart 4 allows for an additional extension of up to five years if the area demonstrates that the mandated attainment deadline is infeasible, all requirements and commitments have been met, and the state implementation plan (SIP) includes the most stringent measures (MSM) possible. If an area fails to attain an applicable attainment deadline, under CAA § 189(d), the area must submit a SIP revision demonstrating expeditious attainment, with PM or PM precursor emissions reduced by at least 5% per year until attainment.

Following the 2013 D.C. Circuit Court ruling, EPA began redirecting all PM2.5 implementation efforts to be consistent with Subpart 4, but under a truncated schedule as compared to what would have occurred had EPA initially designated nonattainment areas under Subpart 4 in 2005. In June 2014, EPA classified the Valley as a Moderate nonattainment area under Subpart 4 with an attainment date of April 5, 2015. In August 2014, the District submitted a formal request to EPA to reclassify the Valley to Serious nonattainment. EPA granted the Valley's Serious reclassification request in April 2015, setting a new attainment date of December 31, 2015.

After implementing the commitments in the *2008 PM2.5 Plan*, the Valley had been on the verge of attaining the 1997 PM2.5 Standard. However, due to the extreme drought, stagnation, strong inversions, and historically dry conditions experienced over the winter

[1] *Nat. Res. Def. Council v. E.P.A.*, 706 F.3d 428 (D.C. Cir. 2013)

of 2013-2014, it was clear in 2014 that attainment by 2015 (based on 2013-2015 data) would be impossible.

The District adopted the *2015 PM2.5 Plan for the 1997 PM2.5 Standard* (*2015 PM2.5 Plan*) in April 2015 with an MSM demonstration and an attainment date extension request of 2020, as provided for in Subpart 4. The District had worked closely with EPA for over a year developing this plan to address concerns and ensure CAA requirements were satisfied. The *2015 PM2.5 Plan's* comprehensive control strategy would achieve a 38% reduction in NOx emissions between 2012 and 2020 as well as significant reductions in directly emitted PM2.5.

EPA formally proposed to approve portions of the *2015 PM2.5 Plan* and the attainment date extension on February 9, 2016. EPA needed to finalize its approval of the Valley's attainment date extension by July 2016, but EPA failed to finalize this action. EPA subsequently denied the District's attainment extension request on the basis that they did not have enough information to act, and found that the Valley failed to attain the 1997 standard by its December 2015 attainment deadline. EPA's action was effective December 23, 2016,[2] just seven days before the new SIP amendment would be due to EPA as a result of EPA's action.

Pursuant to CAA §189(d), EPA's 2016 PM2.5 Implementation Rule,[3] and 40 CFR §51.1003(c), the District was then required to ~~must now~~ submit a SIP revision that meets the requirements summarized in Table 5-1, commonly called a 5% Plan. Although this 1997 PM2.5 SIP update was technically due by December 2016, this was not feasible given the already-truncated schedule described above. Addressing these requirements as part of this *2018 Plan for the 1997, 2006, and 2012 PM2.5 Plan* (Plan) allowed for better stakeholder involvement and harmonization of SIP elements between the 1997, 2006, and 2012 PM2.5 standards. The Plan was adopted by the District Governing Board on November 15, 2018, and subsequently adopted by the California Air Resources Board (CARB) on January 24, 2019. CARB and the District have been actively implementing the control strategies outlined in the Plan.

District and CARB recently prepared a clean data determination to confirm the Valley's attainment of the 1997 24-hour PM2.5 standard of 65 µg/m³ by the 2020 attainment target. This analysis included "exceptional event" documentation of the severe wildfire impacts on the Valley's air quality in the year 2020. On July 13, 2021, EPA formally approved the District's exceptional event documentation, and the Valley is now able to demonstrate that it meets the 65 µg/m³ standard.

Due to EPA's proposed disapproval of the portions of the *2018 PM2.5 Plan* that address the 15 µg/m³ annual average standard, as discussed above, the District is amending the State Implementation Plan to update the attainment demonstration for the 15 µg/m³ standard from the original projected attainment date of 2020, to a new demonstrated attainment deadline of 2023.

[2] https://www.gpo.gov/fdsys/pkg/FR-2016-11-23/pdf/2016-28100.pdf
[3] 81 Fed. Reg. 58098-58106, available at https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

This attainment Plan satisfies statutory requirements for a CAA §189(d) plan for a Serious nonattainment area SIP submission.

Table 5-1 Summary of 5% Plan Requirements

5% Plan Element	Source of Requirement	Location of Plan Where Element Satisfied
Emissions Inventory that includes a Base Year Inventory and an Attainment Projected Inventory for the Area	40 CFR §§51.1003(c) and 51.1008(c) 81 Fed Reg 58098	Appendix B
Identify Pollutants to be Addressed	CAA 189(d) 81 Fed Reg 58099	Appendices G and K
Control Strategy Analysis	40 CFR §§ 51.1003(c)(1)(iii) and 51.1010(c)	Section 5.1 and Appendices C and D
5% Demonstration	CAA §189(d) 40 CFR §51.1003(c)	Section 5.2 and Chapter 4
Attainment Demonstration and Modeling	40 CFR §§ 51.1003(c)(1)(iv), 51.1010(c), and 51.1011	Section 5.3 and Appendices K and L
Reasonable Further Progress	40 CFR §§ 51.1003(c)(1)(v) and 51.1012	Section 5.4, Appendix H
Quantitative Milestone	40 CFR §§ 51.1003(c)(1)(vi) and 51.1013(a)(3 and 4)	Section 5.5, Appendix H
Contingency Measures	CAA §172(c)(9) 40 CFR §§ 51.1003(c)(1)(vii) and 51.1014.	Section 5.6, Appendix H
Nonattainment New Source Review Requirements	CAA §189(b)(3) 40 CFR §51.1003(c)(1)(viii)	Section 5.7
Transportation Conformity	40 CFR §51.1003(d) 81 Fed. Reg. 58103	Section 5.8, Appendix D

5.1 5% Plan Control Strategy Requirements

This CAA §189(d) Plan must include a control strategy satisfying the requirements of 40 CFR §§ 51.1003(c)(1)(iii) and 51.1010(c).[4] This control strategy must be sufficient to achieve the emissions reductions necessary for the 5% demonstration and expeditious attainment. The District's evaluation of emissions sources and emissions controls demonstrates that the most stringent measures, which includes all reasonably available emission reduction opportunities and best available control measures, are in place in the Valley for NOx and directly emitted PM2.5 emissions. Refer to Appendices C and D for these demonstrations.

5.2 5% Plan Demonstration

Pursuant to 40 CFR §51.1003(c), this 189(d) Plan's control strategy must achieve a 5 percent annual reduction in either direct PM2.5 emissions *or* in the emissions of any PM2.5 Plan precursor based on the most recent emissions inventory.[5] Areas can vary

[4] See also 81 Fed. Reg. 58099-58100
[5] See also 81 Fed. Reg. 58100-58101.

between direct PM2.5 and PM2.5 precursors, or among precursors, from year to year. Areas are not penalized for achieving emissions reductions early, as they are permitted to carry forward any emissions reductions beyond the required minimum 5 percent in a given year to subsequent years.

The base year for this analysis should be one of the three years used to determine that the area failed to attain the 1997 PM2.5 standard. For the Valley, these years were 2013, 2014, and 2015. Using 2013 as the inventory base year, the following demonstrates that NOx emissions reductions achieved from already adopted control measures are sufficient to provide at least a 5% annual reduction from the plan submittal date until attainment.

Table 5-2 Summary of Emission Reductions in Valley Demonstrating 5% Annual Reductions through Attainment (2013-~~2020~~2023)

		% reduction from 2013 base	5% Target (tpd NOx)	CEPAM Inventory v1.05 (tpd NOx)	Meets 5%
Base Year	2013			**317.3**	
	2014			283.5	
	2015			263.4	
	2016			248.4	
Year 1	2017	5%	301.3	233.4	YES
Year 2	2018	10%	285.5	221.5	YES
Year 3	2019	15%	269.6	214.5	YES
Year 4	2020	20%	253.8	203.3	YES
Year 5	2021	25%	238.0	191.0	YES
Year 6	2022	30%	222.1	179.8	YES
Year 7	2023	35%	206.3	153.6	YES

5.3 ATTAINMENT DEMONSTRATION AND MODELING

This CAA §189(d) Plan must demonstrate expeditious attainment pursuant to 40 CFR §§ 51.1003(c)(1)(iv), 51.1010(c), and 51.1011.[6] "Expeditious attainment" should be no later than five years from the date of EPA's finding of failure to attain, which EPA finalized in 2016. EPA may extend the attainment date by up to five additional years considering the severity of nonattainment and the availability and feasibility of pollution control measures. The modeling performed by California Air Resources Board (CARB) and the District demonstrates the Valley will attain the annual standard by ~~2020~~2023 (see below and Appendix K). In fact, the Valley has already attained the 24-hour portion of the standard, based on monitoring data from the three year period of 2014 to

[6] See also 81 Fed. Reg. 58102-58103 and 58106.

2016, and continues to attain based on monitoring data from 2015-2020. ~~from the three year period from 2015 to 2017.~~ This Plan demonstrates the Valley will attain the annual standard as expeditiously as practicable (Appendices K and H).

5.3.1 SUMMARY OF MODELING RESULTS

[Section 5.3.1 provided by California Air Resources Board]

Photochemical modeling plays a crucial rule in demonstrating attainment of the national ambient air quality standards based on projected future year emissions. Currently, the San Joaquin Valley (SJV or Valley) is designated as a serious nonattainment area for the 1997 U.S. EPA annual (15 µg/m^3) and 24-hour (65 µg/m^3) $PM_{2.5}$ standards with an attainment deadline 2020 for both standards. Consistent with U.S. EPA guidance for model attainment demonstrations (U.S. EPA, 2014[7]), photochemical modeling was used to project $PM_{2.5}$ design values (DVs) to the future. The original plan (i.e., the 2018 SJV $PM_{2.5}$ SIP submittal) showed that the 2020 annual and 24-hour $PM_{2.5}$ DVs at each monitoring site in the Valley show attainment of the 1997 annual and 24-hour $PM_{2.5}$ standards. However, because of adverse meteorological conditions and increased impacts from wildfires, as well as data collection issues at a key monitoring site in Bakersfield that made it challenging to ascertain attainment, SJV did not attain the 1997 annual $PM_{2.5}$ standard in 2020. This revision is intended to demonstrate that SJV will attain the 1997 annual $PM_{2.5}$ standard in 2023 based on the 2018-2020 baseline design values and the emission reductions that will be achieved in 2023.

The findings from the original (i.e., the 2018 submittal) model attainment demonstration were ~~are summarized~~ retained below for the demonstration of the 1997 24-hour $PM_{2.5}$ standards. The findings from the updated attainment demonstration for the 1997 annual $PM_{2.5}$ standard are added as an additional subsection below. ~~A detailed description of the model inputs, modeling procedures, and attainment test can be found in the Modeling Attainment Demonstration and Modeling Protocol Appendices of this document.~~

Modeling results pertaining to the 1997 24-hour $PM_{2.5}$ standard

The ~~current~~ modeling approach draws on the products of large-scale, scientific studies as well as past $PM_{2.5}$ SIPs in the region, collaboration among technical staff at state and local regulatory agencies, and from participation in technical and policy groups in the region (See Photochemical Modeling Protocol Appendix for further details). In this work, the Weather Research and Forecasting (WRF) model version 3.6 was utilized to generate the annual meteorological fields. The Community Multiscale Air Quality (CMAQ) Model version 5.0.2 with state-of-the-science aerosol treatment was used for modeling annual $PM_{2.5}$ in the Valley. Other model inputs and configuration, including the modeling domain definition, chemical mechanism, initial and boundary conditions,

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[7] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

and emission processing can be found in the Photochemical Modeling Protocol and Modeling Emissions Inventory Appendices.

The U.S. EPA modeling guidance (U.S. EPA, 2014[8]) recommends using modeling in a "relative" rather than "absolute" sense. Based on analysis of recent years' ambient $PM_{2.5}$ levels and meteorological conditions leading to elevated $PM_{2.5}$ concentrations, the year 2013 was selected for baseline modeling calculations. In particular, in 2013 SJV experienced one of the worst years for $PM_{2.5}$ pollution in the Valley within the last decade.

Specifying the baseline design value is a key consideration in the model attainment test, because this value is projected forward to the future and used to test for future attainment of the standard at each monitor. To minimize the influence of year-to-year variability in demonstrating attainment, the U.S. EPA modeling guidance recommends using the average of three DVs, where one of the DV years is the same as the baseline emissions inventory and modeling year. This average DV is referred to as the baseline (or reference) DV. Here, the average DVs from 2012, 2013, and 2014 are used to calculate baseline DVs (see table below for the baseline DVs utilized in the attainment demonstration modeling).

In order to use the modeling in a relative sense, five simulations were conducted: 1) base year simulation for 2013, which demonstrated that the model reasonably reproduced the observed $PM_{2.5}$ concentrations in the Valley; 2) reference (or baseline) year simulation for 2013, which was the same as the base year simulation, but excluded exceptional event emissions such as wildfires; and 3) future year simulations for 2020. These simulations were the same as the reference year simulation, except projected anthropogenic emissions for 2020 were used in lieu of the 2013 emissions.
Table 5-3 shows the 2013 and 2020 Valley annual anthropogenic emissions for the five $PM_{2.5}$ precursors calculated from the model-ready emissions inventory. From 2013 to 2020, anthropogenic emissions in the Valley are estimated to drop approximately 35%, 8%, 6%, 8%, and 1% for nitrogen oxides (NO_x), reactive organic gases (ROG), primary $PM_{2.5}$, sulfur oxides (SO_x), and ammonia (NH_3), respectively. Among these five precursors, anthropogenic NO_x emissions show the largest relative reduction, dropping from 288.2 tons/day in 2013 to 187.1 tons/day in 2020. Note that the emission totals presented in the following table were calculated from the modeling inventory based on CEPAM version 1.05.

Since the modeling inventory includes day-specific adjustments not included in the planning inventory, the planning and modeling inventories are expected to be comparable, but not identical.

[8] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

Table 5-3 Valley Model-Ready Annual Emissions for 2013 and 2020

Category	NO_x	ROG	$PM_{2.5}$	SO_x	NH_3
2013 (tons/day)					
Stationary	38.5	90.8	8.5	7.2	13.9
Area	8.1	153.3	40.2	0.3	310.0
On-road Mobile	154.6	45.1	5.7	0.6	4.4
Other Mobile	87.1	35.8	6.2	0.3	6.0
Total	288.2	325.0	60.5	8.4	334.3
2020 (tons/day)					
Stationary	28.5	95.1	8.4	6.5	15.2
Area	7.8	151.8	40.0	0.3	306.9
On-road Mobile	81.0	22.4	3.2	0.6	3.6
Other Mobile	69.8	28.7	5.4	0.3	6.0
Total	187.1	298.0	57.0	7.7	331.7
Total change from 2013 to 2020	-35%	-8%	-6%	-8%	-1%

In this relative approach, the fractional change (or ratio) in $PM_{2.5}$ concentration between the modeled future year (2020) and modeled baseline year (or reference year, 2013) are calculated. These ratios are called relative response factors (RRFs). Since $PM_{2.5}$ is comprised of different chemical species, which respond differently to changes in emissions of various pollutants, separate RRFs were calculated for individual $PM_{2.5}$ species. In addition, because of potential seasonal differences in $PM_{2.5}$ formation mechanisms, RRFs for each species were also calculated separately for each quarter. The RRF for a specific $PM_{2.5}$ component *j* for each quarter is calculated using the following expression:

$$RRF_j = \frac{[C]_{j,\ future}}{[C]_{j,\ reference}} \tag{1}$$

Where ~~for the annual $PM_{2.5}$ standard, $[C]_{j,\ future}$ is the modeled quarterly mean concentration for component *j* predicted for the future year averaged over the 3x3 array of grid cells surrounding the monitor, and $[C]_{j,reference}$ is the same, but for the reference year simulation. For~~ for the 24-hour $PM_{2.5}$ standard, $[C]_{j,\ future}$ is the mean concentration for component *j* (for the top 10 percent of modeled $PM_{2.5}$ days in a quarter) predicted at the single grid cell which contains the monitor, and $[C]_{j,reference}$ is the same, but for the reference year simulation.

The measured FRM/FEM (i.e., Federal Reference Method/Federal Equivalent Method) $PM_{2.5}$ must be separated into its various chemical components. Species concentrations were obtained from the four $PM_{2.5}$ chemical speciation sites in the Valley. These four speciation sites are located at: Bakersfield – California Avenue, Fresno – Garland, Visalia – North Church, and Modesto – 14th Street. Since not all of the 16 FRM/FEM $PM_{2.5}$ sites in the Valley have collocated speciation monitors, the speciated $PM_{2.5}$ measurements at one of the four speciation sites were utilized to represent the speciation profile at each of the FRM/FEM sites based on geographic proximity, analysis of local emission sources, and measurements from previous field studies.

Since the FRM $PM_{2.5}$ monitors do not retain all of the $PM_{2.5}$ mass that is measured by the speciation samplers, the U.S. EPA modeling guidance recommends using the SANDWICH approach (Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance) described by Frank (2006[9]) to apportion the FRM $PM_{2.5}$ mass to individual $PM_{2.5}$ species based on nearby chemical speciation measurements. Based on completeness of the data, $PM_{2.5}$ speciation data from 2010 – 2013 were utilized. ~~For each quarter, percent contributions from individual chemical species to FRM/FEM $PM_{2.5}$ mass were calculated as the average of the corresponding quarter from 2010-2013 for the annual standard calculation.~~ For the 24-hour standard calculation, only the top 10% of measured $PM_{2.5}$ days from that quarter were utilized for percentage calculations.

Projected 2020 ~~annual and~~ 24-hour $PM_{2.5}$ DVs for each site are given in ~~Tables~~ Table 5-4 ~~and 5-5, respectively. For the annual standard, the Bakersfield-Planz site has the highest projected DV at 14.6 $\mu g/m^3$, which is below the 1997 annual $PM_{2.5}$ standard of 15 $\mu g/m^3$.~~ For the 24-hour standard, the Bakersfield-California Avenue site has the highest projected DV at 47.6 $\mu g/m^3$, which is also below the 1997 U.S EPA 24-hour $PM_{2.5}$ standard of 65 $\mu g/m^3$. Since projecting future year $PM_{2.5}$ DVs is performed by projecting individual $PM_{2.5}$ components and then summing those components to get the total $PM_{2.5}$, it is useful to examine the RRFs associated with individual components to evaluate how the changes in each component contributes to the overall change in $PM_{2.5}$. From 2013 to 2020, there are modest reductions projected for ammonium nitrate, EC, and organic matter (OM), a slight reduction in sulfate, and a slight increase in crustal material. The reduction in ammonium nitrate is a direct result of NO_x emission reductions from 2013 to 2020. EC and OM reductions are primarily tied to the reduction in primary $PM_{2.5}$ emissions from 2013 to 2020. Detailed RRFs and base/future year concentrations for each individual species can be found in the Modeling Attainment Demonstration.

To evaluate the impact of reducing emissions of different $PM_{2.5}$ precursors to $PM_{2.5}$ DVs, a series of model sensitivity simulations were performed, for which anthropogenic emissions within the SJV were reduced by a certain percentage from the baseline emissions. Following U.S. EPA precursor demonstration guidance[10] as well as considering SJV's control strategies, sensitivity runs involving 30% emission reductions were performed for NO_x and direct $PM_{2.5}$. For other precursors (i.e., ammonia, VOCs, and SO_x), both 30% and 70% emission reductions were performed. In addition, sensitivity simulations were performed for the years 2013, 2020, and 2024. The key conclusion from the sensitivity runs is that in 2024, reductions of direct $PM_{2.5}$ and NO_x emissions will continue to have a significant impact on annual and 24-hour $PM_{2.5}$ DVs, while reductions of ammonia, ROG, and SO_x have a much smaller impact compared to that of direct $PM_{2.5}$ and NO_x.

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[9] Frank, N.H., 2006, Retained nitrate, hydrated sulfates, and carbonaceous mass in federal reference method fine particulate matter for six eastern U.S. cities, Journal of Air & Waste Management Association, 56, 500-511.

[10] U.S. EPA, 2016, PM2.5 Precursor Demonstration Guidance, available at https://www.epa.gov/sites/production/files/2016-11/documents/transmittal_memo_and_draft_pm25_precursor_demo_guidance_11_17_16.pdf

~~Table 5-4 Projected Future Year 2020 Annual PM2.5 DVs at Each Monitor~~

~~Site AQS ID~~	~~Name~~	~~Base DV (µg/m^3)~~	~~2020 Annual DV (µg/m^3)~~
~~60290016~~	~~Bakersfield - Planz~~	~~17.2~~	~~14.6~~
~~60392010~~	~~Madera~~	~~16.9~~	~~14.2~~
~~60311004~~	~~Hanford~~	~~16.5~~	~~13.3~~
~~61072002~~	~~Visalia~~	~~16.2~~	~~13.5~~
~~60195001~~	~~Clovis~~	~~16.1~~	~~13.4~~
~~60290014~~	~~Bakersfield - California~~	~~16.0~~	~~13.5~~
~~60190011~~	~~Fresno-Garland~~	~~15.0~~	~~12.4~~
~~60990006~~	~~Turlock~~	~~14.9~~	~~12.5~~
~~60195025~~	~~Fresno - Hamilton & Winery~~	~~14.2~~	~~11.9~~
~~60771002~~	~~Stockton~~	~~13.1~~	~~11.4~~
~~60470003~~	~~Merced - S Coffee~~	~~13.1~~	~~10.9~~
~~60990005~~	~~Modesto~~	~~13.0~~	~~11.0~~
~~60472510~~	~~Merced - Main Street~~	~~11.0~~	~~9.3~~
~~60772010~~	~~Manteca~~	~~10.1~~	~~8.7~~
~~60192009~~	~~Tranquility~~	~~7.7~~	~~6.4~~

Table 5-5 Projected Future Year 2020 24-hour PM2.5 DVs at Each Monitor

Site AQS ID	Name	Base DV (µg/m^3)	2020 24-hour DV (µg/m^3)
60290014	Bakersfield – California	64.1	47.6
60190011	Fresno – Garland	60.0	44.3
60311004	Hanford	60.0	43.7
60195025	Fresno – Hamilton & Winery	59.3	45.6
60195001	Clovis	55.8	41.1
61072002	Visalia	55.5	42.8
60290016	Bakersfield – Planz	55.5	41.2
60392010	Madera	51.0	38.9
60990006	Turlock	50.7	37.8
60990005	Modesto	47.9	35.8
60472510	Merced – M. Street	46.9	32.9
60771002	Stockton	42.0	33.5
60470003	Merced – S Coffee	41.1	30.0
60772010	Manteca	36.9	30.1

Site AQS ID	Name	Base DV (µg/m^3)	2020 24-hour DV (µg/m^3)
60192009	Tranquility	29.5	21.5

Modeling results pertaining to the 1997 annual $PM_{2.5}$ standard

In this revision, the baseline DV is the average of the 2018, 2019, and 2020 DVs, and is calculated in a similar fashion as the average of 2012, 2013, and 2014 DVs in the original submittal. The baseline DVs utilized in the attainment demonstration modeling are shown in the same table as the projected 2023 DVs.

To perform the speciated modeled attainment test, the measured FRM/FEM $PM_{2.5}$ mass must be separated into its various chemical components. Species concentrations were obtained from the four $PM_{2.5}$ chemical speciation sites in the Valley. These four speciation sites are located at: Bakersfield – California Avenue, Fresno – Garland, Visalia – North Church, and Modesto – 14th Street. In addition, FRM $PM_{2.5}$ do not retain all of the $PM_{2.5}$ mass that is measured by the speciation samplers, the SANDWICH approach described by Frank (2006[9]) is used to apportion the FRM $PM_{2.5}$ mass to individual $PM_{2.5}$ species based on nearby speciation data. Based on data availability and completeness associated with $PM_{2.5}$ speciation and temperature/relative humidity measurements, speciation data from 2016-2019 were utilized for Bakersfield, Visalia, and Modesto, and speciation data from 2017-2019 were utilized for Fresno. For each quarter, percent contributions from individual chemical species to FRM $PM_{2.5}$ mass were calculated as the average of the corresponding quarters from 2017-2019 for Fresno and from 2016-2019 for the other three sites.

The 2018 SJV $PM_{2.5}$ SIP submittal involved the modeling of years 2013, 2020, 2024, and 2025. Given that the current revision involves base year 2018 and future year 2023, using modeling response (i.e., RRFs) from 2020 to 2024 from the 2018 submittal would be most appropriate to derive the modeling response from 2018 to 2023 given that emissions differences between 2018 and 2020, and 2023 and 2024 are smallest compared to other years. The RRFs from 2018 to 2023 involved scaling of RRFs from 2020 to 2024 based on the following equations:

$$RRF = 1 - (1 - RRF') \times Scaling\_factor$$

$$Scaling\_factor = \frac{\frac{(E_F - E_B)}{E_B}}{\frac{(E_F' - E_B')}{E_B'}}$$

Where: *RRF* is the new RRF from 2018 to 2023 that is used to project the 2023 DV; *RRF'* is the old RRF from 2020 to 2024 from the 2018 $PM_{2.5}$ SIP; *Scaling_factor* is calculated by the ratios of emissions reductions/changes and is specific to each $PM_{2.5}$ component; E_F is the 2023 emissions; E_B is the 2018 emissions; E_F' is the 2024 emissions; and the E_B' is the 2020 emissions. RRFs are calculated for nitrate, sulfate, OC, EC, and crustal materials. For nitrate, the new RRF is scaled based on NO_x

emissions reductions; for sulfate, the new RRF is scaled using SO_x emissions change; for OC, EC, and crustal materials, source level emissions speciation profiles were applied to the $PM_{2.5}$ emission inventory to calculate specific emissions of those compounds. Then, the new RRFs for OC, EC, and crustal materials were scaled based on emissions change of OC, EC, and other $PM_{2.5}$ components, respectively. Once the RRFs are calculated for each $PM_{2.5}$ components, projecting baseline annual $PM_{2.5}$ DVs to future year is done in a similar fashion as the 2018 SJV $PM_{2.5}$ SIP submittal.

Table 5-5 summarizes 2018 baseline and 2023 attainment SJV annual anthropogenic emissions for the five $PM_{2.5}$ precursors. Noting that the 2018 emissions are based on the 2016 CEPAM1.0.5 baseline emissions; and the 2023 attainment emissions are the 2016 CEPAM1.0.5 2023 baseline emissions minus additional emission reductions that will be achieved in 2023. From 2018 to 2023, there is a 32% reduction in NO_x emissions, 1.4% reduction in primary $PM_{2.5}$ emissions, and 1.7% reduction in ROG emissions between 2018 and the 2023 attainment inventory, while NH_3 emissions are almost flat and there is a slight increase in SO_x emissions.

Projected future year 2023 annual $PM_{2.5}$ DVs for each monitor are given in Table 5-6. The Bakersfield-Planz site has the highest projected DV at 14.7 µg/m^3, which is below the 15 µg/m^3 annual $PM_{2.5}$ standard established by the U.S. EPA in 1997. The corresponding RRFs, baseline $PM_{2.5}$ compositions, and projected 2023 $PM_{2.5}$ compositions can be found in the Attainment Modeling Demonstration. From 2018 to 2023, there are decent reductions projected for ammonium nitrate and EC. Small reduction is projected for OM. The reduction in ammonium nitrate is a direct result of NO_x emission reductions in 2023 compared to 2018 (i.e., ~32% reduction), while EC and OM reductions are tied to the reduction in primary $PM_{2.5}$ emissions.

Table 5-6 SJV annual planning emissions (tons/day) for 2018 (baseline) and 2023 (attainment)*

Category	NO_x	ROG	$PM_{2.5}$	SO_x	NH_3
			2018 (baseline)		
Stationary	29.1	89.8	8.7	6.4	14.8
Area	8.0	152.0	41.6	0.3	308.1
On-road Mobile	110.7	28.9	3.6	0.6	3.8
Other Mobile	73.6	28.0	5.0	0.3	0.03
Total	221.4	298.7	58.8	7.7	326.7
			2023 (Attainment)		
Stationary	29.1	89.8	8.7	6.4	14.8
Area	8.0	152.0	41.6	0.3	308.1
On-road Mobile	110.7	28.9	3.6	0.6	3.8
Other Mobile	73.6	28.0	5.0	0.3	0.03
Total	221.4	298.7	58.8	7.7	326.7

*the 2023 attainment emissions are 2016 CEPAM1.0.5 2023 baseline emissions minus additional emission reductions that will be achieved in 2023.

Table 5-7 Projected Future Year 2023 Annual $PM_{2.5}$ DVs at Each Monitor

Site AQS ID	Name	Base DV ($\mu g/m^3$)	2023 Annual DV ($\mu g/m^3$)
60290016	Bakersfield - Planz	16.3	14.7
61072002	Visalia	15.2	14.0
60290010	Bakersfield – Golden State	15.1	13.6
60311004	Hanford	14.8	12.8
60290014	Bakersfield – California Ave.	14.6	13.2
60310004	Corcoran	14.3	13.3
60195025	Fresno – Hamilton & Winery	13.9	13.0
60190011	Fresno - Garland	13.3	12.4
60195001	Clovis	12.2	11.4
60990006	Turlock	12.2	11.3
60771002	Stockton	11.7	11.1
60470003	Merced - S Coffee	11.5	10.6
60392010	Madera	11.3	10.2
60472510	Merced - Main Street	11.3	10.8
60990005	Modesto	10.6	9.9
60772010	Manteca	9.9	9.4
60192009	Tranquility	7.5	6.8

Table 5-8 Projected Future Year 2020 24-hour PM2.5 DVs at Each Monitor

Site AQS ID	Name	Base DV ($\mu g/m^3$)	2020 24-hour DV ($\mu g/m^3$)
60290014	Bakersfield – California	64.1	47.6
60190011	Fresno – Garland	60.0	44.3
60311004	Hanford	60.0	43.7
60195025	Fresno – Hamilton & Winery	59.3	45.6
60195001	Clovis	55.8	41.1
61072002	Visalia	55.5	42.8
60290016	Bakersfield – Planz	55.5	41.2
60392010	Madera	51.0	38.9
60990006	Turlock	50.7	37.8

~~Site AQS ID~~	~~Name~~	~~Base DV (µg/m³)~~	~~2020 24-hour DV (µg/m³)~~
~~60990005~~	~~Modesto~~	~~47.9~~	~~35.8~~
~~60472510~~	~~Merced – M. Street~~	~~46.9~~	~~32.9~~
~~60771002~~	~~Stockton~~	~~42.0~~	~~33.5~~
~~60470003~~	~~Merced – S Coffee~~	~~41.1~~	~~30.0~~
~~60772010~~	~~Manteca~~	~~36.9~~	~~30.1~~
~~60192009~~	~~Tranquility~~	~~29.5~~	~~21.5~~

5.4 Reasonable Further Progress (RFP)

This CAA §189(d) Plan must demonstrate Reasonable Further Progress (RFP) pursuant to 40 CFR §§ 51.1003(c)(1)(v) and 51.1012.[11] RFP is the incremental emission reductions leading to the attainment date of a standard for an area. Refer to Appendix H for a full description and the RFP demonstration.

5.5 Quantitative Milestones

This CAA §189(d) Plan must include quantitative milestones pursuant to CAA §189(c) and 40 CFR §§ 51.1003(c)(1)(vi) and 51.1013(a)(3 and 4). Quantitative milestones are designed to track RFP, to track progress in achieving the minimum 5 percent annual emission reductions as well as control measures needed for expeditious attainment. See Appendix H for this demonstration. The quantitative milestone years for this CAA §189(d) Plan are 2017, 2020, ~~and~~ 2023, and 2026.

5.6 Contingency Measures

This CAA §189(d) Plan must include contingency measures pursuant to CAA §172(c)(9) and 40 CFR §§ 51.1003(c)(1)(vii) and 51.1014. Contingency measures are additional control measures to be implemented in the event that EPA issues final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure. See Appendix H for this demonstration.

5.7 Fulfillment of Serious Area Permitting Requirements

Pursuant to CAA §189(b)(3) and 40 CFR §51.1003(c)(1)(viii), the District must provide a revision to the nonattainment new source review (NNSR) program to lower the applicable "major stationary source" thresholds from 100 tons per year (tpy) to 70 tpy. The District's New and Modified Stationary Source Review Rule (Rule 2201) identifies the major source emission thresholds for each pollutant. The District adopted amendments to Rule 2201 on February 18, 2016, to meet requirements related to the District's reclassification from Moderate to Serious nonattainment for the 1997 and 2006 federal standards for PM2.5. Currently, through Rule 2201, the District identifies the major source emission threshold for NOx major sources at 10 tpy and PM2.5 at 70 tpy. However, the rule amendments have not been submitted to EPA for inclusion into

[11] See also 81 Fed. Reg. 58103-58104.

the SIP because CARB and EPA requested changes to some of the new rule language. The District hosted a public workshop on the proposed amendments on July 26, 2016. District staff had planned on presenting the rule to the Governing Board for adoption in September of 2016. While these revisions do not change the District's interpretation or implementation of the rule, these amendments must be adopted by the District Governing Board before CARB can submit the rule to EPA for inclusion into the SIP. However, in August of 2016, EPA released long-overdue regulations on implementing the PM2.5 standards in NSR rules that require an assessment of the significance of precursor pollutant emissions using a specific type of air quality modeling. Due to these new requirements, EPA will not be able to approve an NSR rule that does not address EPA's implementation regulation, so adoption has been delayed until such modeling can be completed. The District anticipates taking rule amendments to the District's Governing Board in 2019.

5.8 TRANSPORTATION CONFORMITY

This CAA §189(d) Plan must include transportation conformity budgets for the attainment year pursuant to 40 CFR §51.1003(d)[12]. See Appendix D for more information.

[12] See also 81 Fed. Reg. 58103.

APPENDIX C

Updated *2018 PM2.5 Plan* Appendix D: Mobile Source Control Measure Analyses

Appendix D

Mobile Source Control Measure Analyses

Updated July 20, 2021

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Best Available Control Measures (BACM) and Most Stringent Measures (MSM) Analysis of Mobile Source Control Programs

[This Appendix provided by the California Air Resources Board]

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Executive Summary

The Clean Air Act (the Act) specifies required levels of emission controls in a State Implementation Plan (SIP), depending upon the severity of the air quality problem and amount of time a nonattainment area needs to meet the PM2.5 standard. The State has conducted this analysis for each mobile source category in the San Joaquin Valley (SJV or Valley). The suite of control measures that is currently being implemented by California Air Resources Board (CARB or Board) – both the current control program and new measures proposed for the Valley – satisfy the applicable control requirements for Best Available Control Measures (BACM) and Most Stringent Measures (MSM) for the four PM2.5 standards addressed in this plan. This analysis finds that California's mobile source control program is the most stringent and far-reaching suite of mobile source control measures that is currently implemented in the nation, and meets the required levels of emissions controls.

In conducting this analysis, CARB staff followed a four-step process of assessing California's mobile source program. First, staff identified mobile source emissions as a significant contributor to ambient PM2.5 emissions. Next, staff identified potential control measures for each mobile source sector, including an analysis of California's mobile source control program, other control measures in practice throughout the nation, and reconsideration of control measures that were previously considered to be infeasible. Staff then assessed the stringency and feasibility of the potential control measures that were identified. And finally, while many of the measures identified in this analysis are already measures in the California SIP, additional control measures have been included as commitments in the Valley's proposed SIP.

In aggregate, California's comprehensive suite of new vehicle and engine emission standards, in-use control measures, fuel specifications, and incentive programs for mobile sources represent the most stringent level of controls in the nation, and achieve the maximum feasible emission reductions for this category:

- California's control measures for the passenger vehicle fleet includes new vehicle emission standards, fuel specifications, and the most rigorous in-use inspection program for on-road light-and medium-duty vehicles in the country. The suite of on-road light-duty vehicle control measures included in the Valley's plan is anticipated to achieve the maximum feasible emission reductions possible, and is comprised of the most stringent level of control measures for this category in the nation.

- California's heavy-duty on-road vehicle and engine control program is comprised of the most stringent emission standards for new engines in the nation (i.e. new vehicle tailpipe emission and evaporative emission standards; certification, testing, and verification requirements; warranty and useful life requirements, and OBD system requirements). Additionally, to reduce in-use emissions and accelerate fleet turnover to cleaner engines, California's in-use control measures include the most stringent inspection and maintenance program, idling requirements, and legacy fleet requirements for on-road heavy-duty fleets in the nation. Finally, California's clean diesel regulations provide the most stringent emission controls in the nation for conventional and renewable diesel fuels and diesel substitute fuels. In aggregate, the suite of on-road heavy-duty control measures included in the Valley's plan is anticipated to achieve the maximum feasible emission reductions possible, and is comprised of the most stringent level of control measures for this category in the nation.

- California's off-road engine and equipment control program includes the most stringent emission standards for new engines in the nation, comprehensive in-use fleet requirements to address emissions from the legacy fleets, and the cleanest off-road diesel fuel specifications in the nation. California's in-use control measures are national models for aggressive and successful efforts to reduce in-use emissions and accelerate fleet turnover to cleaner engines. In aggregate, the suite of off-road mobile source control measures included in the Valley's plan is anticipated to achieve the maximum feasible emission reductions possible, and is comprised of the most stringent level of control measures for this category in the nation.

Chapter I. Clean Air Act Requirements for Emission Control Measures

The particulate matter provisions in the Act establish a step-wise process for classifications and attainment dates:

- The first step is a Moderate area SIP, with an initial attainment date six years after the area is designated nonattainment;
- If attainment within six years is impracticable given the severity of the PM2.5 challenge in that area, then U.S. EPA re-classifies the area to Serious, and establishes requirements for a second SIP submittal that must show attainment within 10 years after the area was originally designated nonattainment.

Likewise, the Act specifies a step-wise process for the required level of emission controls in a SIP, depending upon the severity of the air quality problem and amount of time a nonattainment area needs to meet the PM2.5 standard:

- For a Moderate nonattainment area, the required level of control is Reasonably Available Control Measures (RACM).[1]
- For a Serious PM2.5 nonattainment area, BACM is the required level of control. U.S. EPA defines BACM to be the maximum degree of emission reductions achievable from a source or source category determined on a case-by-case basis considering energy, economic, and environmental impacts.[2]
- For a Serious PM2.5 nonattainment area for which air quality modeling demonstrates that the area cannot practicably attain by the end of the tenth calendar year (i.e. designated as “Serious with Extension”), MSM is the required level of control.[3] U.S. EPA defines MSM as, “the maximum degree of emission reductions that has been required or achieved from a source or source category in any other attainment plans or in practice in any other states and that can feasibly be implemented in the area.”[4] MSM is also inclusive of BACM requirements.
- For a Serious PM2.5 nonattainment area that has not attained by the applicable attainment date (i.e. designated as “Serious – 5% Plan”), the required level of control is also MSM.[5]

The Valley is a Serious nonattainment area for each of the four PM2.5 standards discussed in this plan.

REQUIRED STRINGENCY OF CONTROL MEASURES: DEFINING BACM AND MSM

Based on the Valley’s current classification for each standard, Table 1 describes the level of control measures required for each of the applicable four PM2.5 standards.

[1] RACM requirements are addressed in the Moderate SIP for the Valley. For further information see https://www.arb.ca.gov/planning/sip/planarea/sanjqnvllysip.htm

[2] U.S. EPA 1994 Addendum to the General Preamble p. 42010

[3] 40 CFR 51.1010(b)(2)(i)

[4] See U.S. EPA “Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements” pp. 326 July 2016 https://www.epa.gov/sites/production/files/2016-07/documents/pm25-naaqs-implementation-final-preamble-rule-signature.pdf

[5] 40 CFR 51.1003(c)(2)(i)

Table 1: Stringency of Control Measures Required[6]

Standard	Classification	Type of Plan	Control Measure Requirements
12 µg/m3 Annual (2012)	Moderate with Request to Serious	Serious	**Best Available Control Measures** "The state shall identify, adopt, and implement best available control measures, including control technologies, on sources of direct PM2.5 emissions and sources of emissions of PM2.5 plan precursors." 40 CFR 51.1010(a)
35 µg/m^3 24-Hour (2006)	Serious with Extension	Most Stringent Measures (MSM)	**Most Stringent Measures** "The state shall identify, adopt, and implement the most stringent control measures that… can be feasibly implemented in the area." 40 CFR 51.1010(b)
15 µg/m^3 Annual (1997) 65 µg/m^3 24-Hour (1997)	Serious, failed to attain by attainment date	5% Plan*	**Most Stringent Measures** "For the sources and source categories represented in the emission inventory for the nonattainment area, the state shall identify the most stringent measures for reducing direct PM2.5 and PM2.5 plan precursors." 40 CFR 51.1010(c)(2)(i)

* 5% plan means than a 5% reduction in directly emitted PM2.5/precursor emissions per year in the nonattainment area is required until attainment (which must be achieved as expeditiously as possible).

For areas like that Valley that are nonattainment for multiple PM2.5 standards that have become more stringent over time, classification is influenced by the timing of when the standards were finalized. Due to the step-wise nature of reclassification for PM2.5 standards, the Valley's control measures for this plan must satisfy U.S. EPA's requirements for both BACM and MSM.

The variance in the required levels of control measure stringency among the four standards shown in Table 1 is due to timing differences in when the standards were finalized, as this – along with the severity of its air quality – influences the Valley's classification status. Although the older standards are less stringent in value, the emission control requirements are most stringent for the 1997 standards because they were finalized earlier than the other standards (which were finalized in 2006 and 2012, respectively). Therefore, the Valley is furthest along in the step-wise process for the 1997 standards, relative to the more recent 2006 and 2012 standards.

BEST AVAILABLE CONTROL MEASURES

BACM is the level of stringency required for the 2012 Annual Standards of 12 µg/m^3. The Act defines BACM as, "any technologically and economically feasible control measure that can be implemented in whole or in part within four years after the date of reclassification of a Moderate PM2.5 nonattainment area to Serious and that generally can achieve greater permanent and enforceable emissions reductions in direct PM2.5 emissions and/or emissions of PM2.5 plan precursors from sources in the area than can be achieved through the implementation of RACM on the same source"[7] U.S. EPA has further clarified that BACM-level of controls are:[8]

[6] The Valley's Comprehensive PM2.5 SIP has been developed to provide the necessary elements for each of the PM2.5 standards for which the Valley is classified as nonattainment. This appendix has been developed to meet a subset of these requirements; namely the requirement that staff demonstrate that the mobile source control strategies used to model the Valley's attainment demonstration for the PM2.5 standards listed in Table 2 satisfy U.S. EPA's requirements for Serious area attainment plan control strategy requirements, as set forth in § 51.1010.

[7] 40 Code of Federal Regulations (CFR) Title 40 – Protection of Environment § 51.1000 – Definitions https://www.gpo.gov/fdsys/pkg/CFR-2017-title40-vol2/xml/CFR-2017-title40-vol2-sec51-1000.xml

[8] U.S. EPA 1994 "Addendum to the General Preamble" pp. 42009 -42013

- The maximum degree of emissions reductions achievable from a source or source category, which is determined on a case-by-case basis considering energy, economic and environmental impacts;
- More stringent than RACM, but less stringent than the lowest achievable emission rate (LAER), which doesn't take into consideration the cost effectiveness of implementing a particular control measure;
- Additive to RACM, as BACM will generally consist of a more extensive implementation of RACM measures; and
- Inclusive of Best Available Control Technology (BACT).

U.S. EPA defines BACT similarly to BACM as an emission limitation based on the, "maximum degree of reduction of each pollutant emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and techniques." [9] BACT is also at least as stringent as new source performance standards (NSPS) and national emissions standards for hazardous air pollutants (NESHAPs)[10]

MOST STRINGENT MEASURES

MSM is the level of stringency required for the 2006 24-Hour Standard of 35 µg/m^3, the 1997 Annual Standard of 15 µg/m^3, and the 24-Hour Standard of 65 µg/m^3. The Act defines MSM as, "any permanent and enforceable control measure that achieves the most stringent emissions reductions in direct PM2.5 emissions and/or emissions of PM2.5 plan precursors from among those control measures which are either included in the SIP for any other National Ambient Air Quality Standard (NAAQS), or have been achieved in practice in any state, and that can feasibly be implemented in the relevant PM2.5 NAAQS nonattainment area."[11]

U.S. EPA indicates that MSM is inclusive of the requirements and process for determining BACM, but with one additional step of comparing the potentially MSM against the measures already adopted in the area to determine if the existing measures are the most stringent.[12] Further U.S. EPA guidance defined MSM as "the maximum degree of emission reduction that has been required or achieved from a source or source category in any other attainment plans or in practice in any other states and that can feasibly be implemented in the area seeking the extension, such as what LAER represents for new or modified sources under the New Source Review permit program."[13]

[9] 42 U.S. Code § 7479 – Definitions https://www.gpo.gov/fdsys/pkg/USCODE-2011-title42/html/USCODE-2011-title42-chap85-subchapI-partC-subparti-sec7479.htm See § 7479(3) BACT

[10] U.S. EPA 1994 "Addendum to the General Preamble" pp. 42009 -42013

[11] Code of Federal Regulations (CFR) Title 40 – Protection of Environment § 51.1000 – Definitions https://www.gpo.gov/fdsys/pkg/CFR-2017-title40-vol2/xml/CFR-2017-title40-vol2-sec51-1000.xml

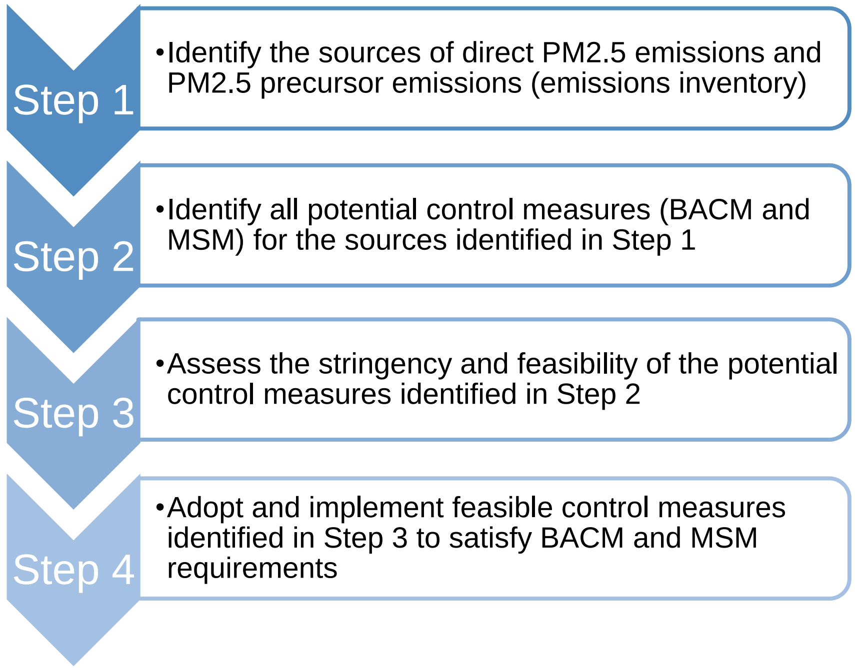
[12] U.S. EPA 2001 *Final TSD for Maricopa County PM10 Nonattainment Area*. Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

[13] U.S. EPA 1994. *Addendum to the General Preamble*, 59 FR 41998 page 42010

Chapter II. Process for Determining BACM and MSM

U.S. EPA prescribes a four-step process for the identification and determination of whether the control measures satisfy the Serious area attainment plan control strategy requirements.

Figure 1 Process for Determining BACM and MSM



This process starts with identifying the sources of PM2.5 emissions (both direct and precursor emissions; then expands the analysis to identify all potential BACM/MSM control measures to reduce emissions. Step 3 begins to narrow the scope of analysis by refining the list of all potential BACM/MSM control measures to determine which of the control measures are sufficiently stringent to meet the applicable BACM and MSM requirements, and that are technically and economically feasible. The final step to adopt any control measures identified through this process, if they are feasible to implement in the Valley.

The process for identifying MSM generally follow the same steps as the process for identifying BACM.[14] This is because the Serious area attainment plan control strategy requirements described in § 51.1010 are additive as the plans become more stringent. That is to say, the MSM requirements are inclusive of the requirements for BACM, with additional requirements added to reflect the increased stringency in control levels that result from a bump-up in classification.[15] Table 2 delves more deeply into this process, showing each required element in the steps listed above for each of the four applicable PM2.5 Standards.

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[14] In accordance with U.S. EPA's prescribed process described in the *TSD for the Maricopa County Serious Area PM10 Plan – 24-Hour Standard* (U.S. EPA 2001), which states, "Given this similarity between the BACM requirement and the MSM requirement, we believe that determining MSM should follow a process similar to determining BACM, but with one additional step, to compare the potentially most stringent measure against the measures already adopted in the area to determine if the existing measures are most stringent." Document is available at: https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

[15] § 51.1003(b)(2)(iii) requires that a submittal requesting a Serious area attainment date extension that is simultaneous with the Serious area attainment plan shall meet the most stringent measure (MSM) requirements set forth at § 51.1010(b), in addition to the BACM and BACT and additional feasible measure requirements set forth at § 51.1010(a)". For more details, see the Serious area attainment plan control strategy requirements identified in 40 CFR § 51.1010(a)(5), § 51.1010(b)(5), and § 51.1010(c)(5)

Table 2: BACM/BACT and MSM Requirements

Standard	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997) 65 ug/m3 24-Hour (1997)
Classification	Serious	Serious with Extension	Serious - 5% Plan
Control Strategy	BACM/BACT	MSM	MSM
Step 1: Identify sources of direct PM2.5 and precursor emissions (emissions inventory)	Required "The state shall identify all sources of direct PM2.5 emissions and all sources of emissions of PM2.5 precursors in the nonattainment area in accordance with the emissions inventory requirements…" § 51.1010(a)(1)	Required "The state shall identify all sources of direct PM2.5 emissions and sources of emissions of PM2.5 precursors in the nonattainment area in accordance with the emissions inventory requirements…" § 51.1010(b)(1)	Required "The state shall identify all sources of direct PM2.5 emissions and sources of emissions of PM2.5 precursors in the nonattainment area in accordance with the emissions inventory requirements…" § 51.1010(c)(1)
Step 2: Identify all potential control measures	Required "The State shall identify all potential control measures to reduce emissions from all sources of direct PM2.5 emissions and sources of emissions of PM2.5 plan precursors" § 51.1010(a)(2)	Required "The State shall identify all potential control measures to reduce emissions from all sources of direct PM2.5 emissions and sources of emissions of PM2.5 plan precursors" § 51.1010(b)(2)	Required "The State shall identify all potential control measures to reduce emissions from all sources of direct PM2.5 emissions and sources of emissions of PM2.5 plan precursors" § 51.1010(c)(2)
Step 2(a): Begin with the area's current control measures	Recommended Begin identification of potential control measures by updating list of control measures already in the nonattainment area	Recommended[16] "A state… should be able to start its process using the work already undertaken for the nonattainment area's RACM and BACM demonstrations and to make updates to the list of potential control measures"	Recommended "A state… should be able to start its process using the work already undertaken for the nonattainment area's RACM and BACM demonstrations and to make updates to the list of potential control measures"
Step 2(b): Survey other states and nonattainment areas for additional potential control measures	Required "The state shall survey other NAAQS nonattainment areas in the U.S. and identify any measures for direct PM2.5 and PM2.5 plan precursors not previously identified" § 51.1010(a)(2)(i)	Required "The state shall identify the most stringent measures for reducing direct PM2.5 and PM2.5 plan precursors adopted into any SIP or used in practice to control emissions in any state" § 51.1010(b)(2)(i)	Required "The state shall identify the most stringent measures for reducing direct PM2.5 and PM2.5 plan precursors adopted into any SIP or used in practice to control emissions in any state" § 51.1010(c)(2)(i)
Step 2(c): Reconsider and reassess any measures previously rejected	Not required for BACM/BACT	Required "The state shall reconsider and reassess any measures previously rejected by the state during the development of any previous Moderate area or Serious area attainment plan control strategy" § 51.1010(b)(2)(ii)	Required "The state shall reconsider and reassess any measures previously rejected by the state during the development of any Moderate area or Serious area attainment plan control strategy for the area" § 51.1010(c)(2)(ii)
Step 3: Assess potential control measures' stringency and feasibility	Required	Required	Required
Step 3(a): Evaluate stringency	Required BACT/BACM control levels required	Required MSM control levels required	Required MSM control levels required
Step 3(b): Assess technological and economic feasibility	Required "The state may make a demonstration that any measure identified… is not technologically or economically feasible to implement in whole or in part by the end of the tenth calendar year following the effective date of designation of the area, and may eliminate such whole or partial measure from further consideration" § 51.1010(a)(3)	Required "The state may make a demonstration that a measure identified… is not technologically or economically feasible to implement in whole or in part by 5 years after the applicable attainment date for the area, and may eliminate such whole or partial measure from further consideration" § 51.1010(b)(3)	Required "The state may make a demonstration that a measure identified… is not technologically or economically feasible to implement in whole or in part within 5 years or such longer period as the EPA may determine is appropriate after the EPA's determination that the area failed to attain by the Serious area attainment date, and may eliminate such whole or partial measure from further consideration" § 51.1010(c)(3)
Step 4: If found to be economically and technologically feasible, adopt control measures	Required "The state shall identify, adopt, and implement best available control measures, including control technologies, on sources of direct PM2.5 emissions and sources of emissions of PM2.5 plan precursors located in any Serious PM2.5 nonattainment area" § 51.1010(a)	Required "The state shall identify, adopt, and implement the most stringent control measures that are included in the attainment plan for any state or are achieved in practice in any state, and can be feasibly implemented in the area" § 51.1010(b)	Required "Except as provided under paragraph (c)(3) of this section, the state shall adopt and implement all control measures …that collectively achieve attainment of the standard as expeditiously as practicable" § 51.1010(c)(4)

[16] See U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" July 2016 https://www.epa.gov/sites/production/files/2016-07/documents/pm25-naaqs-implementation-final-preamble-rule-signature.pdf

Step 1: Mobile Source Emissions of Direct PM2.5 and NOx

The first step required in the Act's specified BACM and MSM evaluation process is to identify and quantify the sources of PM2.5, including direct PM2.5 emissions and emissions of precursor pollutants.

In the Valley, air quality measurements and modeling have shown that emissions from mobile sources – cars, trucks, and a myriad of off-road equipment – are a significant contributor to ambient PM2.5 levels. Overall, mobile sources contribute to approximately 50 to 60 percent of the particles that make up PM2.5 in the Valley. These contributions come through both directly emitted PM2.5 and gaseous precursors such as NOx, the key precursor to atmospheric formation of PM2.5 in the Valley.

Steps 2 and 3: Identification and Evaluation of Potential BACM/MSM Control Measures

The second and third steps required in the Act's BACM / MSM evaluation process have been grouped together in this appendix so that the control measures for each mobile sector (i.e. passenger vehicles, on-road heavy-duty trucks and buses, off-road mobile sources, and fuels) can be more cohesively identified and evaluated.

STEP 2: IDENTIFICATION OF POTENTIAL BACM/MSM CONTROL MEASURES

Step 2 calls for the identification of all possible control measures for each of the mobile sources of PM2.5 and NOx identified in Step 1.[17] To satisfy the Act's MSM requirements, this is a three-part process.[18]

STEP 2(A): CALIFORNIA'S CONTROL MEASURES

The identification of all potential mobile source control measures begins with an analysis of California's mobile control program. Due in part to the severity of its air quality needs, and in part to unique authority provided under the Act, California's mobile source controls go far beyond other states' and even national programs, and thus provides an excellent starting place in identifying a comprehensive range of control measures as required by the Act. This approach also aligns with U.S. EPA guidance, which suggests starting the identification process with any controls previously identified in prior Moderate or Serious SIPs for the nonattainment area.[19]

Section 209(b) Waiver Authority

In recognition of California's early efforts and extent of air quality challenges, the State has unique authority to regulate emissions from some source categories more stringently than the federal government under the Act's §209(b) waiver provision.

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[17] In a departure from previous SIP guidance, EPA guidance indicates that are no *de minimis* source categories for this plan. Thus, emissions of direct PM2.5 and PM2.5 precursors (i.e. NOx) from all mobile source categories must be controlled in the Valley, and meet the applicable BACM/BACT and MSM requirements. See U.S. EPA April 2016 "SIP Requirements Rule" 81 FR 58010 https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

[18] Step 2(c), the identification of any control measures that were previously rejected as infeasible in prior Moderate or Serious SIPs for the Valley is a requirement for MSM, not BACM. See 40 CFR § 51.1010(b)(2)(ii) and § 51.1010(c)(2)(ii)

[19] U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" July 2016

While U.S. EPA has primary authority for interstate trucks, aircraft, ships, locomotives, and some farm and construction equipment, this waiver provision also allows California to seek a waiver from U.S. EPA to enact more stringent emission standards for passenger vehicles, heavy-duty trucks, and certain off-road vehicles and engines.

Over nearly five decades, CARB has consistently sought waivers and authorizations for its new motor vehicle regulations and has received waivers and authorizations for over 100 regulations. CARB's history of progressively strengthening standards as technology advances, coupled with the waiver process requirements, ensures that California's regulations remain the most stringent in the nation, and that necessary emission reductions from the mobile sector continue.

This provision preserves a critical role for California in the control of emissions from new motor vehicles, recognizing that California plays an important leadership role and serves as a "laboratory" state for more stringent motor vehicle emission standards. For example, CARB's LEV I and LEV II, and the ZEV Programs have resulted in the production and sales of hundreds of thousands of ZEVs in California since first adopted in 1990.

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' CONTROL MEASURES

The second component required to identify all potential BACM/MSM control measures is the identification of any additional control measures used in other states or nonattainment areas, and an assessment of their stringency relative to the control measures in the Valley's attainment plan and demonstration.[20, 21] The purpose is to identify whether there are additional potential BACM/MSM control measures used to control mobile emissions of direct PM2.5 and/or NOx in other states or nonattainment areas that are more stringent than the measures included in the Valley's attainment plan and demonstration. If this assessment finds that there are more stringent measures in use elsewhere – and if they are found to be sufficiently stringent and technically and economically feasible to implement in the Valley (see Step 3) – statute requires that any such measures are adopted and implemented in the Valley's plan (see Step 4), in order to meet the requirements that the area, "attain the standard as expeditiously as practicable."[22]

Identification

U.S. EPA guidance provides recommendations for possible resources to assist in the search for other control measures used in other states or nonattainment areas, including:[23]

- Other states' control programs (including those measures identified in U.S. EPA's list of national, state and/or local air quality agencies' control measures);[24]

[20] § 51.1010(a)(2)(i), § 51.1010(b)(2)(i), and § 51.1010(c)(2)(i)

[21] U.S. EPA "Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements" July 2016

[22] For the 35 µg/m3 24-Hour PM2.5 Standard (2006), see § 51.1010(b)(4). For the 15 µg/m3 Annual PM2.5 Standard (1997) and 65 µg/m3 24-Hour PM2.5 Standard (1997), see § 51.1004(a)(3)

[23] U.S. EPA April 2016 "SIP Requirements Rule" 81 FR 58010 https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

[24] U.S. EPA https://www.epa.gov/pm-pollution/epa-summaries-and-reports-several-state-and-local-pm-control-measures. Accessed April 24, 2018

- U.S. EPA's "Menu of Control Measures" for PM2.5;[25] and
- U.S. EPA's mobile-specific control measures for PM2.5.[26]

Beyond these suggested resources, CARB staff has also taken additional steps to identify any additional mobile source control measures currently in use in jurisdictions outside of California. This process included inquiries to U.S. EPA staff in Region 9, as well as inquiries to CARB technical staff that are engaged in developing control strategies across a wide range of mobile sources throughout the agency, including passenger vehicles, heavy-duty trucks and buses, off-road equipment, and fuels. Furthermore, CARB staff has performed internet searches of other jurisdictions' mobile control measures to ensure that our research process for this appendix identifies any control programs that have been more recently developed and which therefore may not otherwise be reflected in the abovementioned resources specified by U.S. EPA.

Assessment

In order to identify the most stringent suite of control measures currently, "adopted into any SIP or used in practice to control emissions in any state,"[27] staff has identified in the tables included in Chapter IV Step 2(b) the most stringent suite of control measures in the nation, for each mobile source category. Staff has assessed the relative stringency of measures based on the efficiency of a given measure or control technology to reduce the level of emissions from category of the mobile source fleet – for example, by comparing the technical capacity for a given control measure to reduce in-use emissions from the on-road heavy-truck fleet, relative to other potential control measures that target the same emission source(s) for reductions. This assessment demonstrates that, for each mobile source category, the suite of control measures included in the Valley's attainment plan and demonstration are the most stringent that are in use in any state or adopted into any SIP.

STEP 2(C) RECONSIDERATION AND REASSESSMENT OF ANY CONTROL MEASURES PREVIOUSLY REJECTED AS INFEASIBLE

The final component required to identify all potential BACM/MSM control measures is to reconsider and reassess any control measures proposed in prior Moderate or Serious SIPs for the Valley that were previously rejected as infeasible.[28]

CARB staff reviewed all previous Valley PM2.5 SIPs[29] and found that there are no mobile source control measures that were proposed in previous Moderate or Serious attainment plan control strategies for the Valley but which were not adopted by CARB. Thus, there are no applicable control measures previously rejected as infeasible that would need to be reconsidered for the purposes of this BACM/MSM demonstration process.

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[25] U.S. EPA 2016 "*Menu of Control Options*" Accessed April 2018 at https://www.epa.gov/air-quality-implementation-plans/menu-control-measures-naaqs-implementation

[26] U.S. EPA https://www.epa.gov/advance/control-measures-programs-pm. Accessed April 24, 2018

[27] Per MSM requirements in 40 CFR § 51.1010(b)(2)(i) and § 51.1010(c)(2)(i), which call for the identification of the most stringent suite of control measures in any state or nonattainment area.

[28] Identification of any control measures that were previously rejected as infeasible in prior Moderate or Serious SIPs for the area is a requirement for MSM, not BACM. See 40 CFR § 51.1010(b)(2)(ii) and § 51.1010(c)(2)(ii)

[29] See CARB's list of San Joaquin Valley Air Quality Management Plans at https://www.arb.ca.gov/planning/sip/planarea/sanjqnvllysip.htm

STEP 3: EVALUATION OF STRINGENCY AND FEASIBILITY

While the focus of Step 2 is on expanding the scope of analysis to ensure that all possible control measures are identified and incorporated into a list of potential BACM/MSM control measures, Step 3 focuses on narrowing that list to identify and discard from further consideration any measures that do not satisfy the applicable requirements for stringency and feasibility. Step 3 therefore calls for an evaluation of each of the potential BACM/MSM control measures identified in Step 2, in order to evaluate first whether they satisfy the level of stringency of each control measure (i.e. do they meet the definition of BACM or MSM); and secondly, whether they are technically and economically feasible to implement in the Valley.

Step 3(a): Evaluating Stringency

For a potential control measure to meet the definition of BACM and/or MSM as identified in Chapter I, staff must demonstrate that the measure satisfies stringency requirements in terms of both:

(i) the efficiency of a given measure or control technology to reduce the level of emissions from a specific mobile source, relative to emission controls in place in other states and nonattainment areas; and

(ii) the timing of when each control measure will begin to be implemented, relative to each plan's timing milestones and deadlines.

Much of the assessment required to evaluate the efficiency of the level of control provided by a given control measure or technology is included in Step 2(b), wherein staff analyzes the control measures in the Valley's plan relative to those in other states and nonattainment areas. In order to evaluate the stringency of implementation schedule requirements relative to the attainment deadline, staff has identified in Step 3(a) when each control measure has begun to be implemented or is anticipated to begin to be implemented, and compared that timeframe to the applicable timing milestones and deadlines for each of the four PM2.5 standards discussed in this plan.

As was discussed in the introduction, the Act requires differing levels of stringency in control measures, depending on the severity of the area's classification for each standard and status of where the plan falls in the step-wise process called for in the Act's particulate matter provisions.

For BACM, a measure must be implemented in whole or in part by the end of the fourth year following the date of reclassification of the area to Serious.[30] BACM measures fall within one of two sub-categories, depending on implementation timeframes:

- BACT a BACM measure is considered BACT if it can be implemented in whole or in part by the end of the fourth year following the date of reclassification of the area to Serious."[31]
- Additional Feasible Measure (AFM) a BACM measure is considered AFM if it can be implemented in whole or in part between the end of the fourth year following

[30] 40 CFR § 51.1010(a)(3)(i)

[31] 40 CFR § 51.1010(a)(3)(i)

> the date of reclassification of the area to Serious and the applicable attainment date for the area."[32]

Unlike BACM, the Act does not specify an implementation deadline for MSM; U.S. EPA states that MSM should be implemented, "as expeditiously as practicable".[33]

For each of the applicable four PM2.5 standards discussed in this plan, Table 3 summarizes the required levels of control measures and the required timeframe for implementation in order to meet the definition of BACM and/or MSM.

Table 3: Implementation and Timing Requirements for BACM and MSM

Standard	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997) 65 ug/m3 24-hour (1997)
Classification Status	Moderate with request to Serious	Serious with Extension	Serious (5% plan)
Type of Plan Required	Serious	MSM	5% Plan
Control Measure Requirements	BACM	MSM	MSM
Definition of BACM and MSM (regarding timing)	BACM**:** implemented in whole or in part by the end of the fourth year following the date of reclassification of the area to Serious.[34] BACM has two sub-categories: • BACT: implemented in whole or in part by the end of the fourth year following the date of reclassification of the area to Serious[35] • AFM: implemented in whole or in part between the end of the fourth year following the date of reclassification of the area to Serious and the applicable attainment date for the area[36]	MSM: implemented in whole or in part by 5 years after the applicable attainment date for the area[37]	MSM: implemented in whole or in part within 5 years or such longer period as the EPA may determine is appropriate after the EPA's determination that the area failed to attain by the Serious area attainment date[38]
Attainment deadline	2025	2024	2020
Timeframe for Implementation to be Considered BACM/MSM	BACM if implemented ≤ 2025 Either: • BACT if ≤2019 • AFM if 2020 - 2025	MSM if implemented ≤ 2029	MSM if implemented ≤ 2021

[32] 40 CFR § 51.1010(a)(3)(ii)
[33] U.S. EPA, 2001 *Final TSD for Maricopa County PM10 Nonattainment Area* (page 31). Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf
[34] 40 CFR § 51.1010(a)(3)(i)
[35] 40 CFR § 51.1010(a)(3)(i)
[36] 40 CFR § 51.1010(a)(3)(ii)
[37] 40 CFR § 51.1010(b)(3)
[38] 40 CFR § 51.1010(c)(3)

Given the timing of when each control measure has begun or is anticipated to begin implementation, staff has assessed each control measure in order to categorized each as falling into MSM or BACM 'bins' (the BACM bin is further subdivided into BACT or ADF). It is important to note that the variance in timing of each standard's attainment date means that the definition of which control measures fall into the MSM or BACM bin may differ among the standards. In other words, a measure may fall into different bins for each standard, due to the timing differences in when the standards were finalized. This is because the requirements to determine of feasibility for each measure also vary among the standards, depending on when the control measures are anticipated to be implemented relative to the standards' attainment dates.[39]

In addition to timing considerations, the bin into which each potential control measure falls into correlates with how hard each measure pushes to control emissions. The determination of whether each control measure falls into the BACM/BACT, BACM/ADF, or MSM bin thus indicates both the control measure' stringency and the control measures' implementation schedule, relative to the varying attainment dates among the Valley's four PM2.5 SIPs. Generally speaking, the control measures included in CARB's current control program meet the definition of BACM, and the new measures included in the Valley SIP Strategy satisfy MSM requirements. The new measures have been identified to push beyond the stringency of controls required in the current control program and have been developed to achieve "the maximum degree of emission reduction… that can be feasibly implemented in the area."[40] This is also in keeping with U.S. EPA's interpretation of BACM as, "more stringent than reasonably available control measure (RACM), but less stringent than the lowest achievable emission rate (LAER), which doesn't take into consideration the cost effectiveness of implementing a particular control measure,"[41] while MSM has been defined as, "what LAER represents for new or modified sources under the New Source Review permit program."[42]

Comparing the Stringency of the Valley's Plan to the Current Control Program

The final step called for in U.S. EPA's process to demonstrate that the suite of control measures included in the Valley's attainment plan satisfy the stringency definition for MSM is to compare the measures included in the Valley's plan against the measures already adopted in the Valley's SIP to determine if the existing control measures alone are more stringent.[43] Staff has compared the current control program to the control

[39] For the 2012 Annual Standard of 12 ug/m3, the Valley has not yet been reclassified to Serious. In order to proceed with the assessment and determination of whether control measures satisfy the timing requirements for BACM, BACT and/or AFM for this standard, CARB staff has inferred an effective date of 2015 as the redesignation year: per § 51.1010(a)(5), the attainment deadline for a Serious plan is ten years from date of designation as Serious. Because staff's air quality modeling shows that the Valley's projected attainment date for this plan is 2025, CARB staff has assigned 2015 as the proxy date of redesignation to Serious for purposes of identifying BACM/BACT. Continuing with this assumption, a control measure would therefore be considered BACT if implemented before or during 2019, and would be considered an AFM if implemented between 2020 and 2025.

[40] U.S. EPA definition of MSM from the 2001 *Final TSD for Maricopa County PM10 Nonattainment Area* (page 31). Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

[41] U.S. EPA 1994 "Addendum to the General Preamble" (*59 FR 41998* pages 42009 -42013) Available at https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19940816_59fr_41998-42017_addendum_general_preamble.pdf

[42] U.S. EPA 1994 "Addendum to the General Preamble" (*59 FR 41998* pages 42009 -42013) Available at https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19940816_59fr_41998-42017_addendum_general_preamble.pdf

[43] U.S. EPA's 2001 *Final TSD for Maricopa County PM10 Nonattainment Area* see page 32. Available at https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd0901.pdf

measures included in the Valley's attainment plan and demonstration, and has found that:

- The suite of control measures in the Valley's attainment plan and demonstration include all of the potential BACM and MSM measures identified through the processes described above, including measures in the current control program.
- The suite of control measures in the Valley's attainment plan is more stringent than the existing control program alone because the plan encompasses both the existing suite of control programs and the new measures from the State SIP Strategy and the Valley SIP Strategy. The new measures exceed the stringency of the current control program for control requirements applying to all mobile source categories, including the passenger vehicle fleet, the on-road heavy-duty fleet, and off-road equipment and engines.
- The Valley's attainment demonstration provides further evidence that the additional stringency of the control measures included in the Valley's plan, relative to the current control program: the additional emission reductions provided by the new measures in the plan (i.e. those from the State SIP Strategy and Valley SIP Strategy) are needed for the Valley to attain its PM2.5 targets.

Step 3(b): Determination of Technical and Economic Feasibility

The second half of the required process for evaluating the potential BACM/MSM measures is an assessment of their economic and technical feasibility. As part of this process, statute directs that the State may eliminate any control measures identified in Step 2 from further consideration if it is demonstrated to be technologically or economically infeasible to implement in the Valley within the specified timeframes.

Per U.S. EPA's guidance and precedence, this requirement is not required to be applied unless a potential BACM/MSM control measure is rejected from inclusion in the SIP on the grounds of feasibility.[44] For this appendix, staff's proposed SIP and attainment demonstration for the Valley do not recommend eliminating any of the potential BACM/MSM control measures identified in Step 2 on the basis of technical or economic infeasibility. Thus, the assessment of technological and economic feasibility for purposes of eliminating such measures in whole or part from further consideration (i.e. Step 3(b)) is not applicable for this plan, and is not substantively addressed in this appendix beyond this section.

Nonetheless, staff has conducted an initial assessment of technical feasibility for the proposed control measures in the State SIP Strategy and Valley SIP Strategy through the ongoing technology assessments that CARB staff has been conducting in collaboration with U.S. EPA and the National Highway Traffic Safety Administration. These Technology Assessments have identified the current technological potential for more stringent emission control measures for on- and off-road heavy-duty applications,

[44] See page 400 of U.S. EPA's 2001 *Technical Support Documentation for Maricopa County PM10 Nonattainment Area* https://www3.epa.gov/region9/air/phoenixpm/pdf/tsd30102.pdf where EPA staff explain that they are applying to Maricopa County's SIP the decision from a Phoenix Serious SIP not to apply this requirement if no potential control measures are rejected.

together with the fuels necessary to power them, along with ongoing review of advanced vehicle technologies for the light-duty sector.[45]

Additionally, an economic impact analysis was conducted for many of the newly proposed measures that were first identified in the Mobile Source Strategy.[46] Furthermore, all control measures that are regulatory in nature must also undergo a rule-specific, rigorous public review process when proposed by staff and/or approved by the Board, as specified by the Administrative Procedures Act (APA). These requirements include an Initial Statement of Reasons (ISOR) prepared for each proposed CARB regulation, an Environmental Analysis to satisfy California Environmental Quality Act (CEQA) requirements, and an Economic Analysis, including a Standardized Regulatory Impact Assessment (SRIA) for any proposed regulation has an economic impact exceeding $50 million.

While these processes occur beyond the requirements addressed in this plan, these requirements ensure there will be further opportunity for public and stakeholder input, as well as ongoing technology review and a more refined assessment of costs and environmental impacts as the measures move through CARB's public process for development into proposed regulations.

Step 4: Adopt and Implement Feasible Control Measures

The final step required by the Act's step-wise process is to adopt and implement the feasible control measures identified in Step 3, in order to satisfy BACM and MSM requirements. Staff's proposed SIP for the Valley to attain all four of the PM2.5 standards this document discusses includes all of the measures identified as BACM and/or MSM in Step 3. The process for adoption and implementation of these control measures is discussed in more detail in the body of the main document to which this analysis is appended.

[45] Technology and Fuel Assessments http://www.arb.ca.gov/msprog/tech/tech.htm
[46] CARB 2016 "Mobile Source Strategy Appendix A: Economic Impact Analysis" https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.htm

Chapter III. Step 1: Mobile Source Emissions of Direct PM2.5 and NOx

Tables 4 and 5 show the mobile emissions of direct PM2.5 and NOx, the key precursor to secondary formation of PM2.5 in the Valley.[47] It is important to note that, as this appendix is an assessment of mobile sources control measures, these tables reflect only a subset of the total emissions in the Valley, and do not reflect emissions from stationary and areawide sources.

Table 4: Direct PM2.5 Emissions (tpd) from Mobile Sources in the Valley

	2013	2020	2024	2025	2030
On-Road Light-Duty Vehicles	1.9	2.1	2.2	2.2	2.4
On-Road Heavy-Duty Vehicles	4.5	1.3	1.0	1.0	1.0
Off-Road Federal and International Sources	1.5	1.8	1.8	1.8	1.8
Aircraft	1.2	1.7	1.7	1.7	1.7
Railroad	0.2	0.1	0.1	0.1	0.1
Off-Road Equipment	4.3	3.2	2.6	2.4	1.8
Total Direct PM2.5 from Mobile Sources	**12**	**8**	**8**	**7**	**7**

**Numbers may not add up due to rounding.*

Table 5: NOx Emissions (tpd) from Mobile Sources in the Valley

	2013	2020	2024	2025	2030
On-Road Light-Duty Vehicles	34	16	11	10	7
On-Road Heavy-Duty Vehicles	149	81	45	44	40
Off-Road Federal and International Sources	15	15	13	13	11
Aircraft	2	5	5	5	5
Railroad	13	10	8	8	6
Off-Road Equipment	72	55	45	42	33
Total NOx from Mobile Sources	**270**	**167**	**114**	**109**	**91**

**Numbers may not add up due to rounding.*

[47] Data from CEPAM 2016 Ozone SIP Version 1.05 with external adjustments http://outapp.arb.ca.gov/cefs/2016ozsip/index.php

Chapter IV. Steps 2 and 3: Identification and Evaluation of Potential Mobile Source Control Measures

The second and third steps required in the Act's BACM / MSM evaluation process have been grouped together in this appendix so that staff can more cohesively identify and analyze control measures for each mobile sector (i.e. passenger vehicles, on-road heavy-duty trucks and buses, and off-road mobile sources).

On-Road Light-Duty Vehicles

On-road light-duty vehicles, often referred to as passenger vehicles, include motorcycles, passenger cars, and light to mid-sized trucks and SUVs. The vast majority of these vehicles currently have gasoline powered internal combustion engines, however this sector is projected to increasingly rely on electric drive vehicles of varying types (e.g. battery electric, plug-in hybrid, or fuel cell electric vehicles).

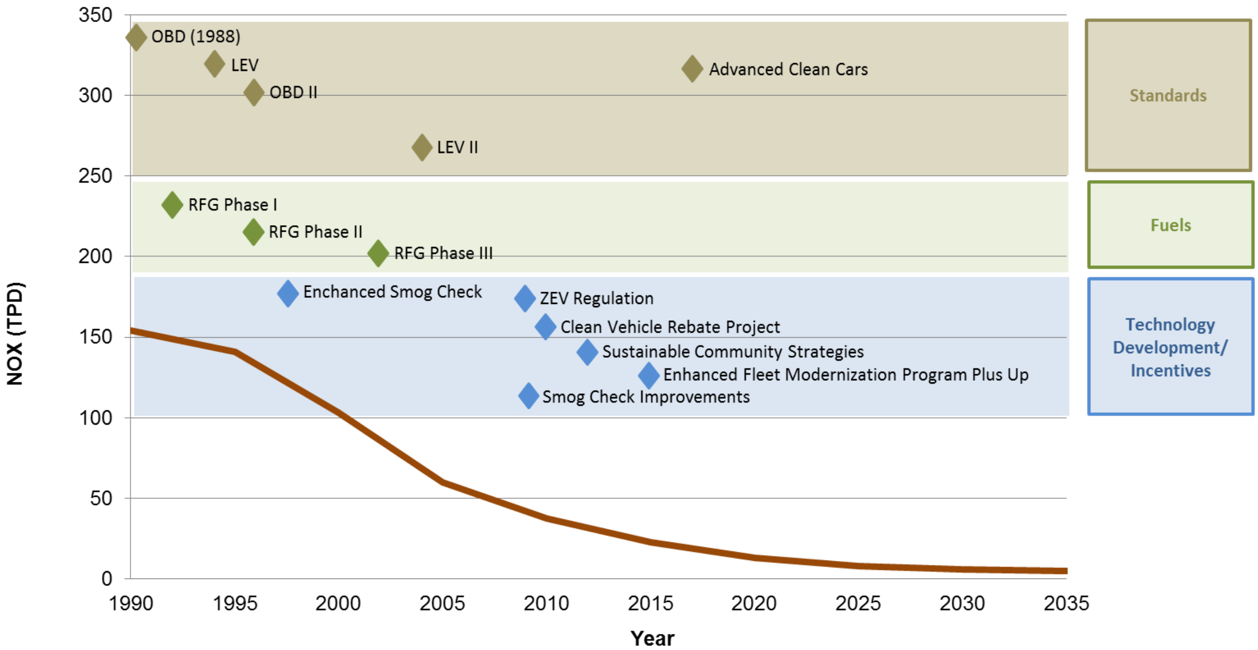
STEP 2(A): CALIFORNIA'S LIGHT-DUTY CONTROL MEASURES

Since setting the nation's first motor vehicle exhaust emission standards in 1966 that led to the first pollution controls, California has dramatically tightened emission standards for light-duty vehicles. Through CARB regulations, today's new cars pollute 99 percent less than their predecessors did thirty years ago. In 1970, CARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions. The simultaneous control of emissions from motor vehicles and fuels led to the use of cleaner-burning gasoline that has removed the emissions equivalent of 3.5 million vehicles from California's roads. Since first adopted in 1990, CARB's LEV I and LEV II, and the ZEV Programs have resulted in the production and sales of hundreds of thousands of ZEVs in California.

In the light-duty sector, the maturity of advanced technologies required under currently adopted control programs results in NOx emission reductions of over 70 percent between 2013 and 2025, as shown in Figure 2.

The historical improvement in NOx emissions largely is the result of new engine standards that have significantly reduced emissions from conventionally fueled vehicles (LEV programs). Alongside these programs, Zero-Emission Vehicle (ZEV) technologies have achieved commercial status, and sales mandates are increasing ZEV penetration. The major regulatory and programmatic control measures that provide for the needed emission reductions in the on-road light-duty mobile source category are described subsequently.

Figure 2 Adopted Control Programs Reducing NOx Emissions from the Light-Duty Vehicle Fleet in the Valley



NEW VEHICLE STANDARDS

Emission Standards

California is the only state with the authority to adopt and enforce emission standards for new motor vehicle engines that differ from the federal emission standards, which enables CARB to develop more stringent motor vehicle control measures than other states. Adopted in 2012, the ***Advanced Clean Car (ACC)*** program is a suite of regulations that ensure emission reductions from the State's passenger vehicle fleet. In 2013, U.S. EPA issued a waiver for the ACC Program.[48]

CARB's (ACC) program has in recent years been a major driver of turnover to and zero and near-zero emission vehicles in the light-duty sector, providing significant emission reduction benefits. The ACC brought together three major regulations that were previously separate, combining the control of criteria pollutants and greenhouse gas emissions into a single coordinated set of requirements for light-duty vehicles of model years 2015 through 2025.

- Two of these regulations, the ***LEV III GHG*** and ***LEV III Criteria Emission*** rules, are fleet average performance standards for new vehicles that provide for continued annual emission reductions as the stringency increases through 2025. When fully phased-in, these requirements will achieve near-zero emission levels from new light-duty vehicles. These programs apply to the entire light-duty fleet

[48] U.S. EPA 2013 "California State Motor Vehicle Pollution Control Standards; Advanced Clean Car Program; Final Notice of Decision" Federal Register January 9, 2013 Volume 78, Number 6 pp. 2211 – 2145. https://www.gpo.gov/fdsys/pkg/FR-2013-01-09/pdf/2013-00181.pdf

by setting an average emissions requirement across all new vehicles that creates inherent market flexibility for compliance.

- The third regulation, the ***ZEV Regulation***, focuses on advanced technology development and fleet penetration of ZEVs (i.e. battery electric vehicles and hydrogen fuel cell vehicles), and plug-in hybrid electric vehicles (PHEVs) in order to enable manufacturers to successfully meet 2018 and subsequent model year requirements. The ZEV regulation ensures that advanced electric drive technology is commercialized and brought to production scale for cost reductions by 2025, in order to ensure that these low-emission technology vehicles transition from demonstration phase to full commercialization in a reasonable timeframe to meet long-term emission reductions goals. The ZEV amendments for 2018 and subsequent model years in the ACC program are intended to achieve commercialization through simplifying the regulation and pushing technology to higher volume production in order to achieve cost reductions.

The ACC Program will continue produce increasing benefits over time as new cleaner cars enter the fleet, displacing older and dirtier vehicles. In this manner, the benefits in 2023 will be realized through the cumulative reduction in emissions achieved by new cars entering the fleet in 2017 through 2023. This program will continue to provide benefits well after 2023 as vehicles meeting the new standards replace older, higher-emitting vehicles and continue to provide ongoing emission reduction benefits over their lifecycle, relative to the older, dirtier vehicles replaced.

Pushing beyond those requirements, the State SIP Strategy also included a commitment to develop the next generation of requirements for the passenger vehicle fleet through the ***Advanced Clean Cars 2*** measure. CARB will consider expanded California-specific standards for new light-duty vehicles to increase the number of new ZEVs and PHEVs sold in California, with the goal to make sure that near-zero and zero-emission technology options continue to be commercially available. The Advanced Clean Cars 2 measure is designed to ensure that near-zero and zero-emission technology options continue to be commercially available, with electric driving range improvements to address consumer preferences and maximize electric vehicle miles travelled (eVMT). The regulation may include lowering fleet emissions further beyond the super-ultra-low-emission vehicle standard for the entire light-duty fleet through at least the 2030 model year, and look at ways to improve real world emissions through implementation programs. As these vehicles continue to be commercially available, the new technologies they employ, including regenerative braking and lower rolling resistance tires, can reduce criteria pollutant emissions from brake and tire wear. CARB would quantify these previously unaccounted-for criteria pollutant co-benefits of ACC 2 in order to better inform future planning. Additionally, new standards would be considered to further increase the sales of zero-emission vehicles (ZEV) and plug-in hybrid electric vehicles (PHEVs) beyond the levels required in 2025.

Additionally, under the ***Reduced ZEV Brake and Tire Wear*** measure, CARB will quantify the emission reductions that will accrue from new technologies employed in fuel cell and plug-in electric vehicles, including regenerative braking and lower rolling resistance tires, which can reduce emissions from brake and tire wear. As increasing numbers of zero-emission vehicles enter the fleet over the coming decade, these technologies offer opportunities to reduce PM2.5 emissions from the passenger vehicle fleet.

On-Board Diagnostic (OBD) Systems

In addition to emission standards for the light-duty fleet, CARB's suite of control measure requirements for new vehicles also includes actions to ensure that vehicles continues to operate as cleanly as possible once they are part of the in-use fleet. These measures include requirements that new vehicles come equipped with in-use inspections and on-board self-diagnostic equipment. On-Board Diagnostics (OBD) systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications. Studies show that the highest emitting 20 percent of the light-duty fleet contribute well over 50 percent of the fleet's total emissions, emphasizing the need to identify and repair these high emitting vehicles.[49]

On-Board Diagnostics II (OBD II) is the second generation of requirements for on-board, self-diagnostic equipment that monitors a passenger vehicle's control components to ensure they are functioning correctly. California's first OBD regulation required manufacturers to monitor some of the emission control components on vehicles starting with the 1988 model year. In 1989, CARB adopted OBD II, which required 1996 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with second generation OBD systems. CARB subsequently strengthened OBD II requirements and added OBD II specific enforcement requirements for 2004 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines. U.S. EPA granted CARB a waiver of preemption for the OBD II regulation in 2016.[50]

Emissions Standards for Motorcycles

While representing a relatively small fraction of the emissions coming from the passenger vehicle fleet, CARB has also taken a comprehensive control approach for emissions from motorcycles. For the most part, motorcycles are on-road two-wheeled, self-powered vehicles with engine displacements of 50 cubic centimeters (cc) or greater. First adopted in 1975, ***California's on-road motorcycle regulation*** obtained its first waiver of preemption from U.S. EPA in 1976. The 1975 regulation set emission standards for all motorcycles with engine displacements of at least 50 cc. The 1998 amendments affected only Class 3 motorcycles (280 cc or greater) and set a Tier I and Tier II standard for 2004 and 2008 model years, respectively. While CARB has the same emission standard as the federal standard, the California standard applies to engines starting in 2008 rather than 2010 under the federal requirement. The California

[49] CARB 2015 https://www.arb.ca.gov/msprog/obdprog/obdfaq.htm

[50] U.S. EPA 2016 "California State Motor Vehicle Pollution Control Standards; Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines; Final Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2016-11-07/pdf/2016-26861.pdf November 7, 2016 Federal Register Volume 81, Number 215 pp. 78143-78149

Motorcycle Regulation controls both exhaust emission standards and test procedures for on-road motorcycles and motorcycle engines. U.S. EPA granted CARB a waiver of preemption for the 1998 amendments in August 2006.[51]

REDUCING IN-USE EMISSIONS

Inspection and Maintenance (I/M) Program

Although new vehicles sold in California are the cleanest in the world, the millions of passenger vehicles on California roads, and the increasing miles they travel each day make them our single greatest source of NOx emissions. While the new vehicles in California may start out with very low emissions, improper maintenance or faulty components can cause vehicle emission levels to sharply increase. Studies estimate that approximately 50 percent of the total emissions from late-model vehicles are excess emissions, meaning that they are the result of emission-related malfunctions. California's ***Smog Check Program*** works to ensure that the vehicles remain as clean as possible over their entire life. The Bureau of Automotive Repair (BAR) is the State agency charged with administration and implementation of the Smog Check Program. The Smog Check Program is designed to reduce air pollution from California registered light-duty vehicles by requiring periodic inspections for emission control system problems, and by requiring repairs for any problems found. Technicians are required to perform an OBD II check (visual and functional) during the Smog Check inspection.

Additionally, CARB has committed in the State SIP Strategy to work with BAR staff to perform a joint agency, ***comprehensive evaluation*** of California's in-use performance-focused inspection procedures and, if necessary, make ***improvements to increase the Smog Check Program's effectiveness***. Assembly Bill (AB) 2289 (Eng, Chapter 258, Statutes of 2010) required BAR to implement a new protocol for testing 2000 and newer model-year vehicles, effective in 2015. This new test, which relies primarily on the vehicle's OBD system, provides for a faster and more cost effective inspection compared to tailpipe testing. To facilitate state-of-the-art OBD-based testing, BAR developed equipment specifications for a new OBD communications device, referred to as the Data Acquisition Device (DAD), which is a component of the new OBD Inspection System (OIS) that replaces the EIS. These changes are aimed at providing for quicker and potentially less costly Smog Check inspections for consumers, and lower Smog Check station operating costs, all while preserving, or even enhancing the emission benefits associated with the Smog Check Program. However, because the OBD inspection procedure does not provide for direct measurement of vehicle emission levels, CARB believes it is prudent to monitor the effectiveness of the new procedure in identifying vehicles in need of emission repairs, and to implement changes necessary to address any issues that are uncovered. As part of the comprehensive evaluation, CARB will conduct a study to further evaluate California's in-use performance inspection procedures through analysis of the Smog Check database and vehicle sampling obtained through BAR's Random Roadside Inspection Program to improve inspection test procedures as necessary, address program fraud, improve the

[51] https://www.epa.gov/state-and-local-transportation/vehicle-emissions-california-waivers-and-authorizations See Code of Federal Regulations Volume 71, Number 149 pp. 44027-44029

effectiveness and durability of emission-related repair work, and to improve the regulations governing the design of in-use performance systems on motor vehicles.

Additionally, the ***Lower In-Use Emission Performance Assessment*** committed to in the State SIP Strategy is designed to ensure that in-use passenger vehicles continue to operate at their cleanest possible level by evaluating California's in-use performance-focused inspection procedures and, if necessary, making improvements to further the program's effectiveness. Results from the assessment may be used to improve inspection test procedures, address program fraud, improve the effectiveness and durability of emission-related repair work, and to improve the regulations governing the design of in-use performance systems on motor vehicles to the extent necessary.

Finally, CARB staff's discovery of Volkswagen's (VW's) use of illegal defeat devices—software designed to cheat on emissions tests—in certain 2009 to 2016 model year diesel cars that were sold in California illustrates the success and stringency of California's program to control emissions from the in-use passenger vehicle fleet, and to identify excess in-use emissions. Due to the discovery of VW's emissions cheating scandal and subsequent actions to remediate the environmental damages caused by these vehicles' excess emissions, the VW Environmental Mitigation Trust provides about $423 million for California to fund projects that accelerate the turnover of mobile sources to cleaner, lower-emitting vehicles and engines.

FUELS

Cleaner fuel has an immediate impact in reducing emissions from the mobile source, and thus represent an important component in reducing NOx and VOC emissions from the passenger vehicle fleet. California's stringent air quality programs treat motor vehicles and their fuels holistically (as a system, rather than as separate components). As a result, CARB's fuels programs achieve significant reductions in criteria emissions from gasoline-fueled vehicles used in California.

California's Reformulated Gasoline program (CaRFG) sets stringent standards for California gasoline that produced cost-effective emission reductions from gasoline-powered vehicles. Reformulated gasoline (RFG) is gasoline blended to burn more cleanly than conventional gasoline and to reduce smog-forming and toxic pollutants in the air we breathe. Since the Valley was reclassified to a Serious ozone nonattainment in December 2001, the use of cleaner-burning gasoline that is at least as stringent as federal RFG requirements has been required since December 2002. The CaRFG program has been implemented in three phases.

- Phase 1, which was implemented in 1991, eliminated lead from gasoline and set regulations for deposit control additives and reid vapor pressure (RVP).
- Phase 2 CaRFG (CaRFG2 in 1994) set specifications for sulfur, aromatics, oxygen, benzene, T50, T90, Olefins, and RVP and established a Predictive Model.
- The final and current phase, Phase 3 CaRFG, eliminated in 1996 the use of methyl-tertiary-butyl-ether in California gasoline.

Phase 3 CaRFG also revised specifications for Phase 3 gasoline that reduces ozone precursor emissions (including aromatic hydrocarbons and olefins) by ~15 percent and toxic air contaminant emissions by about 40 percent, compared with CaRFG2. The regulation strengthened specification requirements for cleaner-burning gasoline, including:

- Reduced sulfur content. Sulfur inhibits the effectiveness of catalytic converters. Cleaner-burning gasoline enables catalytic converters to work more effectively and further reduce tailpipe emissions.
- Reduced benzene content. Benzene is known to cause cancer in humans. Cleaner-burning gasoline has about one-half the benzene of earlier gasoline, thus reducing cancer risks.
- Reduced levels of aromatic hydrocarbons (ozone precursor)
- Reduced levels of olefins (ozone precursor)
- Reduced vapor pressure, which ensures that gasoline evaporates less readily.
- Two specifications for reduced distillation temperatures, which ensure the gasoline burns more completely, and
- Use of an oxygen-containing additive, such ethanol, which also helps the gasoline burn more cleanly.

More recently, CARB developed ***the LCFS and ADF regulations,*** which work together to reduce emissions from renewable fuels, including criteria emissions, and further incentivizes the use of ZEV technologies. The LCFS and ADF regulations (as amended in 2014) reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends (a mix of fuels made from renewable feedstocks, which are then blended with conventional gasoline or diesel).

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' LIGHT-DUTY CONTROL MEASURES

Table 6 summarizes the most stringent control measures currently in use in any state or nonattainment that have been identified and discussed for on-road light-duty vehicles. Each of the measures identified in this table are discussed in more detail in this section, below.

Table 6: Summary of Most Stringent Light-Duty Control Measures Identified

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Light-Duty Vehicles			
New Vehicle Standards			
New Vehicle Standards • Emission standards	LEV III program (CARB) *(part of Advanced Clean Cars program)* CARB anticipated to propose to further increase stringency *(ACC 2 measure)*	12 states have matched California's Low Emission Vehicle III (LEV III) program, which set fleet average performance standards for new passenger vehicles. CARB may further increase the stringency of CARB's emission standards beyond SULEV. *(NOTE: CARB has committed to develop the ACC 2 measure but it has not yet been proposed to the Board for approval/adoption.)*	12 Section 177 states (LEV III): • CT, DE, ME, MD, MA, NJ, NY, OR, PA, RI, WA, and VT
New Vehicle Standards • ZEV regulation	ZEV program (CARB) *(part of Advanced Clean Cars program)* CARB anticipated to propose to further increase stringency *(ACC 2 measure)*	9 states have matched California's ZEV Regulation for battery electric vehicles (BEVs), hydrogen fuel cell vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). CARB may further increase the stringency of sales requirements for ZEVs and PHEVs beyond the levels required in 2025. *(NOTE: CARB has committed to develop the ACC 2 measure but it has not yet been proposed to the Board for approval/adoption.)*	9 Section 177 states (ZEV Regulation): • CT, ME, MD, MA, NJ, NY, OR, RI, and VT
New Vehicle Standards • On-Board Diagnostic (OBD) systems requirements	California OBD II Requirements (CARB)	CARB's On-Board Diagnostic II (OBD II) Systems Requirements exceed Federal requirements in stringency. OBD II ensures that the in-use fleet continues to operate as cleanly as possible.	In practice, virtually all vehicles sold in the U.S. are designed and certified to meet California's OBD II requirements, regardless of where in the U.S. they are sold.
New Vehicle Standards • Motorcycle emission standards	On-Road Motorcycle Regulation (CARB)	CARB's emission standards and in-use testing for on-road motorcycles exceeds the stringency of any other in the nation.	California is the only state with emission control requirements for exhaust emission standards and test procedures for on-road motorcycles that exceed the stringency of U.S. EPA requirements.
In-Use Emission Controls			
In-Use Emissions Controls • Inspection and maintenance program (I/M program)	Smog Check Program (CARB & Bureau of Automotive Repair)	The Inspection / Maintenance (I/M) Program testing and in-use emission controls in the San Joaquin Valley are consistent with the most stringent of any other I/M program in the nation. Biennial SmogCheck inspections ensure that the in-use passenger vehicle fleet continues to operate as cleanly as possible.	• 33 State and local areas (including CA) require vehicle emissions tests. • 30 other states and local areas have an I/M program in at least a portion of their state (AK, AZ, CO, CA, CT, DE, GA, ID, IL, IN, KY, LA, ME, MD, MA, NV, NH, NJ, NM, NC, OH, OR, PA, RI, UT, TN, TX, VT, WA, WI, and DC); the majority use U.S. EPA OBD Requirements. • Three more states will require OBD checks in the future (MS, NY, VA).

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Light-Duty Vehicles			
Fuel Controls			
Fuels Standards Gasoline Standards	CaRFG Phase 3 (CARB)	The CaRFG Phase III program requires that California gasoline is the lowest-emitting and cleanest-burning in the nation. It includes more stringent requirements for emission controls than the applicable federal standard (U.S. EPA's RFG Phase II).	U.S. EPA RFG Phase II is currently required in nonattainment areas in 17 states and the District of Columbia (including the Valley) • Areas of CA, CT, DE, the District of Columbia, IL, IN, MD, NJ, NY, PA, TX, VA, WI Other "opt in" areas for Federal RFG Phase II • Entire states: CT and DE • Portions of states: IL, KT, MD, ME, MA, MS, NH, NJ, NY, RI, TX, VA
Fuels Standards Alternative Fuel Standards (Gasoline substitutes)	LCFS and ADF (CARB)	The LCFS and ADF regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends.	No other state has set as stringent of criteria emission requirements on alternative fuels and alternative fuel blends than California.

NEW VEHICLE STANDARDS

Emission standards and ZEV Regulation

CARB's new vehicle standards for on-road light-duty vehicles are consistent with the most stringent of any other area in the nation. Due to constraints in the Act, California is the only state that can set new vehicle standards (including control measures such as emission standards, ZEV sales mandates, warranty provisions, and on-board diagnostic (OBD) requirements) that are more stringent than U.S. EPA's national standards.

As a result of CARB's efforts, and as provided for in the Act, a number of other states have now adopted CARB's LEV III and ZEV programs, as listed below in Table 7. Other states can adopt California programs for which U.S. EPA has provided California with waivers.[52] These states are also known as the "Section 177 States" in reference to this provision of the Act.

Table 7: Section 177 States: LD Emission Standards and ZEV Regulation

Section 177 States	2012 ZEV	2012 LEVIII
Connecticut	X	X
Delaware		X
Maine	X	X
Maryland	X	X
Massachusetts	X	X
New Jersey	X	X
New York	X	X
Oregon	X	X
Pennsylvania		X
Rhode Island	X	X
Washington		X
Vermont	X	X

On-Board Diagnostics (OBD) Requirements

California's OBD requirements for on-road light-duty vehicles are consistent with the most stringent of any other area in the nation. CARB's OBD II program requires that all 1996 and newer model year gasoline and alternate fuel passenger cars and trucks are required to be equipped from the factory with an OBD II system. All 1997 and newer model year diesel fueled passenger cars and trucks are required to meet the OBD II requirements.

[52] The Clean Air Act allows other states to adopt California's on- and off-road vehicle or engine emission standards under section 209(e)(2)(B). Section 209(e)(2)(B) requires, among other things, that such standards be identical to the California standards for which an authorization has been granted. States are not required to seek U.S. EPA approval to adopt standards identical to the California standards that have received a waiver authorization.

U.S. EPA also requires all 1996 and newer model year passenger cars and trucks sold in any state to meet the U.S. EPA OBD requirements.[53] While U.S. EPA's OBD requirements differ slightly from California's OBD II requirements, virtually all vehicles sold in the U.S. are designed and certified to meet the more stringent California's OBD II requirements, regardless of where in the U.S. they are sold.[54] U.S. EPA issued a waiver for California's OBD II program in November 2016, indicating that the California OBD II system requirements are at least as protective of public health as U.S. EPA's OBD requirements.[55]

New vehicle standards and in-use emissions testing for motorcycles

CARB's emission standards and in-use testing for on-road motorcycles exceeds the stringency of any other in the nation. California is the only state with emission control requirements for exhaust emission standards and test procedures for on-road motorcycles that exceed the stringency of U.S. EPA requirements.

REDUCING IN-USE EMISSIONS

The Inspection / Maintenance (I/M) Program testing and in-use emission controls in the Valley are consistent with the most stringent of any other I/M program in the nation. California's Smog Check Program is designed to reduce air pollution from California-registered passenger vehicles by requiring periodic inspections for emission control system problems, and by requiring repairs for any problems found. In California, technicians are required to perform an OBD II check (visual and functional) during the Smog Check inspection. On board, self diagnostic equipment monitors a passenger vehicle's control components to ensure they are functioning correctly. Specifically, the technician visually checks to make sure the warning light is functional, and then the Smog Check test equipment communicates with the on-board computer for fault information. If a fault is currently causing the light to be on, the malfunctioning component must be repaired in order to pass the inspection.

- Stringency of I/M Program

  Thirty-three states and local jurisdictions have an I/M program in at least a portion of their state that require vehicle emissions tests.[56] Thirty other states and local areas have an I/M program in at least a portion of their state; the majority use U.S. EPA Requirements, which are less stringent than California's.[57,58]

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[53] CARB 2015 "On-Board Diagnostic II (OBD II) Systems - Fact Sheet / FAQs" https://www.arb.ca.gov/msprog/obdprog/obdfaq.htm

[54] CARB 2009 https://www.arb.ca.gov/msprog/smogcheck/march09/transitioning_to_obd_only_im.pdf

[55] U.S. EPA 2016 "California State Motor Vehicle Pollution Control Standards; Malfunction and Diagnostic System Requirements and Enforcement for 2004 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles and Engines; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2016-11-07/pdf/2016-26861.pdf Federal Register Vol. 81, No. 215 pp. 78143

[56] U.S. EPA "On-Board Diagnostics (OBD): Status of State and Local (OBD) Inspection/Maintenance (I/M) Programs" https://www.epa.gov/state-and-local-transportation/board-diagnostics-obd-status-state-and-local-obd Accessed 4/25/2018

[57] U.S. EPA "On-Board Diagnostics (OBD): Status of State and Local (OBD) Inspection/Maintenance (I/M) Programs" https://www.epa.gov/state-and-local-transportation/board-diagnostics-obd-status-state-and-local-obd Accessed 4/25/2018

[58] U.S. EPA 2016 "California State Motor Vehicle Pollution Control Standards; Malfunction and Diagnostic System Requirements and Enforcement for 2004 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles and Engines; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2016-11-07/pdf/2016-26861.pdf Federal Register Vol. 81, No. 215 pp. 78143

- Effectiveness of Inspection and Testing Methodology

  Nearly every state besides California that has an I/M program currently relies exclusively on vehicle OBD II system inspections as the basis for its emission inspections of 1996 and newer vehicles.[59] Only California and Colorado still use tailpipe testing: Colorado relies on tailpipe testing exclusively; California's Smog Check program currently includes two overlapping inspection procedures. Under California's SmogCheck program, each 1996 and newer model year vehicles vehicle is subjected to a tailpipe emission test, and also to an inspection of its On-Board Diagnostic II (OBD II) system, which independently monitors the performance of the vehicle's emission control systems and related components during everyday driving.

  U.S. EPA acknowledges the viability of OBD II inspections by providing full emission credits to state I/M programs that are based on OBD II only inspections. While U.S. EPA and CARB have generally found that OBD II systems are more effective in detecting emission-related malfunctions on in-use vehicles compared to existing tailpipe testing procedures, the SmogCheck program utilizes both approaches – erring on the side of increased stringency – to ensure each vehicle passes both tests.[60]

  Furthermore, to ensure that California's I/M program remains as effective as possible, CARB has committed in the State SIP Strategy to work with BAR staff to perform a joint agency, comprehensive evaluation of California's in use performance focused inspection procedures and, if necessary, make improvements to increase the Smog Check Program's effectiveness. CARB will conduct a study to further evaluate California's in-use performance inspection procedures through analysis of the Smog Check database and vehicle sampling obtained through BAR's Random Roadside Inspection Program. This will, as necessary: inform improvements in inspection test procedures; address program fraud; improve the effectiveness and durability of emission related repair work; and improve the regulations governing the design of in-use performance systems on motor vehicles.

- Frequency of I/M

  The Valley nonattainment area requires biennial SmogCheck, which is as frequent as SmogCheck requirements as any other part of California. This is consistent with the most stringent of any other area in the nation, and is the same frequency as the only other Extreme nonattainment area for PM2.5 in the country, the South Coast.

FUELS

Since 1995, U.S. EPA has required federal reformulated gasoline (RFG) to be used in the nine worst-polluted areas in the nation – including the Valley and other California

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[59] CARB 2009 https://www.arb.ca.gov/msprog/smogcheck/march09/transitioning_to_obd_only_im.pdf

[60] California's Smog Check data indicates that vehicles are more than twice as likely to fail an OBD II-based inspection than the required tailpipe emissions test. CARB 2009 https://www.arb.ca.gov/msprog/smogcheck/march09/transitioning_to_obd_only_im.pdf

nonattainment areas (Federal RFG Phase I 1995 requirements). Effective in 2000, U.S. EPA increased the stringency of the federal RFG requirements under the RFG II program. In 2014, U.S. EPA adopted its most recent amendments, Tier 3 Fuel standards, which require lower sulfur content in gasoline to a maximum of 10ppm beginning in 2017 on an annual average basis, and lower Reid Vapor Pressure to zero, reducing fuel vapor emissions to near zero levels. The program also reduces PM emissions by approximately 70 percent, and NOx and VOCs emissions by approximately 80 percent, relative to the former federal Phase II levels (which were set in 1995). Sulfur content in gasoline is reduced from 30 parts per million (ppm) to 10 ppm on average.

In aggregate, the Phase III RFG requirements bring federal gasoline fuel controls in line with those already in place in California. However, CARB's gasoline specifications under the CaRFG requirements are still more stringent than the Federal Phase III program. CARB significantly controls NOx emissions under requirements in CaRFG Phase III that are not mirrored by comparably stringent controls on NOx emissions under the federal RFG Phase III requirements. Additionally, CARB requires sulfur contents to be capped at 10 ppm, rather than an annual average of 10 ppm as required federally.

Beyond the Federal Phase III requirements described above, the Act also allows states to adopt unique fuel programs to meet local air quality needs, which are referred to as Boutique Fuel Programs. Most of these programs set lower gasoline volatility requirements than the federal standards, and most are effective for only part of the year. As of January 19, 2017 U.S. EPA provided as snapshot of these programs that had been approved in SIPs,[61] which are listed below in Table 8 below. Table 8 also compares the stringency of the boutique fuel requirements in these areas to CARB's CaRFG Phase III. This comparison shows that the CaRFG Phase III program requires that California gasoline is the lowest-emitting and cleanest-burning in the nation.

Table 8: Boutique Gasoline Fuel Programs in the U.S.

Type of Fuel Control	State	Comparison to CaRFG Phase III
Reid Vapor Pressure (RVP) of 7.8 psi	PA and IN (year-round) TX (May 1 – Oct 1)	CaRFG Phase III sets flat limits of RVP of 7.0 psi (oxygenated fuels) and 6.9 psi (non-oxygenated fuels)
RVP of 7.0 psi	KS, MI, MO, TX	CaRFG Phase III sets flat limits of RVP of 7.0 psi (oxygenated fuels) and 6.9 psi (non-oxygenated fuels)
Cleaner Burning Gasoline (Summer)	AZ	As of 2005, AZ requires CARB's CaRFG Phase III in certain areas
Cleaner Burning Gasoline (non-Summer)	AZ	As of 2005, AZ requires CARB's CaRFG Phase III in certain areas
Winter Gasoline (aromatics & sulfur)	NV	In 1999, Clark County (Las Vegas) adopted California sulfur and aromatics limits

[61] U.S. EPA, 2017 https://19january2017snapshot.epa.gov/gasoline-standards/state-fuels_.html

STEP 3(A): EVALUATION OF STRINGENCY: LIGHT-DUTY CONTROL MEASURES

Step 3(a) calls for an evaluation of each of the control measures identified in Step 2, in order to evaluate their stringency and determine whether they meet all applicable requirements to satisfy the definitions of BACM and/or MSM discussed in Chapter I and Chapter II.

in order to determine whether each potential MSM/BACM measure meets the definition of MSM and/or BACM, staff has assessed each potential MSM/BACM on-road light-duty vehicle control measure identified in Steps 2(a) and 2(b). Based on this assessment, staff then characterized each potential MSM / BACM measure as falling into 'bins' representing whether it meets the definition of MSM or BACM for each of the four PM2.5 standards covered in this document (note that the BACM bin is further subdivided into BACT or ADF). The determination of which bin each control measure falls into thus indicates both the control measure' stringency and the control measures' implementation schedule, relative to the varying attainment dates among the Valley's four PM2.5 SIPs. In other words, the bin into which each control measure falls correlates with how hard each measure pushes to control emissions, given the implementation timeframes associated with each standards' plan. Generally speaking, the control measures included in CARB's current control program meet the definition of BACM; the new measures included in the Valley SIP Strategy satisfy MSM requirements.

Figure 3 shows the timing for implementation of each potential MSM / BACM on-road light-duty vehicle control measure identified in the prior sections (i.e. Steps 2(a) and 2(b)), for each of the four PM2.5 standards discussed in this SIP.

Figure 3: Timeline for Implementation of BACM / MSM Light-Duty Control Measures

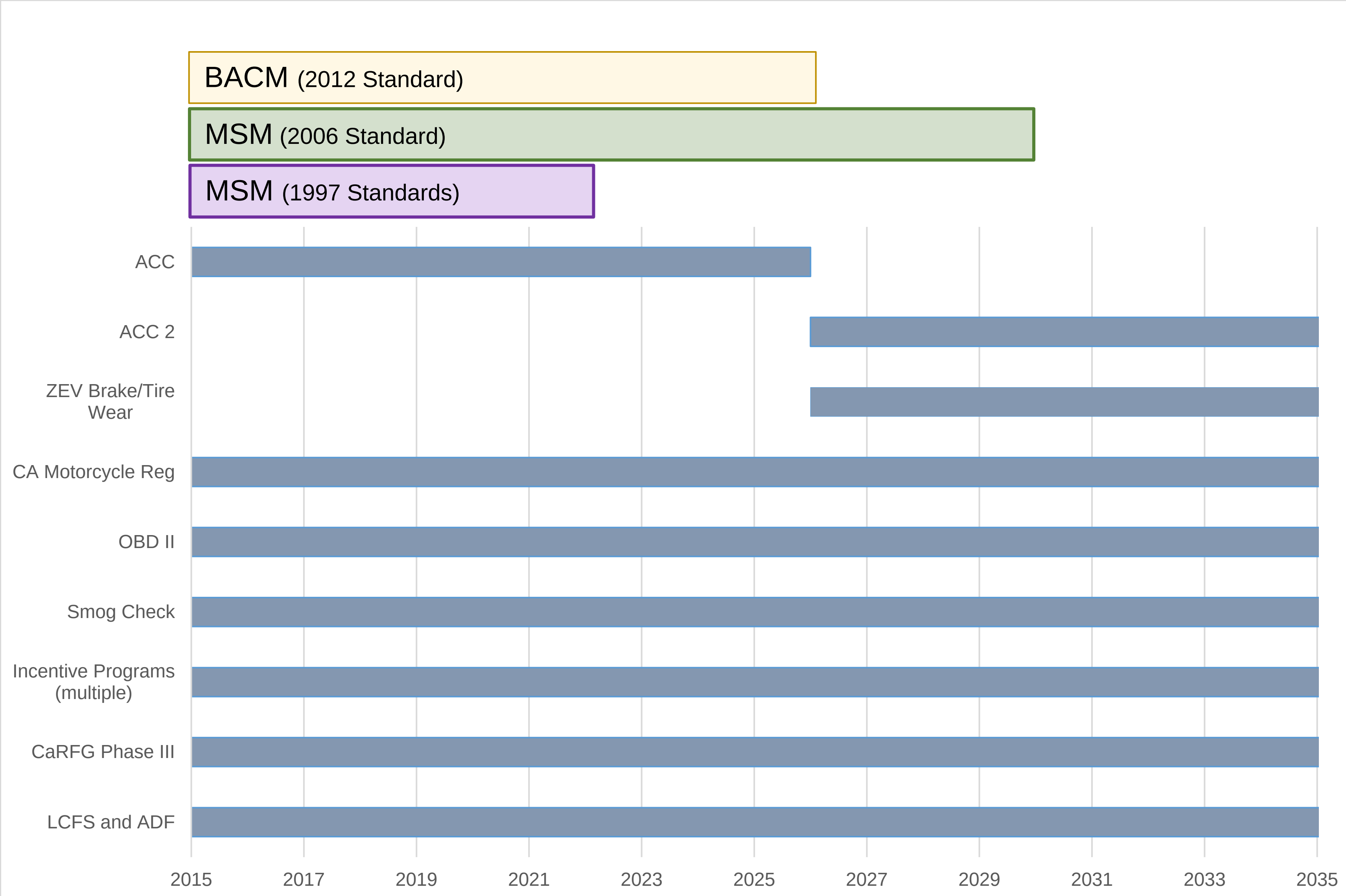


Table 9 summarizes which of the categories of stringency (i.e. BACM/BACT, BACM/ADF, or MSM) that each light-duty control measure falls into, for each PM2.5 standard. It is important to note that some measures CARB has committed to in the State SIP Strategy and proposed in the Valley SIP Strategy have anticipated implementation dates that exceed the timeframe thresholds of this analysis for some standards. Specifically, implementation of the Advanced Clean Cars 2 and Zero-Emission Vehicle Brake and Tire Wear measures is anticipated to begin in 2026, which falls after the 2025 threshold of the analysis for the 2012 Annual Standard, and the 2021 threshold of the analysis for the 1997 Annual and 24-Hour Standards. While these measures may not meet the timeline requirements to fall into the strict definition of MSM for these standards, the intent behind these measures is nonetheless to continue pushing for additional emission reductions to ensure that attainment is achieved as expeditiously as possible, which aligns with the broader purpose of MSM.

Table 9: Identification of Light-Duty Control Measures as BACM and/or MSM

Measures	Implementation Begins	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997)	65 ug/m3 24-hour (1997)
Current Control Measures					
Advanced Clean Cars (ACC) (Includes both LEV III and ZEV Program)	ongoing	BACM - BACT	MSM	MSM	MSM
California Motorcycle Regulation	ongoing	BACM - BACT	MSM	MSM	MSM
On-Board Diagnostics II (OBD II)	ongoing	BACM - BACT	MSM	MSM	MSM
Smog Check	ongoing	BACM - BACT	MSM	MSM	MSM
Light-Duty Incentive Programs	ongoing	BACM - AFM	MSM	MSM	MSM
California's Reformulated Gasoline (CaRFG) Phase III	ongoing	BACM - AFM	MSM	MSM	MSM
Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF)	ongoing	BACM - BACT	MSM	MSM	MSM
State SIP Strategy Measures (with Commitment)					
Advanced Clean Cars 2	2026	--	MSM	--	--
Reduced ZEV Brake and Tire Wear		--	MSM	--	--

STEP 3(B): EVALUATION OF FEASIBILITY: LIGHT-DUTY CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's proposed SIP and attainment demonstration, but which is identified as a potential BACM/MSM control measure in Step 2. For this plan, staff's proposed SIP and attainment demonstration do not recommend eliminating any of the potential BACM/MSM control measures identified in Step 2 on the basis of technical or economic infeasibility. Thus, a feasibility assessment for purposes of eliminating such measures from further consideration (i.e. Step 3(b)) is not applicable.

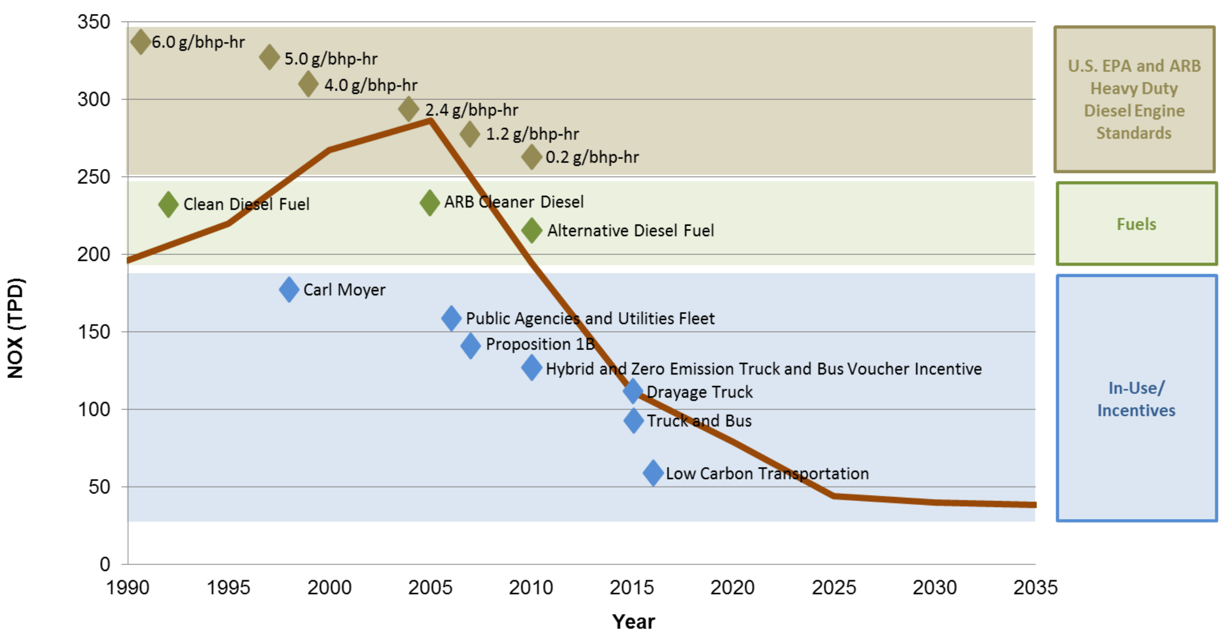
On-Road Heavy-Duty Vehicles

On-road heavy-duty vehicles include buses and trucks over 8,500 pounds gross vehicle weight rate (GVWR). The majority of these vehicles operate on diesel-cycle engines, especially in the higher weight classes. Gasoline and natural gas Otto-cycle spark-ignited engines are also used in heavy-duty trucks, primarily in the lower weight classifications.

STEP 2(A): CALIFORNIA'S CURRENT HEAVY-DUTY CONTROL PROGRAM

Through ongoing efforts, CARB has developed the most stringent and successful heavy-duty vehicle emission control program in the world. Regulatory programs include requirements for increasingly tighter new engine standards, address vehicle idling, certification procedures, on-board diagnostics, emission control device verification, and requires accelerated turnover of the in-use fleet to cleaner, lower-emitting emission control and engine technologies. Ongoing implementation of CARB's current heavy-duty control programs is anticipated to result in a 70 percent reduction in NOx emissions from the on-road heavy-duty sector between 2013 and 2025, as shown in Figure 4.

Figure 4: Programs reducing NOx emissions from heavy-duty trucks in the Valley



The major regulatory and programmatic control measures that provide emission reductions in the on-road heavy-duty mobile source category are described below.

NEW VEHICLE AND ENGINE STANDARDS

Heavy-duty engine emission standards (mandatory standards)

California is the only state with the authority to adopt and enforce emission standards for new motor vehicle engines that differ from the federal emission standards. A central element of CARB's heavy-duty diesel vehicle program is requiring that new trucks, buses and on-road diesel engines meet increasingly stringent engine emission standards. CARB has phased-in implementation of these increasingly stringent ***new heavy-duty vehicle and engine emission standards*** since the mid 1980's, resulting in significant emission reductions.

As shown in Table 10, California PM and NOx engine emission standards have historically been more stringent than applicable federal standards on several occasions, as indicated in the darker shaded portions of the table. In these instances, California has, functioning as a 'laboratory' state, paved the way for later federal increases in the stringency of PM and NOx emission standards. These standards reflect the increased efficiency in control technologies over time, as innovations in vehicles, engines, and emission-capturing technology progress. Since 1990***,*** heavy-duty engine NOx emission standards have become dramatically more stringent, dropping from 6 grams per brake horsepower-hour (g/bhp-hr) in 1990 down to the current 0.2 g/bhp-hr NOx standard, which took effect in 2010. Due to these requirements, new heavy-duty trucks sold since 2010 emit 98 percent less NOx and PM2.5 than new trucks sold in 1986.

On August 26, 2005, CARB obtained a waiver from the federal preemption for the Engine Standards for 2007 and Subsequent Model Year Heavy-Duty Diesel Engines/Vehicles regulation, which generally aligned California's mandatory heavy-duty emission exhaust standards with the federal standards for 2007 and subsequent model year vehicles and engines. Subsequent mandatory exhaust emission standards for heavy-duty engines CARB has developed and adopted have aligned with federal standards.

Beyond the requirements currently in place for heavy-duty engine emission standards, the State SIP Strategy includes a commitment for CARB to develop the next generation of even more stringent Low-NOx Engine Standards for On-Road Heavy-Duty Trucks. CARB began development of new heavy-duty low-NOx emission standards in 2016, and Board action is expected in 2019. CARB staff will continue to coordinate as much as possible with U.S. EPA and urge U.S. EPA to develop a similar federal standard. A ***California low-NOx standard*** would apply to vehicles with new heavy-duty engines sold in California starting in 2023. While CARB's Truck and Bus Regulation will ensure that nearly every heavy-duty vehicle operated in California by 2023 will meet 2010 heavy-duty engine emission standards, even this a highly aggressive full-fleet

Table 10: Adopted California and Federal Heavy-Duty Engine Emission Standards
(for compression-ignition engines, shown in g/bhp-hr)

Model Year	California NOx		Federal NOx	California PM		Federal PM	
	General	Urban Buses		General	Urban Buses	General	Urban Buses
1985 - 86	10.7		10.7	n/a		n/a	
1987	6.0		10.7	0.60		n/a	
1988 - 89	6.0		10.7	0.60		0.60	
1990	6.0		6.0	0.60		0.60	
1991 - 92	5.0		5.0	0.25	0.10	0.25	
1993	5.0		5.0	0.25	0.10	0.25	0.10
1994 - 95	5.0	5.0 3.50 - 0.50 Optional (1995+)	5.0	0.10	0.07	0.10	0.07
1996 - 97	5.0	4.0 2.50 - 0.50 Optional	5.0	0.10	0.05* *(*0.07 in-use)*	0.10	0.05* *(*0.07 in-use)*
1998 - 03	4.0 2.50 - 0.50 Optional		4.0	0.10 0.03 – 0.01 Optional (2002+)	0.05* *(*0.07 in-use)*	0.10	0.05* *(*0.07 in-use)*
2004 - 06	2.0	0.50 - 0.01	2.0	0.10 0.03 – 0.01 Optional	0.01	0.10	0.05* *(*0.07 in-use)*
2007 - 09	0.20* *phased-in (*fleet avg ~1.2)*	0.20	0.20* *phased-in (*fleet avg ~1.2)*	0.01		0.01	
2010 - 14	0.20		0.20	0.01		0.01	
2015+	0.20 0.10 – 0.02 Optional		0.20	0.01		0.01	

penetration of 2010-compliant engines would not provide sufficient NOx reductions to attain the standards in the timeframe required. This drives the need for progressively more stringent heavy-duty engine NOx emission standards. For this reason, the adoption of a more stringent engine performance standard reflecting technology that is effectively 90 percent cleaner than today's standards (i.e. a 0.02 g/bhp-hr low-NOx standard) is a key component of the control strategy for mobile sources in the Valley.

Due to the preponderance of interstate trucking's contribution to in State VMT, federal action would be far more effective at reducing in-State emissions than a California only standard. Federal low-NOx standards could apply to all new heavy-duty trucks sold nationwide starting in 2024 or later. This would ensure that mobile source control measures that are under federal control also satisfy the same BACT/MSM requirements that are discussed in this SIP, and ensure that all trucks traveling within California would eventually be equipped with an engine meeting the lower NOx standard. Federal action is critical to implement this emission standard, since emission reductions from a California-only CARB regulation would come mostly from Class 4-6 vehicles (as most Class 7 and 8 vehicles operating in California were originally purchased outside the State).

To facilitate this effort, CARB staff has been working with U.S. EPA to support the development of federal low-NOx requirements. The San Joaquin Valley District, in partnership with 18 other states and local jurisdictions, submitted petitions to U.S. EPA requesting federal action.[62, 63] As a result of this ongoing engagement, in their final rulemaking on the Phase 2 Greenhouse Gas (GHG) Standards in August of 2016[64], U.S. EPA signaled their intent to begin developing more stringent federal low-NOx emission requirements. Moreover, on December 20, 2016, U.S. EPA responded to the petitions, acknowledging the need for federal action to achieve further NOx reductions from on-road heavy-duty vehicles, and announcing it would initiate the work necessary to begin rulemaking efforts, targeting standards going into effect in the 2024 timeframe.[65] CARB will continue to call on U.S. EPA to move expeditiously in developing these requirements in recognition of the critical public health benefits it will provide.

Optional heavy-duty engine emission standards

In addition to mandatory NOx standards, CARB has also adopted several generations of ***optional lower NOx standards*** over the past 15 years. The optional standards allow local air districts and CARB to preferentially provide incentive funding to buyers of cleaner trucks, which encourages the development of cleaner engines.

- From 1998 to 2003, optional NOx standards ranged from 0.5 g/bhp-hr to 2.5 g/bhp-hr, at 0.5 g/bhp-hr increments, which was much lower than the mandatory 4 g/bhp-hr limit.
- Starting in 2004, engine manufacturers could choose to certify to optional NOx + non--methane hydrocarbon (NMHC) standards ranging from 0.3 g/bhp-hr to 1.8 g/bhp-hr, at 0.3 g/bhp-hr increments, which was significantly below the mandatory 2.4 g/bhp-hr NOx+NMHC standard.
- Most recently, in ongoing efforts to go beyond federal standards and achieve further reductions, CARB adopted in 2014 the ***Optional Reduced Emissions Standards for Heavy-Duty Engines*** regulation, which established the new generation of optional NOx emission standards for heavy-duty engines, and a certification pathway for a new generation of requirements for heavy-duty engines. Starting in 2015, engine manufacturers could certify to three optional NOx emission standards of 0.1 g/bhp-hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than the current mandatory standard of 0.2 g/bhp-hr). This optional standard has resulted in substantial investments in California's heavy-duty fleets over the past decade in order to adopt modern, lower-emitting vehicles and equipment.

[62] SJVAPCD, 2016 *Petition Requesting that EPA Adopt New National Standards for On-Road Heavy-Duty Trucks and Locomotives under Federal Jurisdiction* is available at https://www.epa.gov/sites/production/files/2016-11/documents/san_joaquin_valley_petition_for_hd_and_locomotive.pdf

[63] South Coast AQMD et al, 2016 *Petition to U.S. EPA for Rulemaking to Adopt Ultra-Low NOx Exhaust Emission Standards for On-Road Heavy-Duty Trucks and Engines* is available at https://www.epa.gov/sites/production/files/2016-09/documents/petition_to_epa_ultra_low_nox_hd_trucks_and_engines.pdf

[64] U.S. EPA Phase 2 Greenhouse Gas Standards available at: https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-and-fuel-efficiency.

[65] https://www.epa.gov/regulations-emissions-vehicles-and-engines/petitions-revised-nox-standards-highway-heavy-duty

Warranty Requirements and Useful Life

In 1978, CARB adopted ***emission warranty regulations*** to clarify the rights and responsibilities of individual motor vehicle and engine owners, motor vehicle and engine manufacturers, and the service industry. The emission warranty is used to cover any repairs needed to correct defects in materials or workmanship which would cause an engine or vehicle not to meet its applicable emission standards. In 1982, CARB adopted regulations that established California's first in-use recall program. These regulations were intended to reduce vehicular emissions by ensuring that noncompliant vehicles are identified, recalled, and repaired to comply with the applicable emission standards and regulations during customer use, and to encourage manufacturers to improve the design and durability of emission control components to avoid the expense of a recall. In 1982 and 1984, U.S. EPA promulgated heavy-duty vehicle useful life and warranty requirements identical to those adopted in California. Both U.S. EPA and CARB require that heavy-duty vehicles meet emission standards throughout their useful life periods. The current heavy-duty vehicle emission warranty period is 100,000 miles for all categories of heavy-duty vehicles with GVWR greater than 14,000 lbs.

Beyond the current California requirements described above, the Valley's plan also includes a proposed commitment to ensure that trucks continue to operate as cleanly as possible over their entire useful life. The ***Amended Warranty Requirements for On-Road Heavy-Duty Vehicles*** measure proposes developing lengthened warranty period requirements for on-road heavy-duty vehicles with gross vehicle weight rating (GVWR) greater than 14,000 lbs. The primary goal of this proposed measure is to reduce NOx and PM emissions by encouraging vehicle owners to make emission-related repairs. This measure may also incentivize manufacturers to design more durable components. The current heavy-duty vehicle emission warranty period is 100,000 miles for all categories of heavy-duty vehicles with GVWR greater than 14,000 lbs. This mileage is typically reached relatively early in vehicle lives, especially for vehicles with GVWR greater than 33,000 lbs., and well before the mileage at which rebuild typically occurs. Furthermore, recent CARB studies have identified some heavy-duty vehicles with NOx emission levels significantly above their applicable certification standards while still within the vehicles' useful lives. For this proposed measure, CARB staff would propose lengthening the 100,000 mile emissions warranty, potentially to the useful life for each classification of heavy-duty vehicle type. For example, the new warranty mileage period for Class 8 heavy-duty diesel vehicles could become 435,000 miles, ensuring that emission-related parts are warranted throughout a greater portion of the vehicles' service life.

OBD Requirements

In addition to new vehicle emission standards for the heavy-duty fleet, CARB's suite of control measures also includes actions to ensure that the in-use fleet continues to operate as cleanly as possible through requiring that new vehicles come equipped with in-use inspections and on-board self-diagnostic equipment. On-Board Diagnostics (OBD) systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications.

CARB adopted ***heavy-duty specific OBD requirements (HD OBD)*** in 2005, which applies to 2010 and subsequent model year heavy-duty engines and vehicles (i.e., vehicles with a gross vehicle weight rating greater than 14,000 pounds). This regulation required by 2013 that all heavy-duty engines offered for sale in California come equipped with OBD systems. U.S. EPA issued a waiver of preemption for the California 2010 Model Year Heavy-Duty Vehicle and Engine On-Board Diagnostic Standards in 2008, and has also issued two subsequent waivers for amendments CARB has made to the heavy-duty OBD requirements in later years to increase the stringency of these requirements.[66]

REDUCING IN-USE EMISSIONS

While increasingly stringent standards for new vehicles and engines collectively ensure that new vehicles are as clean as possible, older, higher-emitting heavy-duty vehicles with long useful lifecycles can remain on the road for many years. To address this legacy fleet, CARB has adopted heavy-duty vehicle in-use control measures to significantly reduce PM2.5 and NOx emissions from existing diesel vehicles operating in California. These measures fall within three categories: measures that utilize inspections and maintenance programs in order to improve in-use emission performance levels; truck idling requirements; and fleet turnover rules.

Inspection and Maintenance (I/M) Program

CARB also adopted a suite of control measures to lower in-use emission performance levels to ensure that the heavy-duty vehicles in the in-use fleet continue to operate at their cleanest possible level.

Opacity Limits

The ***Heavy-Duty Vehicle Inspection Program (HDVIP)***, adopted into law in 1988, requires heavy-duty vehicles to be inspected for smoke opacity (i.e., excessive smoke), tampering, and engine certification label compliance. Any heavy-duty vehicle operating in California, including vehicles registered in other states and foreign countries, may be inspected. Inspections are performed by CARB inspection teams at border crossings, California Highway Patrol weigh stations, fleet facilities, and randomly selected roadside locations. Currently, under HDVIP, vehicles equipped with a 1991 model year (MY) or newer engine must meet a 40 percent opacity limit, while vehicles operating with a 1990 MY or older engine must meet a 55 percent opacity limit.

To ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level, the Valley's plan also includes new, supplemental actions to address in-use emissions. The ***Lower Opacity Limits for Heavy-Duty Vehicles*** measure would ensure that in-use, heavy-duty vehicles continue to operate at their cleanest possible level. CARB staff would develop and propose new, supplemental actions to lower the opacity limits for on-road heavy-duty trucks. The current HDVIP and PSIP opacity limits (40 and 55 percent) are no longer adequate to identify and require repairs of vehicles

[66] U.S. EPA 2012 "California State Motor Vehicle Pollution Control Standards; Amendments to the California Heavy-Duty Engine On-Board Diagnostic Regulation; Waiver of Preemption; Final Notice of Decision" Federal Register Volume 77, Number 237 pp. 73459-73461 https://www.gpo.gov/fdsys/pkg/FR-2012-12-10/pdf/2012-29792.pdf

operating with damaged PM emission control components. Even vehicles with heavily damaged and malfunctioning emission control systems emit exhaust at opacity levels below the current, out-of-date, opacity limits. Because of this, many HD vehicles operating in California are emitting excess PM emissions. For this measure, CARB staff would develop and propose lower opacity limits which reflect the current emission control technology equipped on today's HD diesel vehicles. The proposed amendments are intended to improve the identification and repair of malfunctioning PM emission control components on HD diesel vehicles in California. Lowering the opacity limits to the proposed levels would ensure that the opacity limits are more representative of current PM emission control technology and that vehicles operating with malfunctioning PM emission control components are more readily identified and repaired.

I/M Testing

All heavy-duty vehicles in California are subject to in-use inspections in order to control excessive smoke emissions and tampering. The ***Periodic Smoke Inspection Program (PSIP)***, adopted into law in 1990, requires heavy-duty vehicle fleet owners to conduct annual smoke opacity inspections of their vehicles, and have them repaired if excessive smoke emissions are observed. In addition, CARB has the authority to randomly audit these fleets, by reviewing the owners' maintenance and inspection records, and conducting opacity inspections on a representative sample of the vehicles. The current PSIP opacity limits are the same as for HDVIP (40 and 55 percent).

To ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level, the Valley's plan also includes new, supplemental actions to address in-use emissions and compliance. The ***Lower In-Use Performance*** measure will ensure that in-use, heavy-duty vehicles' emission control components and systems are properly functioning so that these vehicles continue to operate at their cleanest possible levels for the duration of their on-road operation. For this measure, CARB staff would develop and propose a regulatory program that reflects the current state of advanced engine and exhaust emission control technologies, including on-board diagnostics (OBD). For this proposed measure, CARB staff would develop and propose a comprehensive, multi-pollutant HD I/M program that that may be based largely on the extensive capabilities of OBD systems in newer engines (2013 and later model year engines) for monitoring the performance of nearly every engine and emission control component. Under the staff's current concept for the HD I/M program, heavy-duty vehicles would be required to demonstrate annual compliance with HD I/M program requirements in order to register with the Department of Motor Vehicles. This program concept also includes the use of telematics for OBD data transmittal to provide ease-of-of access to truckers, as well as an inspection component at physical locations, primarily for program validation and directed vehicle testing, for out-of-State vehicles entering California, or for older vehicles with pre-OBD engines.

Idling Requirements

To reduce idling emissions from new heavy-duty diesel vehicles and emissions from auxiliary power units used as alternatives to heavy-duty vehicle idling, the Airborne Toxic Control Measure (ATCM) to Limit Diesel-Fueled Commercial Motor Vehicle Idling ***(Heavy-Duty Diesel Vehicle Idling Reduction Program)*** requires, among other things, that drivers of diesel-fueled commercial motor vehicles with gross vehicle weight ratings greater than 10,000 pounds, including buses and sleeper berth equipped trucks, not idle the vehicle's primary diesel engine longer than five minutes at any location. First adopted in July 2004 and subsequently amended, the regulation consists of new engine and in-use truck requirements and emission performance requirements for technologies used as alternatives to idling the truck's main engine. Under the new engine requirements, 2008 and newer model year heavy-duty diesel engines need to be equipped with a non-programmable engine shutdown system that automatically shuts down the engine after five minutes of idling. In 2012, U.S. EPA issued a waiver of preemption for the most recent amendments made to the Idling Reduction Program in 2006, beginning in model year 2008.[67]

The ***School Bus Idling Airborne Toxic Control Measure*** (School Bus ATCM) limits bus and commercial motor vehicle idling near schools or at school bus destinations to only when necessary for safety or operational concerns. It has been in effect since July 16, 2003 and reduces emissions from more than 26,000 school buses that operate daily at or near schools. The program targets school buses, school pupil activity buses, youth buses, paratransit vehicles, transit buses, and heavy-duty commercial motor vehicles that operate at or near schools. In 2009, Senate Bill 124, Oropeza (SB 124) acknowledged and codified CARBs ATCM limiting school bus idling raising the minimum penalty for a violation of this rule from $100 to $300. The bill also clarifies local peace officer and air district authority to enforce the state's school bus idling program. SB 124 became effective on January 1, 2010, and the existing regulation was revised to reflect this change.

Fleet rules

CARB's ***Cleaner In-Use Heavy-duty Truck Regulation (Truck and Bus Regulation)*** is the largest measure of this type of control measures, in terms of emission reductions achieved. The Truck and Bus Regulation impacts approximately one million inter- and intra-state vehicles, and requires privately and federally owned diesel fueled trucks and buses and privately and publicly owned school buses to fully upgrade to newer, cleaner engines by 2023. This measure leverages the benefits provided by new truck emission standards by accelerating introduction of the cleanest trucks. The Truck and Bus Regulation was adopted in December 2008, and was amended in both December 2010 and December 2014. The rule represents a multi-year effort to turn over the legacy fleet of engines and replace them with the cleanest technology available. While heavy-duty engine technology has become significantly cleaner in the past few decades, the long useful lives of some heavy-duty engines means that older, higher-emitting trucks remain on the road for many years after newer generations of engine standards have gone into effect.

Starting in 2012, the Truck and Bus Regulation phases in requirements so that by 2014, nearly all vehicles operating in California will have PM emission controls, and by 2023 nearly all vehicles will meet 2010 model year engine emissions levels. The regulation applies to nearly all diesel fueled trucks and buses with a GVWR greater than 14,000

[67] U.S. EPA 2012 "California State Motor Vehicle and Nonroad Engine Pollution Control Standards; Truck Idling Requirements; Final Notice of Decision" Federal Register Volume 77, Number 32, pp. 9239-9250 http://www.gpo.gov/fdsys/pkg/FR-2012-02-16/pdf/2012-3690.pdf

pounds that are privately or federally owned, including on-road and off-road agricultural yard goats, cargo handling equipment, drayage trucks, solid waste collection vehicles, and school buses. Moreover, the regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles. The regulation also establishes requirements for any in-State or out-of-State motor carrier, California-based broker, or any California resident who directs or dispatches vehicles subject to the regulation. Finally, California sellers of a vehicle subject to the regulation must disclose the regulation's potential applicability to buyers of the vehicles. In January 2017, U.S. EPA granted a waiver of preemption for the portions of the Truck and Bus Regulation for which a waiver was required.[68]

The remainder of CARB's in-use heavy-duty truck regulations focus on fleets by trade vocations. These regulations control in-use emissions, and were developed with the unique duty cycles of vehicles and engines engages in these vocational applications in mind.

- The ***2007 Drayage Truck (Port or Yard) Regulation*** accelerates PM and NOx emission reductions from diesel fueled engines involved in moving goods into and out of California's ports, railyards, and intermodal facilities. This regulation requires drayage trucks to utilize engine Model Year 2007 or newer emission controls until December 31, 2022 for ports and rail yards in California, and requires 2010 Model Year or newer engines to continue entering ports and rail yards starting on January 1, 2023. Additionally, drayage trucks are subject to requirements under the Truck and Bus regulation.

- The ***Solid Waste Collection Vehicle Regulations*** were adopted in 2003 to reduce toxic diesel particulate matter (diesel PM) from approximately 12,000 diesel-fueled commercial and residential solid waste collection vehicle (SWCV) and recycling collection vehicles operated in California. The rule applies to all SWCVs of 14,000 pounds or more that run on diesel fuel, have engines in model years (MY) from 1960 through 2006, and collect waste for a fee. Additionally, SWCVs are subject to requirements under the Truck and Bus regulation.

- California's ***Diesel Particulate Matter Control Measure for Municipality or Utility On-Road Heavy-Duty Diesel Fueled Vehicles*** (***Public Agency and Utility Regulation***) requires a municipality or utility that owns, leases or operates on-road diesel fueled vehicles with engine model year 1960 or newer and GVWR greater than 14,000 pounds to reduce PM2.5 emissions to 0.01 g/bhp-hr. This can be done by repowering, retrofitting, or retiring the vehicle. Implementation of the rule started in 2007, with a compliance schedule based on the engine model year. Additionally, public agencies and utilities' fleets may be subject to requirements under the Truck and Bus regulation.

- Adopted in 2000, the ***Fleet Rule for Transit Agencies (Transit Fleet Rule)*** requires reductions in diesel PM and NOx emissions from urban buses and

[68] U.S. EPA 2017 "Final Notice of Decision - On-Highway Heavy-Duty Vehicle and Engine Regulations for 2007 and Subsequent Model Years" Accessed April 30, 2017 at https://www.gpo.gov/fdsys/pkg/FR-2017-01-17/pdf/2017-00940.pdf Federal Register / Vol. 82, No. 10 / Tuesday, January 17, 2017 pp. 4867

transit fleet vehicles, and required future zero-emission bus purchases. Urban bus fleets were required to select either the diesel path or the alternative-fuel path. Transit agencies on the diesel path needed to demonstrate zero-emission buses, and to meet the zero-emission bus purchase requirements sooner, while agencies on the alternative-fuel path had to ensure that 85 percent of urban bus purchases were alternative fueled without a demonstration requirement. The Transit Fleet Rule was amended in 2004, and again in 2006. The 2006 amendments temporarily postponed the zero-emission bus purchase requirement (until 2011 and 2012, depending on the compliance path) and expanded the initial demonstration with a subsequent advanced technology demonstration phase. In 2009, CARB staff provided a technology update to the Board on the commercial readiness of zero-emission buses, and received Board direction to research and develop commercial readiness metrics to be used as criteria to initiate the zero-emission bus purchase requirement, and to conduct a technology assessment on the readiness of zero-emission bus technologies. U.S. EPA granted CARB a waiver of preemption for the Fleet Rule for Transit Agencies in 2013.[69] Additionally, transit fleets are subject to requirements under the Truck and Bus regulation.

Although ZEV and PHEV technologies are not as mature for heavy-duty trucks as they are in the passenger vehicle sector, Class 3 - 7 delivery trucks and urban buses provide opportunities for introducing ZEV technologies. Several control measures committed to in the State SIP Strategy therefore focus on the deployment of zero-emission technologies in targeted applications, due to their duty cycle, are well-suited to the initial introduction of heavy-duty zero-emission engines, beginning in 2018 to 2020. For example, transit buses, last mile delivery vehicles, and airport shuttle buses are typically operated on short-distance fixed routes and are centrally housed, and may be captive to the District – characteristics that make these applications ideally suited to deploying zero-emission vehicles in targeted heavier applications preceding broader penetration in the heavy-duty engine market. These initial deployments provide a foundation for subsequent migration of zero-emission technology to other heavier platforms, in order to continue to expand heavy-duty ZEV requirements in the long term, especially in certain vocational classes and fleets that are under California regulatory authority.

- The ***Innovative Clean Transit*** measure will support the transition to a suite of cleaner transit options and reduce emissions from transit fleets. Under this measure, CARB staff will develop mechanisms to support the transition to a suite of innovative clean transit options, achieving emission reductions by supporting timely implementation of advanced technologies and improving efficiencies of the transit system.

- To reduce emissions from Classes 3-7 heavy-duty delivery trucks predominately used in urban areas to deliver freight from warehouses and distribution centers to its final point of sale or use, the ***Advanced Clean Local Trucks*** measure will increase the use of low-NOx engines and accelerate the deployment of

[69] U.S. EPA 2013, "California State Motor Vehicle Pollution Control Standards; Urban Buses; Request for Waiver of Preemption; Final Notice of Decision" Federal Register July 23, 2013 Volume 78, Number 141 pp. 44112-44117 https://www.gpo.gov/fdsys/pkg/FR-2013-07-23/pdf/2013-17700.pdf

zero-emission trucks. Experience gained from demonstrating the viability of advanced technologies in these fleets will benefit the market and enable the same technologies to be used in other heavy-duty vehicle applications.

- The ***Zero-Emission Airport Shuttle Bus*** measure is also designed to achieve NOx emission reductions through deployment of zero-emission airport shuttles. Airport shuttle buses transport passengers between car parking lots, airport terminals, and airport car rental facilities. Like transit buses and last mile delivery trucks, the inclusion of zero-emission airport shuttles would serve as a stepping stone to encourage broader deployment of zero-emission technologies in the on-road sector.

Fuels

In addition to new engine and in-use standards, cleaner burning fuels represent an important component in reducing emissions from on-road heavy-duty diesel trucks and buses. Cleaner fuel has an immediate impact in reducing emissions from the mobile source, and thus represent an important component in reducing NOx and diesel PM emissions from the on-road heavy-duty fleet. California's stringent air quality programs treat motor vehicles and their fuels holistically (as a system, rather than as separate components). As a result, CARB's fuels programs achieve significant reductions in criteria emissions from motor vehicles used in California.

CARB Diesel Fuel Regulations

The California diesel fuel program sets stringent standards for diesel fuel sold in California, and ensures that in-use diesel engines continue to operate as cleanly as possible. CARB's Diesel Fuel Regulations have, over time, phased in more stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur (a precursor to formation of secondary PM), and have establish a lubricity standard which apply fuels used in on- and off-road applications in California. ***"CARB diesel" Specifications*** adopted in 1988 limited the allowable sulfur content of diesel fuel 500 parts per million by weight (ppmw), and the aromatic hydrocarbon content to 10 percent, and became effective in 1993.

In 2003, ***CARB's Ultra Low Sulfur Diesel (ULSD) Regulation*** increased the stringency of the sulfur content limits in to 15 ppm, which harmonized with the 1993 U.S. EPA regulation that also limited sulfur in on-road diesel fuels to the same level. Both the California and federal ULSD regulations began implementation in 2006. CARB's ULSD Regulation had an immediate impact in reducing emissions from the in-use on-road heavy-duty fleet, while also enabling the use of advanced emissions control technologies, including the use of catalyzed diesel particulate filters (DPF), NOx after-treatment, and other advanced after-treatment based emission control technologies that higher sulfur levels would have inhibit the performance of (at the time of CARB's ULSD rulemaking, the average sulfur content of California diesel was approximately 140 ppmw).

Controlling Criteria Emissions from Renewable Fuels

The ***Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) Regulations,*** as amended in 2014, work together to reduce the carbon intensity of the California fuel supply. The regulations also limit criteria emissions from alternative fuels and/or alternative fuel mix blends (a mix of fuels made from renewable feedstocks, which are then blended with conventional gasoline or diesel).

Beyond the current fuels control program, CARB committed to develop a ***Low Emission Diesel*** Measure that will require diesel fuel providers to steadily decrease criteria pollutant emissions from their diesel products. The use of low-emission diesel in on-road vehicles and off-road equipment will reduce tailpipe NOx and PM emissions, in addition to other criteria pollutants. Some studies carried out to date on hydrotreated vegetable oil have reported NOx emission reductions of 6 percent to 25 percent and PM emission reductions of 28 percent to 46 percent, depending on the types of fuels, drive cycles tested, and diesel engines used. This standard is anticipated to both increase consumption of low-emission diesel fuels, and to reduce emissions from conventional fuels. This measure is anticipated to provide NOx benefits predominately from legacy (pre-2010) on-road heavy-duty vehicles, off-road engines, stationary engines, portable engines, marine vessels and locomotives, as well as NOx and diesel PM benefits in potentially all model year off-road engines, stationary engines, portable engines, marine vessels and locomotives. Interstate vehicles, even those registered out-of-State but operating on CARB diesel blended with low-emission diesel, are also anticipated to provide emission reduction benefits.

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' ON-ROAD HEAVY-DUTY CONTROL MEASURES

Table 11 summarizes the most stringent control measures currently in use in any state or nonattainment that have been identified and discussed for on-road heavy-duty vehicles. Each of the measures identified in this table are discussed in more detail in this section, below.

Table 11: Summary of Most Stringent Heavy-Duty Control Measures Identified

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
New Engine Standards			
New Vehicle and Engine Standards • Heavy-duty engine emission standards (mandatory standards)	Current CARB and U.S. EPA limit exhaust emissions to same levels: • NOx: 0.2 g/bhp-hr • PM: 0.01 g/bhp-hr CARB anticipated to propose to further increase stringency to ~0.02 g/bhp-hr (NOx). • *(Low-NOx Truck measure)*	CARB's current emission standards for heavy-duty engines (NOx and PM) are set at the same level of stringency as Federal standards. CARB is anticipated to further increase the stringency of controls by proposing California NOx standards that are effectively 90 percent cleaner than today's federal NOx standards (i.e. 0.02 g/bhp-hr) *(NOTE: CARB has committed to develop the Low-NOx Truck measure but it has not yet been proposed to the Board for approval/adoption.)*	No other state has more stringent exhaust emission standards than California.
New Vehicle and Engine Standards • Optional heavy-duty engine emission standards	Optional Low NOx Emission Standard (CARB) • 0.1 g/bhp hr, 0.05 g/bhp-hr, or 0.02 g/bhp-hr	CARB's optional standards accelerate the pace of innovation and development of cleaner engine technologies by certifying engines that go beyond the stringency of federal standards. Starting in 2015, engine manufacturers could choose to certify to three optional NOx emission standards of 0.1 g/bhp hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than the current mandatory standard of 0.2 g/bhp-hr). Together with the mandatory standards that harmonize with federal emission requirements, this program makes California's suite of HD engine emission controls the most stringent in the nation.	California is the only state with optional exhaust emission standards for heavy-duty engines that exceed the stringency of U.S. EPA requirements.
New Vehicle and Engine Standards • Warranty Requirements and Useful Life	CARB's warranty requirements are currently set at the same level of stringency as Federal standards. CARB anticipated to propose to further increase stringency *(Amended Warranty Requirements for On-Road HD Vehicles measure)*	Both U.S. EPA and CARB currently require that heavy-duty vehicles meet emission standards throughout their useful life periods of 5 years / 100,000 miles (GVWR > 14,000 lbs.) CARB is anticipated to further increase the stringency of controls by proposing lengthened warranty period requirements, potentially up to >400,000 miles. *(NOTE: CARB has not yet been proposed the Amended Warranty Requirements for On-Road HD Vehicles measure to the Board for approval/adoption.)*	No other state has more stringent warranty requirements than California.
New Vehicle and Engine Standards • OBD Requirements	Heavy-Duty OBD (CARB) and OBD II (CARB)	CARB and federal OBD regulations for heavy-duty vehicles generally align for MY2013 and newer engines, although CARB's program has been amended to be more stringent than U.S. EPA's for certain vehicle types. California OBD requirements are at least as stringent as applicable federal requirements.	No other state has more stringent OBD requirements than California.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
In-Use Emission Controls			
In-Use Emissions Controls • I/M program (opacity limits)	New Jersey (NJ) has more stringent opacity limits than CARB's currently adopted regulations. However, the Valley's plan proposes to increase the stringent of CARB's opacity limits, which would it the most stringent in the nation. *(Lower Opacity Limits measure)*	CARB's current HVIP program sets opacity limits at 40% (for MY1991 and newer) and 55% (MY1990 and older). CARB is anticipated to further increase the stringency of controls by proposing to lower the opacity limits for non-DPF-equipped vehicles to a range equivalent to NJ's program (20% – 40%), and to 5% for DPF-equipped engines. *(NOTE: CARB has committed to develop the Lower Opacity Limits measure but it has not yet been proposed to the Board for approval/adoption.)*	New Jersey's opacity limits range from 40% - 20%
In-Use Emissions Controls • I/M program (Testing)	California's current I/M program for heavy-duty vehicles is the most stringent in the nation. CARB anticipated to propose to further increase stringency. *(Lower In-Use Performance Level measure)*	CARB's I/M program (including the HDVIP and PSIP regulations) is the most stringent in the nation, with further increases in stringency anticipated to be proposed. *(NOTE: CARB has committed to develop the Heavy-Duty Vehicle Inspection and Maintenance Program measure, but it has not yet been proposed to the Board for approval/adoption.)*	Three other states also test OBD in heavy-duty vehicles (MA, NJ, and WI), but none aside from California are currently enforcing on OBD scans for vehicles >14,000 lb. GVWR. Additionally, they do not control emissions from out-of-state trucks, or include the potential use of telematics like CARB.
In-Use Emissions Controls • Idling requirements	Heavy-Duty Diesel Vehicle Idling Reduction Program (CARB)	CARB's program the most stringent in the nation. It limits idling time to five minutes, and requires that MY 2008 and newer engines are equipped to automatically shut down after five minutes of idling. While other jurisdictions have adopted similar idling time limits requirements – some with more stringent time limits than CARB – none surpassed the stringency of California's program in effect, because emission performance requirements for idle reduction technologies are unique to California's program.	Areas with more stringent time limits: • 2 minute restrictions, no exemptions: Philadelphia, PA • 2 minute restrictions, some exemptions: Salt Lake City and Salt Lake County, UT • 3 minute restrictions, some exemptions: CT, DC, City of Ketchum (ID), New York City (NY), the Village of Larchmont (NY), the Village of Mamaroneck (NY), the County of Westchester (NY), Park City (UT), and the City of Birmingham (VT) Areas with less stringent time limits: • 3 minute restrictions, some exemptions DE, Chicago (IL), NJ, Town of Mamaroneck (NY), and Rockland County (NY)

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
In-Use Emissions Controls • Fleet Rules (Truck and Bus)	Truck and Bus Regulation (CARB)	CARB's Truck and Bus regulation is the most comprehensive and stringent mandatory heavy-duty fleet turnover rule in the nation, affecting approximately one million inter- and intra-state on-road diesel vehicles. The regulation applies to nearly all privately or federally owned diesel-fueled trucks and buses > 14,000 lbs., GVWR, including on-road and off-road agricultural yard goats, cargo handling equipment, drayage trucks, solid waste collection vehicles, and school buses. Its phased-in requirements mandate diesel particulate filters in early years, eventually requiring vehicles to fully upgrade to newer, cleaner engines that meet MY 2010 engine equivalent emissions levels when fully implemented in 2023.	No other state requires diesel particulate filters (DPF) and MY 2010 + equivalent engines as a mandatory fleet rule affecting nearly the entire on-road diesel fleet
In-Use Emissions Controls • Fleet Rules (Drayage Trucks)	Drayage Truck (Port or Yard) Regulation and Truck and Bus Regulation (CARB)	California's emission controls for drayage trucks are the most stringent in the country. The Drayage Truck (Port or Yard) Regulation requires 2010 Model Year or newer engines at ports and rail yards starting in 2023.	No other jurisdiction mandates more stringent fleet requirements for drayage trucks.
In-Use Emissions Controls • Fleet Rules (Solid Waste Collection Vehicles)	Solid Waste Collection Vehicle Regulations and Truck and Bus Regulation (CARB)	California's solid waste collection vehicles (SWCVs) fleet control program is the most stringent in the nation. Compared to New York City's program, CARB's Solid Waste Collection Vehicles regulation limits PM emissions at approximately the same level of stringency; because these vehicles are also subject to more stringent requirements under Truck and Bus, however, the overall level of emission controls are more stringent in California than any other jurisdiction.	New York City (NY) requires that at least 90 percent of the ~8,300 qualifying privately and publicly-owned SWCVs meet the U.S. EPA's 2007 diesel standard for PM. Comparatively, CARB controls ~12,000 SWCVs (MYs 1960 through 2006) at approximately the same level of PM control (i.e. equivalent to the 2007 MY standard of 0.01 g/bhp-hr).
In-Use Emissions Controls • Fleet Rules (Public fleets)	Public Agency and Utility Regulation and Truck and Bus Regulation (CARB)	California's public fleet controls are the most stringent in the nation. CARB's Public Agency and Utility Regulation requires similar stringency in PM emissions limits as the Boston, MA program; because these fleets are also subject to more stringent requirements under Truck and Bus, the overall level of emission controls are more stringent in CA than any other jurisdiction.	The city of Boston (MA) requires by 2018 all pre-2007 diesel vehicles and equipment not previously retrofit to be controlled to achieve emission reductions of at least 85 percent (approximately equivalent to the 2007 PM standard of 0.01 g/bhp-hr). Comparatively, CARB limits are set equivalent to the 2007 MY standard of 0.01 g/bhp-hr for engine MY 1960 or newer, GVWR > 14,000 lbs.
In-Use Emissions Controls • Fleet Rules (Transit fleets)	Transit Fleet Rule (CARB) CARB anticipated to propose to further increase stringency. *(Innovative Clean Transit measure)*	California's emission controls for transit vehicles are the most stringent in the country. The Transit Fleet Rule requires emission reductions (PM and NOx) from urban buses and transit fleet vehicles, and required future zero-emission bus purchases. Further increases in the stringency of public fleet controls are anticipated under the Innovative Clean Transit measure. *(NOTE: CARB has committed to develop Innovative Clean Transit measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other jurisdiction mandates more stringent fleet requirements for transit fleets.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
In-Use Emissions Controls • Fleet Rules (Last mile delivery trucks)	Truck and Bus Regulation (CARB) CARB anticipated to propose to further increase stringency. *(Advanced Clean Local Trucks measure)*	California's emission controls for last mile delivery vehicles (Class 3-7 heavy-duty delivery trucks used to deliver freight from warehouses and distribution centers to the final point of sale or use) are the most stringent in the country. Truck and Bus requires MY 2010 or equivalent engines by 2023. Further increases in the stringency of last mile delivery fleets are anticipated under the Advanced Clean Local Trucks measure. *(NOTE: CARB has committed to develop the Advanced Clean Local Trucks measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other jurisdiction mandates more stringent fleet requirements for last mile delivery trucks.
In-Use Emissions Controls • Fleet Rules (Airport shuttle buses)	Truck and Bus Regulation (CARB) CARB anticipated to propose to further increase stringency. *(Zero-Emission Airport Shuttle Bus measure)*	California's emission controls for airport shuttle buses (vehicles used to transport passengers between car parking lots, airport terminals, and airport car rental facilities) are the most stringent in the country. Truck and Bus requires MY 2010 or equivalent engines by 2023. Further increases in the stringency of airport shuttle buses and similar fleets are anticipated under the Zero-Emission Airport Shuttle Bus measure. *(NOTE: CARB has committed to develop Zero-Emission Airport Shuttle Bus measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other jurisdiction mandates more stringent fleet requirements for airport shuttle buses.
In-Use Emissions Controls • Fleet Rules (School Buses)	Truck and Bus Regulation (CARB)	California's emission controls for school buses are the most stringent in the nation. The Truck and Bus regulation requires that all school buses fully upgrade by 2023 to engines that meet MY 2010 engine emissions levels. Since 2003, California also limits bus and vehicle idling time near schools or at school bus destinations through the School Bus ATCM, reducing emissions from >26,000 school buses operating daily at or near schools.	Colorado (CO) controls emissions from school buses through a School Bus Retrofit Program funded by DERA Grants from U.S. EPA. This voluntary program began in 2009, and controls PM emissions through retrofits. CARB staff is unaware of any other jurisdictions that mandate retrofits or turnover of the school bus fleet to ensure engines meet MY2010-equivalent level of controls.
Fuels Programs			
Fuels Standards • Diesel Standards	CARB Diesel Fuel Regulations and Ultra Low Sulfur Diesel (CARB)	CARB Diesel Fuel Regulations include stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur, and have establish a lubricity standard and applies to sales of fuel used in on-road vehicles and off-road vehicles and locomotives in California CARB's Ultra-Low Sulfur Diesel (ULSD) program reduces ozone precursor emissions significantly relative to U.S. EPA requirements (providing approximately 7 percent more NOx reductions and 25 percent more dPM reductions than federal diesel).	No state requires cleaner burning diesel than California. The California diesel fuel regulations exceed federal requirements in stringency.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
On-Road Heavy-Duty Vehicles			
Fuels Standards • Alternative Fuel Standards (Diesel substitutes)	LCFS and ADF (CARB) CARB is anticipated to propose to further increase stringency. *(Low Emission Diesel measure)*	The LCFS and ADF regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends. CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products. *(NOTE: CARB has committed to develop the Low Emission Diesel measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other state has set as stringent of criteria emission requirements on alternative fuels and alternative fuel blends than California.

NEW HEAVY-DUTY VEHICLE AND ENGINE STANDARDS

Heavy-duty engine emission standards

CARB's truck engine standards for on-road heavy-duty engines are consistent with the most stringent of any other area in the nation. Due to constraints in the Act, California is the only state that can set new engine standards (including control measures such as emission standards, warranty provisions, and on-board diagnostic (OBD) requirements) that are more stringent than U.S. EPA's national standards. Other states may adopt California programs for which U.S. EPA has provided California with waivers (under provisions specified in Section 177). These states are also known as the "Section 177 States" in reference to this provision of the Act. The ability to set more stringent controls than U.S. EPA, however is unique to California, and thus ensures that the California control measures for new engine and truck standards are at least equal in stringency to the most stringent controls in the nation.

Similar to the light-duty sector, as provided for in the Act, a number of other states have historically followed California's lead and adopted at least one of California's heavy-duty regulations. These states are listed below in Table 12.

Table 12: Section 177 for CARB's Heavy-Duty Engine Emission Standards

Section 177 States	Heavy-Duty Diesel Engine Regulation
Connecticut	X
Delaware	X
Georgia	X
Maine	X
Massachusetts	X
New Jersey	X
New York	X
North Carolina	X
Pennsylvania	X

CARB's current heavy-duty engine emission standards sets exhaust emission standards for PM2.5 at 0.01 g/bhp-hr and NOx at 0.2 g/bhp-hr. This aligns with the applicable federal standards set by U.S. EPA, which are also set at the same levels of stringency.[70]

With the adoption and implementation of the proposed Low-NOx Standards for Heavy-Duty Vehicles, CARB will further increase the stringency of these requirements to reduce NOx exhaust emissions standards to 0.02 g/bhp-hr (i.e. 90 percent lower than the current mandatory standard).

Optional engine emission standards

To achieve further reductions and incentivize ongoing development of increasingly more efficient engine technologies, CARB has also provided certification to optional emission

[70] U.S. EPA 2016 "Heavy-Duty Highway Compression-Ignition Engines and Urban Buses: Exhaust Emission Standards" https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZZ.pdf accessed May 1, 2018.

standards at levels 50 percent, 75 percent, and 90 percent cleaner than currently mandated emission standards. This allows CARB and local air districts to preferentially incentivize and fund the purchase of cleaner trucks and engines than would have otherwise met the mandatory standard. CARB staff is unaware of any other state with a similar control program.

Certification and Warranty Requirements

CARB's certification and warranty requirements for new on-road heavy-duty vehicles exceeds the stringency of any other in the nation. California is the only state with certification and warranty requirements for new on-road heavy-duty engines that exceed the stringency of U.S. EPA requirements.

Lower In-Use Emission Performance Standards and Test Procedures

CARB's in-use emission performance standards and test procedures for new on-road heavy-duty engines and vehicles exceeds the stringency of any other in the nation. California is the only state with emission performance standards and test procedures for new on-road heavy-duty engines and vehicles that exceed the stringency of U.S. EPA requirements.

OBD Requirements

CARB's OBD requirements for new on-road heavy-duty vehicles exceeds the stringency of any other in the nation. California is the only state with OBD requirements for new on-road heavy-duty engines that exceed the stringency of U.S. EPA requirements.

IN-USE EMISSION CONTROLS FOR HEAVY-DUTY VEHICLES

In-Use Inspection Program

The Inspection / Maintenance (I/M) Program testing and in-use emission controls in the Valley for on-road heavy-duty trucks and buses are consistent with the most stringent of any other I/M program in the nation.

Opacity Limits

During the current year of 2018, New Jersey has more stringent opacity limits than California[71], but this differential will be fully addressed through the ***Lower Opacity Limits for Heavy-Duty Vehicles*** measure as described in the Valley's plan; when implemented in 2019, California opacity limits will once again become the most stringent in the nation.

I/M Testing

CARB's HDVIP program requires heavy-duty trucks and buses to be inspected for excessive smoke and tampering, and engine certification label compliance, including all applicable OBD requirements. Any heavy-duty vehicle traveling in California, including vehicles registered in other states and foreign countries, may be tested. Tests are performed by CARB inspection teams at border crossings, weigh stations, fleet facilities, and randomly selected roadside locations. Owners of trucks and buses found in

[71] For more information on the New Jersey Opacity Limits, please see http://www.nj.gov/dep/bmvim/bmvim_emisStds.htm

violation are subject to minimum penalties starting at $300 per violation. The PSIP program requires that diesel and bus fleet owners conduct annual smoke opacity inspections of their vehicles and repair those with excessive smoke emissions to ensure compliance. CARB randomly audits fleets, maintenance and inspection records and tests a representative sample of vehicles. All vehicles that do not pass the test must be repaired and retested. A fleet owner that neglects to perform the annual smoke opacity inspection on applicable vehicles is subject to a penalty of $500.00 per vehicle, per year.

Comparatively, three other states have efforts to include OBD testing on heavy-duty vehicles, which are summarized below:

- Massachusetts currently requires opacity testing for diesel engines over 14,000 lbs., GVWR, and OBD testing starting at 2007, with plans to develop a more stringent OBD testing program that will include OBD testing on vehicles 14,000 lbs., GVWR and above.
- New Jersey currently requires opacity testing for diesel engines over 18,000 lbs., GVWR, and has announced the award of a new program to include OBD testing on all diesels over 18,000 lbs., GVWR
- Wisconsin currently requires OBD testing for diesel engines up to 14,000 lbs., GVWR, which began in 2007. Wisconsin is considering an option to move toward testing OBD on 14,000 lbs., GVWR and above in the future.

While Massachusetts and New Jersey are developing similar I/M programs as California (all three states are collecting OBD test data for vehicles over 14,000 lbs., GVWR) no jurisdictions aside from California are currently enforcing on OBD scans for vehicles over 14,000 lb. GVWR. Furthermore, none include the potential use of telematics or are trying to also capture out-of-State trucks in the program as California's control program does. Thus, CARB's I/M testing controls are the most stringent in the nation.

Idling Requirements

The idling requirements in the Valley's plan are aligned with the most stringent in the nation. California has a 5-minute idling time restriction. In addition, it has emission performance requirements for alternative idle reduction technologies such as auxiliary power units (APU) and fuel-fired heaters. While other states have adopted similar HD idling requirements as California, none have surpassed the stringency of California requirements in effect, due to the unique exemptions provided California under the CAA that enables CARB to set emissions performance requirements that exceed the stringency of those required by U.S. EPA. The following states, counties and cities have more stringent timing requirements for idling time restrictions. However, they do not set performance requirements for idle reduction technologies to reduce the intensity of emissions emitted over a given amount of time.

- The City of Philadelphia (PA) has the most stringent idling restriction of 2-minutes with no exemptions.

- Salt Lake City and Salt Lake County in Utah have also idling restrictions of 2 minutes with some exemptions but still more stringent than California idling restrictions.
- Connecticut, the District of Columbia, City of Ketchum (Idaho), New York City (NY), the Village of Larchmont (NY), the Village of Mamaroneck (NY), the County of Westchester (NY), Park City (Utah), and the City of Birmingham (Vermont) have idling time restriction of 3 minutes with some exemptions.
- Delaware, Chicago (Illinois), New Jersey, Town of Mamaroneck (NY), and Rockland County (NY) also have 3-minute idling restrictions, but their exemptions make their rules less stringent than California idling rule.

Only California has emission performance requirements for idle reduction technologies. Therefore, even if another jurisdiction has an idle time restriction shorter than California's 5-minute idling restriction, for sleeper cabs that use APUs as an alternative technology, California's regulation is more stringent because of the differences in APU emissions. Thus, all other state, county, or city idling rules are less stringent than California's idling restriction.

Heavy-Duty Fleet Rules

California's fleet rules for heavy-duty trucks and buses are the most stringent of any in the nation. The Truck and Bus regulation requires that by 2014, nearly all vehicles operating in California will have PM emission controls, and by 2023 nearly all vehicles will meet 2010 model year engine emissions levels. The regulation applies to nearly all diesel fueled trucks and buses with a gross vehicle weight rating greater than 14,000 pounds that are privately or federally owned, including on-road and off-road agricultural yard goats, and privately and publicly owned school buses. Moreover, the regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles.

Additionally, California has adopted and implemented fleet-specific rules that are consistent with the most stringent in the nation.

- Public Fleet Rules
  The city of Boston (MA) requires that all pre-2007 City-owned or operated vehicles to have equipment that reduces diesel emissions by at least 20 percent by the end of 2015, and that all pre-2007 diesel vehicles and equipment not previously retrofit would be required to have retrofits achieving at least 85-percent—or best available—pollution reductions by the end of 2018.

  Comparatively, California's statewide Public Agency and Utility Regulation requires any municipality or utility that owns, leases or operates on-road diesel fueled vehicles with engine model year 1960 or newer and GVWR greater than 14,000 pounds to reduce PM2.5 emissions to 0.01 g/bhp-hr. This can be done by repowering, retrofitting, or retiring the vehicle. Implementation of the rule started in 2007, with a compliance schedule based on the engine model year.

- Solid Waste Vehicles
  New York City (NY) is implementing a control measure that began in 2017 to modernize the city's fleet of diesel-powered solid waste vehicles of approximately 2,000 trucks used for picking up residential waste and recyclables with newer, less-polluting models. This program requires that at least 90 of qualifying vehicles must meet the tougher emission control standards for diesel trucks that the federal Environmental Protection Agency set in 2007.[72] A newly proposed control measure would strengthen those requirements to apply to approximately 8,300 private collection trucks to meet the same federal emissions standards by 2020, three years after the deadline for the municipal fleet. This new proposal has not been adopted by the City Council, whose vote is required.[73]

  Comparatively, California's Solid Waste Collection Vehicle Regulation was adopted in 2003 to reduce toxic diesel PM from approximately 12,000 diesel fueled commercial and residential SWCV and recycling collection vehicles operated in California. The rule applies to all SWCVs of 14,000 pounds or more that run on diesel fuel, have engines in MYs from 1960 through 2006, and collect waste for a fee.

- School Buses
  Colorado controls emissions from school buses through a School Bus Retrofit Program funded by DERA Grants from U.S. EPA. This program began in 2009, and reduces emissions of diesel exhaust by retrofitting school buses with proven emissions-reduction technologies, including diesel-oxidation catalysts, engine preheaters and closed-crankcase filtration systems.

  Comparatively, California's Truck and Bus regulation requires that all privately and publicly owned school buses to fully upgrade by 2023 to newer, cleaner engines that meet 2010 model year engine emissions levels. California also limits bus and vehicle idling time near schools or at school bus destinations through the School Bus ATCM. It has been in effect since 2003 and reduces emissions from more than 26,000 school buses that operate daily at or near schools. The program targets school buses, school pupil activity buses, youth buses, paratransit vehicles, transit buses, and heavy-duty commercial motor vehicles that operate at or near schools.

FUELS

Diesel Fuel Regulations

U.S. EPA began regulating sulfur content in diesel in 1993. At that time, uncontrolled fuels (i.e. non-CARB diesel) contained approximately 5,000 parts per million (ppm) of sulfur. In 2006, U.S. EPA began to phase-in more stringent requirements under the federal Ultra-Low Sulfur Diesel (ULSD) regulations, which lowered the amount of sulfur in on-road diesel fuel to 15 ppm. The Onroad (Highway) Diesel Fuel Standard was

[72] https://www.nytimes.com/2016/08/19/opinion/how-garbage-trucks-can-drive-a-green-future.html
[73] ibid

phased-in from 2006 to 2010, and since 2011 have required that all highway diesel fuel supplied to the market be ULSD, and that all highway diesel vehicles must use ULSD. CARB's ultra-low sulfur diesel program limits sulfur content at the same levels as U.S. EPA's on-road ULSD program (i.e. at 15 ppm); however, due to other specifications that uniquely apply to CARB diesel, the California program reduces emissions significantly relative to federal diesel, about 7 percent reduction in NOx and 25 percent in diesel PM.[74]

Beyond the federal diesel requirements described above, the Act also allows states to adopt unique fuel programs to meet local air quality needs, which are referred to as Boutique Fuel Programs. As of January 19, 2017 U.S. EPA identified only one boutique fuel programs that had been approved in a SIP,[75] the Low Emission Diesel Program in Texas (TxLED). The fuel specifications for the TxLED are based on CARB diesel requirements,[76] and fuel formulations approved by CARB are also considered approved by the Texas Commission on Environmental Quality (TCEQ), and may be used to comply with the TxLED regulations.[77] Additionally, independent analysis of TxLED, CARB ULSD and federal ULSD shows that the TxLED fuel emissions performance does not provide as significant of emission reduction benefits as the California specifications,[78] although U.S. EPA credited the TxLED program with providing approximately a 5% NOx emission reduction benefit over federal ULSD fuels.[79] Furthermore, the stringency of Texas' testing requirements are based on the federal Complex Model, which is less stringent and nuanced than the California Predictive Model that is used to determine compliance with California fuel requirements.

Controlling Criteria Emissions from Renewable Fuels

The Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) regulations work together to limit criteria emissions from alternative fuels. While other states have adopted or are considering adopting similar programs to the California LCFS, no other state has set criteria emission requirements on alternative fuels. U.S. EPA's Renewable Fuel Standard (RFS II) does not specify criteria emission requirements for alternative fuels. Furthermore, CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products under the Low Emission Diesel measure. No other state or nonattainment area controls criteria emissions from renewable fuels more stringently than CARB.

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[74] Beyond sulfur limits at 15 ppm, CARB's program also requires the aromatic hydrocarbon content of the diesel fuel sold in the state not to exceed 10 percent by volume. Alternative diesel fuel formulations can be used to demonstrate equivalent compliance without actually meeting the aromatic limit.

[75] U.S. EPA, 2017 https://19january2017snapshot.epa.gov/gasoline-standards/state-fuels_.html

[76] Texas Administrative Code Title 30 Part I Chapter 114 Subchapter H, Division 2 Rule §114.312 http://texreg.sos.state.tx.us/public/readtac%24ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=114&rl=312

[77] Texas Commission on Environmental Quality https://www.tceq.texas.gov/assets/public/implementation/air/sip/texled/List%20of%20TCEQ-Approved%20Alternative%20Diesel%20Formulations.pdf

[78] American Transportation Research Institute (ATRI) 2008 "Energy and Other Fuel Property Changes with On-Road Ultra-Low Sulfur Diesel Fuel" http://www.atri-online.org/research/results/environmentalfactors/2008ATRIDiesel.pdf

[79] U.S. EPA 2001, "Approval and Promulgation of Air Quality State Implementation Plans (SIP); Texas: Low Emission Diesel Fuel" https://www.federalregister.gov/documents/2001/11/14/01-27581/approval-and-promulgation-of-air-quality-state-implementation-plans-sip-texas-low-emission-diesel Federal Register Vol. 66, No. 220 pages 57196-57219

STEP 3(A): EVALUATION OF STRINGENCY: ON-ROAD HEAVY-DUTYCONTROL MEASURES

Step 3(a) calls for an evaluation of each of the control measures identified in Step 2, in order to evaluate their stringency and determine whether they meet all applicable requirements to satisfy the definitions of BACM and/or MSM discussed in Chapter 1 and Chapter 2.

in order to determine whether each potential MSM/BACM measure meets the definition of MSM and/or BACM, staff has assessed each potential MSM/BACM on-road heavy-duty vehicle control measure identified in Steps 2(a) and 2(b). Based on this assessment, staff then characterized each potential MSM / BACM measure as falling into 'bins' representing whether it meets the definition of MSM or BACM for each of the four PM2.5 standards covered in this document (note that the BACM bin is further subdivided into BACT or ADF). The determination of which bin each control measure falls into thus indicates both the control measure' stringency and the control measures' implementation schedule, relative to the varying attainment dates among the Valley's four PM2.5 SIPs. In other words, the bin into which each control measure falls correlates with how hard each measure pushes to control emissions, given the implementation timeframes associated with each standards' plan. Generally speaking, the control measures included in CARB's current control program meet the definition of BACM; the new measures included in the Valley SIP Strategy satisfy MSM requirements.

Figure 5 shows the timing for implementation of each potential MSM / BACM on-road heavy-duty vehicle control measure identified in the prior sections (i.e. Steps 2(a) and 2(b)), for each of the four PM2.5 standards discussed in this SIP.

Figure 5: Timeline for Implementation of BACM / MSM Heavy-Duty Control Measures

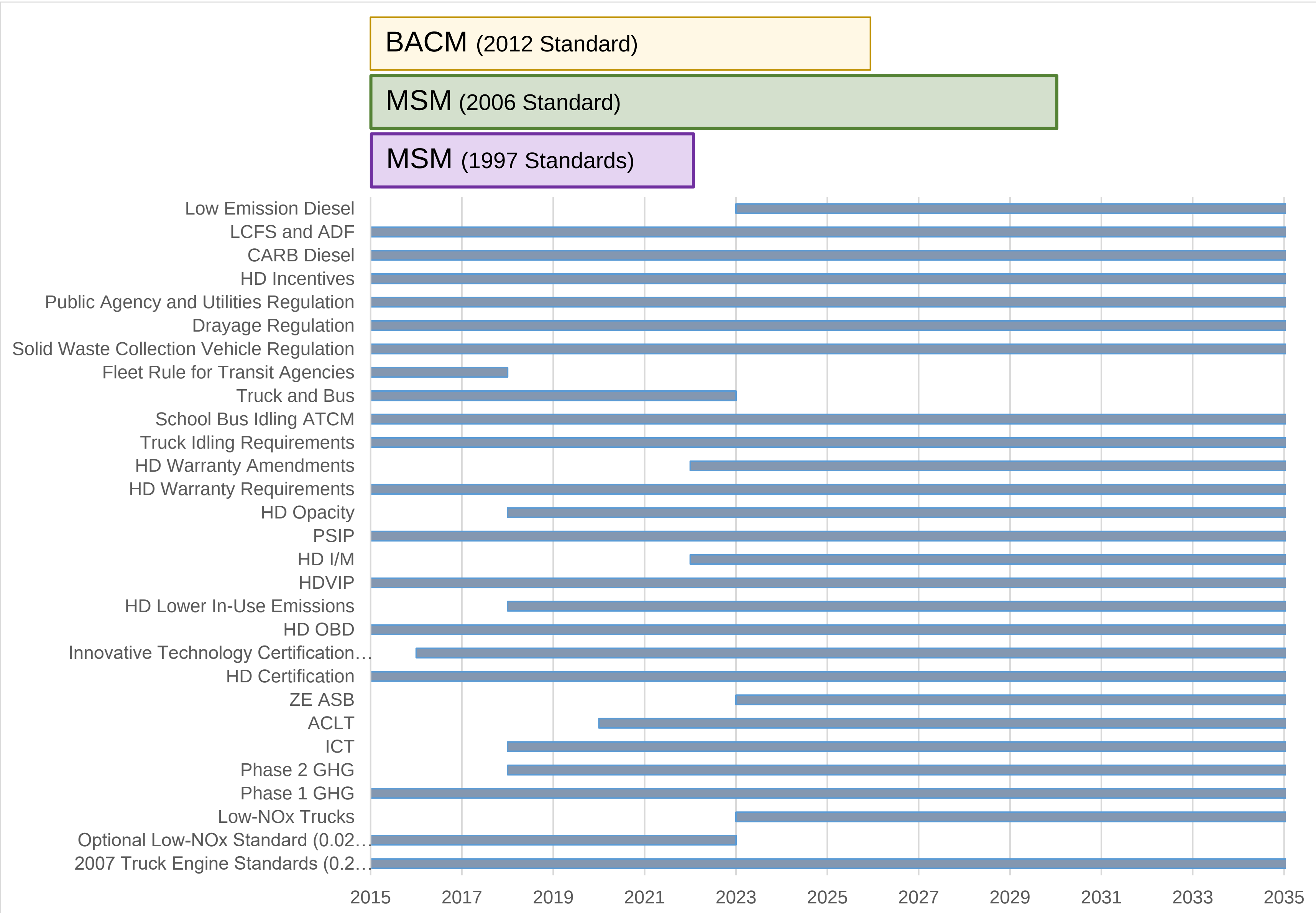


Table 13 summarizes which of the categories of stringency (i.e. BACM/BACT, BACM/ADF, or MSM) that each heavy-duty control measure falls into, for each PM2.5 standard. It is important to note that some measures CARB has committed to in the State SIP Strategy have anticipated implementation dates that exceed the timeframe thresholds of this analysis for some standards. Specifically, implementation of the Low-NOx Engine Standard, Zero-Emission Airport Shuttle Bus, and Low-Emission Diesel measures is anticipated to begin in 2023, which falls after the 2021 threshold of the analysis for the 1997 Annual and 24-Hour Standards. While these measures may not meet the timeline requirements to fall into the strict definition of MSM for these standards, the intent behind their development is nonetheless to continue pushing for additional emission reductions to ensure that attainment is achieved as expeditiously as possible, which aligns with the broader purpose of MSM.

Table 13: Identification of On-Road Heavy-Duty Control Measures as BACM and/or MSM

Measures	Implementation Begins	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997)	65 ug/m3 24-Hour (1997)
Adopted Heavy-Duty Vehicle Control Measures					
HD Exhaust Emission Standards for MY 2007+ Diesel Engines and Vehicles (0.2 g/bhp-hr)	ongoing	BACM - BACT	MSM	MSM	MSM
Optional Reduced Emission Standards for Heavy-Duty Engines (0.02 g/bhp-hr)	ongoing	BACM - AFM	MSM	MSM	MSM
HD On-Board Diagnostics (HD OBD)	ongoing	BACM - BACT	MSM	MSM	MSM
HD Diesel Vehicle Inspection Program (HD VIP)	ongoing	BACM - BACT	MSM	MSM	MSM
Periodic Smoke Inspection Program	ongoing	BACM - BACT	MSM	MSM	MSM
HD Emissions Warranty Requirements	ongoing	BACM - BACT	MSM	MSM	MSM
School Bus Idling ATCM	ongoing	BACM - BACT	MSM	MSM	MSM
ATCM to Limit Diesel-Fueled Commercial Motor Vehicle Idling (Diesel Idling Reduction Program)	ongoing	BACM - BACT	MSM	MSM	MSM
On-Road Heavy-Duty Diesel Vehicle In-Use Regulation (Truck and Bus)	ongoing	BACM - AFM	MSM	MSM	MSM
Fleet Rule for Transit Agencies	ongoing	BACM - BACT	MSM	MSM	MSM
Solid Waste Collection Vehicle Regulation	ongoing	BACM - BACT	MSM	MSM	MSM
Drayage (Port or Rail Yard) Regulation	ongoing	BACM - BACT	MSM	MSM	MSM
Diesel PM Control Measure for Municipality or Utility On-Road HD Diesel Fueled Vehicles (Public Agency and Utility Regulation)	ongoing	BACM - BACT	MSM	MSM	MSM
CARB Ultra Low Sulfur Diesel	ongoing	BACM - BACT	MSM	MSM	MSM
Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF)	ongoing	BACM - BACT	MSM	MSM	MSM
State SIP Strategy Measures (with Commitment)					
Lower In-Use Emission Performance Level:	2018 +	BACM - BACT	MSM	MSM	MSM
Lower Opacity Limits for Heavy-Duty Vehicles	2018 – 2024	BACM - BACT	MSM	MSM	MSM
Amended Warranty Requirements for Heavy-Duty Vehicles	2022	BACM - AFM	MSM	MSM	MSM
Inspection and Maintenance Program for Heavy-Duty Vehicles	2022 +	BACM - AFM	MSM	MSM	MSM
Low-NOx Engine Standard – California Action	2023	BACM - AFM	MSM	--	--
Innovative Clean Transit	2018	BACM - BACT	MSM	MSM	MSM
Advanced Clean Local Trucks (Last Mile Delivery)	2020	BACM - AFM	MSM	MSM	MSM

Table 13: Identification of On-Road Heavy-Duty Control Measures as BACM and/or MSM

Measures	Implementation Begins	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997)	65 ug/m3 24-Hour (1997)
Zero-Emission Airport Shuttle Buses	2023	BACM - AFM	MSM	--	--
Zero-Emission Off-Road Forklift Regulation Phase 1	2023	BACM - AFM	MSM	--	--
Zero-Emission Airport Ground Support Equipment	2023	BACM - AFM	MSM	--	--
Small Off-Road Engines	2022	BACM - AFM	MSM	--	--
Transport Refrigeration Units Used for Cold Storage	2020 +	BACM - AFM	MSM	MSM	MSM
Low-Emission Diesel Requirement	2023	BACM - AFM	MSM	MSM	MSM

STEP 3(B): EVALUATION OF FEASIBILITY: HEAVY-DUTY CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's proposed SIP and attainment demonstration, but which is identified as a potential BACM/MSM control measure in Step 2. For this plan, staff's proposed SIP and attainment demonstration do not recommend eliminating any of the potential BACM/MSM control measures identified in Step 2 on the basis of technical or economic infeasibility. Thus, a feasibility assessment for purposes of eliminating such measures from further consideration (i.e. Step 3(b)) is not applicable.

OFF-ROAD SOURCES

Off-road mobile sources include a wide variety of engines ranging from locomotives, ships, and aircraft, to equipment used in the agricultural, construction, mining, and freight / goods movement industries. This category is composed of off-road compression ignition (diesel) engines and equipment, small spark ignition off-road engines and equipment less than 25 hp (including lawn and garden equipment, and small industrial equipment), off-road large spark ignition (gasoline and liquefied petroleum gas) engines and equipment 25 hp and greater (including industrial equipment, forklifts, and portable generators), airport ground support equipment, and cargo handling equipment used at railyards, warehouses, and the Port of Stockton.

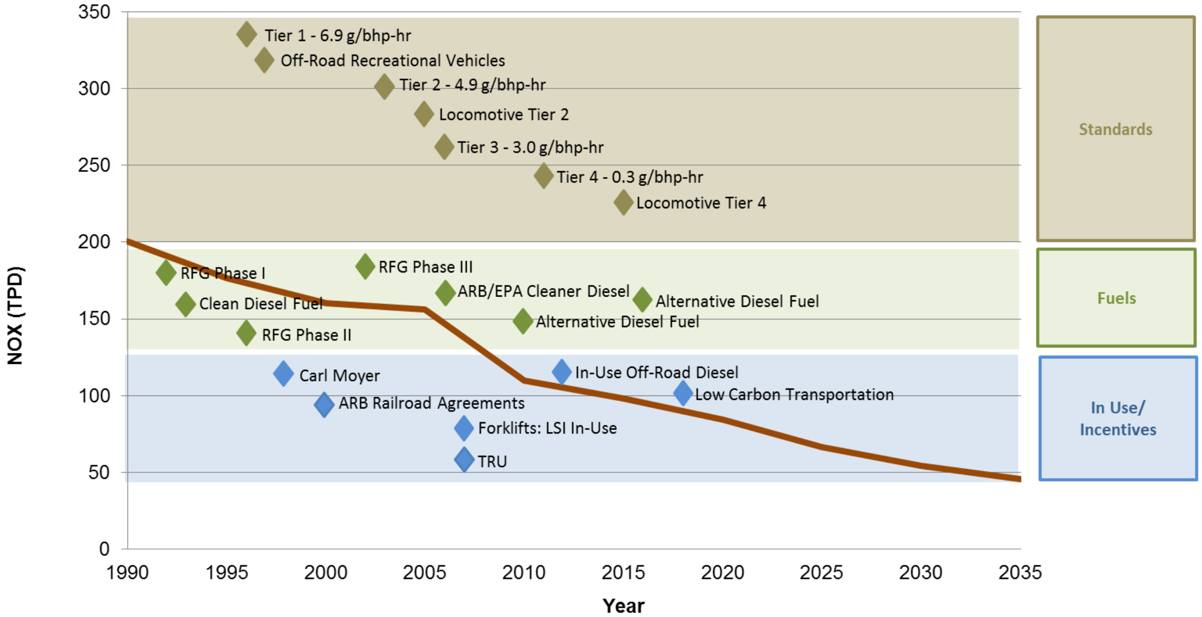
As the Valley is home to one of the most productive agricultural regions in the world, farm equipment is also an important off-road source category for the Valley. The farm equipment category is composed of agricultural equipment that includes tractors, agricultural tractor-trailers, harvesting equipment, sprayers, and other agricultural equipment and engines. Similar to the on-road sectors, California has a comprehensive program for reducing emissions from off-road equipment that goes well beyond current requirements in place elsewhere in the nation.

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. Regulations requiring cleaner diesel fuel requirements for intrastate locomotives have reduced NOx and diesel PM emissions from these sources. CARB staff and the Class I railroads have also been implementing a memorandum of understanding to accelerate the introduction of cleaner locomotives. Further emission reductions from combustion engines beyond current engine standards for locomotives are feasible with the use of aftertreatment technologies such as oxidation or three-way catalysts, diesel particulate filters, or selective catalytic reduction.

STEP 2(A): CALIFORNIA'S CURRENT OFF-ROAD CONTROL PROGRAM

Emission reductions from ongoing implementation of the current control program are projected to reduce NOx emissions from the off-road sector by approximately 40 percent between 2013 and 2025. Achieving reductions in the off-road sectors remains a greater challenge than in the on-road sector due to the diverse nature of these sources, regulatory authority that rests outside of CARB in many cases, and the length of time sources remain in the fleet.

Figure 6: Current Control Programs Reducing NOx Emissions from Off-road Sources



The major regulatory and programmatic control measures that provide these emissions reductions are described below.

NEW VEHICLE, EQUIPMENT,AND ENGINE STANDARDS

Off-Road Equipment (General)

To control emissions from off-road equipment, CARB adopted in 2004 a fourth tier of increasingly stringent PM and NOx standards based on the use of advanced aftertreatment emission controls. U.S. EPA also adopted the Tier 4 standards in 2004. California's current standards are equal in stringency to current federal standards. These ***"Tier 4" standards*** apply to new off-road compression-ignition engines, and were phased-in across product lines from 2008 through 2015 and reduced exhaust emission levels by up to 95 percent compared to previous control strategies. New engine standard requirements vary according to the power rating of engines. Table 14 shows the schedule for phasing in tiered requirements for new off-road engines with a power rating between 175 and 300 hp. Beginning in 2014, new Tier 4 construction equipment must emit about 96 percent less NOx and PM than new Tier 1 equipment sold in the year 2000.

Table 14: Phase-in of Off-Road Engine Standards

Model year	Level of Control	Applicable Emission Standard for New Off-road Engines 175<hp<300 g/bhp-hr	
		NOx	PM
1996-2002	Tier 1	6.9	0.4
2003-2005	Tier 2	4.9*	0.15
2006-2010	Tier 3	3.0*	0.15
2011-2013	Tier 4 interim	1.5	0.015
2014+	Tier 4 final	0.3	0.015

*Reflects combined limit for non-methane hydrocarbons and NOx

Given the diversity of types of engines, vehicles, and equipment used in the off-road sector, CARB's control strategy includes multiple requirements that are specific to categories of sources within the off-road sector. This includes:

Agricultural Equipment

In 2004, U.S. EPA and California adopted equivalent standards that require additional reductions from off-road engines, including engines used in mobile agricultural equipment. These new ***Tier 4 Engine Standards*** will achieve substantial reductions in PM2.5 and NOx as new farm equipment is introduced into the fleet.

Airport Ground Support Equipment (GSE)

Engines used in newly manufactured GSE operating on gasoline, LPG, and CNG are required to meet California's new engine emission standards for LSI. The ***LSI engine standard*** for engines greater than 1.0 liter (typical for GSE) is 0.6 g/bhp-hr of hydrocarbons (HC) and NOx. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, fleets operating LSI GSE must meet the in-use LSI engine fleet requirements. Adopted in 2006, the LSI fleet rule requires GSE fleets to maintain an average emission level of no more than 2.5 g/bhp hr HC+NOx, starting January 1, 2013. Diesel engines in newly manufactured GSE must meet the ***Tier 4 emission standards*** applicable to off-road compression-ignition engines. These standards vary by horsepower and are more than 90 percent cleaner than the emissions levels of engines produced twenty years ago. Lastly, non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the ***Portable Diesel-Engines Air Toxic Control Measure*** (ATCM). The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average.

Cargo Handling Equipment (CHE)

Cargo handling equipment (CHE) is used to transfer goods or perform maintenance and repair activities and includes equipment such as yard trucks (hostlers), rubber-tired gantry cranes, top handlers, side handlers, forklifts, and loaders at ports and intermodal rail yards. California's ***Cargo Handling Equipment regulation*** was adopted in 2005 and amended in 2011. CARB obtained authorization for the 2005 version of the regulation in 2012. CARB's CHE regulations set performance standards for engines in newly acquired, as well as in-use, mobile CHE at ports or intermodal rail yards in California.

Commercial Harbor Craft (CHC)

There are several types of commercial harbor craft (CHC) used in California, including crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry/excursion vessels, pilot vessels, towboats or push boats, tug boats, and work boats. The ***Commercial Harbor Craft regulation*** pertains to the reduction of diesel PM and NOx. The Board adopted the first CHC regulation in 2007 that implemented in-use limits and upgraded engine requirements. For this regulation, CARB obtained an authorization of preemption in 2011 from U.S. EPA.

In addition, the Board approved an amended CHC regulation in 2010, which extended the in-use engine requirements to other types of CHC, deleting certain exemptions, defining swing engines, clarifying certain in-use requirements, adding replacement engine exemptions, expanding compliance extension options, and allowing continued use of existing engines in certain circumstances. On January 19, 2017, U.S. EPA issued a final notice of rulemaking for these amendments.[80]

Forklifts

Forklifts operate in many different industry sectors but are most prevalent in manufacturing and at locations such as warehouses, distribution centers, and ports. Forklift fleets can be subject to either the LSI fleet regulation, if fueled by gasoline or propane, or the off-road diesel fleet regulation if fueled by diesel.[81] Both regulations require fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. Diesel-fueled forklifts were first subject to engine standards and durability requirements in 1996. The ***off-road diesel regulation*** was adopted by the Board in 2007 with implementation beginning in 2010. It is applicable to all diesel-fueled, self-propelled off-road equipment with at least 25 HP. Forklifts are included in the fleet average along with other equipment. The most recent ***Tier 4 Final emission standards*** were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction. Forklifts powered by LSI engines have been subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010. Additionally, the ***LSI fleet regulation*** (which was originally adopted with requirements beginning in 2009) requires fleets with four or more LSI forklifts to meet fleet average emission standards. While the LSI fleet regulation applies to forklifts, tow tractors, sweeper/scrubbers, and airport ground support equipment, it maintains a separate fleet average requirement specifically for forklifts.

Beyond the requirements of the current control program, the ***Zero-Emission Off-Road Forklift Regulation Phase 1*** measure as described in the State SIP Strategy will accelerate the deployment of zero-emission technologies in off-road equipment types that are already primed for the technologies that exist today, and will facilitate further

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[80] U.S. EPA 2017 "California State Nonroad Engine Pollution Control Standards; Diesel Engines on Commercial Harbor Craft; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2017-01-19/pdf/2017-01261.pdf Federal Register Volume 82, Number 12, pp. 6500-6506

[81] The Act preempts states, including California, from adopting requirements for new off-road engines less than 175 HP used in farm or construction equipment. California may adopt emission standards for in-use off-road engines pursuant to Section 209(e)(2), but must receive authorization from U.S. EPA before it may enforce the adopted standards.

technology development and infrastructure expansion by demonstrating its viability. Under this measure, CARB has committed to develop a regulation that focuses on forklifts with lift capacities equal to or less than 8,000 pounds, for which zero-emission technologies have already gained appreciable customer acceptance and market penetration.[82] There are approximately 100,000 forklifts operating in California, most of which are battery-electric, propane, diesel, or gasoline-fueled. Although battery-electric forklifts offer reduced maintenance requirements, lifetime cost savings, and cleaner tailpipe emissions, electric forklift usage has not changed significantly relative to internal combustion forklift usage over the past 20 years. This regulation is intended to send a market signal to technology manufacturers and investors that zero-emission technologies will be strongly supported moving forward. This proposed measure would advance ZEV commercialization by increasing the penetration of zero-emission technologies. Experience gained from demonstrating the viability of advanced technologies in heavier-duty applications will spur market development and enable the technologies to be transferred to larger, higher power-demand off-road equipment types, such as high lift-capacity forklifts and other equipment types in the construction, industrial, and mining sectors.

Locomotives

Under the Act, U.S. EPA has the sole authority to establish emissions standards for new locomotives.[83] U.S. EPA has previously promulgated two sets of national locomotive emission regulations (1998 and 2008). In 1998, U.S. EPA approved national regulations that primarily emphasized NOx reductions through Tier 0, 1, and 2 emission standards. Tier 2 NOx emission standards reduced older uncontrolled locomotive NOx emissions by up to 60 percent, from 13.2 to 5.5 g/bhp-hr.

In 2008, U.S. EPA approved a second set of national locomotive regulations. Older locomotives, upon remanufacture, are required to meet more stringent particulate matter (PM) emission standards, which are about 50 percent cleaner than Tier 0-2 PM emission standards. U.S. EPA refers to the PM locomotive remanufacture emission standards as Tier 0+, Tier 1+, and Tier 2+. The new Tier 3 PM emission standard (0.1 g/bhp-hr), for model years 2012-2014, is the same as the Tier 2+ remanufacture PM emission standard. The 2008 regulations also included new ***Tier 4 locomotive NOx and PM emission standards*** (2015 and later model years). U.S. EPA Tier 4 NOx and PM emission standards further reduced emissions by approximately 90 percent from uncontrolled levels.

Beyond the currently adopted levels of controls, CARB staff has petitioned U.S. EPA to promulgate by 2020 both Tier 5 national emission standards for newly manufactured locomotives, and more stringent national requirements for remanufactured locomotives, as committed to in the ***More Stringent National Locomotive Emission Standards*** measure. This would reduce emissions of criteria and toxic pollutants, fuel

[82] The Act preempts states, including California, from adopting requirements for new off-road engines less than 175 HP used in farm or construction equipment. California may adopt emission standards for in-use off-road engines pursuant to Section 209(e)(2), but must receive authorization from U.S. EPA before it may enforce the adopted standards.
[83] 42 United States Code (U.S.C.) §7547, (a)(5)

consumption, and GHG emissions. CARB staff estimates that U.S. EPA could require manufacturers to implement the new locomotive emission regulations by as early as 2023 for remanufactures and 2025 for newly manufactured locomotives. As documented in the Final Technology Assessment for Freight Locomotives,[84] CARB staff believes the most technologically feasible advanced technology for near-term deployment is the installation of a compact aftertreatment system (e.g., combination of selective catalytic reduction (SCR) and diesel oxidation catalyst (DOC)) onto new and remanufactured diesel-electric freight interstate line haul locomotives. Newly manufactured locomotives can also be augmented with on-board batteries to provide an additional 10-25 percent reduction in diesel fuel consumption and GHG emissions to achieve the Tier 5 emission levels. On board batteries could also provide zero emission track mile capabilities in and around railyards to further reduce diesel PM and the associated health risks.

A new federal standard could also facilitate development and deployment of zero-emission track mile locomotives and zero-emission locomotives by building incentives for those technologies into the regulatory structure. The compact SCR and DOC aftertreatment system could also be retrofitted to existing Tier 4 locomotives to be able to achieve a Tier 4+ emissions standard, when Tier 4 locomotives are scheduled for remanufacture (every 7 to 10 years). Based on the typical remanufacture schedule, all Tier 4 locomotives could potentially be retrofitted with aftertreatment between 2025 and 2037. Existing locomotives originally manufactured to meet Tier 2 or Tier 3 standards could also be upgraded with the same compact aftertreatment system upon remanufacture to achieve emissions equal to Tier 4 levels.

Off-Highway Recreational Vehicles (OHRV)

Off-road recreation vehicles, also known as off-highway recreational vehicles (OHRV), primarily include off-highway motorcycles, all-terrain vehicles (ATVs), and utility-terrain vehicles, off-road sport and utility vehicles, sand cars, and golf carts. In 1994, CARB adopted ***exhaust emission standards for OHRVs***. At that time, there were no equivalent federal standards regulating exhaust emissions from the vehicles and engines covered by California's OHRV regulations (U.S. EPA first set exhaust emission limits for OHRVs in 2002). U.S. EPA granted authorization for CARB's 1994 OHRV regulations in 1996. CARB subsequently amended the regulations to increase the stringency of controls and expand the categories of OHRVs controlled under the program; first in 1999, subsequently in 2003, and finally in 2007. All three OHRV Engine Emission Standard amendments were granted authorization concurrently by U.S. EPA in 2014.[85]

The 2007 amendments to CARB's OHRV program also set ***evaporative emission standards*** beginning in MY 2008, establishing a fuel tank permeation limit of 1.5 grams per square meter per day (g/m^2/day) of total organic gas (TOG) for a 3-day diurnal period, and a fuel hose permeation limit of 15 g/m^2/day. At the time, these limits were

[84] Final Technology Assessment for Freight Locomotives available at: https://www.arb.ca.gov/msprog/tech/report.htm

[85] U.S. EPA, 2014. "California State Nonroad Engine Pollution Control Standards; Off-Highway Recreational Vehicles and Engines; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2014-02-04/pdf/2014-02297.pdf Federal Register, Vol. 79, No. 23

identical to the national limits set by U.S. EPA. In July 2013, CARB adopted more stringent evaporative emission control standards for OHRVs that established a new test procedure and reduced evaporative emission limits to 1.0 g/m^2/day. Authorization was granted by U.S. EPA in 2017.[86]

Recreational Boats

The recreational boat (marine) engine program is another important element in CARB's efforts to address emissions from all mobile source sectors. In 1998, CARB approved ***exhaust emission regulations for spark-ignition marine engines*** that accelerated implementation of the federal standards for 2006 engines for personal watercraft (PWC) and outboard (OB) marine engines in California to 2001. In 2001, CARB adopted Tier I and ***Tier II emission standards for inboard and stern-drive marine engines***. In 2007, U.S. EPA granted California authorization to enforce CARB's regulations for OB/PWC engines and Tier I of the California inboard and stern-drive marine engine emissions standards. In 2011, U.S. EPA granted California authorization to enforce CARB's Tier II exhaust emission standards for spark ignited inboard and stern-drive marine engines. While CARB has the same exhaust emission standard as the federal standard, the California standard applies to engines starting in 2008 rather than 2010 under the federal requirement.

In February 2015, CARB Board approved more stringent ***Evaporative Emission Control Standards*** than those set forth by the U.S. EPA's 2008 rule for gasoline-fueled spark-ignition marine watercraft configured with engines greater than 30 kilowatts.

Small Off-Road Equipment (SORE)

SORE are spark-ignited engines rated at or below 19 kilowatts. This category includes handheld and non-handheld lawn and garden and industrial equipment such as string trimmers, leaf blowers, walk-behind lawn mowers, generators, and lawn tractors. They are used in applications such as lawn and garden, industrial, construction and mining, logging, airport ground support, commercial utility, and farm equipment, golf carts, and specialty vehicles. Staff estimates that there are approximately 16.5 million pieces of SORE equipment in California, the majority of which are spark-ignition (SI) engines used in residential and commercial lawn and garden applications, together with other utility and small industrial applications.

CARB first adopted ***SORE Exhaust Emission Standards and Test Procedures*** in 1990, with amendments in 1998 that increased the stringency and extended the types of engines and equipment applicable to the standard. In September 2003, CARB adopted more stringent exhaust emission standards, and set the first ***Evaporative Emission Standards*** for SORE. Prior to the adoption of these standards, evaporative emissions were uncontrolled. U.S. EPA granted full authorization for this suite of

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[86] U.S. EPA, 2017. "California State Nonroad Engine Pollution Control Standards; Evaporative Emission Standards and Test Procedures for Off-Highway Recreational Vehicles (OHRVs); Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2017-01-19/pdf/2017-01259.pdf Federal Register, Vol. 82, No. 12

waivers in 2006, and these more stringent standards were phased-in for model-years 2006 through 2013.[87]

In 2010, CARB set ***Standards for Zero-Emission SORE Equipment***.[88] In 2011, CARB again amended the regulation, modifying CARB's existing test procedures and aligned California procedures to be consistent with U.S. EPA's amendments to the federal certification and exhaust emission testing requirements (see Title 40 CFR Parts 1054 and 1065.11). The 2011 Amendments also set ***Exhaust Emission Certification Test Fuel Amendments*** for using ethanol blends of up to 10 percent (E10) in Off-Road SI SORE Engines, if it is certified by U.S. EPA. U.S. EPA approved the full suite of 2011 Amendments in 2015.[89] In 2016, CARB amended its evaporative emission standards for the entire category of SORE to increase stringency.[90]

Beyond the measures included in the current control program, the ***Small Off-Road Engines*** measure committed to in the State SIP Strategy will reduce emissions through actions to promote increased use of zero-emission equipment, propose tighter exhaust and evaporative emission standards, and enhance enforcement of current emission standards for SORE. Additionally, high failure rates have been observed in evaporative emissions testing of SORE, preventing previously-claimed emission reductions from being realized. Exhaust and evaporative emissions from SORE would be reduced through enhanced enforcement of the current emission standards, adoption of tighter exhaust and evaporative emission standards, and increased use of zero-emission equipment. Strategies will be developed for transitioning to zero-emission technologies, including an initial focus on incentives for use of zero-emission equipment, coupled with increasingly stringent emission standards for criteria pollutants.

REDUCING IN-USE EMISSIONS

Fleet Rules

Off-Road Equipment (General)

Large diesel off-road equipment typically remains in use for long periods of time. As with heavy-duty trucks, this long life means that newer, lower-emitting engines would be introduced into fleets relatively slowly. To address this, ***the Cleaner In-use Off-Road Equipment Regulation (Off-Road Regulation)*** was adopted in 2007, and amended in 2010. The Off-Road Regulation requires off-road fleets to reduce their emission by retiring, replacing or repowering older engines. This regulation expanded the penetration of existing clean technology to ensure that the engines and vehicles used today are as clean as possible. U.S. EPA provided their authorization for this regulation in 2013. The types of off-road equipment controlled by this regulation are used in construction, manufacturing, the rental industry, road maintenance, airport ground

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[87] U.S. EPA, 2006. "California State Non-road Engine and Vehicle Pollution Control Standards; Decision of the Administrator" https://www.gpo.gov/fdsys/pkg/FR-2006-12-15/pdf/E6-21378.pdf Federal Register / Vol. 71, No. 241

[88] CARB 2010. "Final Regulations Order" accessed June 2018 https://www.arb.ca.gov/regact/2008/sore2008/soreresubfro.pdf?_ga=2.218709145.1039751104.1528225837-29497060.1519676686

[89] U.S. EPA 2015. "California State Non-road Engine Pollution Control Standards; Small Off-Road Engines Regulations; Notice of Decision

[90] CARB 2016. "Final Regulations Order" accessed June 2018 https://www.arb.ca.gov/regact/2016/sore2016/finalreg.pdf?_ga=2.102358145.1039751104.1528225837-29497060.1519676686

support, and landscaping. In December 2011, the Off-Road Regulation was modified to include on-road trucks with two diesel engines.

The Off-Road Regulation is an extensive program designed to accelerate the penetration of the cleanest equipment into California's fleets. This regulation will significantly reduce emissions of diesel PM and NOx from the over 150,000 in-use off-road diesel vehicles that operate in California by requiring their owners to modernize their fleets and install exhaust retrofits. In 2015, this extensive program will have affected 10,447 vehicles used in 838 fleets by requiring owners to modernize their fleets by replacing older engines or vehicles with newer, cleaner models, retiring older vehicles or using them less often, or by applying retrofit exhaust controls. The Off-Road Regulation imposes idling limits on off-road diesel vehicles, requires a written idling policy, and requires a disclosure when selling vehicles. The regulation also requires that all vehicles be reported to CARB and labeled, restricts the addition of older vehicles into fleets, and requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing verified exhaust retrofits. The requirements and compliance dates of the Off-Road Regulation vary by fleet size.

Additionally, CARB has developed and implemented control measures that target specific to categories of sources within the off-road sector, which are described below.

Agricultural Equipment

The 2007 SIP included the ***2007 Cleaner In-Use Agricultural Equipment Measure*** (Ag Measure) to achieve 5 to 10 tpd of NOx reductions in 2017 by modernizing agricultural equipment in the Valley. The Valley agricultural industry immediately began working on implementing this SIP measure by leveraging federal and local incentives to provide farmers assistance to replace their older, higher polluting equipment with the cleanest available technology. Specifically, new incentive funds were secured through the federal Farm Bill to be used alongside funds from existing programs. Since 2009, over 400 million dollars in private and public funding has been invested in the Valley for the replacement of older agricultural tractors with newer, cleaner models, with significant continued investments ongoing. Through 2016, the U.S. Department of Agriculture's Natural Resource Conservation Service's grant program and the District has provided over $129 million replacing over 5,000 tier 0 and tier 1 tractors to implement the Ag Measure and meet the 2017 SIP goal. The incentives targeted the largest and most used tractors in addition to other types of farm equipment.

To push beyond the 2007 Ag Equipment Measure, CARB staff is proposing in the Valley SIP Strategy the ***Cleaner In-Use Agricultural Equipment*** measure, which would electrify agricultural equipment less than 25 horsepower, such as utility quads and small yard tractors used on farms and ranches. CARB will develop a SIP measure designed to identify the agricultural equipment that is well suited for electrification with requirements in place by 2024.

In parallel with electrifying agricultural equipment less than 25 horsepower, CARB staff is also proposing in the Valley SIP Strategy an incentive measure to accelerate the turnover of large tier 0, tier 1 and tier 2 agriculture tractors to tier 4 through existing projects and new projects. Incentives are cost-effective in replacing old high-polluting tractors on most farms. However, there are many of these high-polluting tractors still in service on small farms in which the cost of the new tractor is not feasible even with incentives. To provide cleaner tractors to small farms, CARB staff along with the District and the agricultural industry are working to implement a new tractor trade up program through funding provided by a CARB grant. The trade-up program is designed to assist small farmers overcome potential financial barriers to accessing cleaner mobile agricultural technologies, and is intended to accelerate emission reductions by replacing the oldest tractors with cleaner used models. This is accomplished through a multi-step transaction in which an owner of an older, high-emitting piece of mobile agricultural equipment agrees to scrap that equipment in exchange for a previously used and reconditioned piece of equipment with a cleaner diesel engine at little or no out-of-pocket cost. The owner of the used equipment is provided incentive funding to assist in the purchase of new equipment that employs the cleanest, commercially available technology.

While identifying and securing incentive funding will be an important element going forward, the Cleaner In-Use Agricultural Equipment measure is designed to function as a backstop rule, serving as an overall emission reduction target, while at the same time acting as a catalyst for attracting early replacement of agricultural equipment using incentives. The backstop rule could require that by 2030 all agricultural equipment operating in the Valley be Tier 2 or cleaner. In combination, the backstop rule, tractor trade-up, incentives and significant lead time, ensures cleaner agricultural equipment will be used in the Valley through 2030.

Airport Ground Support Equipment (GSE)

In addition to adopting regulations limiting emissions from new engines used in GSE, California has adopted regulations to reduce emissions from existing, in-use GSE. On 2007, California adopted the ***In-Use Off-Road Diesel-Fueled Fleets Regulation,*** which requires fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time. For example, for equipment over 175 and under 750 HP, the final 2023 NOx fleet average target is 1.5 g/bhp hr, which is equivalent to the interim Tier 4 NOx standard for newly produced engines. Fleets that do not meet the required annual fleet average must meet the BACT requirements that require turnover, repower or retrofit of a specific percent of a fleet's total HP. These requirements are currently being phased in.

Cargo Handling Equipment (CHE)

As described earlier, the ***Cargo Handling Equipment regulation*** (adopted in 2005, amended in 2011) includes performance standards for in-use, mobile CHE at ports or intermodal rail yards in California.

Commercial Harbor Craft (CHC)

As described earlier, the ***Commercial Harbor Craft regulation*** (adopted in 2007) includes in-use limits that require diesel PM and NOx emission controls. The 2010 amendments extended the types of CHC for which in-use engine requirements apply.

Forklifts

As described earlier, forklift fleets subject to both the ***LSI Fleet Regulation*** (if powered by gasoline or propane), and the ***Off-Road Diesel Fleet Regulation*** (if powered by diesel) are required to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards.

Off-Highway Recreational Vehicles (OHRV)

In 1999, CARB's amendments to the OHRV program added a new control measure by requiring in-use controls for OHRV that do not meet the applicable exhaust emission standards, known as the ***"Red Sticker" program***. These amendments established a new compliance category beginning with the 2003 model year, and designates OHRVs as either "green sticker" or "red sticker", depending on whether the engine meets or exceeds the applicable emission standard. Non-emission compliant OHRVs are identified with a red registration sticker issued from the Department of Motor Vehicles (DMV), while emission-compliant OHRVs are identified with a green sticker. Red sticker OHRVs are subject to in-use restrictions that do not apply to green sticker OHRVs; namely, the red sticker limits operation at certain off-highway recreational vehicle parks located in non-attainment areas during peak ozone season.

Transport Refrigeration Units (TRU)

TRUs are refrigeration systems powered by an internal combustion engine (inside the unit housing), designed to control the environment of temperature sensitive products that are transported in refrigerated trucks, trailers, railcars, and shipping containers. TRUs operate in large numbers at distribution centers, food manufacturing facilities, packing houses, truck stops, and intermodal facilities, and are used to haul perishable products including food, beverages, pharmaceuticals, flowers, medical products, industrial chemicals, and explosives. TRUs may be capable of both cooling and heating. They deliver perishable goods to retail outlets, such as grocery stores, restaurants, cafeterias, convenience stores, etc. Although TRU engines are relatively small (ranging from 9 to 36 hp) significant numbers of these engines congregate at distribution centers, truck stops, and other facilities, exacerbating air quality challenges and resulting in potential for health risks to those that live and work nearby. The growth rate of TRUs is tied to population, since food is the main product type that is hauled.

CARB adopted its ***ATCM for In-Use Diesel-Fueled TRUs and TRU Generator Sets*** in 2004. The TRU regulations establish in-use performance standards for diesel-fueled TRUs and TRU generator sets which operate in California, and facilities where TRUs operate. The regulation is designed to reduce the diesel particulate matter (PM) emissions from in-use TRU and TRU generator set engines that operate in California, using a phased-in implementation approach over about 12 years by requiring engines to meet in-use emission standards by the end of the seventh year after manufacture. Implementation of the TRU ATCM began in 2009, and applies to in-use diesel-fueled TRUs and TRU generator sets that operate in California, whether they are registered in or outside the State. U.S. EPA issued a waiver of preemption for the TRU regulation in

2009.[91] CARB subsequently amended the TRU ATCM in 2010 and again in 2011 to provide owners of TRU engines with certain flexibilities to facilitate compliance, clarify recordkeeping requirements, and establish requirements for businesses that arrange, hire, contract, or dispatch the transport of goods in TRU-equipped trucks, trailers, or containers. U.S. EPA approved waivers for the 2010 Amendments in 2013 and the 2011 Amendments in 2017, respectively.[92, 93]

Beyond the emission controls included in the current control program, the Valley's plan also includes the ***Transport Refrigeration Units Used for Cold Storage*** measure, which will reduce NOx and PM emissions by reducing the amount of time TRUs operate using internal combustion engines while refrigerated trucks, trailers, and shipping containers are parked (stationary) at certain California facilities and other locations. The time limit would decrease on a phased compliance schedule. Compliance options include the use of commercially available hybrid electric TRUs, TRUs equipped with electric standby motors, and cryogenic transport refrigeration systems. Hybrid electric and electric standby-equipped TRUs would plug into electric power plugs while stationary and use diesel engine power while on the road. Facilities may be required to provide the necessary electric infrastructure to support this action. CARB is currently offering funding through the Proposition 1B Goods Movement Emission Reduction Program to support both purchase of TRUs that can plug in and the stationary electric infrastructure. Cryogenic transport refrigerators use liquid nitrogen and liquid carbon dioxide to provide cooling. Development and use of zero-emission technologies, such as all-electric plug-in / advanced battery transport refrigeration systems would be encouraged, as well as adequately sized cold storage facilities, and more efficient inbound delivery appointment and outbound dispatch scheduling.

Other In-Use Emission Controls for Locomotives

In addition to the fleet rules described above, CARB has worked closely with the major railroads in California, together with other stakeholders, to develop innovative measures to reduce in-use emissions from locomotives, a major source of NOx and PM emissions in the Valley, but a source category over which CARB has limited regulatory authority. While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. CARB staff and the Class I railroads have also been implementing through the ***Statewide Rail Yard Agreement for California Rail Yards,*** a Memorandum of Understanding (MOU) to accelerate the introduction of cleaner locomotives since 2010.[94] This agreement obligates the

[91] U.S. EPA, 2009. "California State Nonroad Engine and Vehicle Pollution Control Standards; Authorization of Transport Refrigeration Unit Engine Standards; Notice of Decision" Federal Register Volume 74, Number 11, pp. 3030-3033

[92] U.S. EPA, 2013. "California State Nonroad Engine Pollution Control Standards; Within-the-Scope Determination for Amendments to California's ''Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets and Facilities Where TRUs Operate''; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2013-06-28/pdf/2013-15437.pdf Federal Register Vol. 78, No. 125

[93] U.S. EPA, 2017. "California State Nonroad Engine Pollution Control Standards; In-Use Diesel-Fueled Transport Refrigeration Units (TRUs) and TRU Generator Sets and Facilities Where TRUs Operate; Notice of Decision" https://www.gpo.gov/fdsys/pkg/FR-2017-01-19/pdf/2017-01225.pdf Federal Register Vol. 82, No. 12

[94] CARB 2005 "ARB/Railroad Statewide Agreement: Particulate Emissions Reduction Program at California Rail Yards" https://www.arb.ca.gov/railyard/ryagreement/083005mouexecuted.pdf

railroads to significantly reduce emissions in and around rail yards in California, and established a statewide visible emissions reduction and repair program, provided a detailed evaluation of advanced control measures, and an assessment of remote sensing technology (RST) to identify high-emitting locomotives.

FUELS

In addition to new engines and in-use standards, cleaner burning fuels represent an important component in reducing emissions from the off-road mobile fleet. Cleaner fuel has an immediate impact in reducing emissions from the mobile source, and thus represent an important component in reducing NOx and PM emissions from off-road engines. California's stringent air quality programs treat mobile sources and their fuels holistically (as a system, rather than as separate components). As a result, CARB's fuels programs achieve significant reductions in criteria emissions from vehicles and mobile engines used in California.

CARB Diesel Fuel Regulations

The California diesel fuel program sets stringent standards for diesel fuel sold in California and produces cost-effective emission reductions from diesel-powered vehicles. More stringent fuel requirements further ensure that diesel engines are operating as cleanly as possible. ***CARB Diesel Fuel Regulations*** have, over time, phased in more stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur, and have establish a lubricity standard. The program applies to sales of fuel used in on-road vehicles and off-road vehicles and locomotives in California. . ***"CARB diesel" Specifications*** adopted in 1988 limited the allowable sulfur content of diesel fuel 500 parts per million by weight (ppmw), and the aromatic hydrocarbon content to 10 percent, and became effective in 1993.

In 2003, ***CARB's Ultra Low Sulfur Diesel (ULSD) Regulation*** increased the stringency of the sulfur content limits in to 15 ppm, which harmonized with the 1993 U.S. EPA regulation that also limited sulfur in on-road diesel fuels to the same level. Both the California and federal ULSD regulations began implementation in 2006. CARB's ULSD Regulation had an immediate impact in reducing emissions from the in-use on-road heavy-duty fleet, while also enabling the use of advanced emissions control technologies, including the use of catalyzed diesel particulate filters (DPF), NOx after-treatment, and other advanced after-treatment based emission control technologies that higher sulfur levels would have inhibit the performance of (at the time of CARB's ULSD rulemaking, the average sulfur content of California diesel was approximately 140 ppmw).

Controlling Criteria Emissions from Renewable Fuels

The ***Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) Regulations,*** as amended in 2014, work together to reduce the carbon intensity of the California fuel supply. The regulations also limit criteria emissions from alternative fuels and/or alternative fuel mix blends (a mix of fuels made from renewable feedstocks, which are then blended with conventional gasoline or diesel).

Beyond the current fuels control program, CARB committed to develop a ***Low Emission Diesel*** Measure that will require diesel fuel providers to steadily decrease criteria pollutant emissions from their diesel products. The use of low-emission diesel in on-road vehicles and off-road equipment will reduce tailpipe NOx and PM emissions, in addition to other criteria pollutants. Some studies carried out to date on hydrotreated vegetable oil have reported NOx emission reductions of 6 percent to 25 percent and PM emission reductions of 28 percent to 46 percent, depending on the types of fuels, drive cycles tested, and diesel engines used. This standard is anticipated to both increase consumption of low-emission diesel fuels, and to reduce emissions from conventional fuels. This measure is anticipated to provide NOx benefits predominately from legacy (pre-2010) on-road heavy-duty vehicles, off-road engines, stationary engines, portable engines, marine vessels and locomotives, as well as NOx and diesel PM benefits in potentially all model year off-road engines, stationary engines, portable engines, marine vessels and locomotives. Interstate vehicles, even those registered out-of-State but operating on CARB diesel blended with low-emission diesel, are also anticipated to provide emission reduction benefits.

Cleaner Burning Fuels Requirements (for Locomotives)

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. The Railroud MOU includes a control measure that maximizes the use of lower emitting fuels (i.e. CARB and U.S. EPA low sulfur diesel) in locomotives fueled in California. ***Requiring cleaner diesel fuel requirements for intrastate locomotives*** have reduced NOx and diesel PM emissions from these sources.

STEP 2(B): OTHER STATES' AND NONATTAINMENT AREAS' OFF-ROAD CONTROL MEASURES

Table 15 summarizes the most stringent control measures currently in use in any state or nonattainment that have been identified and discussed for on-road heavy-duty vehicles. Each of the measures identified in this table are discussed in more detail in this section, below.

Table 15: Summary of Most Stringent Off-Road Mobile Control Measures Identified

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
New Engine Standards			
New Engine Standards • Off-road diesel engine emission standards (general)	Currently CARB and U.S. EPA limit exhaust emissions to same "Tier 4" levels: • NOx: 0.3 g/bhp-hr • PM: 0.015 g/bhp-hr	CARB's current emission standards for new off-road engines with a power rating between 175 and 300 hp are set at the same level of stringency as Federal standards, and requires Tier 4 emission standards (which use advanced after treatment technologies such as diesel particulate filters and selective catalytic reduction). This regulation is applicable to all diesel-fueled, self-propelled off road equipment with at least 25 HP.	No other state has more stringent exhaust emission standards for off-road equipment than California.
New Engine Standards • Agricultural equipment	Tier 4 Engine Standards (U.S. EPA and CARB)	U.S. EPA and California adopted equivalent Tier 4 standards in 2004 that require additional emission reductions from off-road engines, including those used in mobile agricultural equipment.	No state has more stringent requirements for new emission performance standards for agricultural equipment engines than California.
New Engine Standards • Airport Ground Support Equipment (GSE)	Large Spark Ignition (LSI) Fleet Regulation and Tier 4 Engine Standards (CARB) CARB anticipated to propose to further increase stringency. *(Zero-Emission Airport Ground Support Equipment measure)*	NOx limits for the LSI Engine Standard for engines > 1.0 liter (the typical engine size for GSE) is 0.6 g/bhp-hr. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression ignition engines. CARB is anticipated to further increase the stringency of emission controls with the Zero-Emission Airport Ground Support Equipment measure. *(NOTE: CARB has committed to develop the Zero-Emission Airport Ground Support Equipment measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other state has more stringent exhaust emission standards for airport ground support equipment than California.
New Engine Standards • Cargo Handling Equipment (CHE)	Cargo Handling Regulation (CARB)	CARB's Cargo Handling Equipment regulation sets performance standards for newly acquired engines, as well as in-use mobile CHE at ports or intermodal rail yards.	No other state has more stringent exhaust emission standards for cargo handling equipment than California.
New Engine Standards • Commercial Harbor Craft (CHC)	Commercial Harbor Craft Regulation (CARB)	CARB's CHC Regulation controls NOx and PM emissions from crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry/excursion vessels, pilot vessels, towboats or push boats, tug boats, and work boats. U.S. EPA has granted a waiver of preemption under §209(b).	No other state has more stringent exhaust emission standards for commercial harbor craft than California.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
New Engine Standards • Forklifts	Off-road Diesel Regulation, Tier 4 Engine Standards, and LSI Fleet Regulation (CARB) CARB anticipated to propose to further increase stringency. *(Zero-Emission Off-Road Forklift Regulation Phase 1 measure)*	Forklifts powered by LSI engines (gasoline and natural gas) are subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010. Diesel Forklifts > 25 HP are subject to fleet average emission requirements under the Off-Road Diesel Regulation starting in 2010 and Tier 4 Final emission standards (based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction) starting in 2013. CARB is anticipated to further increase the stringency of emission controls with a measure designed to accelerate the deployment of zero-emission forklift technologies. *(NOTE: CARB has committed to develop the Heavy-Duty Vehicle Inspection and Maintenance Program measure, but it has not yet been proposed to the Board for approval/adoption.)*	No state has more stringent requirements for new emission performance standards for forklifts engines than California.
New Engine Standards • Locomotives	U.S. EPA Tier 4 NOx and PM emission standards CARB has petitioned U.S. EPA to further increase stringency. *(More Stringent National Locomotive Emission Standards measure)*	U.S. EPA has the sole authority to establish emissions standards for locomotives. CARB petitioned U.S. EPA in 2017 to increase stringency by developing Tier 5 national emission standards for newly manufactured locomotives, and more stringent national requirements for remanufactured locomotives (by ~2020) *(NOTE: CARB has petitioned U.S. EPA for more stringent locomotive standards given the needs in California's nonattainment areas, but approval/adoption of this MSM rests exclusively with U.S. EPA and is thus beyond the purview of CA.)*	No state has emission standards for locomotives that differ from U.S. EPA's.
New Engine Standards • Off-Highway Recreational Vehicles (OHRVs)	Exhaust Emission Standards for OHRVs and Evaporative Emission Standards (CARB)	CARB's exhaust emission standards (2006) and evaporative emission standards (2007) control emissions from motorcycles, all-terrain vehicles, and utility-terrain vehicles at more stringent levels than applicable national standards set by U.S. EPA.	No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.
New Engine Standards • Recreational Boats	Exhaust Emission Regulations for Spark-Ignition Marine Engines, Tier II Emission Standards for Inboard and Stern-Drive Marine Engines, and Evaporative Emission Control Standards (CARB)	CARB's recreational boats and marine engine program exceeds the stringency of U.S. EPA's federal standards: • The Exhaust Emission Regulations for Spark-Ignition Marine Engines (1998) controls emissions at the same level of stringency as national regulations; • The Tier II Emission Standards for Inboard and Stern-Drive Marine Engines (2001) controls emissions at the same level of stringency as national regulations; and • The Evaporative Emission Control Standards (2015) exceeds the stringency of applicable national regulations set by U.S. EPA in 2008 for gasoline-fueled spark-ignition marine watercraft >30 kilowatts.	No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
New Engine Standards • Small Off-Road Equipment (SORE)	Exhaust and Evaporative Standards for Small Off-Road Engines (CARB) CARB is anticipated to propose to further increase stringency. *(Small Off-Road Equipment (SORE) measure)*	CARB's SORE program sets more stringent exhaust and evaporative standards for SORE than applicable federal standards (Exhaust and Evaporative Emission Standards for Small Off-Road Engines (2003)), and sets requirements for Zero-Emission SORE equipment. CARB is anticipated to further increase the stringency of emission controls with a measure designed to accelerate the deployment of zero-emission technologies, set tighter exhaust and evaporative emission standards, and enhance enforcement of current emission standards for SORE. *(NOTE: CARB has committed to develop the Small Off-Road Equipment (SORE) measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.
In-Use Emission Controls			
In-Use Emissions Controls • Fleet Rules (Off-Road Equipment – General)	Cleaner In-use Off Road Equipment Regulation (Off-Road Regulation) (CARB)	CARB's off-road regulation controls diesel PM and NOx emissions from >150,000 in-use off-road engines by requiring their owners to retire, replace, or repower older engines, and/or installing verified exhaust retrofit control technologies. Additionally, all vehicles are reported and labeled, and older, dirtier vehicles are restricted from entering fleets.	While Chicago (IL) and New York City (NY) have in-use fleet controls for construction equipment, no other state or nonattainment area controls in-use off-road equipment fleets more stringently than CARB.
In-Use Emissions Controls • Fleet Rules (Agricultural Equipment)	Cleaner In-Use Agricultural Equipment Measure (CARB) CARB is anticipated to proposed to further increase stringency *(Cleaner In-Use Agricultural Equipment measure)*	The Valley's 2007 SIP included the Cleaner In-Use Agricultural Equipment (Ag Equipment) measure; under this program, the District has replaced over 5,000 tier 0 and tier 1 tractors to meet the targeted NOx emission reductions of 5 to 10 tpd by 2017. CARB is anticipated to further increase the stringency of in-use emission controls a measure designed to accelerate emission reductions from the in-use ag equipment fleet. *(NOTE: CARB is proposing the Cleaner In-Use Agricultural Equipment measure, but this measure has yet to be proposed to the Board for approval/adoption.)*	CARB's agricultural equipment fleet controls are among the most stringent in the nation.
In-Use Emissions Controls • Fleet Rules (Airport Ground Support Equipment)	In-Use Off Road Diesel-Fueled Fleets Regulation (CARB)	The In-Use Off Road Diesel-Fueled Fleets Regulation requires fleets to meet fleet average NOx emission targets equivalent to the interim Tier 4 standards for newly produced engines (i.e. equivalent to MSM).	No other state or nonattainment area controls airport GSE more stringently than CARB.
In-Use Emissions Controls • Fleet Rules (Cargo Handling Equipment)	Cargo Handling Equipment Regulation (CARB)	The Cargo Handling Equipment regulation (adopted in 2005, amended in 2011) includes performance standards for in-use, mobile CHE at ports or intermodal rail yards in California.	No other state or nonattainment area has more stringent in-use fleet requirements for CHE than California.
In-Use Emissions Controls • Fleet Rules (Commercial Harbor Craft)	Commercial Harbor Craft Regulation (CARB)	The Commercial Harbor Craft regulation (adopted in 2007) includes in-use limits that require diesel PM and NOx emission controls. The 2010 amendments extended the types of CHC for which in-use engine requirements apply.	No other state or nonattainment area controls in-use CHC emissions more stringently than CARB.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
In-Use Emissions Controls • Fleet Rules (Forklifts)	Off-road Diesel Regulation, Tier 4 Engine Standards, and LSI Fleet Regulation (CARB)	Forklift fleets subject to both the LSI fleet regulation (if powered by gasoline or propane), and the off-road diesel fleet regulation (if powered by diesel) are required to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards.	No other state or nonattainment area has more stringent fleet requirements for in-use forklifts than CARB.
In-Use Emissions Controls • Fleet Rules (Off-Highway Recreational Vehicles)	OHRV "Red Sticker" program (CARB)	CARB's "Red Sticker" program requires in-use Off-Highway Recreational Vehicles (OHRVs) that do not meet the applicable exhaust emission standards display a red registration sticker that limits operation at certain off-highway recreational vehicle parks located in non-attainment areas during peak ozone season.	No other state or nonattainment area controls in-use emissions from OHRV more stringently than CARB.
In-Use Emission Controls (Fleet Standard) • Transport Refrigeration Units (TRU)	Air Toxic Control Measure (ATCM) for Transport Refrigeration Units (TRU) and TRU Generator Sets (CARB) CARB is anticipated to propose to further increase stringency. *(Transport Refrigeration Units (TRU) Used for Cold Storage measure)*	CARB's ATCM for In-Use Diesel-Fueled TRUs requires engines to meet in-use diesel PM emission standards by the end of the seventh year after manufacture, and applies to TRUs that operate in California, regardless of whether they are registered in or outside of the State. CARB's program is the most stringent of its type in the nation. CARB is anticipated to further increase the stringency of emission controls with a measure designed to limit NOx and PM emissions by reducing the amount of time TRUs operate while stationary. *(NOTE: CARB has committed to develop the Transport Refrigeration Units (TRU) Used for Cold Storage measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other state or nonattainment area controls in-use emissions from TRUs more stringently than CARB.
In-Use Emission Controls (Locomotives) • Memorandum of Understanding	Statewide Rail Yard Agreement for California Rail Yards (CARB)	CARB has developed a Statewide Rail Yard Agreement for California Rail Yards, a Memorandum of Understanding (MOU) with the Class I Railroads to accelerate the introduction of cleaner locomotives.	No other state has an agreement with Class I railroads to accelerate the introduction of cleaner locomotive engines.
Fuels			
Fuels Standards • Diesel Standards	CARB Diesel Fuel Regulations and Ultra Low Sulfur Diesel (CARB)	CARB Diesel Fuel Regulations include stringent requirements for fuel mixture specifications for aromatic hydrocarbons and sulfur, and have establish a lubricity standard and applies to sales of fuel used in on-road vehicles and off-road vehicles and locomotives in California CARB's Ultra-Low Sulfur Diesel (ULSD) program reduces ozone precursor emissions significantly relative to U.S. EPA requirements (providing approximately 7 percent more NOx reductions and 25 percent more PM reductions than federal diesel standards).	No state requires cleaner burning diesel than California. The California diesel fuel regulations exceed federal requirements in stringency.

Type of Control Measure	Most Stringent Control Program Identified	Summary of Findings from Analysis	Other Jurisdiction(s) Analyzed
Off-Road Mobile Sources			
Fuels Standards • Alternative Fuel Standards (Diesel substitutes)	LCFS and ADF (CARB) CARB is anticipated to propose to further increase stringency. *(Low Emission Diesel measure)*	The LCFS and ADF regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends. CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products. *(NOTE: CARB has committed to develop the Low Emission Diesel measure, but it has not yet been proposed to the Board for approval/adoption.)*	No other state has set criteria emission requirements on alternative fuels and alternative fuel blends. The Federal Renewable Fuel Standard (RFS II) does not specify criteria requirements for alternative fuels.
In-Use Emission Controls (Locomotives) Cleaner Burning Fuels Requirement	Statewide Rail Yard Agreement for California Rail Yards (CARB)	The Railroad MOU includes requirements to maximize the use of lower emitting diesel fuels for locomotives fueled in California.	No other state or nonattainment has an agreement with Class I railroads to burn cleaner fuels in their jurisdictional boundaries.

EMISSION STANDARDS FOR NEW ENGINES AND EQUIPMENT

Off-Road Equipment (General)

CARB Tier 4 Off-Road Equipment Standards that are nearly identical to those finalized by U.S. EPA in its Clean Air Nonroad Diesel Rule. These regulations require engine manufacturers to meet aftertreatment-based exhaust standards for PM and NOx starting in 2011 that are over 90 percent lower than the previous engine generation's emission levels. CARB's new engine standards for off-road equipment is thus aligned with most stringent control program of any in the nation.

Due to constraints in the Act, California is the only state that can set new engine standards (including control measures such as emission standards, sales mandates, warranty provisions, and on-board diagnostic (OBD) requirements) that are more stringent than U.S. EPA's national standards. Other states can adopt California programs for which U.S. EPA has provided California with waivers. While the Act allows other states to adopt CARB's regulations for off-road engine or off-road vehicles (provided that such standards are identical to the CARB standards for which an authorization has been obtained), other states have not yet adopted off-road engine emission standards equivalent to the California off-road regulation, although there are some states currently considering doing so.

Agricultural Equipment

CARB's new engine standards for off-road agricultural equipment (ag equipment) is consistent with the most stringent of any in the nation. In 2004, U.S. EPA and California adopted equivalent Tier 4 Off-Road Engine Emission Standards, which includes requirements for ag equipment engines.

Airport Ground Support Equipment (GSE)

CARB's new engine standards for airport GSE is the most stringent of any in the nation. New airport GSE is subject to emission standards under CARB's Large Spark Ignition (LSI) Fleet Regulation (natural gas and gasoline engines), and under CARB's Tier 4 Engine Standards (diesel engines). NOx limits for the LSI Engine Standard for engines > 1.0 liter (the typical engine size for GSE) is 0.6 g/bhp-hr. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression ignition engines. Non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the Portable Diesel-Engines Air Toxic Control Measure (ATCM). The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average. No other state has more stringent exhaust emission standards for airport GSE than CARB. Furthermore, CARB is anticipated to further increase the stringency of emission controls under the the Zero-Emission Airport Ground Support Equipment measure committed to in the State SIP Strategy.

Cargo Handling Equipment (CHE)

CARB's Cargo Handling Regulation established engine performance standards for new CHE used to transfer goods or perform maintenance and repair activities and includes equipment such as yard trucks (hostlers), rubber-tired gantry cranes, top handlers, side handlers, forklifts, and loaders at ports and intermodal rail yards. CARB CHE emission standards are the most stringent of any in the nation. CARB obtained U.S. EPA authorization for a waiver in 2012. No other state or nonattainment area has more stringent exhaust emission standards for CHE than California.

Commercial Harbor Craft (CHC)

CARB's new engine standards for CHC is the most stringent of any in the nation. The Commercial Harbor Craft Regulation controls NOx and PM emissions from crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry/excursion vessels, pilot vessels, towboats or push boats, tug boats, and work boats. U.S. EPA has granted a waiver of preemption under §209(b). No other state has more stringent exhaust emission standards for commercial harbor craft than California.

Forklifts

CARB's new engine standards for forklifts are the most stringent of any in the nation. Forklifts powered by LSI engines (gasoline and natural gas) are subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010. Diesel Forklifts > 25 HP are subject to fleet average emission requirements under the Off-Road Diesel Regulation starting in 2010 and Tier 4 Final emission standards (based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction) starting in 2013. Furthermore, the stringency of these requirements is anticipated to increase under the Zero-Emission Off-Road Forklift Regulation Phase 1 measure committed to in the State SIP Strategy. No other state has more stringent forklift emission standards than CARB.

Locomotives

U.S. EPA sets nationwide emission standards for locomotives. No state, including California, has the authority to regulate emission standards for locomotives. Thus, CARB's locomotive controls are equivalent to the controls used in all other nonattainment areas in the nation. Nonetheless, further increases in stringency of locomotive emission controls are needed for California nonattainment areas, including the Valley, to attain federal ambient air quality standards. For this reason, CARB has petitioned U.S. EPA to set more stringent emission controls for locomotives.

Off-Highway Recreational Vehicles (OHRVs)

CARB's new engine standards for OHRV are the most stringent of any in the nation. CARB's program sets exhaust emissions standards (2006) and evaporative emission standards (2007) for OHRV, together with amendments to the testing procedures to ensure the most stringent level of emission reductions are achieved (2007). U.S. EPA has issued waivers of authorization for CARB's OHRV regulations. No other state or nonattainment area controls emissions from new OHRV more stringently than CARB.

Recreational Boats

CARB's new engine standards for recreational boats are the most stringent of any in the nation, and exceed the stringency of U.S. EPA federal standards:

- The Exhaust Emission Regulations for Spark-Ignition Marine Engines (1998) controls emissions at the same level of stringency as national regulations;
- The Tier II Emission Standards for Inboard and Stern Drive Marine Engines (2001) controls emissions at the same level of stringency as national regulations; and
- The Evaporative Emission Control Standards (2015) exceeds the stringency of applicable national regulations set by U.S. EPA in 2008 for gasoline-fueled spark-ignition marine watercraft >30 kilowatts.

No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.

Small Off-Road Engines (SORE)

CARB's new engine standards for SORE are the most stringent of any in the nation. CARB's Exhaust and Evaporative Standards for SORE set more stringent exhaust and evaporative standards than applicable federal standards, and includes requirements for Zero-Emission SORE equipment. Furthermore, CARB is anticipated to further increase the stringency of emission controls with a measure designed to accelerate the deployment of zero-emission technologies, set tighter exhaust and evaporative emission standards, and enhance enforcement of current emission standards for SORE. No other state has the authority to set exhaust emission and/or evaporative emission standards that exceed the stringency of U.S. EPA's national standards.

IN-USE EMISSION CONTROLS FOR OFF-ROAD ENGINES AND EQUIPMENT

Fleet Rules

Off-Road Equipment (General)

In aggregate, CARB's fleet requirements for off-road equipment are the most stringent in the nation. CARB's Cleaner In-Use Off-Road Equipment Regulation (Off-Road Regulation) controls diesel PM and NOx emissions from >150,000 in-use off-road engines by requiring their owners to retire, replace, or repower older engines, and/or installing verified exhaust retrofit control technologies to BACT-equivalent engines. Additionally, all vehicles are reported and labeled, and older, dirtier vehicles are restricted from entering fleets.

CARB's off-road equipment controls emissions from aerial lifts, aircraft tugs, backhoes, baggage tugs, belt loaders, cargo loaders, crawler tractors (such as bulldozers), excavators, forklifts, graders, loaders, mowers, rollers, rough terrain forklifts, rubber tired loaders, scrapers, skid steer loaders, snow blowers, tractors, trenchers, as well as several types of on-road vehicles, such as two-engine vehicles, and workover rigs.

Some nonattainment areas have fleet requirements that also require BACT-equivalent levels of controls for some off-road equipment (i.e. construction equipment), which are described below.

- New York City's Local Law 77 requires use of ultra-low sulfur diesel fuel and BACT for reducing emissions from non-road equipment above 37 kW used on city construction projects.
- Chicago (IL) Clean Diesel Construction Ordinance bans high-polluting diesel equipment from City construction sites. While the California program requires fleets to turnover to Tier 4 or equivalent control levels, the Chicago ordinance only requires fleets to turnover to Tier 2 or equivalent control levels (on-road vehicles MY 1998 and earlier and pre-US Environmental Protection Agency Tier 1 equipment will be banned under the Chicago ordinance.)

No other state or nonattainment area controls in-use off-road equipment fleets more stringently than CARB. Neither of these programs cover the full suite of off-road equipment engine types and applications that are regulated under CARB's program. Additionally, they do not have as stringent of labeling and reporting requirements as CARB. Finally, the use of ULSD in off-road equipment in New York provides significantly less emission reductions than the use of ULSD inside of California (as is required – see fuels section for more information), as federal USLD specifications allow significantly less stringent caps on sulfur and aromatic hydrocarbon content in fuels than CARB diesel specifications.

Beyond the Off-Road Regulation, CARB also controls sub-categories of off-road equipment through specific fleet requirements, as described below.

Agricultural Equipment

CARB's agricultural equipment fleet controls are among the most stringent in the nation. The 2007 Cleaner In-Use Agricultural Equipment Measure modernizes agricultural equipment in the Valley; under this program, the District has, since 2009, replaced over 5,000 tier 0 and tier 1 tractors to meet the targeted NOx emission reductions of 5 to 10 tpd by 2017. CARB is anticipated to further increase the stringency of in-use emission controls with the Cleaner In-Use Ag Equipment measure proposed in the Valley SIP Strategy, which is designed to accelerate emission reductions from the in-use ag equipment fleet.

Airport Ground Support Equipment (GSE)

CARB's airport GSE fleet requirements are the most stringent in the nation. CARB's In-Use Off-Road Diesel-Fueled Fleets Regulation requires fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time to become equivalent to the interim Tier 4 NOx standard for newly produced engines. No other state or nonattainment area controls airport GSE more stringently than CARB.

Cargo Handling Equipment (CHE)

CARB's Cargo Handling Equipment Regulation includes in-use limits that require diesel PM and NOx emission controls for mobile CHE at ports or intermodal rail yards. No other state or nonattainment area has more stringent in-use fleet requirements for CHE than California.

Commercial Harbor Craft (CHC)

The Commercial Harbor Craft regulation (adopted in 2007) includes in-use limits that require diesel PM and NOx emission controls. The 2010 amendments extended the types of CHC for which in-use engine requirements apply. No other state or nonattainment area controls in-use CHC emissions more stringently than CARB.

Forklifts

California forklifts are subject to either the LSI Fleet Regulation (if powered by gasoline or propane), and the Off-Road Diesel Fleet Regulation (if powered by diesel). Under both regulations, forklift fleets are required to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. No other state or nonattainment area has more stringent fleet requirements for in-use forklifts than CARB.

Off-Highway Recreational Vehicles (OHRV)

CARB's In-Use controls for OHRV under the "Red Sticker" program controls in-use emissions from OHRV more stringently than any other state or nonattainment area in the nation. Under this program, engines that do not meet the applicable emission standard for new engines are subject to in-use restrictions that limits operation at certain off-highway recreational vehicle parks located in non attainment areas during peak ozone season. No other state or nonattainment area controls in-use emissions from OHRV more stringently than CARB.

Transport Refrigeration Units (TRU)

The Air Toxic Control Measure (ATCM) for Transport Refrigeration Units (TRU) and TRU Generator Sets (CARB's ATCM for In-Use Diesel-Fueled TRUs) requires engines to meet in-use diesel PM emission standards by the end of the seventh year after manufacture, and applies to TRUs that operate in California, regardless of whether they are registered in or outside of the State. CARB's program is the most stringent of its type in the nation. Furthermore, CARB is anticipated to further increase the stringency of emission controls under the TRU measure committed to in the State SIP Strategy, which is anticipated to increase NOx and PM emission reductions by reducing the amount of time TRUs operate while stationary. No other state or nonattainment area controls in-use emissions from TRUs more stringently than CARB.

Other In-Use Emission Controls for Locomotive Emissions

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. The Statewide Rail Yard Agreement for California Rail Yards (Railroad MOU) accelerates the introduction of cleaner locomotives, obligates the railroads to significantly reduce emissions in and around rail yards in California, and established a statewide visible emissions reduction and repair program. No other state or nonattainment area has achieved similarly significant levels of emission reductions from in-use locomotives than CARB.

FUELS

CARB Diesel Fuel Regulations

U.S. EPA began regulating sulfur content in diesel in 1993. At that time, uncontrolled fuels (i.e. non-CARB diesel) contained approximately 5,000 parts per million (ppm) of sulfur. In 2006, U.S. EPA began to phase-in more stringent requirements under the federal Ultra-Low Sulfur Diesel (ULSD) regulations, which lowered the amount of sulfur allowed in federal diesel fuels. U.S. EPA's Nonroad Diesel Fuel Standards were phased in from 2007 to 2014, and require that all off-road engines, including those used in locomotives and off-road equipment, use ULSD fuel (with some exemptions for older locomotives and marine engines). The Nonroad Standards also require that diesel fuel sold into the market for off-road use must be ULSD. It is important to note that while U.S. EPA defines ULSD as ≤ 15 ppm for on-road applications, the definition of off-road ULSD is significantly less stringent, defined as ≤ 500 ppm standard.

For the off-road fleet, CARB's current ULSD regulation is significantly more stringent than the applicable current federal ULSD standards (Phase III):

- Whereas the federal ULSD program differs in requirements for on- and off-road fuels, CARB's ultra-low sulfur diesel program sets the same requirements for fuels burned in on- and off-road applications. CARB limits sulfur content at 15 ppm rather than the federal limit of 500 ppm for off-road ULSD. Compared with CARB ULSD standards, federal off-road ULSD allows 33 times the sulfur content.
- CARB's ULSD significantly reduces emissions relative to federal on-road ULSD, which is much cleaner than federal off-road ULSD. Both federal on-road ULSD and CARB ULSD limit sulfur content (a precursor to secondary atmospheric formation of PM2.5) to 15 ppm, yet CARB's fuel emits ~25 percent less PM. Given that federal off-road ULSD sulfur content is capped at levels 3,000 percent higher than CARB's ULSD, the California program is significantly more stringent in terms of its ability to control emissions of sulfur oxide emissions.
- In addition, CARB controls hydrocarbons and aromatics, unlike U.S. EPA requirements.

As was discussed in the on-road diesel fuel section, only one other state has a boutique fuel program with requirements that differ from federal specifications, the Low Emission Diesel Program in Texas (TxLED). CARB diesel specifications are more stringent than federal and other states' programs.

Controlling Criteria Emissions from Renewable Fuels

The Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF) regulations work together to reduce the carbon intensity of the California fuel supply while requiring limits on criteria emissions from alternative fuels and/or alternative fuel mix blends. While other states have adopted or are considering adopting similar programs to the California LCFS, no other state has set criteria emission requirements on alternative fuels and alternative fuel blends. The Federal Renewable Fuel Standard (RFS II), which is the most equivalent program type at the federal level, increases the renewable content of the fuel mix nationally (as the LCFS does in California), however it does not specify criteria requirements for alternative fuels. Furthermore, CARB is anticipated to further increase the stringency of controls on criteria pollutant emissions diesel products under the Low Emission Diesel measure committed to in the State SIP Strategy. No other state or nonattainment area controls criteria emissions from renewable fuels more stringently than CARB.

Cleaner Burning Fuels Requirements (for Locomotives)

While emission standards for locomotives are set by U.S. EPA, CARB has accelerated reductions from these sources through efforts that have focused on cleaner fuel requirements, and increasing use of cleaner locomotives. The Railroad MOU includes a control measure that maximizes the use of lower emitting fuels (i.e. CARB and U.S. EPA low sulfur diesel) in locomotives fueled in California. ***Requiring cleaner diesel fuel requirements for intrastate locomotives*** have reduced NOx and diesel PM emissions from these sources.

STEP 3(A): EVALUATION OF STRINGENCY: OFF-ROAD CONTROL MEASURES

Step 3(a) calls for an evaluation of each of the potential BACM/MSM control measures identified in Step 2, in order to evaluate their stringency and determine whether they meet all applicable requirements to satisfy the definitions of BACM and/or MSM discussed in Chapter 1 and Chapter 2.

in order to determine whether each potential MSM/BACM measure meets the definition of MSM and/or BACM, staff has assessed each potential MSM/BACM off-road mobile source control measure identified in Steps 2(a) and 2(b). Based on this assessment, staff then characterized each potential MSM / BACM measure as falling into 'bins' representing whether it meets the definition of MSM or BACM for each of the four PM2.5 standards covered in this document (note that the BACM bin is further subdivided into BACT or ADF). The determination of which bin each control measure falls into thus indicates both the control measure' stringency and the control measures' implementation schedule, relative to the varying attainment dates among the Valley's four PM2.5 SIPs. In other words, the bin into which each control measure falls correlates with how hard each measure pushes to control emissions, given the implementation timeframes associated with each standards' plan. Generally speaking, the control measures included in CARB's current control program meet the definition of BACM; the new measures included in the Valley SIP Strategy satisfy MSM requirements.

Figure 7 shows the timing for implementation of each potential MSM / BACM off-road control measure identified in the prior sections (i.e. Steps 2(a) and 2(b)), for each of the four PM2.5 standards discussed in this SIP.

Figure 7: Timeline for Implementation of BACM / MSM Off-Road Control Measures

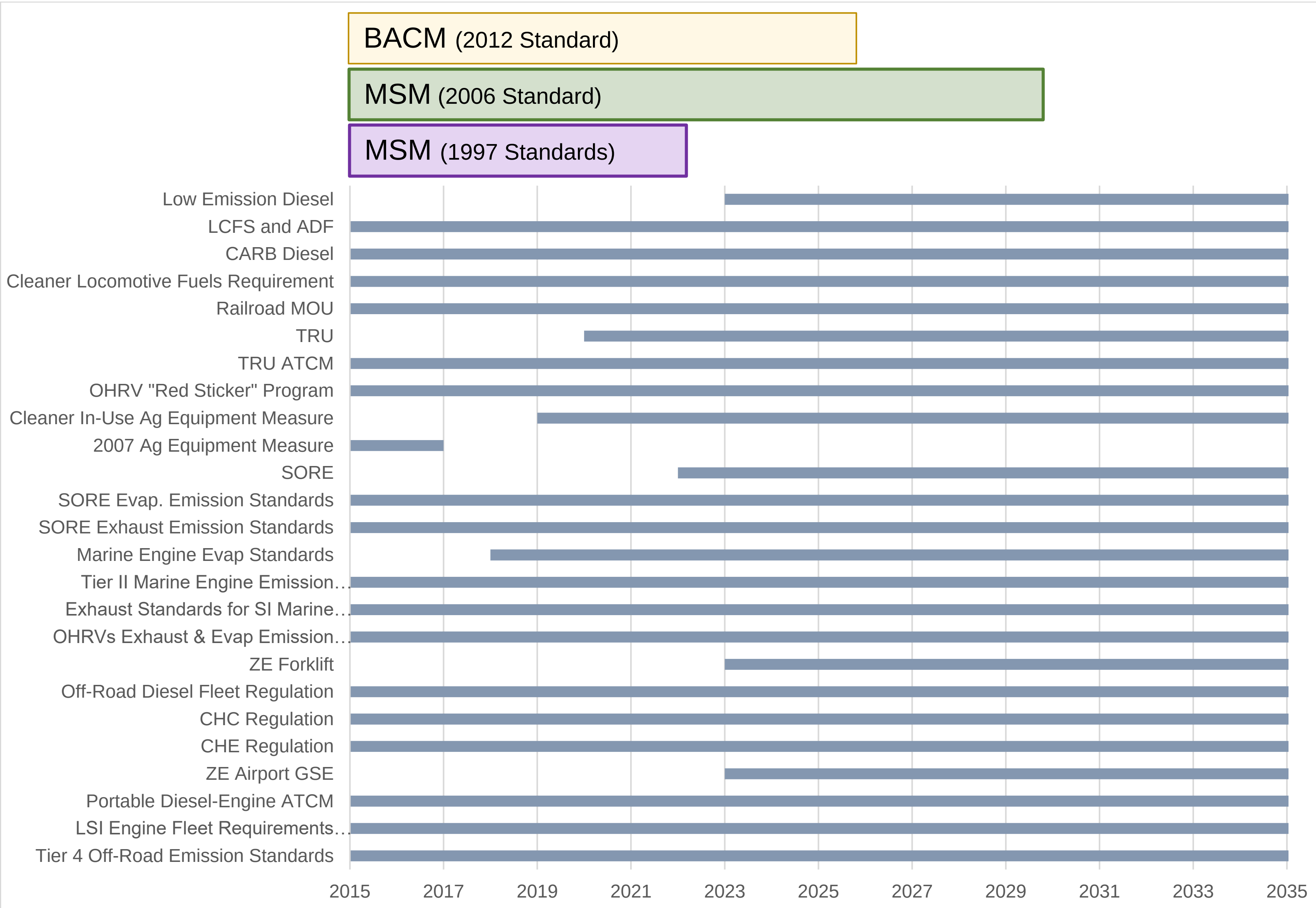

Table 16 summarizes which of the categories of stringency (i.e. BACM/BACT, BACM/ADF, or MSM) that each off-road mobile source control measure falls into, for each PM2.5 standard. It is important to note that some measures CARB has committed to in the State SIP Strategy and proposed in the Valley SIP Strategy have anticipated implementation dates that exceed the timeframe thresholds of this analysis for some standards. Specifically, implementation of the SORE measure is anticipated to begin in 2022, while implementation of the Zero-Emission Airport Ground Support Equipment (GSE) measure, Zero-Emission Forklift Regulation Phase I measure, and the Low-Emission Diesel measure is anticipated to begin in 2023, after the 2021 threshold of the analysis for the 1997 Annual and 24-Hour Standards. While these measures may not meet the timeline requirements to fall into the strict definition of MSM for these standards, the intent behind these measures is nonetheless to continue pushing for additional emission reductions to ensure that attainment is achieved as expeditiously as possible, which aligns with the broader purpose of MSM.

Table 16: Identification of Off-Road Control Measures as BACM and/or MSM

Measures	Implementation Begins	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997)	65 ug/m3 24-Hour (1997)
Adopted Off-Road Control Measures					
Tier 4 Off-Road Emission Standards	ongoing	BACM - BACT	MSM	MSM	MSM
Large Spark Ignition (LSI) Engine Fleet Standards	ongoing	BACM - AFM	MSM	MSM	MSM
Portable Diesel-Engine ATCM	ongoing	BACM - BACT	MSM	MSM	MSM
Cargo Handling Equipment (CHE) Regulation	ongoing	BACM - BACT	MSM	MSM	MSM
Commercial Harbor Craft (CHC) Regulation	ongoing	BACM - BACT	MSM	MSM	MSM
Off-Road Diesel-Fueled Fleets Regulation (Off-Road Regulation)	ongoing	BACM - BACT	MSM	MSM	MSM
Exhaust and Evaporative Emission Standards for OHRVs	ongoing	BACM - BACT	MSM	MSM	MSM
Exhaust Standards for Spark-Ignition Marine Engines	ongoing	BACM - BACT	MSM	MSM	MSM
Tier II Emission Standards for Inboard and Stern-Drive Marine Engines	ongoing	BACM - BACT	MSM	MSM	MSM
Marine Engine Evaporative Emission Control Standards	ongoing	BACM - BACT	MSM	MSM	MSM
SORE Exhaust Emission Standards and Test Procedures	ongoing	BACM - AFM	MSM	MSM	MSM
Evaporative Emission Standards for SORE	ongoing	BACM - BACT	MSM	MSM	MSM
2007 Cleaner In-Use Agricultural Equipment Measure	ongoing	BACM - BACT	MSM	MSM	MSM
Off-Highway Recreational Vehicle (OHRV) "Red Sticker" Program	ongoing	BACM - BACT	MSM	MSM	MSM
ATCM for In-Use Diesel-Fueled Transport Refrigeration Units (TRUs) and TRU Generator Sets	ongoing	BACM - BACT	MSM	MSM	MSM
Statewide Rail Yard Agreement for California Rail Yards (Railroad MOU)	ongoing	BACM - BACT	MSM	MSM	MSM
Cleaner Burning Fuels Requirements for Locomotives	ongoing	BACM - BACT	MSM	MSM	MSM
CARB Ultra Low Sulfur Diesel (ULSD)	ongoing	BACM - BACT	MSM	MSM	MSM
Low Carbon Fuel Standard (LCFS) and Alternative Diesel Fuel (ADF)	ongoing	BACM - BACT	MSM	MSM	MSM

Table 16: Identification of Off-Road Control Measures as BACM and/or MSM

Measures	Implementation Begins	12 ug/m3 Annual (2012)	35 ug/m3 24-Hour (2006)	15 ug/m3 Annual (1997)	65 ug/m3 24-Hour (1997)
State SIP Strategy Off-Road Measures (with Commitment)					
Zero-Emission Airport Ground Support Equipment (GSE)	2023	BACM - AFM	MSM	--	--
Zero-Emission Off-Road Forklift Regulation Phase 1	2023	BACM - AFM	MSM	--	--
Small Off-Road Engines (SORE)	2022	BACM - BACT	MSM	--	--
Transport Refrigeration Units Used for Cold Storage	2020	BACM - AFM	MSM	MSM	MSM
Low-Emission Diesel Requirement	2023	BACM - AFM	MSM	--	--
Valley SIP Strategy Off-Road Measures (Proposed in Valley SIP)					
Cleaner In-Use Agricultural Equipment Measure	2019	BACM - AFM	MSM	MSM	MSM

STEP 3(B): EVALUATION OF FEASIBILITY: OFF-ROAD CONTROL MEASURES

Step 3(b) calls for an assessment of the feasibility of implementing any measure that is not included in the Valley's proposed SIP and attainment demonstration, but which is identified as a potential BACM/MSM control measure in Step 2. For this plan, staff's proposed SIP and attainment demonstration do not recommend eliminating any of the potential BACM/MSM control measures identified in Step 2 on the basis of technical or economic infeasibility. Thus, a feasibility assessment for purposes of eliminating such measures from further consideration (i.e. Step 3(b)) is not applicable.

Summary of Steps 2 and 3

STEP 2: POTENTIAL MOBILE SOURCE CONTROL MEASURES IDENTIFIED

The purpose of Step 2 is to identify all potential BACM/MSM control measures for the emission sources identified Step 1. Per U.S. EPA guidance, staff began to identify the list of all potential BACM/MSM control measures by starting with California's control program (Step 2(a)), which includes:

- Control measures adopted in the SIP for the Valley (i.e. the current control program)
- Control measures committed to in the State SIP Strategy; and
- Control measures proposed in the Valley State SIP Strategy.

In Step 2(b), staff expanded the scope of focus beyond California's controls to identify any additional potential BACM/MSM control measures that are in use in other nonattainment areas and states, and which exceed the stringency of California's controls identified in Step 2(a). The analysis undertaken for Step 2(b) found that, while there are some measures in use in other jurisdictions that are more stringent than the currently adopted mobile source control programs in California, the stringency of similar control measures committed to in the State SIP Strategy and proposed in the Valley State SIP Strategy meets and/or exceeds the stringency of the controls in use in other jurisdictions. Thus, Step 2(b) did not identify any additional potential BACM/MSM control measures in use in other jurisdictions that are more stringent than the California control measures previously identified in Step 2(a).

To meet statutory requirements for the MSM plans, staff also reviewed all previous Valley PM2.5 SIPs in Step 2(c), and found no mobile source control measures that were proposed in previous Moderate or Serious attainment plan control strategies for the Valley that were not subsequently adopted.

As there are no applicable control measures previously rejected as infeasible for the Valley's BACM/MSM demonstration process, Step 2(c) did not identify any additional potential BACM/MSM control measures beyond the control measures identified in Steps 2(a) and 2(b).

STEP 3: ANALYSIS OF STRINGENCY AND FEASIBLILITY

The analysis of stringency and feasibility for each possible BACM/MSM control measure identified in Step 2 has shown that California's mobile source control program is at least consistent with the most stringent of any nonattainment area or state in the nation, with the majority of California control measures exceeding the stringency of controls in use in the rest of the nation. These findings generally correlate with the ongoing technology assessments CARB staff has been conducting in collaboration with U.S. EPA and the National Highway Traffic Safety Administration. These Technology Assessments have been undertaken in order to identify the next generation of technologies and fuels that will need to comprise California's transition to a cleaner, more efficient transportation system.[95] This effort has enabled CARB to identify the types of technologies that will be needed as part of a cleaner, more efficient transportation system that meets California's multiple air quality, and climate goals, including attainment of U.S. EPA's health-based ambient air quality standards for PM2.5 and other criteria air pollutants. The major findings of the Technology Assessments are shown in Figure 8.

Figure 8: Key Technology Assessment Findings

Key Technology Assessment Findings

In the light-duty sector, conventional hybrid electric vehicles have gained significant market share, and ZEV commercialization is well underway, with increasing numbers of BEV, PHEV and FCEV vehicles available for sale.

In the heavy-duty sector, near-zero combustion technologies that provide ultra-low NOx emissions and operate on renewable fuels are beginning to enter the market. Low-NOx natural gas engines in some sizes, certified to an optional 0.02 g/bhp-hr standard are now becoming available, with low-NOx diesel engines certified to the optional standard of either 0.05 or 0.1 g/bhp-hr available thereafter.

The development of heavy-duty zero emission technologies is also underway. Zero-emission vehicles are already available in a number of applications such as forklifts and airport ground support equipment. Battery electric and fuel cell buses are in the early commercialization phase and demonstration projects are underway in additional applications such as zero-emission drayage and last mile delivery trucks, certain types of off-road equipment, and at distribution centers, warehouses and intermodal facilities.

Further emission reductions beyond current engine standards for locomotives and ocean going vessels are feasible with the use of aftertreatment technologies such as oxidation or three-way catalysts, diesel particulate filters, or selective catalytic reduction.

Renewable fuels can provide significant GHG and petroleum reductions, as well as NOx and PM reductions in applications where combustion technologies will continue to operate. Vehicle grid integration and power to gas technologies can also help support a high renewable portfolio electrical grid.

[95] Technology and Fuels Assessments can be found at: https://www.arb.ca.gov/msprog/tech/tech.htm

The Technology Assessment findings illustrate that the control measures included in the Valley's attainment plan and demonstration represent the suite of emission control approaches align with the most stringent levels of control feasible, given the current status of technology and its potential in the near future. Furthermore, CARB staff has not received any public comments to date indicating that more stringent control technologies than those identified in the Technology Assessments would be commercially available and/or technologically and economically feasible to implement in the Valley in the timeframe required for the area's PM2.5 SIPs.

Chapter V. Step 4: Adoption of Mobile Source Control Measures

The final step required by the Act's step-wise process is to adopt and implement feasible control measures identified in Step 3 to satisfy BACT/BACM and MSM requirements.

Staff's proposed SIP for the Valley recommends adoption and implementation all of the measures identified as BACM and MSM in Step 3 that have not already been adopted and/or implemented. The control measures included in the Valley's attainment demonstration and shown to meet the required BACM/MSM requirements in this appendix are in varying stages of the adoption and implementation process at CARB.

- Many of the measures identified as BACM and/or MSM have already been adopted by the Board, submitted into the SIP, and are currently being implemented as part of CARB's current control program.
- Additional control measures have been committed to in the State SIP Strategy, which the Board adopted in March 2017, yet many of these control measures themselves have not yet been adopted by the Board. The Board's adoption of the State SIP Strategy created a commitment to adopt measures according to a defined schedule, an initial commitment to achieve specified emission reductions in the Valley, and a commitment to return to the Board with a comprehensive plan to attain the PM2.5 standards in the Valley.
- Finally, the Valley State SIP Strategy proposes additional control measures which the Board has not yet considered.

Board adoption of the proposed SIP – including the proposed new mobile source control measures described in the Valley SIP Strategy – will satisfy the requirements of Step 4. The process for adoption and implementation of these control measures is discussed in more detail in the body of the main document to which this analysis is appended.

Chapter VI. Conclusion: Findings of MSM and BACM Analysis

California's long history of comprehensive and innovative emissions control has resulted in the strongest mobile source control program in the nation. U.S. EPA has acknowledged the strength of these programs in their approval of CARB's regulations and through the waiver process. In addition, U.S. EPA has provided past determinations that CARB's mobile source control programs meet BACM and MSM requirements as part of their 2004 approval of the Valley's 2003 PM10 Plan:

> "We believe that the State's control programs constitute BACM at this time for the mobile source and fuels categories, since the State's measures reflect the most stringent emission control programs currently available, taking into account economic and technological feasibility."

Since then, CARB has continued to substantially enhance and accelerate reductions from our mobile source control programs through the implementation of more stringent engine emissions standards, in-use requirements, incentive funding, and other policies and initiatives as described in the preceding sections. These efforts not only ensure that all source sectors continue to achieve maximum emission reductions through implementation of the cleanest current technologies, but also promote the ongoing development of more advanced zero and near-zero technologies. As a result, California's mobile source control programs reflect the most stringent and feasible level of emissions control in the nation and fully meet the requirements for BACM/BACT and MSM.

In conclusion, CARB followed the procedures outlined by U.S. EPA for determining BACM and MSM, and have determined that California's mobile source program satisfies the applicable requirements for each PM2.5 standard in this analysis.

The attached table lists all of CARB's regulatory control measures since 1985.

Table 17: CARB Regulatory Mobile Source Control Measures since 1985

Board Action	Hearing Date
Public Hearing to Consider Proposed Amendments to the Airborne Toxic Control Measure For Diesel Particulate Matter from Portable Engines Rated at 50 Horsepower and Greater – and to the Statewide Portable Equipment Registration Program Regulation: The proposed amendments will provide more time for cleaner engine replacement while preserving the expected emission reductions, and make other improvements to the ATCM. PERP will have corresponding amendments and make other improvements to the program.	11/16/17
Public Hearing to Consider the Proposed Amendments to California's Evaluation Procedures for New Aftermarket Catalytic Converters: The proposed amendments are for procedures used to evaluate and approve aftermarket catalytic converters designed for use on California passenger cars and trucks to allow them to be used for Low Emission Vehicle III emission standards.	9/28/17

Public Meeting to Consider Proposed Revisions to the Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines: The updated Carl Moyer Memorial Air Quality Standards Attainment Program 2017 Guidelines implement changes directed by Senate Bill 513 and redesign the Program to meet California's need to transition to the very low and zero-emission technologies of the future.	4/27/17
Public Meeting to Consider the Proposed Amendments to the Evaporative Emission Requirements for Small Off-Road Engines: The proposed amendments will address to non-compliance of small off-road engines (SORE) with existing evaporative emission standards, as well as amendments to streamline the certification process by harmonizing where feasible with federal requirements.	11/17/16
Notice of Public Hearing to Consider Proposed Regulation to Provide Certification Flexibility for Innovative Heavy-Duty Engine and California Certification and Installation Procedures for Medium and Heavy-Duty Vehicle Hybrid Conversion Systems: This proposed regulation's certification flexibility is tailored to encourage development and market launch of heavy-duty engines meeting California's optional low oxides of oxides of nitrogen emission standards, robust heavy-duty hybrid engines, and high-efficiency heavy-duty engines.	10/20/16
Public Hearing to Consider Proposed Amendments to the Large Spark-Ignition Engine Fleet Requirements Regulation: The proposed amendment will establish new reporting and labeling requirements and extend existing recordkeeping requirements. The proposed regulatory amendments are expected to improve the reliability of the emission reductions projected for the existing LSI Fleet Regulation by increasing enforcement effectiveness and compliance rates.	7/21/16
Public Hearing to Consider Proposed Evaluation Procedure for New Aftermarket Diesel Particulate Filters Intended as Modified Parts for 2007 through 2009 Model Year On-Road Heavy-Duty Diesel Engines: The proposed amendment would establish a path for exempting aftermarket modified part DPFs intended for 2007 through 2009 on-road heavy-duty diesel engines from the prohibitions of the current vehicle code. Staff is also proposing to incorporate a new procedure for the evaluation of such DPFs.	4/22/16
Amendments to the Portable Fuel Container Regulation Amendments to the Portable Fuel Container (PFC) regulation, which include requiring certification fuel to contain 10 percent ethanol, harmonizing aspects of the Board's PFC certification and test procedures with those of the U.S. EPA, revising the ARB's certification process, and streamlining, clarifying, and increasing the robustness of ARB's certification and test procedures.	2/18/16
Technical Status and Proposed Revisions to On-Board Diagnostic System Requirements and Associated Enforcement Provisions for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II) Amendments to the OBD II regulations that update requirements to account for LEV III applications and monitoring requirements for gasoline and diesel vehicles, and clarify and improve the regulation; also, updates to the associated OBD II enforcement regulation to align it with the proposed amendments to the OBD II regulations and a minor amendment to the definition of "emissions-related part" in title 13, CCR section 1900.	9/25/15
2015 Low Carbon Fuel Standard (LCFS) Amendments (2 of 2) Re-adoption of the Low Carbon Fuel Standard, which includes updates and revisions to the regulation now in effect. The proposed regulation was first presented to the Board at its February 2015 public hearing, at which the Board directed staff to make modifications to the proposal.	9/24/15
Proposed Regulation on the Commercialization of Alternative Diesel Fuels (2 of 2) Regulation governing the introduction of alternative diesel fuels into the California commercial market, including special provisions for biodiesel.	9/24/15
Intermediate Volume Manufacturer Amendments to the Zero Emission Vehicle Regulation (2 of 2) Amendments regarding intermediate volume manufacturer compliance obligations under the Zero Emission Vehicle regulation.	5/21/15

2015 Amendments to Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities—Aboveground Storage Tanks and Enhanced Conventional Nozzles Amendments would establish new performance standards and specifications for nozzles used at fleet facilities that exclusively refuel vehicles equipped with onboard vapor recovery systems, would provide regulatory relief for owners of certain existing aboveground storage tanks, and would ensure that mass-produced vapor recovery equipment matches the specifications of equipment evaluated during the ARB certification process.	4/23/15
Proposed Regulation for the Commercialization of Alternative Diesel Fuels (1 of 2) Regulation governing the introduction of alternative diesel fuels into the California commercial market, including special provisions for biodiesel. This is the first of two hearings on the item, and the Board will not take action to approve the proposed regulation.	2/19/15
Evaporative Emission Control Requirements for Spark-Ignition Marine Watercraft Regulation for controlling evaporative emissions from spark-ignition marine watercraft. The proposed regulation will harmonize, to the extent feasible, with similar federal requirements, while adding specific provisions needed to support California's air quality needs.	2/19/15
2015 Low Carbon Fuel Standard (LCFS) Amendments (1 of 2) Regulation for a Low Carbon Fuel Standard that includes re- adoption of the existing Low Carbon Fuel Standard with updates and revisions. This is the first of two hearings on the item, and the Board will not take action to approve the proposed regulation.	2/19/15
2014 Amendments to ZEV Regulation Additional compliance flexibility to ZEV manufacturers working to bring advanced technologies to market.	10/23/14
LEV III Criteria Pollutant Requirements for Light- and Medium-Duty Vehicles the Hybrid Electric Vehicle Test Procedures, and the HD Otto-Cycle and HD Diesel Test Procedures Applies to the 2017 and subsequent model years.	10/23/14
Low Carbon Fuel Standard 2014 Update As a result of a California Court of Appeal decision, ARB will revisit the LCFS rulemaking process to meet certain procedural requirements of the APA and CEQA. Following incorporation of any modifications to the regulation, the Board will consider the proposed regulation for adoption at a second hearing held in the spring of 2015.	7/24/14
Revisions to the Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines for On-Road Heavy-Duty Trucks Revisions to 1) reduce surplus emission reduction period, 2) reduce minimum CA usage requirement, 3) prioritize on-road funding to small fleets, 4) include light HD vehicles 14000-19500 libs, and 5) clarify program specifications.	7/24/14
Amendments to Enhanced Fleet Modernization (Car Scrap) Program Amendments consistent with SB 459 which requires ARB to increase benefits for low-income California residents, promote cleaner replacement vehicles, and enhance emissions reductions.	6/26/14
Truck and Bus Rule Update Amendments to the Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen, and Other Criteria Pollutants From In-Use On-Road Diesel-Fueled Vehicles: increasing low-use vehicle thresholds, allowing owners to newly opt-in to existing flexibility provisions, adjusting "NOx exempt" vehicle provisions, and granting additional time for fleets in certain areas to meet PM filter requirements.	4/24/14

Heavy-Duty GHG Phase I: On-Road Heavy-Duty GHG Emissions Rule, Tractor-Trailer Rule, Commercial Motor Vehicle Idling Rule, Optional Reduced Emission Standards, Heavy-Duty Hybrid-Electric Vehicles Certification Procedure New GHG standards for MD and HD engines and vehicles identical to those adopted by the USEPA in 2011 for MYs 2014-18.	12/12/13
Agricultural equipment SIP credit rule Incentive-funded projects must be implemented using Carl Moyer Program Guidelines; must be surplus, quantifiable, enforceable, and permanent, and result in emission reductions that are eligible for SIP credit.	10/25/13
Zero emission vehicle test procedures Existing certification test procedures for plug-in hybrid vehicles need to be updated to reflect technology developments. The ZEV regulation will require minor modifications to address clarity and implementation issues.	10/24/13
Alternative fuel certification procedures Amendments to current alternative fuel conversion certification procedures for motor vehicles and engines that will allow small volume conversion manufacturers to reduce the upfront demonstration requirements and allow systems to be sold sooner with lower certification costs than with the current process, beginning with MY 2018.	9/26/13
Vapor Recovery for Gasoline Dispensing Facilities Amendments to certification and test procedures for vapor recovery equipment used on cargo tanks and at gasoline dispensing facilities.	7/25/13
Off-highway recreational vehicle evaporative emission control Staff proposes to set evaporative emission standards to control hydrocarbon emissions from Off-Highway Recreational Vehicles. The running loss, hot soak, and diurnal performance standards can be met by using proven automobile type control technology.	7/25/13
Gasoline and diesel fuel test standards Adopted amendments to add test standards for the measurement of prohibited oxygenates at trace levels specified in existing regulations.	1/25/13
LEV III and ZEV Programs for Federal Compliance Option Adopted amendments to deem compliance with national GHG new vehicle standards in 2017-2025 as compliance with California GHG standards for the same model years.	11/15/12 12/6/12 EO
Amendments to Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines Approved amendments to the verification procedure used to evaluate diesel retrofits through emissions, durability, and field testing. Amendments will lower costs associated with required in-use compliance testing, streamline the in-use compliance process, and will extend time allowed to complete verifications.	8/23/2012 EO 07/02/13
Amendments to On-Board Diagnostics (OBD I and II) Regulations Approved amendments to the light- and medium-duty vehicle and heavy-duty engine OBD regulations.	8/23/2012 EO 06/26/13
Vapor recovery defect list Adopted amendments to add defects and verification procedures for equipment approved since 2004, and make minor changes to provide clarity	6/11/12 EO
Advanced Clean Cars (ACC) Regulation: Low-Emission Vehicles and GHG Adopted more stringent criteria emission standards for MY 2015-2025 light and medium duty vehicles (LEV III), amended GHG emission standards for model year 2017-2025 light and medium duty vehicles (LEV GHG), amended ZEV Regulation to ensure the successful market penetration of ZEVs in commercial volumes, amended hydrogen fueling infrastructure mandate of the Clean Fuels Outlet regulation, and amended cert fuel for light duty vehicles from an MTBE-containing fuel to an E10 certification fuel.	1/26/12

Zero Emission Vehicle (ZEV) Adopted amendments to increase compliance flexibility, add two new vehicle categories for use in creating credits, increase credits for 300 mile FCVs, increase requirements for ZEVs and TZEVs, eliminate credit for PZEVs and AT PZEVs, expand applicability to smaller manufacturers, base ZEV credits on range, and make other minor changes in credit requirements	1/26/12
Amendments to Low Carbon Fuel Standard Regulation The amendments address several aspects of the regulation, including: reporting requirements, credit trading, regulated parties, opt-in and opt-out provisions, definitions, and other clarifying language.	12/16/11 10/10/12 EO
Amendments to Small Off-Road Engine and Tier 4 Off-Road Compression-Ignition Engine Regulations And Test Procedures; also "Recreational Marine" Spark-Ignition Marine Engine Amendments (Recreational Boats) adopted. Aligns California test procedures with U.S. EPA test procedures and requires off-road CI engine manufacturers to conduct in-use testing of their entire product lines to confirm compliance with previously established Not-To-Exceed emission thresholds.	12/16/2011 10/25/12 EO
Regulations and Certification Procedures for Engine Packages used in Light-Duty Specially Constructed Vehicles (Kit Cars) Ensures that certified engine packages, when placed into any Kit Car, would meet new vehicle emission standards, and be able to meet Smog Check requirements.	11/17/11 9/21/12 EO
Amendments to the California Reformulated Gasoline Regulations Corrects drafting errors in the predictive model, deletes outdated regulatory provisions, updates the notification requirements, and changes the restrictions on blending CARBOB with other liquids.	10/21/11 8/24/12 EO
Amendments to the In-Use Diesel Transport Refrigeration Units (TRU) ATCM Mechanisms to improve compliance rates and enforceability.	10/21/11 8/31/12 EO
Amendments to the Regulation for Cargo Handling Equipment (CHE) at Ports and Intermodal Rail Yards (Port Yard Trucks Regulation) Provides additional compliance flexibility, and maintains anticipated emissions reductions. As applicable to yard trucks and two-engine sweepers.	9/22/11 8/2/12 EO
Amendments to the Enhanced Vapor Recovery Regulation for Gasoline Dispensing Facilities New requirement for low permeation hoses at gasoline dispensing facilities.	9/22/11 7/26/12 EO
Amendments to Cleaner Main Ship Engines and Fuel for Ocean-Going Vessels Adjusts the offshore regulatory boundary. Aligns very low sulfur fuel implementation deadlines with new federal requirements.	6/23/11 9/13/12 EO
Particulate Matter Emissions Measurement Allowance For Heavy-Duty Diesel In-Use Compliance Regulation Emission measurement allowances provide for variability associated with the field testing required in the regulation.	6/23/11
Low Carbon Fuel Standard Carbon Intensity Lookup Table Amendments Adds new pathways for vegetation-based fuels	2/24/11
Amendments to Cleaner In-Use Heavy-Duty On-Road Diesel Trucks and LSI Fleets Regulations Amends five regulations to provide relief to fleets adversely affected by the economy, and take into account the fact that emissions are lower than previously predicted.	12/16/10 9/19/11 EO
Amendments to Cleaner In-Use Off-Road Diesel-Fueled Fleets Regulation Amendments provide relief to fleets adversely affected by the economy, and take into account the fact that emissions are lower than previously predicted.	12/16/10 10/28/11 EO
In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Rail Yard Facilities Amendments add flexibility to fleets' compliance schedules, mitigate the use of noncompliant trucks outside port and rail properties, and provide transition to the Truck and Bus regulation.	12/16/10 9/19/11 EO

Amendment of the ATCM for Diesel Transportation Refrigeration Units (TRU) Amendments expand the compliance options and clarify the operational life of various types of TRUs.	11/18/10 2/2/11 EO
Amendments to the ATCM for Stationary Compression Ignition Engines Approved amendments to closely align the emission limits for new emergency standby engines in the ATCM with the emission standards required by the federal Standards of Performance.	10/21/10 3/25/11 EO
Diesel Vehicle Periodic Smoke Inspection Program Adopted amendments to exempt medium duty diesel vehicles from smoke inspection requirements if complying with Smog Check requirements.	10/21/10 8/23/11 EO
Renewable Electricity Standard Regulation Approved a regulation that will require electricity providers to obtain at least 33% of their retail electricity sales from renewable energy resources by 2020.	9/23/10
Energy Efficiency at Industrial Facilities Adopted standards for the reporting of GHG emissions and the feasibility of emissions controls by the largest GHG-emitting stationary sources.	7/22/10 5/9/11 EO
Amendments to Commercial Harbor Craft Regulation Approved amendments to require the use of cleaner engines in diesel-fueled crew and supply, barge, and dredge vessels.	6/24/10 4/11/11 EO
Accelerated Introduction of Cleaner Line-Haul Locomotives Agreement with railroads sets prescribed reductions in diesel risk and target years through 2020 at four major railyards.	6/24/10
Sulfur Hexafluoride (SF6) Regulation Regulation to reduce emissions of sulfur hexafluoride (SF6), a high-GWP GHG, from high-voltage gas-insulated electrical switchgear.	2/25/10 12/15/10 EO
Amendments to the Statewide Portable Equipment Registration Regulation and Portable Engine ATCM Approved amendments that extend the deadline for removal of certain uncertified portable engines for one year.	1/28/10 8/27/10 EO 12/8/10 EO
Diesel Engine Retrofit Control Verification, Warranty, and Compliance Regulation Amendments Approved amendments to require per-installation compatibility assessment, performance data collection, and reporting of additional information, and enhance enforceability.	1/28/10 12/6/10 EO
Amendments to Limit Ozone Emissions from Indoor Air Cleaning Devices Adopted amendments to delay the labeling compliance deadlines by one to two years and to make minor changes in testing protocols.	12/9/09
Emission Warranty Information Reporting Regulation Amendments Repealed the 2007 regulation and readopted the 1988 regulation with amendments to implement adverse court decision.	11/19/09 9/27/10 EO
Amendments to Maximum Incremental Reactivity Tables Added many new compounds and modified reactivity values for many existing compounds in the tables to reflect new research data.	11/3/09 7/23/10 EO
Passenger Motor Vehicle Greenhouse Gas Limits Amendments Approved amendments granting credits to manufacturers for compliant vehicles sold in other states that have adopted California regulations.	9/24/09 2/22/10 EO
Amendments to In-Use Off-Road Diesel-Fueled Fleets Regulation Approved amendments to implement legislatively directed changes and provide additional incentives for early action.	7/23/09 12/2/09 EO 6/3/10 EO
Methane Emissions from Municipal Solid Waste Landfills Approved a regulation to require smaller and other uncontrolled landfills to install gas collection and control systems, and also requires existing and newly installed systems to operate optimally.	6/25/09 5/5/10 EO
Cool Car Standards Approved a regulation requiring the use of solar management window glass in vehicles up to 10,000 lb GVWR.	6/25/09

Enhanced Fleet Modernization (Car Scrap) Approved guidelines for a program to scrap up to 15,000 light duty vehicles statewide.	6/25/09 7/30/10 EO
Amendments to Heavy-Duty On-Board Diagnostics Regulations Approved amendments to the light and medium-duty vehicle and heavy duty engine OBD regulations.	5/28/2009 4/6/10 EO
Smog Check Improvements BAR adopted amendments to implement changes in state law and SIP commitments adopted by CARB between 1996 and 2007.	5/7/09 by BAR 6/9/09 EO
AB 118 Air Quality Improvement Program Guidelines The Air Quality Improvement Program provides for up to $50 million per year for seven years beginning in 2009-10 for vehicle and equipment projects that reduce criteria pollutants, air quality research, and advanced technology workforce training. The AQIP Guidelines describe minimum administrative, reporting, and oversight requirements for the program, and provide general criteria for how the program shall be implemented.	04/23/09 08/28/09 EO
Pesticide Element Reduce volatile organic compound (VOC) emissions from the application of agricultural field fumigants in the South Coast, Southeast Desert, Ventura County, San Joaquin Valley, and Sacramento Metro federal ozone nonattainment areas.	4/20/09 10/12/09 EO (2) 8/2/11 EO
Low Carbon Fuel Standard Approved new standards to lower the carbon content of fuels.	4/20/09 11/25/09 EO
Pesticide Element for San Joaquin Valley DPR Director approved pesticide ROG emission limit of 18.1 tpd and committed to implement restrictions on non-fumigant pesticide use by 2014 in the San Joaquin Valley.	4/7/09 DPR
Tire Pressure Inflation Regulation Approved a regulation requiring automotive service providers to perform tire pressure checks as part of every service.	3/26/09 2/4/10 EO
Sulfur Hexafluoride from Non-Utility and Non-Semiconductor Applications Approved a regulation to phase out use of Sulfur Hexafluoride over the next several years.	2/26/09 11/12/09 EO
Semiconductor Operations Approved a regulation to set standards to reduce fluorinated gas emissions from the semiconductor and related devices industry.	2/26/09 10/23/09 EO
Plug-In Hybrid Electric Vehicles Test Procedure Amendments Amends test procedures to address plug-in-hybrid electric vehicles.	1/23/09 12/2/09 EO
In-Use Off-Road Diesel-Fueled Fleets Amendments Makes administrative changes to recognize delays in the supply of retrofit control devices.	1/22/09
Aftermarket Critical Emission Parts on Highway Motorcycles Allows for the sale of certified critical emission parts by aftermarket manufacturers.	1/22/09 6/19/09 EO
Cleaner In-Use Heavy-Duty Diesel Trucks (Truck and Bus Regulation) Approved a regulation to reduce diesel particulate matter and oxides of nitrogen through fleet modernization and exhaust retrofits. Makes enforceability changes to public fleet, off-road equipment, and portable equipment regulations.	12/11/08 10/19/09 EO 10/23/09 EO
Large Spark-Ignition Engine Amendments Approved amendments to reduce evaporative, permeation, and exhaust emissions from large spark-ignition (LSI) engines equal to or below 1 liter in displacement.	11/1/08 3/12/09 EO
Small Off-Road Engine (SORE) Amendments Approved amendments to address the excessive accumulation of emission credits.	11/21/08 2/24/10 EO
Proposed AB 118 Air Quality Guidelines for the Air Quality Improvement Program and the Alternative and Renewable Fuel and Vehicle and Technology Program. The California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (AB 118) requires CARB to develop guidelines for both the Alternative and Renewable Fuel and Vehicle Technology Program and the Air Quality Improvement Program to ensure that both programs do not adversely impact air quality.	09/25/08 EO 05/20/09

Portable Outboard Marine Tanks and Components (part of Additional Evaporative Emission Standards) Approved a regulation that establishes permeation and emission standards for new portable outboard marine tanks and components.	9/25/08 7/20/09 EO
Cleaner Fuel in Ocean Going Vessels Approved a regulation that requires use of low sulfur fuel in ocean-going ship main engines, and auxiliary engines and boilers.	7/24/08 4/16/09 EO
Spark-Ignition Marine Engine and Boat Amendments Provides optional compliance path for > 500 hp sterndrive/inboard marine engines.	7/24/08 6/5/09 EO
Zero emission vehicles Updated California's ZEV requirements to provide greater flexibility with respect to fuels, technologies, and simplifying compliance pathways. Amendments give manufacturers increased flexibility to comply with ZEV requirements by giving credit to plug-in hybrid electric vehicles and establishing additional ZEV categories in recognition of new developments in fuel cell vehicles and battery electric vehicles.	3/27/08 12/17/08 EO
Amendments to the Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines Adds verification requirements for control technologies that only reduce NOx emissions, new reduction classifications for NOx reducing technologies, new testing requirements, and conditional extensions for verified technologies.	1/24/08 12/4/08 EO
Gaseous Pollutant Measurement Allowances for In-Use Heavy-Duty Diesel Compliance Measurement accuracy margins are to be determined through an ongoing comprehensive testing program performed by an independent contractor. Amendments include these measurement accuracy margins into the regulation.	12/6/07 10/14/08 EO
Ocean-Going Vessels While at Berth (aka Ship Hoteling) - Auxiliary Engine Cold Ironing and Clean Technology Approved a regulation that reduces emissions from auxiliary engines on ocean-going ships while at-berth.	12/6/07 10/16/08 EO
In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Rail Yard Facilities Approved a regulation that establishes emission standards for in-use, heavy-duty diesel-fueled vehicles that transport cargo to and from California's ports and intermodal rail facilities.	12/6/07 10/12/08 EO
Commercial Harbor Craft Approved a regulation that establishes in-use and new engine emission limits for both auxiliary and propulsion diesel engines on ferries, excursion vessels, tugboats, and towboats.	11/15/07 9/2/08 EO
Suggested Control Measure for Architectural Coatings Amendments Approved amendments to reduce the recommended VOC content of 19 categories of architectural coatings.	10/26/07
Aftermarket Catalytic Converter Requirements Approved amendments that establish more stringent emission performance and durability requirements for used and new aftermarket catalytic converters offered for sale in California.	10/25/07 2/21/08 NOD
Limiting Ozone Emissions from Indoor Air Cleaning Devices Approved ozone emission limit of 0.050 ppm for portable indoor air cleaning devices in response to requirements of AB 2276 (2006).	9/27/07 8/7/08 EO
Pesticide Commitment for Ventura County in 1994 SIP Approved substitution of excess ROG emission reductions from state motor vehicle program for 1994 SIP reduction commitment from pesticide application in Ventura County.	9/27/07 11/30/07 EO
In-Use Off-Road Diesel Equipment Approved a regulation that requires off-road diesel fleet owners to modernize their fleets and install exhaust retrofits.	7/26/07 4/4/08 EO

Emission Control and Environmental Performance Label Regulations Approved amendments to add a Global Index Label and modify the formal of the Smog Index Label on new cars.	6/21/07 5/2/08 EO
Vapor Recovery from Aboveground Storage Tanks Approved a regulation to establish new performance standards and specifications for the vapor recovery systems and components used with aboveground storage tanks.	6/21/07 5/2/08 EO
CaRFG Phase 3 amendments Approved amendments to mitigate the increases in evaporative emissions from on-road motor vehicles resulting from the addition of ethanol to gasoline.	6/14/07 4/25/08 EO 8/7/08 EO
Formaldehyde from Composite Wood Products Approved an ATCM to limit formaldehyde emissions from hardwood plywood, particleboard, and medium density fiberboard to the maximum amount feasible.	4/26/07 3/5/08 EO
Portable equipment registration program (PERP) and airborne toxic control measure for diesel-fueled portable engines Approved amendments to allow permitting of Tier 0 portable equipment engines used in emergency or low use duty and to extend permitting of certain Tier 1 and 2 "resident" engines to 1/1/10.	3/22/07 7/31/07 EO
Perchloroethylene Control Measure Amendments Approved amendments to the Perchloroethylene ATCM to prohibit new Perc dry cleaning machines beginning 2008 and phase out all Perc machines by 2023.	1/25/07 11/7/07 EO
Amendments to Emission Warranty Information Reporting & Recall Regulations Approved amendments that tighten the provisions for recalling vehicles for emissions-related failures, helping ensure that corrective action is taken to vehicles with defective emission control devices or systems.	12/7/06 3/22/07 10/17/07 EO
Voluntary accelerated vehicle retirement regulations Approved amendments that authorize the use of remote sensing to identify light-duty high emitters and that establish protocols for quantifying emissions reductions from high emitters proposed for retirement.	12/7/06
Emergency regulation for portable equipment registration program (PERP), airborne toxic control measures for portable and stationary diesel-fueled engines	12/7/06
Amendments to the Hexavalent Chromium ATCM Approved amendments that require use of best available control technology on all chrome plating and anodizing facilities.	12/7/06
Requirements for Stationary Diesel In-Use Agricultural Engines Approved amendments to the stationary diesel engine ATCM which set emissions standards for in-use diesel agricultural engines.	11/16/06 7/3/07 NOD
Ships - Onboard Incineration Approved amendments to cruise ship incineration ATCM to include all oceangoing ships of 300 gross registered tons or more.	11/16/06 9/11/07 EO
Zero Emission Bus Approved amendments postponing the 15 percent purchase requirement three years for transit agencies in the diesel path and one to two years for transit agencies in the alternative fuel path, in order to keep pace with developments in zero emission bus technology, and adding an Advanced Demonstration requirement to offset emission losses.	10/19/06 8/27/07 EO
Distributed generation certification Approved amendments improving the emissions durability and testing requirements, adding waste gas emission standards, and eliminating a redundant PM standard in the current 2007 emission standards.	10/19/06 5/17/07 NOD
Heavy-Duty Diesel In-Use Compliance Regulation Approved amendments to the heavy-duty diesel engine regulations and test procedures to create a new in-use compliance program conducted by engine manufacturers. The amendments would help ensure compliance with applicable certification standards throughout an engine's useful life.	9/28/06 7/19/07 NOD

Revisions to OBD II and the Emission Warranty Regulations Approved amendments to the OBD II regulation to provide for improved emission control monitoring including air-fuel cylinder imbalance monitoring, oxygen sensor monitoring, catalyst monitoring, permanent fault codes for gasoline vehicles and new thresholds for diesel vehicles.	9/28/06 8/9/07 EO
Off-Highway Recreational Vehicle Amendments Approved amendments to the Off-Highway Recreational Vehicle Regulations including harmonizing evaporative emission standards with federal regulations, expanding the definition of ATVs, modifying labeling requirements, and adjusting riding seasons.	7/20/06 6/1/07 EO
Portable Equipment Registration Program (PERP) Amendments Approved amendments to the Statewide Portable Equipment Registration program that include installation of hour meters on equipment, and revisions to recordkeeping, reporting, and fees.	6/22/06 11/13/06 NOD
Heavy Duty Vehicle Service Information Approved amendments to the Service Information Rule to require manufacturers to make available diagnostic equipment and information for sale to the aftermarket.	6/22/06 5/3/07 EO
LEV II technical amendments Approved amendments to evaporative emission test procedures, four-wheel drive dynamometer provisions, and vehicle label requirements.	6/22/06 9/27/06 NOD
Dry Cleaning ATCM Amendments Approved amendments to the Dry Cleaning ATCM to limit siting of new dry cleaners, phase out use of Perc at co-residential facilities, phase out higher emitting Perc sources at other facilities, and require enhanced ventilation at existing and new Perc facilities.	5/25/06
Forklifts and other Large Spark Ignition (LSI) Equipment Adopted a regulation to reduce emissions from forklifts and other off-road spark-ignition equipment by establishing more stringent standards for new equipment, and requiring retrofits or engine replacement on existing equipment. Adopts EPA's standards for 2007; adopts more stringent standards for 2010.	5/25/06 3/2/07 EO
Enhanced Vapor Recovery Amendments Approved amendments to the vapor recovery system regulation and adopted revised test procedures.	5/25/06
Diesel Retrofit Technology Verification Procedure Approved amendments to the Diesel Emission In-use Control Strategy Verification Procedure to substitute a 30% increase limit in NOx concentration for an 80% reduction requirement from PM retrofit devices.	3/23/06 12/21/06 NOD
Heavy duty vehicle smoke inspection program amendments Approved amendments to impose a fine on trucks not displaying a current compliance certification sticker.	1/26/06 12/4/06 EO
Ocean-going Ship Auxiliary Engine Fuel Approved a regulation to require ships to use cleaner marine gas oil or diesel to power auxiliary engines within 24 nautical miles of the California coast.	12/8/05 10/20/06 EO
Diesel Cargo Handling Equipment Approved a regulation to require new and in-use cargo handling equipment at ports and intermodal rail yards to reduce emissions by utilizing best available control technology.	12/8/05 6/2/06 EO
Public and Utility Diesel Truck Fleets Approved a regulation to reduce diesel particulate matter emissions from heavy duty diesel trucks in government and private utility fleets.	12/8/05 10/4/06 EO
Cruise ships – Onboard Incineration Adopted an Air Toxic Control Measure to prohibit cruise ships from conducting onboard incineration within three nautical miles of the California coast.	11/17/05 2/1/06 NOD
Inboard Marine Engine Rule Amendments Approved amendments to the 2001 regulation to include additional compliance options for manufacturers.	11/17/05 9/26/06 EO
Heavy-Duty Diesel Truck Idling Technology Approved a regulation to limit sleeper truck idling to 5 minutes. Allows alternate technologies to provide cab heating/cooling and power.	10/20/05 9/1/06 EO

Automotive Coating Suggested Control Measure Approved an SCM for automotive coatings for adoption by air districts. The measure will reduce the VOC content of 11 categories of surface protective coatings.	10/20/05
2007-09 Model-year heavy duty urban bus engines and the fleet rule for transit agencies Adopted amendments to align urban bus emission limits with on-road heavy duty truck emission limits and allow for the purchase of non- complying buses under the condition that bus turnover increase to offset NOx increases.	10/20/05 10/27/05 7/28/06 EO
Portable fuel containers (part 2 of 2) Approved amendments to revise spout and automatic shutoff design.	9/15/05 7/28/06 EO
Portable Fuel Containers (part 1 of 2) Approved amendments to include kerosene containers in the definition of portable fuel containers.	9/15/05 11/9/05 NOD
2007-09 Model-year heavy duty urban bus engines and the fleet rule for transit agencies Adopted amendments to require all transit agencies in SCAQMD to purchase only alternate fuel versions of new buses.	9/15/05 Superceded by 10/20/05
Reid vapor pressure limit emergency rule Approved amendments to relax Reid vapor pressure limit to accelerate fuel production for Hurricane Katrina victims.	9/8/05 Operative for September and October 2005 only
Heavy-Duty Truck OBD Approved a regulation to require on-board diagnostic (OBD) systems for new gas and diesel trucks, similar to the systems on passenger cars.	7/21/05 12/28/05 EO
Definition of Large Confined Animal Facility Adopted a regulation to define the size of a large CAF for the purposes of air quality permitting and reduction of ROG emissions to the extent feasible.	6/23/05 4/13/06 EO
ATCM for stationary compression ignition engines Approved emergency amendments (3/17/05) and permanent amendments (5/26/05) to relax the diesel PM emission limits on new stationary diesel engines to current off-road engine standards to respond to the lack of availability of engines meeting the original ATCM standard.	3/17/05 5/26/05 7/29/05 EO
Transit Fleet Rule Approved amendments to add emission limits for non-urban bus transit agency vehicles, require lower bus and truck fleet-average NOx and PM emission limits, and clarify emission limits for CO, NMHC, and formaldehyde.	2/24/05 10/19/05 NOD
Thermal Spraying ATCM Approved a regulation to reduce emissions of hexavalent chromium and nickel from thermal spraying operations.	12/9/04 7/20/05 EO
Tier 4 Standards for Small Off-Road Diesel Engines (SORE) Approved new emission standards for off-road diesel engines to be phased in between 2008 and 2015.	12/9/04 10/21/05 EO
Emergency Regulatory Amendment Delaying the January 1, 2005 Implementation Date for the Diesel Fuel Lubricity Standard Adopted an emergency regulation delaying the lubricity standard compliance deadline by five months to respond to fuel pipeline contamination problems.	11/24/04 12/10/04 EO
Enhanced vapor recovery compliance extension Approved amendments to the EVR regulation to extend the compliance date for onboard refueling vapor recovery compatibility to the date of EVR compliance.	11/18/04 2/11/05 EO
CaRFG Phase 3 amendments Approved amendments correcting errors and streamlining requirements for compliance and enforcement of CaRFG Phase 3 regulations adopted in 1999.	11/18/04
Clean diesel fuel for harborcraft and intrastate locomotives Approved a regulation that required harborcraft and locomotives operating solely within California to use clean diesel fuel.	11/18/04 3/16/05 EO

Nonvehicular Source, Consumer Product, and Architectural Coating Fee Regulation Amendment Approved amendments to fee regulations to collect supplemental fees when authorized by the Legislature.	11/18/04
Greenhouse gas limits for motor vehicles Approved a regulation that sets the first ever greenhouse gas emission standards on light and medium duty vehicles starting with the 2009 model year.	9/24/04 8/4/05 EO
Gasoline vapor recovery system equipment defects list Approved the addition of defects to the VRED list for use by compliance inspectors.	8/24/04 6/22/05 EO
Unihose gasoline vapor recovery systems Approved an emergency regulation and an amendment to delay the compliance date for unihose installation to the date of dispenser replacement.	7/22/04 11/24/04 EO
General Idling Limits for Diesel Trucks Approved a regulation that limits idling of heavy-duty diesel trucks operating in California to five minutes, with exceptions for sleeper cabs.	7/22/04
Urban bus engines/fleet rule for transit agencies Approved amendments to allow for the purchase of hybrid diesel buses and revise the zero emission bus demonstration and purchase timelines.	6/24/04
Engine Manufacturer Diagnostics Approved a regulation that would require model year 2007 and later heavy duty truck engines to be equipped with engine diagnostic systems to detect malfunctions of the emission control system.	5/20/04
Chip Reflash Approved a voluntary program and a backstop regulation to reduce heavy duty truck NOx emissions through the installation of new software in the engine's electronic control module.	3/25/04 3/21/05 EO
Portable equipment registration program (PERP) Approved amendments to allow uncertified engines to be registered until December 31, 2005, to increase fees, and to modify administrative requirements.	2/26/04 1/7/05 EO 6/21/05 EO
Portable Diesel Engine ATCM Adopted a regulation to reduce diesel PM emissions from portable engines through a series of emission standards that increase in stringency through 2020.	2/26/04 1/4/05 EO
California motor vehicle service information rule Adopted amendments to allow for the purchase of heavy duty engine emission-related service information and diagnostic tools by independent service facilities and aftermarket parts manufacturers.	1/22/04 5/20/04
Transportation Refrigeration Unit ATCM Adopted a regulation to reduce diesel PM emissions from transport refrigeration units by establishing emission standards and facility reporting requirements to streamline inspections.	12/11/03 2/26/04 11/10/04 EO
Diesel engine verification procedures Approved amendments that reduced warranty coverage to the engine only, delayed the NOx reduction compliance date to 2007, added requirements for proof-of-concept testing for new technology, and harmonized durability requirements with those of U.S. EPA.	12/11/03 2/26/04 10/17/04
Chip Reflash Approved a voluntary program and a backstop regulation to reduce heavy duty truck NOx emissions through the installation of new software in the engine’s electronic control module.	12/11/03 3/27/04 3/21/05 EO
Revised tables of maximum incremental reactivity values Approved the addition of 102 more chemicals with associated maximum incremental reactivity values to existing regulation allowing these chemicals to be used in aerosol coating formulations.	12/3/03
Stationary Diesel Engines ATCM Adopted a regulation to reduce diesel PM emissions from stationary diesel engines through the use of clean fuel, lower emission standards, operational practices.	11/20/03 12/11/03 2/26/2004 9/27/04 EO

Solid waste collection vehicles Adopted a regulation to reduce toxic diesel particulate emissions from solid waste collection vehicles by over 80 percent by 2010. This measure is part of ARB's plan to reduce the risk from a wide range of diesel engines throughout California.	9/25/03 5/17/04 EO
Small off-road engines (SORE) Adopted more stringent emission standards for the engines used in lawn and garden and industrial equipment, such as string trimmers, leaf blowers, walk-behind lawn mowers, generators, and lawn tractors.	9/25/03 7/26/04 EO
Off-highway recreational vehicles Changes to riding season restrictions.	7/24/03
Clean diesel fuel Adopted a regulation to reduce sulfur levels and set a minimum lubricity standard in diesel fuel used in vehicles and off-road equipment in California, beginning in 2006.	7/24/03 5/28/04 EO
Ozone Transport Mitigation Amendments Adopted amendments to require upwind districts to (1) have the same no-net-increase permitting thresholds as downwind districts, and (2) Adopt "all feasible measures."	5/22/03 10/2/03 NOD
Zero emission vehicles Updated California's ZEV requirements to support the fuel cell car development and expand sales of advanced technology partial ZEVs (like gasoline-electric hybrids) in the near-term, while retaining a role for battery electric vehicles.	3/27/03 12/19/03 EO
Heavy duty gasoline truck standards Aligned its existing rules with new, lower federal emission standards for gasoline-powered heavy-duty vehicles starting in 2008.	12/12/02 9/23/03 EO
Low emission vehicles II Minor administrative changes.	12/12/02 9/24/03 EO
Gasoline vapor recovery systems test procedures Approved amendments to add advanced vapor recovery technology certification and testing standards.	12/12/02 7/1/03 EO 10/21/03 EO
CaRFG Phase 3 amendments Approved amendments to allow for small residual levels of MTBE in gasoline while MTBE is being phased out and replaced by ethanol.	12/12/02 3/20/03 EO
School bus Idling Adopted a measure requiring school bus drivers to turn off the bus or vehicle engine upon arriving at a school and restart it no more than 30 seconds before departure in order to limit children's exposure to toxic diesel particulate exhaust.	12/12/02 5/15/03 EO
California Interim Certification Procedures for 2004 and Subsequent Model Year Hybrid-Electric Vehicles in the Urban Transit Bus and Heavy-Duty Vehicle Classes Regulation Amendment Adopted amendments to allow diesel-path transit agencies to purchase alternate fuel buses with higher NOx limits, establish certification procedures for hybrid buses, and require lower fleet-average PM emission limits.	10/24/02 9/2/03 EO
CaRFG Phase 3 amendments Approved amendments delaying removal of MTBE from gasoline by one year to 12/31/03.	7/25/02 11/8/02 EO
Diesel retrofit verification procedures, warranty, and in-use compliance requirements Adopted regulations to specify test procedures, warranty, and in-use compliance of diesel engine PM retrofit control devices.	5/16/02 3/28/03 EO
On-board diagnostics for cars Adopted changes to the On-Board Diagnostic Systems (OBD II) regulation to improve the effectiveness of OBD II systems in detecting motor vehicle emission-related problems.	4/25/02 3/7/03 EO
Voluntary accelerated light duty vehicle retirement regulations Establishes standards for a voluntary accelerated retirement program.	2/21/02 11/18/02 EO
Residential burning Adopted a measure to reduce emissions of toxic air contaminants from outdoor residential waste burning by eliminating the use of burn barrels and the outdoor burning of residential waste materials other than natural vegetation.	2/21/02 12/18/02 EO

California motor vehicle service information rule Adopted regulations to require light- and medium-duty vehicle manufacturers to offer for sale emission-related service information and diagnostic tools to independent service facilities and aftermarket parts manufacturers.	12/13/01 7/31/02 EO
Vapor recovery regulation amendments Adopted amendments to expand the list of specified defects requiring equipment to be removed from service.	11/15/01 9/27/02 EO
Distributed generation guidelines and regulations Adopted regulations requiring the permitting by ARB of distributed generation sources that are exempt from air district permitting and approved guidelines for use by air districts in permitting non-exempt units.	11/15/01 7/23/02 EO
Low emission vehicle regulations (LEV II) Approved amendments to apply PM emission limits to all new gasoline vehicles, extend gasoline PZEV emission limits to all fuel types, and streamline the manufacturer certification process.	11/15/01 8/6/02 EO
Gasoline vapor recovery systems test methods and compliance procedures Adopted amendments to add test methods for new technology components, streamline test methods for liquid removal equipment, and***.	10/25/01 7/9/02 EO
Heavy-duty diesel trucks Adopted amendments to emissions standards to harmonize with EPA regulations for 2007 and subsequent model year new heavy-duty diesel engines.	10/25/01
Inboard and sterndrive marine engines Lower emission standards for 2003 and subsequent model year inboard and sterndrive gasoline-powered engines in recreational marine vessels.	7/26/01 6/6/02 EO
Asbestos from construction, grading, quarrying, and surface mining Adopted an Airborne Toxic Control Measure for construction, grading, quarrying, and surface mining operations requiring dust mitigation for construction and grading operations, road construction and maintenance activities, and quarries and surface mines to minimize emissions of asbestos-laden dust.	7/26/01 6/7/02 EO
Zero emission vehicle infrastructure and standardization of electric vehicle charging equipment Adopted amendments to the ZEV regulation to alter the method of quantifying production volumes at joint-owned facilities and to add specifications for standardized charging equipment.	6/28/01 5/10/02 EO
Pollutant transport designation Adopted amendments to add two transport couples to the list of air basins in which upwind areas are required to adopt permitting thresholds no less stringent than those adopted in downwind areas.	4/26/01
Zero emission vehicle regulation amendments Adopted amendments to reduce the numbers of ZEVs required in future years, add a PZEV category and grant partial ZEV credit, modify the ZEV range credit, allow hybrid-electric vehicles partial ZEV credit, grant ZEV credit to advanced technology vehicles, and grant partial ZEV credit for several other minor new programs.	1/25/01 12/7/01 EO 4/12/02 EO
Heavy duty diesel engines supplemental test procedures Approved amendments to extend "Not-To-Exceed" and EURO III supplemental test procedure requirements through 2007 when federal requirements will include these tests.	12/7/00
Light and medium duty low emission vehicle alignment with federal standards Approved amendments that require light and medium duty vehicles sold in California to meet the more restrictive of state or federal emission standards.	12/7/00 12/27/00 EO
Exhaust emission standards for heavy duty gas engines Adopted amendments that establish 2005 emission limits for heavy duty gas engines that are equivalent to federal limits.	12/7/00 12/27/00 EO
CaRFG Phase 3 amendments Approved amendments to regulate the replacement of MTBE in gasoline with ethanol.	11/16/00 4/25/01 EO

CaRFG Phase 3 test methods Approved amendments to gasoline test procedures to quantify the olefin content and gasoline distillation temperatures.	11/16/00 7/11/01 EO 8/28/01 EO
Diesel risk reduction plan Adopted plan to reduce toxic particulate from diesel engines through retrofits on existing engines, tighter standards for new engines, and cleaner diesel fuel.	9/28/00
Conditional rice straw burning regulations Adopted regulations to limit rice straw burning to fields with demonstrated disease rates reducing production by more than 5 percent.	9/28/00
Asbestos from unpaved roads Tightened an existing Air Toxic Control Measure to prohibit the use of rock containing more than 0.25% asbestos on unsurfaced roads.	7/20/00
Enhanced vapor recovery emergency regulation Adopted a four-year term for equipment certifications.	5/22/01 EO
Enhanced vapor recovery Adopted amendments to require the addition of components to reduce spills and leakage, adapt to onboard vapor recovery systems, and continuously monitor system operation and report equipment leaks immediately.	3/23/00 7/25/01 EO
Agricultural burning smoke management Adopted amendments to add marginal burn day designations, require day-specific burn authorizations by districts, and smoke management plans for larger prescribed burn projects.	3/23/00 1/22/01 EO
Urban transit buses Adopted a public transit bus fleet rule and emissions standards for new urban buses that mandates a lower fleet-average NOx emission limit, PM retrofits, lower sulfur fuel use, and purchase of specified percentages of zero emission buses in future years.	1/27/00 2/24/00 11/22/00 EO 5/29/01 EO
Small Off-Road (diesel) Equipment (SORE) Adopted amendments to conform with new federal requirements for lower and engine power-specific emission limits, and for the averaging, banking, and trading of emissions among SORE manufacturers.	1/28/00
CaRFG Phase 3 MTBE phase out Adopted regulations to enable refiners to produce gasoline without MTBE while preserving the emissions benefits of Phase 2 cleaner burning gasoline.	12/9/99 6/16/00 EO
Portable fuel cans Adopted a regulation requiring that new portable fuel containers, used to refuel lawn and garden equipment, motorcycles, and watercraft, be spill-proof beginning in 2001.	9/23/99 7/6/00 EO
Clean fuels at service stations Adopted amendments rescinding requirements applicable to SCAB in 1994-1995, modifying the formula for triggering requirements, and allowing the Executive Officer to make adjustments to the numbers of service stations required to provide clean fuels.	7/22/99
Gasoline vapor recovery Adopted amendments to certification and test methods.	6/24/99
Reformulated gasoline oxygenate Adopted amendments rescinding the requirement for wintertime oxygenate in gasoline sold in the Lake Tahoe Air Basin and requiring the statewide labeling of pumps dispensing gasoline containing MTBE.	6/24/99
Marine pleasurecraft Adopted regulations to control emissions from spark-ignition marine engines, specifically, outboard marine engines and personal watercraft.	12/11/98 2/17/00 EO 6/14/00 EO
Voluntary accelerated light duty vehicle retirement Adopted regulation setting standards for voluntary accelerated retirement program.	12/10/98 10/22/99 EO
Off-highway recreational vehicles and engines Approved amendments to allow non-complying vehicles to operate in certain seasons and in certain ORV-designated areas.	12/10/98 10/22/99 EO

On-road motorcycles Amended on-road motorcycle regulations, to lower the tailpipe emission standards for ROG and NOx.	12/10/98
Portable equipment registration program (PERP) Approved amendments to exclude non-dredging equipment operating in OCS areas and equipment emitting hazardous pollutants, include NSPS Part OOO rock crushers, require SCR emission limits and onshore emission offsets from dredging equipment operating in OCS areas, set catalyst emission limits for gasoline engines, and relieve certain retrofitted engines from periodic source testing.	12/10/98
Liquid petroleum gas motor fuel specifications Approved amendment rescinding 5% propene limit and extending 10% limit indefinitely.	12/11/98
Reformulated gasoline Approved amendments to rescind the RVP exemption for fuel with 10% ethanol and allow for oxygen contents up to 3.7% if the Predictive Model weighted emissions to not exceed original standards.	12/11/98
Low-emission vehicle program (LEV II) Adopted regulations adding exhaust emission standards for most sport utility vehicles, pick-up trucks and mini-vans, lowering tailpipe standards for cars, further reducing evaporative emission standards, and providing additional means for generating zero-emission vehicle credits.	11/5/98 9/17/99 EO
Off-road engine aftermarket parts Approved implementation of a new program to test and certify aftermarket parts in gasoline and diesel, light-duty through heavy duty, engines used in off-road vehicles and equipment.	11/19/98 10/1/99 EO 7/18/00 EO
Off-road spark ignition engines Adopted new emission standards for small and large spark ignition engines for off-road equipment, a new engine certification program, an in-use compliance testing program, and a three-year phase-in for large LSI.	10/22/98
Gasoline deposit control additives Adopted amendments to decertify pre-RFG additives, tighten the inlet valve deposit limits, add a combustion chamber deposit limit, and modify the test procedures to align with the characteristics of reformulated gasoline formulations.	9/24/98 4/5/99 EO
Stationary source test methods Adopted amendments to stationary source test methods to align better with federal methods.	8/27/98 7/2/99 EO
Locomotive MOA for South Coast Memorandum of agreement (MOA) signed by ARB, U.S. EPA and major railroads to concentrate cleaner locomotives in the South Coast by 2010 and fulfill 1994 ozone SIP commitment.	7/2/98
Gasoline vapor recovery Adopted amendments to certification and test methods to add methods for onboard refueling vapor recovery, airport refuelers, and underground tank interconnections, and make minor changes to existing methods.	5/21/98 8/27/98
Reformulated gasoline Approved amendments to rescind the wintertime oxygenate requirement, allow for sulfur content averaging, and make other minor technical amendments.	8/27/98
Ethylene oxide sterilizers Adopted amendments to the ATCM to streamline source testing requirements, add EtO limits in water effluent from control devices, and make other minor changes.	5/21/98
Chrome platers Adopted amendments to ATCM to harmonize with requirements of federal NESHAP standards for chrome plating and chromic acid anodizing facilities.	5/21/98
On-road heavy-duty vehicles Approved amendments to align on-road heavy duty vehicle engine emission standards with EPA's 2004 standards and align certification, testing, maintenance, and durability requirements with those of U.S. EPA.	4/23/98 2/26/99 EO

Small off-road engines (SORE) Approved amendments to grant a one-year delay in implementation, relaxation of emissions standards for non-handheld engines, emissions durability requirements, averaging/banking/trading, harmonization with the federal diesel engine regulation, and modifications to the production line testing requirements.	3/26/98
Heavy duty vehicle smoke inspection program Adopted amendments to require annual smoke testing, set opacity limits, and exempt new vehicles from testing for the first four years.	12/11/97 3/2/98 EO
Light-duty vehicle off-cycle emissions Adopted standards to control excess emissions from aggressive driving and air conditioner use in light duty vehicles and added two light duty vehicle test methods for certification of new vehicles under these standards.	7/24/97 3/19/98 EO
Enhanced evaporative emissions standards Adopted amendments extending the compliance date for ultra-small volume vehicle manufacturers by one year.	5/22/97
Emission reduction credit program Adopted standards for District establishment of ERC programs including certification, banking, use limitation, and reporting requirements.	5/22/97
Lead as a toxic air contaminant Adopted an amendment to designate inorganic lead as a toxic air contaminant.	4/24/97
Portable engine registration program (PERP) Adopted standards for (1) the permitting of portable engines by ARB and (2) District recognition and enforcement of permits.	3/27/97
Liquefied petroleum gas Adopted amendments to extend the compliance deadline from January 1, 1997, to January 1, 1999, for the 5% propene limit in liquefied petroleum gas used in motor vehicles.	3/27/97
Onboard diagnostics, phase II Adopted amendments to extend the phase-in of enhanced catalyst monitoring, modify misfire detection requirements, add PVC system and thermostat monitoring requirements, and require manufacturers to sell diagnostic tools and service information to repair shops.	12/12/96
Pollutant transport designation Adopted amendments to modify transport couples from the Broader Sacramento area and add couples to the newly formed Mojave Desert and Salton Sea Air Basins.	11/21/96
Diesel fuel certification test methods Approved amendments specifying the test methods used for quantifying the constituents of diesel fuel.	10/24/96 6/4/97 EO
Wintertime requirements for utility engines & off-highway vehicles Optional hydrocarbon and NOx standards for snow throwers and ice augers, raising CO standard for specialty vehicles under 25hp.	9/26/96
Large off-road diesel Statement of Principles National agreement between ARB, U.S. EPA, and engine manufacturers to reduce emissions from heavy-duty off-road diesel equipment four years earlier than expected in the 1994 SIP for ozone.	9/13/96
Regulatory improvement initiative Rescinded two regulations relating to fuel testing in response to Executive Order W-127-95.	5/30/96
Zero emission vehicles Adopted amendments to eliminate zero emission vehicle quotas between 1998 and 2002, and approved MOUs with seven automobile manufacturers to accelerate release of lower emission "49 state" vehicles.	3/28/96 7/24/96 EO
CaRFG variance requirements Approved amendments to add a per gallon fee on non-compliant gasoline covered by a variance and to made administrative changes in variance processing and extension.	1/25/96 2/5/96 EO 4/2/96 EO

Utility and lawn and garden equipment engines Adopted an amendment to relax the CO standard from 300 to 350 ppm for Class I and II utility engines.	1/25/96
National security exemption of military tactical vehicles Such vehicles would not be required to adhere to exhaust emission standards.	12/14/95
CaRFG regulation amendments Approved amendments to allow for downstream addition of oxygenates and expansion of compliance options for gasoline formulation.	12/14/95
Required additives in gasoline (deposit control additives) Terms, definitions, reporting requirements, and test procedures for compliance are to be clarified.	11/16/95
CaRFG test method amendments Approved amendments to designate new test methods for benzene, aromatic hydrocarbon, olefin, and sulfur content of gasoline.	10/26/95
Motor vehicle inspection and maintenance program Handled by BAR.	10/19/95 by BAR
Antiperspirants and deodorants, consumer products, and aerosol coating products Ethanol exemption for all products, modifications to aerosol special requirements, modifications for regulatory language consistency, modifications to VOC definition.	9/28/95
Low emission vehicle (LEV III) standards Reactivity adjustment factors, introduction of medium-duty ULEVs, window labels, and certification requirements and test procedures for LEVs.	9/28/95
Medium- and heavy-duty gasoline trucks Expedited introduction of ultra-low emission medium-duty vehicles and lower NOx emission standards for heavy-duty gasoline trucks to fulfill a 1994 ozone SIP commitment.	9/1/95
Retrofit emission standards: all vehicle classes to be included in the alternate durability test plan, kit manufacturers to be allowed two years to validate deterioration factors under the test plan, update retrofit procedures allowing manufacturers to disable specific OBDs if justified by law.	7/27/95
Gasoline vapor recovery systems Adopts revised certification and test procedures.	6/29/95
Onboard refueling vapor recovery standards 1998 and subsequent MY engine cars, LD trucks, and MD trucks less than 8500 GVWR.	6/29/1995 4/24/96 EO
Heavy duty vehicle exhaust emission standards for NOx Amendments to standards and test procedures for 1985 and subsequent MY HD engines, amendments to emission control labels, amendments to Useful Life definition and HD engines and in-use vehicle recalls.	6/29/95
Aerosol coatings regulation Adopted regulation to meet California Clean Air Act requirements and a 1994 ozone SIP commitment.	3/23/95
Periodic smoke inspection program Delays start of PSIP from 1995 to 1996.	12/8/94
Onboard diagnostics phase II Amendments to clarify regulation language, ensure maximum effectiveness, and address manufacturer concerns regarding implementation.	12/8/94
Alternative control plan (ACP) for consumer products A voluntary, market-based VOC emissions cap upon a grouping of consumer products, flexible by manufacturer that will minimize overall costs of emission reduction methods and programs.	9/22/94
Diesel fuel certification: new specifications for diesel engine certification fuel, amended oxygen specification for CNG certification fuel, and amended commercial motor vehicle liquefied petroleum gas regulations.	9/22/94

Utility and lawn and garden equipment (UGLE) engines Modification to emission test procedures, ECLs, defects warranty, quality-audit testing, and new engine compliance testing.	7/28/94
Evaporative emissions standards and test procedures Adopted evaporative emissions standards for medium-duty vehicles.	2/10/94
Off-road recreational vehicles Adopted emission control regulations for off-road motorcycles, all-terrain vehicles, go-karts, golf carts, and specialty vehicles.	1/1/94
Perchloroethylene from dry cleaners Adopted measure to control perchloroethylene emissions from dry cleaning operations.	10/1/93
Wintertime oxygenate program Amendments to the control time period for San Luis Obispo County, exemption for small retailers bordering Nevada, flexibility in gasoline delivery time, calibration of ethanol blending equipment, gasoline oxygen content test method.	9/9/93
Onboard diagnostic phase II	7/9/93
Urban transit buses Amended regulation to tighten state NOx and particulate matter (PM) standards for urban transit buses beyond federal standards beginning in 1996.	6/10/93
1-year implementation delay in emission standards for utility engines	4/8/93
Non-ferrous metal melting Adopted Air Toxic Control Measure for emissions of cadmium, arsenic, and nickel from non-ferrous metal melting operations.	1/1/93
Certifications requirements for low emission passenger cars, light-duty trucks & medium duty vehicles	1/14/93
Airborne toxic control measure for emissions of toxic metals from non-ferrous metal melting	12/10/92
Periodic self-inspection program Implemented state law establishing a periodic smoke self-inspection program for fleets operating heavy-duty diesel-powered vehicles.	12/10/92
Notice of general public interest for consumer products	11/30/92
Substitute fuel or clean fuel incorporated test procedures	11/12/92
New vehicle testing using CaRFG Phase 2 gasoline Approved amendments to require the use of CaRFG Phase 2 gasoline in the certification of exhaust emissions in new vehicle testing.	8/13/92
Standards and test procedures for alternative fuel retrofit systems	5/14/92
Alternative motor vehicle fuel certification fuel specification	3/12/92
Heavy-duty off-road diesel engines Adopted the first exhaust emission standards and test procedures for heavy-duty off-road diesel engines beginning in 1996.	1/9/92
Wintertime oxygen content of gasoline Adopted regulation requiring the addition of oxygenates to gasoline during winter to satisfy federal Clean Air Act mandates for CO nonattainment areas.	12/1/91
CaRFG Phase 2 Adopted CaRFG phase 2 specifications including lowering vapor pressure, reducing the sulfur, olefin, aromatic, and benzene content, and requiring the year-round addition of oxygenates to achieve reductions in ROG, NOx, CO, oxides of sulfur (SOx) and toxics.	11/1/91
Low emissions vehicles amendments revising reactivity adjust factor (RAF) provisions and adopting a RAF for M85 transitional low emission vehicles	11/14/91
Onboard diagnostic, phase II	11/12/91
Onboard diagnostics for light-duty trucks and light & medium-duty motor vehicles	9/12/91
Utility and lawn & garden equipment Adopted first off-road mobile source controls under the California Clean Air Act regulating utility, lawn and garden equipment.	12/1/90

Control for abrasive blasting	11/8/90
Roadside smoke inspections of heavy-duty vehicles Adopted regulations implementing state law requiring a roadside smoke inspection program for heavy-duty vehicles.	11/8/90
CaRFG Phase I Adopted CaRFG Phase I reformulated gasoline regulations to phase-out leaded gasoline, reduce vapor pressure, and require deposit control additives.	9/1/90
Low-emission vehicle (LEV) and clean fuels Adopted the landmark LEV/clean fuel regulations which called for the gradual introduction of cleaner cars in California. The regulations also provided a mechanism to ensure the availability of alternative fuels when a certain number of alternative fuel vehicles are sold.	9/1/90
Evaporative emissions from vehicles Modified test procedure to include high temperatures (up to 105 F) and ensure that evaporative emission control systems function properly on hot days.	8/9/90
Dioxins from medical waste incinerators Adopted Airborne Toxic Control Measure to reduce dioxin emissions from medical waste incinerators.	7/1/90
CA Clean Air Act guidance for permitting Approved California Clean Air Act permitting program guidance for new and modified stationary sources in nonattainment areas.	7/1/90
Medium duty vehicle emission standards Adopted three new categories of low emission MDVs, required minimum percentages of production, and established production credit and trading.	6/14/90
Medium-duty vehicles Amended test procedures for medium-duty vehicles to require whole-vehicle testing instead of engine testing. This modification allowed enforcement of medium-duty vehicle standards through testing and recall.	6/14/90
Ethylene oxide sterilizers Adopted Airborne Toxic Control Measure to reduce ethylene oxide emissions from sterilizers and aerators.	5/10/90
Asbestos in serpentine rock Adopted Airborne Toxic Control Measure for asbestos-containing serpentine rock in surfacing applications.	4/1/90
Certification procedure for aftermarket parts	2/8/90
Residential woodstoves Approved suggested control measure for the control of emissions from residential wood combustion.	11/1/89
On-Board Diagnostic Systems II Adopted regulations to implement the second phase of on-board diagnostic requirements which alert drivers of cars, light-trucks and medium-duty vehicles when the emission control system is not functioning properly.	9/1/89
Cars and light-duty trucks Adopted regulations to reduce ROG and CO emissions from cars and light trucks by 35 percent.	6/1/89
Reformulated Diesel Fuel Adopted regulations requiring the use of clean diesel fuel with lower sulfur and aromatic hydrocarbons beginning in 1993.	11/1/88
Vehicle Recall Adopted regulations implementing a recall program which requires auto manufacturers to recall and fix vehicles with inadequate emission control systems (Vehicles are identified through in-use testing conducted by the ARB).	9/1/88

Suggested control measure for oil sumps Approved a suggested control measure to reduce emissions from sumps used in oil production operations.	8/1/88
Suggested control measure for boilers Approved suggested control measure to reduce NOx emissions from industrial, institutional, and commercial boilers, steam generators and process heaters.	9/1/87
Benzene from service stations Adopted Airborne Toxic Control Measure to reduce benzene emissions from retail gasoline service stations (Also known as Phase II vapor recovery).	7/1/87
Agricultural burning guidelines Amended existing guidelines to add provisions addressing wildland vegetation management.	11/1/86
Heavy-duty vehicle certification Amended certification of heavy-duty diesel and gasoline-powered engines and vehicles to align with federal standards.	4/1/86
Cars and light-duty trucks Adopted regulations reducing NOx emissions from passenger cars and light-duty trucks by 40 percent.	4/1/86
Sulfur in diesel fuel Removed exemption for small volume diesel fuel refiners.	6/1/85
On-Board Diagnostics I Adopted regulations requiring the use of on-board diagnostic systems on gasoline-powered vehicles to alert the driver when the emission control system is not functioning properly.	4/1/85
Suggested control measure for wood coatings Approved a suggested control measure to reduce emissions from wood furniture and cabinet coating operations.	3/1/85
Suggested control measure for resin manufacturing Approved a suggested control measure to reduce ROG emissions from resin manufacturing.	1/1/85

Transportation Conformity

Section 176(c) of the Federal Clean Air Act (CAA) establishes transportation conformity requirements which are intended to ensure that transportation activities do not interfere with air quality progress. The CAA requires that transportation plans, programs, and projects that obtain Federal funds or approvals *conform to* applicable state implementation plans (SIP) before being approved by a Metropolitan Planning Organization (MPO). Conformity to a SIP means that proposed activities must not:

(1) Cause or contribute to any new violation of any standard,
(2) Increase the frequency or severity of any existing violation of any standard in any area, or
(3) Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

A SIP analyzes the region's total emissions inventory from all sources for purposes of demonstrating rate of progress (RFP), attainment, or maintenance. The portion of the total emissions inventory from on-road highway and transit vehicles in these analyses becomes the "motor vehicle emissions budget."[96] Motor vehicle emissions budgets are the mechanism for ensuring that transportation planning activities conform to the SIP. Budgets are set for each criteria pollutant or its precursors, for all RFP milestone years and attainment years. Subsequent transportation plans and programs produced by transportation planning agencies are required to conform to the SIP by demonstrating that the emissions from the proposed plan, program, or project do not exceed the budget levels established in the applicable SIP.

PM2.5 Requirements for Conformity

The United States Environmental Protection Agency (U.S. EPA) has promulgated separate rule makings addressing the PM2.5 emission categories and precursors that must be considered in PM2.5 transportation conformity determinations.

PM2.5 Motor Vehicle Emission Category Requirements

Guidance on the motor vehicle emission categories that must be considered in transportation conformity determinations is found in the July 1, 2004, Final Rule amending the Transportation Conformity Rule to implement criteria and procedures for the 8-hour ozone and PM2.5 standards (69 FR 40004):

> [A]ll regional emissions analyses in PM2.5 nonattainment and maintenance areas [must] consider directly emitted PM2.5 motor vehicle emissions from the tailpipe, brake wear, and tire wear…Sections IX. and X. [of the Final Rule] provide information on when re-entrained road dust and construction-related dust must also be included in PM2.5 conformity analyses…[T]he analysis for direct PM2.5 must include:
>
> - Tailpipe exhaust particles,

[96] Federal Transportation Conformity Regulations are found in 40 CFR Part 51, subpart T – Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. of the Federal Transit Laws.

- Brake and tire wear particles,
- Re-entrained road dust, if before a SIP is submitted EPA or the state air agency has made a finding of significance or if the applicable or submitted SIP includes re-entrained road dust in the approved or adequate budget, and
- Fugitive dust from transportation-related construction activities, if the SIP has identified construction emissions as a significant contributor to the PM2.5 problem. (69 FR 40331-40333)[97]

PM2.5 Motor Vehicle Emission Precursor Requirements

Following the July 1, 2004, Final Rule identifying the motor vehicle emission categories that must be considered in transportation conformity determinations, U.S. EPA issued the May 6, 2005, Final Rule (70 FR 24280) amending the Transportation Conformity Regulation to indicate the PM2.5 precursors that must be considered in regional transportation conformity determinations. In this Final Rule, U.S. EPA "identifies four transportation-related PM2.5 precursors—nitrogen oxides (NO_X), volatile organic compounds (VOCs), sulfur oxides (SO_X)[98], and ammonia (NH_3)—for consideration in the conformity process in PM2.5 nonattainment and maintenance areas." (70 FR 24282)[99] Of these PM2.5 precursors, the Final Rule indicates NO_X is required to be included in the regional transportation conformity determination unless it is found to be an insignificant contributor to the regional PM2.5 air quality problem per Section 93.102(f) of the Conformity Regulation. (70 FR 24282)[100] Conversely, VOCs, SO_2, and NH_3 are not required unless any of these precursors are found to be significant contributors to the regional PM2.5 air quality problem. If it is determined through the SIP process that the on-road contribution of a precursor is a significant contributor the regional air quality problem, then an emissions budget must be prepared for that precursor in the SIP and MPOs are required to provide a conformity determination for each precursor for which there is an adequate or approved budget in the SIP. (70 FR 24287)

Factors for Determining Significance

As previously indicated, Sections 93.102(b)(2)(iv) and (v) of the Conformity Regulation require motor vehicle emissions budgets for PM2.5 precursors if they are deemed significant contributors to the regional air quality problem, while Section 93.102(b)(3) of the Conformity Regulation identifies re-entrained road dust from paved and unpaved roads as a PM2.5 emission category that must also have a motor vehicle emissions budget if deemed significant. Finally, Section 93.122(f) of the Conformity Regulation requires an emissions budget for fugitive dust PM2.5 emissions from highway and transit construction if they are deemed significant.

Within the context of transportation conformity, Section 93.109(f) of the Transportation Conformity Rule indicates that U.S. EPA considers a number of factors when making a finding that a SIP demonstrates that its motor vehicle pollutant or precursor emissions

[97] Codified in Sections 93.102(b)(1) and (3) and Section 93.122(f) of the Conformity Regulation.

[98] U.S. EPA revised the transportation conformity rule to revise PM2.5 precursors from SO_X to SO_2 for consistency with the broader PM2.5 implementation strategy. (73 FR 4435)

[99] Codified in Sections 93.102(b)(2)(iv) and (v) of the Conformity Regulation.

[100] Codified in § 93.119(f)(9) and (10) of the Conformity Regulation.

are insignificant contributors to regional air quality problems for a given air quality standard.[101] These factors used by U.S. EPA to make the finding of significance include "the percentage of motor vehicle emissions in the context of the total SIP inventory, the current state of air quality as determined by monitoring data for that NAAQS, the absence of SIP motor vehicle control measures, and historical trends and future projections of the growth of motor vehicle emissions." (Section 93.109(f))

It should be noted that while PM2.5 precursors must be included if they are found to be significant contributors to the regional PM2.5 air quality problem, SO_2 is deemed insignificant in all areas and conformity determinations are not required for this precursor. (70 FR 24283)

Based on guidance from the July 1, 2004, Final Rule, the significance finding for re-entrained road dust emissions will be based on a review of the following factors: "the contribution of road dust to current and future PM2.5 nonattainment, an area's current design value for the PM2.5 standard, whether control of road dust appears necessary to reach attainment, and whether increases in re-entrained dust emissions may interfere with attainment." (69 FR 40033) Such a review would include consideration of local air quality data, air quality modeling results, or emissions modeling results.

Assessment of Significance

This plan establishes motor vehicle emission budgets for primary emissions of PM2.5 from vehicle exhaust, tire and brake wear, and the precursor NOx. As discussed above, VOCs, SO_2, and ammonia are not required to be included in the regional transportation conformity determination unless found to be significant contributors to the regional PM2.5 air quality problem. Based on the criteria from Section 93.109(f), VOCs, SO_2, and ammonia are not found to be significant for the reasons discussed in the sections below, and therefore this plan does not establish motor vehicle emissions budgets for conformity purposes for these precursors. Please see Appendix B, Emissions Inventory, for a detailed description of the Valley's emissions inventory that was used to estimate the percentage of the Valley's total emissions inventory that are comprised from on-road mobile emissions.

VOC: On-road mobile emissions account for approximately ten percent of the Valley's total VOC emissions in the budget years. Air quality modeling for this plan indicates that control of VOC is generally ineffective in the control of PM2.5 and in some cases may actually result in increases in PM2.5 levels. (See Appendix G.) Therefore, on-road VOC emissions are considered insignificant and this plan does not establish VOC motor vehicle emissions budgets for conformity purposes.

SO_2: SO_2 is deemed insignificant in all areas and conformity determinations are not required for this precursor. (70 FR 24283) In addition, on-road mobile exhaust

[101] Pollutants and/or precursors from <u>all sources</u> may be found to be a significant contributor to the regional $PM_{2.5}$ air quality problem; however, the contribution of the motor vehicle emissions to these pollutants and/or precursors may be found insignificant based on the criteria indicated in Section 93.109(f) of the Transportation Conformity Regulation. Consequently, the pollutants and/or precursors found to be insignificant per Section 93.109(f) would not require regional transportation conformity determinations.

estimates are less than one ton per day Valley-wide in the budget years which equates to less than ten percent of the total SO_2 emissions inventory. SO_2 controls are focused on industrial sources, which contribute almost 80 percent of the total inventory. Therefore, on-road SO_2 emissions are considered insignificant and this plan does not establish SO_2 motor vehicle emissions budgets for conformity purposes.

Ammonia: The contribution of ammonia from on-road motor vehicles is approximately one percent of the total Valley-wide ammonia inventory. Consequently, ammonia emissions are not included in the motor vehicle emissions budgets for conformity purposes. Past research has demonstrated that ammonia is abundant throughout the Valley and does not act as a limiting precursor in the formation of PM2.5. Through performing sensitivity-based analysis and considering relevant contextualizing information such as emissions trends, studies, and available controls, the California Air Resources Board has determined that emissions of ammonia do not contribute significantly to PM2.5 levels that exceed the 1997, 2006, or 2012 NAAQS in the area. (See Appendix G.)

Paved Road Dust: Paved road dust PM2.5 emissions account for less than ten percent of the Valley's total direct PM2.5 emissions inventory in the budget years. While there are no additional paved road dust controls included in the attainment demonstration for this plan, paved road dust is controlled through the PM10 Plan and evaluated as part of PM10 conformity determinations. Analysis of average composition data from ambient air monitoring stations shows paved road dust contributes about two percent to the design values in the Valley. Therefore, paved road dust emissions are considered insignificant and this plan does not establish paved road dust motor vehicle emissions budgets for conformity purposes.

Unpaved Road Dust: Total unpaved road dust is less than seven percent of the Valley's total direct PM2.5 emissions inventory in the budget years. Local roads are one of seven subcategories of unpaved road dust, and, as noted above, on-road dust makes a small contribution to design values in the Valley. While there are no additional unpaved road dust controls included in the plan, unpaved road dust is controlled via the PM10 Plan (including the prohibition of any new local unpaved roads), and unpaved road dust is evaluated as part of PM10 conformity determinations. Analysis of average composition data from ambient air monitoring stations shows unpaved road dust contributes less than two percent to the design values in the Valley. Therefore, unpaved road dust is considered insignificant and this plan does not establish emissions budgets for unpaved road dust for conformity purposes.

Construction Dust: Total construction and demolition dust is less than five percent of the Valley's total direct PM2.5 emissions inventory in the budget years. Because road construction is one of five subcategories of construction dust, its contribution to the total direct PM2.5 inventory would be even less than the total construction and demolition category. While there are no additional construction dust controls included in the plan, road construction dust is controlled extensively via the PM10 Plan and is evaluated as part of PM10 conformity determinations. Therefore, road construction dust is considered insignificant and this plan does not establish emissions budgets for road construction dust for conformity purposes.

Conformity Budgets

Conformity budgets must be set for the attainment year for each PM2.5 NAAQS as well as each year for which reasonable further progress (RFP) is demonstrated. The attainment years are as follows:

- 1997 24-hour ~~and annual~~ standard: 2020
- 1997 annual standard: 2023
- 2006 24-hour standard: 2024
- 2012 annual standard: 2025

The RFP years for the various PM2.5 standards are as follows:

- 1997 24-hour ~~and annual~~ standard: 2017, 2020, and 2023
- 1997 annual standard: 2017, 2020, 2023, and 2026
- 2006 24-hour standard: 2017, 2020, 2023, and 2026
- 2012 annual standard: 2019, 2022, 2025, and 2028

Note that the attainment year is also an RFP year for the 1997 and 2012 standards, while these years do not coincide for the 2006 standard.

Average daily emissions are used in the plan consistent with how the standard is measured. Consequently, conformity budgets were calculated in EMFAC2014 using annual average daily emissions for the 1997 and 2012 standards, while winter average daily emissions were used to calculate conformity budgets for the 2006 standard, for the analysis years listed above.

Section 93.124(e) of the Federal Conformity Regulation states that nonattainment areas with more than one MPO may establish motor vehicle emission budgets for each MPO in the non-attainment area. This plan establishes county-level emission budgets for each of the eight MPOs[102] in the Valley.

The transportation conformity budgets developed for this plan include recent travel activity projections provided by the Valley MPOs. This travel activity is consistent with the Final 2017 Federal Transportation Improvement Plan (2017 FTIP) for each of the eight Valley MPOs. Using this recent activity results in on-road emissions approximately one percent lower than the 2020, 2024, and 2025 attainment demonstration inventories for the 1997, 2006, and 2012 standards, respectively.

The budgets have been constructed to be consistent with the on-road emissions inventory using the following method:

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[102] The boundary of the Kern Council of Governments encompasses all of Kern County, while the portion of Kern County located within the PM2.5 non-attainment area only includes the portion located within the San Joaquin Valley Air Basin (SJVAB)/San Joaquin Valley Air Pollution Control District (SJVAPCD). Consequently, the motor vehicle emissions budgets for Kern County only include the non-attainment area located within the SJVAB/SJVAPCD.

1) Sum the emissions results for each county.
2) Calculate the budget by rounding each county's values to the nearest tenth ton (for both NOx and PM2.5) using conventional rounding.

This plan establishes sub-area county emission budgets for PM2.5 and NOx for the horizon years listed above as summarized in Tables 18, 19, and 20 below.

Table 18 San Joaquin Valley 1997 24-hour and Annual PM2.5 Motor Vehicle Emissions Budgets* (Annual average tons per day)

County	2017		2020		2023		2026	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
Fresno	0.9	28.5	0.9	25.3	0.8	15.1	0.8	14.0
Kern (SJV)	0.8	28.0	0.8	23.3	0.7	13.3	0.8	12.5
Kings	0.2	5.8	0.2	4.8	0.2	2.8	0.2	2.6
Madera	0.2	5.3	0.2	4.2	0.2	2.5	0.2	2.2
Merced	0.3	10.7	0.3	8.9	0.3	5.3	0.3	4.8
San Joaquin	0.7	14.9	0.6	11.9	0.6	7.6	0.6	6.7
Stanislaus	0.4	11.9	0.4	9.6	0.4	6.1	0.4	5.4
Tulare	0.4	10.8	0.4	8.5	0.4	5.2	0.4	4.5

* Budgets based on the most recently amended 2017 FSTIP for each MPO as of January 2018. Budgets are rounded up to the nearest tenth of a ton.

Table 19 San Joaquin Valley 2006 24-hour PM2.5 Motor Vehicle Emissions Budgets* (Winter average tons per day)

County	2017		2020		2023		2024		2026	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
Fresno	0.9	29.3	0.9	25.9	0.8	15.5	0.8	15.0	0.8	14.3
Kern (SJV)	0.8	28.7	0.8	23.8	0.7	13.6	0.7	13.4	0.8	12.8
Kings	0.2	5.9	0.2	4.9	0.2	2.9	0.2	2.8	0.2	2.7
Madera	0.2	5.5	0.2	4.4	0.2	2.6	0.2	2.5	0.2	2.3
Merced	0.3	11.0	0.3	9.1	0.3	5.5	0.3	5.3	0.3	4.9
San Joaquin	0.7	15.5	0.6	12.3	0.6	7.9	0.6	7.6	0.6	6.9
Stanislaus	0.4	12.3	0.4	9.8	0.4	6.2	0.4	6.0	0.4	5.6
Tulare	0.4	11.2	0.4	8.7	0.4	5.3	0.4	5.1	0.4	4.6

* Budgets based on the most recently amended 2017 FSTIP for each MPO as of January 2018. Budgets are rounded up to the nearest tenth of a ton.

Table 20 San Joaquin Valley 2012 Annual PM2.5 Motor Vehicle Emissions Budgets* (Annual average tons per day

County	2019		2022		2025		2028	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
Fresno	0.9	27.6	0.9	21.2	0.8	14.3	0.9	13.5
Kern (SJV)	0.8	25.1	0.8	19.4	0.8	12.8	0.8	11.9
Kings	0.2	5.1	0.2	4.1	0.2	2.7	0.2	2.5
Madera	0.2	4.6	0.2	3.5	0.2	2.3	0.2	2.0
Merced	0.3	9.4	0.3	7.6	0.3	5.0	0.3	4.5
San Joaquin	0.6	12.7	0.6	10.0	0.6	6.9	0.6	6.3
Stanislaus	0.4	10.5	0.4	8.1	0.4	5.6	0.4	5.2
Tulare	0.4	9.3	0.4	6.9	0.4	4.7	0.4	4.2

* Budgets based on the most recently amended 2017 FSTIP for each MPO as of January 2018. Budgets are rounded up to the nearest tenth of a ton.

Emissions Trading Mechanism

Section 93.124(b) of the Federal Conformity Regulation allows for the SIP to establish emissions trading mechanisms between budgets for pollutants or precursors, or among budgets allocated to mobile and other sources. The 2008 PM2.5 Plan (as revised in 2011) included an emissions trading mechanism, approved by U.S. EPA effective January 9, 2012, to be used for analysis years after 2014.

Air quality modeling to support the SIP was used to determine the ratios for trading from the motor vehicle emissions budget for the PM2.5 precursor NOx to the motor vehicle emissions budget for primary PM2.5 in the San Joaquin Valley (SJV). To determine the NOx:PM2.5 trading ratios on both an annual and a 24-hour wintertime basis, two modeling sensitivity simulations were performed, reducing 30 percent of NO_x and PM2.5 emissions from on-road transportation in the SJV. The baseline model simulation was the 2024 attainment run. Consistent with past trading ratio determination in the San Joaquin Valley, only sources included in the transportation conformity process (i.e. on-road vehicles, paved road dust, unpaved road dust, and road construction dust) were evaluated in the emissions trading analysis.

Based on the 30 percent emission reduction sensitivity runs, reductions in both annual and 24-hour PM2.5 design values[103] (DVs) were calculated. Results for two sites in Bakersfield and two sites in Fresno are shown below since those two regions generally control the annual and 24-hour DVs in the SJV. Tables 21 and 22 show the change in DV per ton of emissions reduction at the four selected sites. For annual PM2.5 standards, annual emission totals are used, and for the 24-hour PM2.5 standards, wintertime emission totals are used. Dividing the change in DV per ton of PM2.5 emissions reduction by the change in DV per ton of NO_x emissions reduction yields the NOx:PM2.5 trading ratios, summarized in Table 23, which are the number of tons of NOx that achieve the same DV impact as one ton of direct PM2.5.

Table 21 Change in Annual DV per ton of PM2.5 or NOx Emissions Reduction from Transportation Related Sources in the SJV (µg/m3/ton emissions

Site	2024 annual DVs	ΔDV/ton of PM2.5 reduction	ΔDV/ton of NO_x reduction
Bakersfield-California Avenue	10.9	0.105	0.015
Bakersfield – Planz	11.9	0.118	0.017
Fresno – Garland	10.4	0.068	0.012
Fresno – Hamilton & Winery	10.0	0.068	0.012

[103] Consistent with past trading ratio determination in the San Joaquin Valley, the inter-pollutant trading ratios (relative to NOx) were calculated as the ratio in the reduction of annual PM2.5 DV at a particular location by reducing a ton of PM2.5 emissions as compared to a ton of NOx emission reductions.

Table 22 Change in 24-hour DV per ton of PM2.5 or NOx Emissions Reduction from Transportation Related Sources in the SJV (µg/m3/ton emissions)

Site	2024 24-hour DVs	ΔDV/ton of PM2.5 reduction	ΔDV/ton of NO_x reduction
Bakersfield-California Avenue	33.1	0.310	0.136
Bakersfield – Planz	29.8	0.215	0.102
Fresno – Garland	32.8	0.191	0.109
Fresno – Hamilton & Winery	35.1	0.187	0.117

Table 23 NOx:PM2.5 Trading Ratios (tons NOx per 1 ton direct PM2.5) for the Annual PM2.5 and 24-hour PM2.5 Standards

Site	Annual PM2.5 trading ratio *	24-hour PM2.5 trading ratio *
Bakersfield-California Avenue	7.0	2.3
Bakersfield – Planz	7.1	2.1
Fresno – Garland	6.0	1.8
Fresno – Hamilton & Winery	6.0	1.6
Average SIP Trading Ratio	**6.5**	**2.0**

* Due to rounding for display only in Tables 21 and 22, trading ratios shown here may differ from trading ratios calculated using the ΔDV/ton values shown in Tables 21 and 22.

Consistent with past trading ratio determination in the San Joaquin Valley, annual and 24-hour NOx:PM2.5 trading ratios across the four sites shown in Table 23 were averaged to obtain the trading ratios used in this SIP for the annual and 24-hour standards. Based on this analysis, this SIP allows trading from the motor vehicle emissions budget for NOx to the motor vehicle emissions budget for primary PM2.5 using a 6.5 to 1 ratio on an annual basis and a 2 to 1 ratio on a wintertime basis. These ratios indicate that PM2.5 reductions are approximately 6.5 times more effective at reducing annual PM2.5 DVs than are NO_x reductions, and that PM2.5 reductions are approximately twice as effective at reducing 24-hour PM2.5 DVs as NO_x reductions. It should be noted that the calculated trading ratios presented in Table 23 (e.g., a calculated ratio of 6.5 to 1 for the annual PM2.5 standard) are lower than the previous trading ratio estimates presented in the 2016 Moderate Area Plan for the 2012 PM2.5 Standard (e.g., a ratio of 8.8 to 1 for the annual PM2.5 standard[104]), as the trading ratios presented in Table 23 are based on model sensitivity simulations associated with 30 percent NOx and PM2.5 reductions, while the trading ratios from the 2016 Moderate Area Plan for the 2012 PM2.5 Standard are derived from carrying capacity isopleths.

The NOx emissions reductions available for trading are only those remaining after the NOx budget is met. For example, for a proposed plan that has a total of seven tons of NOx, and a NOx budget of ten tons, there are three tons of NOx available to meet the

[104] Table 3-10 from the 2016 Moderate Area Plan for the 2012 PM2.5 Standard.

PM2.5 emissions budget. Each agency responsible for demonstrating transportation conformity shall clearly document the calculations used in the trading, along with any additional reductions of NOx or PM2.5 emissions in the conformity analysis.

Local Transportation Control Measures

Transportation Control Measures (TCMs) in CAA §108(f) are currently being implemented by the Valley MPOs as part of the adopted Congestion Mitigation and Air Quality (CMAQ) cost effectiveness policy and in the development of each Regional Transportation Plan (RTP). In addition, existing and new transportation legislation (MAP-21 and FAST Act) include enhanced emphasis on funding PM2.5 projects.

Valley MPOs continue to implement the adopted San Joaquin Valley CMAQ Policy, which was included in the District's *2007 Ozone Plan*, *2008 PM2.5 Plan, 2012 PM2.5 Plan, 2015 PM2.5 Plan, and 2016 Ozone Plan*. The CMAQ policy includes a standardized process for distributing 20 percent of the CMAQ funds to projects that meet a minimum cost effectiveness beginning in fiscal year 2011. This policy focuses on achieving the most cost effective emissions reductions, while maintaining flexibility to meet local needs. The minimum cost effectiveness standard was revisited in 2018 as part of the 2018 RTP and 2019 Federal Transportation Improvement Program (FTIP) development, consistent with the Valley CMAQ Policy. The Valley MPOs are implementing all reasonable transportation control measures at this time, and a listing of Adopted Transportation Control Measures may be found in Tables D-10 through D-17 in Appendix D of the 2016 Plan for the 2008 8-Hour Ozone Standard.

Each Valley MPO is required to update its RTP every four years. The RTP is a long-term regional transportation plan that provides a vision for transportation investments throughout the Valley. The 2018 RTPs were adopted by the Valley MPO Boards in the summer of 2018 and integrate land use and transportation planning to achieve, where feasible, regional greenhouse gas (GHG) targets set by ARB pursuant to Senate Bill 375 (SB 375).

To further illustrate the eight SJV MPOs commitment to the implementation of TCMs throughout the Valley, the RTPs contains a host of improvements to every component of the regional multimodal transportation system including:

- Active transportation (non-motorized transportation, such as biking and walking)
- Transportation demand management (TDM)
- Transportation system management (TSM)
- Transit
- Passenger rail
- Goods movement
- Aviation and airport ground access
- Highways
- Arterials
- Operations and maintenance

Included within these transportation system improvements are TCM projects that reduce vehicle use or change traffic flow or congestion conditions. TCMs include the following categories of transportation improvement projects and programs:

- Improved Transit
- High Occupancy Vehicle Lanes
- Traffic Flow Improvements
- Park and Ride Lots
- Ridesharing/Trip Reduction Programs
- Bicycle/Pedestrian Facilities

SB 375

The Sustainable Communities and Climate Protection Act of 2008 (Sustainable Communities, SB 375) enhances California's strategy to reduce GHG emissions through the coordination of transportation and land-use to reduce vehicle miles traveled per person through the development of a Sustainable Community Strategy. SB 375 identifies specific reduction goals for each of California's MPOs in 2020 and 2035 which the Sustainable Community Strategy must meet, if feasible. For the Valley, the current SB 375 target reductions are a 5% per capita GHG emissions reduction from 2005 by 2020 and a 10% per capita GHG emissions reduction from 2005 by 2035. Further, on March 2018, ARB has revised SB 375 targets for the Valley MPOs to make them more stringent as shown in Table 24 below. In order to meet these revised targets, the Valley MPOs will need to invest and implement additional TCM.

Table 24 Summary of San Joaquin Valley MPO SB 375 GHG Reduction Targets

MPO	2020 SB 375 Target	2035 SB 375 Target
Fresno	-6%	-13%
Kern	-9%	-15%
Kings	-5%	-13%
Madera	-10%	-16%
Merced	-10%	-14%
San Joaquin	-12%	-16%
Stanislaus	-12%	-16%
Tulare	-13%	-16%

The strategies contained in the RTP/SCS produce air quality co-benefits for the region far beyond simply reducing GHG emissions through reductions in VMT. The SCS integrates the transportation network and related strategies with an overall land use pattern that responds to projected growth, housing needs, changing demographics, and transportation demands. As a result, Sustainable Community Strategy development is anticipated to complement the *2018 PM2.5 Plan*.

San Joaquin Valley 1997 Annual PM2.5 Motor Vehicle Emissions Budgets

2018 PM2.5 Plan for the 1997, 2006, and 2012 PM2.5 Standards

(tons per annual average day)

Activity is the most recently amended 2017 FSTIP for each MPO as of January, 2018.

Motor Vehicle Emissions Budgets 2017

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.86	28.48	0.79	27.96	0.15	5.72	0.16	5.29	0.29	10.69	0.60	14.86	0.39	11.88	0.37	10.79	3.62	115.66
^																		
Total Budget	**0.86**	**28.48**	**0.79**	**27.96**	**0.15**	**5.72**	**0.16**	**5.29**	**0.29**	**10.69**	**0.60**	**14.86**	**0.39**	**11.88**	**0.37**	**10.79**	**3.70**	**115.70**
Budget*	**0.9**	**28.5**	**0.8**	**28.0**	**0.2**	**5.8**	**0.2**	**5.3**	**0.3**	**10.7**	**0.7**	**14.9**	**0.4**	**11.9**	**0.4**	**10.8**	**3.9**	**115.9**

Motor Vehicle Emissions Budgets 2020

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.84	25.21	0.73	23.25	0.14	4.75	0.15	4.18	0.26	8.87	0.58	11.86	0.36	9.51	0.33	8.41	3.39	96.03
^																		
Total Budget	**0.84**	**25.21**	**0.73**	**23.25**	**0.14**	**4.75**	**0.15**	**4.18**	**0.26**	**8.87**	**0.58**	**11.86**	**0.36**	**9.51**	**0.33**	**8.41**	**3.40**	**96.10**
Budget*	**0.9**	**25.3**	**0.8**	**23.3**	**0.2**	**4.8**	**0.2**	**4.2**	**0.3**	**8.9**	**0.6**	**11.9**	**0.4**	**9.6**	**0.4**	**8.5**	**3.8**	**96.5**

* Budgets rounded up to the nearest tenth

^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

Motor Vehicle Emissions Budgets 2023

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.77	15.04	0.67	13.25	0.13	2.80	0.14	2.47	0.25	5.29	0.56	7.57	0.34	6.01	0.31	5.11	3.17	57.54
^																		
Total Budget	**0.77**	**15.04**	**0.67**	**13.25**	**0.13**	**2.80**	**0.14**	**2.47**	**0.25**	**5.29**	**0.56**	**7.57**	**0.34**	**6.01**	**0.31**	**5.11**	**3.20**	**57.60**
Budget*	**0.8**	**15.1**	**0.7**	**13.3**	**0.2**	**2.8**	**0.2**	**2.5**	**0.3**	**5.3**	**0.6**	**7.6**	**0.4**	**6.1**	**0.4**	**5.2**	**3.6**	**57.9**

Motor Vehicle Emissions Budgets 2026

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.79	13.97	0.71	12.43	0.13	2.56	0.14	2.16	0.25	4.74	0.58	6.63	0.35	5.39	0.31	4.45	3.26	52.33
^																		
Total Budget	**0.79**	**13.97**	**0.71**	**12.43**	**0.13**	**2.56**	**0.14**	**2.16**	**0.25**	**4.74**	**0.58**	**6.63**	**0.35**	**5.39**	**0.31**	**4.45**	**3.30**	**52.40**
Budget*	**0.8**	**14.0**	**0.8**	**12.5**	**0.2**	**2.6**	**0.2**	**2.2**	**0.3**	**4.8**	**0.6**	**6.7**	**0.4**	**5.4**	**0.4**	**4.5**	**3.7**	**52.7**

* Budgets rounded up to the nearest tenth
^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

San Joaquin Valley 2006 24-Hour PM2.5 Motor Vehicle Emissions Budgets

2018 PM2.5 Plan for the 1997, 2006, and 2012 PM2.5 Standards

(tons per annual average day)

Activity is the most recently amended 2017 FSTIP for each MPO as of January, 2018.

Motor Vehicle Emissions Budgets 2017

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.86	29.23	0.80	28.66	0.15	5.88	0.17	5.46	0.29	10.99	0.60	15.43	0.39	12.25	0.37	11.15	3.62	119.05
^																		
Total Budget	**0.86**	**29.23**	**0.80**	**28.66**	**0.15**	**5.88**	**0.17**	**5.46**	**0.29**	**10.99**	**0.60**	**15.43**	**0.39**	**12.25**	**0.37**	**11.15**	**3.70**	**119.10**
Budget*	**0.9**	**29.3**	**0.8**	**28.7**	**0.2**	**5.9**	**0.2**	**5.5**	**0.3**	**11**	**0.7**	**15.5**	**0.4**	**12.3**	**0.4**	**11.2**	**3.9**	**119.4**

Motor Vehicle Emissions Budgets 2020

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.84	25.21	0.73	23.79	0.14	4.87	0.15	4.30	0.26	9.09	0.58	11.86	0.36	9.78	0.33	8.67	3.39	98.59
^																		
Total Budget	**0.84**	**25.21**	**0.73**	**23.79**	**0.14**	**4.87**	**0.15**	**4.30**	**0.26**	**9.09**	**0.58**	**11.86**	**0.36**	**9.78**	**0.33**	**8.67**	**3.40**	**98.60**
Budget*	**0.9**	**25.3**	**0.8**	**23.8**	**0.2**	**4.9**	**0.2**	**4.4**	**0.3**	**9.19**	**0.6**	**11.9**	**0.4**	**9.8**	**0.4**	**8.7**	**3.8**	**98.9**

* Budgets rounded up to the nearest tenth
^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

Motor Vehicle Emissions Budgets 2023

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.77	15.42	0.67	13.58	0.13	2.87	0.14	2.55	0.25	5.43	0.56	7.85	0.34	6.19	0.31	5.27	3.17	59.17
^																		
Total Budget	**0.77**	**15.42**	**0.67**	**13.58**	**0.13**	**2.87**	**0.14**	**2.55**	**0.25**	**5.43**	**0.56**	**7.85**	**0.34**	**6.19**	**0.31**	**5.27**	**3.20**	**59.20**
Budget*	**0.8**	**15.5**	**0.7**	**13.6**	**0.2**	**2.9**	**0.2**	**2.6**	**0.3**	**5.5**	**0.6**	**7.9**	**0.4**	**6.2**	**0.4**	**5.3**	**3.6**	**59.5**

Motor Vehicle Emissions Budgets 2024

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**	**PM2.5**	**NOx**
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.78	14.99	0.69	13.38	0.13	2.76	0.14	2.42	0.25	5.26	0.57	7.51	0.34	5.93	0.31	5.02	3.21	57.28
^																		
Total Budget	**0.78**	**14.99**	**0.69**	**13.38**	**0.13**	**2.76**	**0.14**	**2.42**	**0.25**	**5.26**	**0.57**	**7.51**	**0.34**	**5.93**	**0.31**	**5.02**	**3.30**	**57.30**
Budget*	**0.8**	**15.0**	**0.7**	**13.4**	**0.2**	**2.8**	**0.2**	**2.5**	**0.3**	**5.3**	**0.6**	**7.6**	**0.4**	**6.0**	**0.4**	**5.1**	**3.6**	**57.7**

* Budgets rounded up to the nearest tenth
^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

Motor Vehicle Emissions Budgets 2026

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.79	14.28	0.71	12.71	0.13	2.63	0.14	2.22	0.25	4.85	0.58	6.86	0.35	5.53	0.31	4.58	3.26	53.64
^																		
Total Budget	**0.79**	**14.28**	**0.71**	**12.71**	**0.13**	**2.63**	**0.14**	**2.22**	**0.25**	**4.85**	**0.58**	**6.86**	**0.35**	**5.53**	**0.31**	**4.58**	**3.30**	**53.70**
Budget*	**0.8**	**14.3**	**0.8**	**12.8**	**0.2**	**2.7**	**0.2**	**2.3**	**0.3**	**4.9**	**0.6**	**6.9**	**0.4**	**5.6**	**0.4**	**4.6**	**3.7**	**54.1**

* Budgets rounded up to the nearest tenth
^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

San Joaquin Valley 2012 Annual PM2.5 Motor Vehicle Emissions Budgets

2018 PM2.5 Plan for the 1997, 2006, and 2012 PM2.5 Standards

(tons per annual average day)

Activity is the most recently amended 2017 FSTIP for each MPO as of January, 2018.

Motor Vehicle Emissions Budgets 2019

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.88	27.53	0.76	25.04	0.14	5.09	0.16	4.53	0.26	9.31	0.58	12.69	0.38	10.43	0.35	9.22	3.50	103.84
^																		
Total Budget	**0.88**	**27.53**	**0.76**	**25.04**	**0.14**	**5.09**	**0.16**	**4.53**	**0.26**	**9.31**	**0.58**	**12.69**	**0.38**	**10.43**	**0.35**	**9.22**	**3.60**	**103.90**
Budget*	**0.9**	**27.6**	**0.8**	**25.1**	**0.2**	**5.1**	**0.2**	**4.6**	**0.3**	**9.4**	**0.6**	**12.7**	**0.4**	**10.5**	**0.4**	**9.3**	**3.8**	**104.3**

Motor Vehicle Emissions Budgets 2022

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.80	21.71	0.71	19.36	0.13	4.02	0.15	3.43	0.26	7.52	0.57	9.93	0.35	8.03	0.32	6.89	3.29	80.35
^																		
Total Budget	**0.80**	**21.17**	**0.71**	**19.36**	**0.13**	**4.02**	**0.15**	**3.43**	**0.26**	**7.52**	**0.57**	**9.93**	**0.35**	**8.03**	**0.32**	**6.89**	**3.30**	**80.40**
Budget*	**0.9**	**21.2**	**0.8**	**19.4**	**0.2**	**4.1**	**0.2**	**3.5**	**0.3**	**7.6**	**0.6**	**10.0**	**0.4**	**8.1**	**0.4**	**6.9**	**3.8**	**80.8**

* Budgets rounded up to the nearest tenth

^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

Motor Vehicle Emissions Budgets 2025

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.78	14.29	0.71	12.76	0.13	2.62	0.14	2.26	0.25	4.95	0.57	6.83	0.34	5.51	0.31	4.63	3.23	53.88
^																		
Total Budget	**0.78**	**14.29**	**0.71**	**12.76**	**0.13**	**2.62**	**0.14**	**2.26**	**0.25**	**4.95**	**0.57**	**6.83**	**0.34**	**5.51**	**0.31**	**4.63**	**3.30**	**53.90**
Budget*	**0.8**	**14.3**	**0.8**	**12.8**	**0.2**	**2.7**	**0.2**	**2.3**	**0.3**	**5.0**	**0.6**	**6.9**	**0.4**	**5.6**	**0.4**	**4.7**	**3.7**	**54.3**

Motor Vehicle Emissions Budgets 2028

County	Fresno (SJV)		Kern (SJV)		Kings (SJV)		Madera (SJV)		Merced (SJV)		San Joaquin (SJV)		Stanislaus (SJV)		Tulare (SJV)		Total San Joaquin Valley Air Basin	
	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx	PM2.5	NOx
EMFAC2014 V1.0.7 exhaust, tire and brake wear	0.80	13.42	0.72	11.81	0.13	2.45	0.14	1.97	0.25	4.44	0.59	6.24	0.35	5.11	0.32	4.12	3.31	49.56
^																		
Total Budget	**0.80**	**13.42**	**0.72**	**11.81**	**0.13**	**2.45**	**0.14**	**1.97**	**0.25**	**4.44**	**0.59**	**6.24**	**0.35**	**5.11**	**0.32**	**4.12**	**3.40**	**49.60**
Budget*	**0.9**	**13.5**	**0.8**	**11.9**	**0.2**	**2.5**	**0.2**	**2.0**	**0.3**	**4.5**	**0.6**	**6.3**	**0.4**	**5.2**	**0.4**	**4.2**	**3.8**	**50.1**

* Budgets rounded up to the nearest tenth
^ Blank row indicates reductions from control measures *outside* of EMFAC. There are currently none in EMFAC2014.

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APPENDIX D

Updated *2018 PM2.5 Plan* Appendix H: RFP, Quantitative Milestones, and Contingency

Appendix H

RFP, Quantitative Milestones, and Contingency

Updated July 20, 2021

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H. RFP, QUANTITATIVE MILESTONES, AND CONTINGENCY

Pursuant to federal Clean Air Act (CAA) requirements, states are required to submit a state implementation plan (SIP) to U.S. Environmental Protection Agency (EPA) for areas designated nonattainment of National Ambient Air Quality Standards (NAAQS, or standards) for PM2.5.[1] This appendix fulfills the following federal Clean Air Act requirements for PM2.5 nonattainment areas as identified in the CAA, codified in the code of federal regulations,[2] and clarified in the 2016 PM2.5 Implementation Rule:[3]

1. Reasonable Further Progress [CAA §172(c)(2)]
2. Quantitative Milestones [CAA §189(c)]
3. Contingency [CAA §172(c)(9)]

For standard-specific demonstrations of federal requirements refer to the following plan chapters:

- 1997 PM2.5 Standard Demonstration – Chapter 5
- 2006 PM2.5 Standard Demonstration – Chapter 6
- 2012 PM2.5 Standard Demonstration – Chapter 7

H.1 REASONABLE FURTHER PROGRESS (RFP)

The term "reasonable further progress" (RFP) means such annual incremental reductions in emissions of the relevant air pollutant as are required for the purpose of ensuring attainment of the applicable NAAQS by the applicable date.[4] Each attainment plan for a PM2.5 nonattainment area shall include an RFP plan that demonstrates that sources in the area will achieve such annual incremental reductions in emissions of PM2.5 and PM2.5 plan precursors as are necessary to ensure attainment of the applicable PM2.5 NAAQS as expeditiously as practicable. As demonstrated in this Plan (Appendices G and K), California Air Resources Board (CARB) modeling determined ammonia, VOCs, and SOx do not contribute significantly to PM2.5 levels that exceed the 1997, 2006, or 2012 NAAQS in the Valley. As such, the demonstrations in this appendix appropriately address direct PM2.5 emissions and NOx.

Regardless of whether a state is submitting a Moderate area plan, a Serious area plan, or a plan required pursuant to CAA §189(d) (5% Plan), to satisfy the statutory requirements for RFP at CAA §172(c)(2), a state must submit an RFP plan.

[1] Clean Air Act, Title 1, Part D Subpart 1 and CAA Title 1, Part D Subpart 4
[2] CFR part 51 – Requirements for preparation, adoption, and submittal of implementation Plans
[3] Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule. 81 Fed. Reg. 164, pp. 58010-58162. (2016, August 24). (to be codified at 40 CFR Parts 50, 51, and 93). https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf
[4] Clean Air Act Section 171(1)

Linear emission reductions
Historically, EPA's interpretation of the RFP requirement has been "generally linear progress" from the base year to the attainment year, demonstrated at RFP milestone years.[5]

Stepwise emission reductions
In its most recent Implementation Rule, EPA clarified that RFP requirements may be satisfied through generally linear progress, or through a stepwise demonstration. Stepwise emissions reductions would be slower than ''generally linear'' reductions for certain periods, and then would decline sharply (due to implementation of a new emission reduction program, or new operation of control technology on one or more stationary sources).

For example, in one area new emission standards for mobile sources may achieve reductions in a generally linear manner over time, as a portion of the existing vehicle fleet is replaced each year with new vehicles meeting the more stringent standards. In another area, regulations to reduce emissions from certain stationary source sectors could have a single compliance date by which controls must be in place, which could result in a significant drop in emissions in a "stepwise" manner over a relatively short period. In the first case, the EPA expects that, so long as the attainment date is as expeditious as practicable, then generally linear progress toward attainment by that date would satisfy the RFP requirement. In the second case, where progress is slower than generally linear, the state is required to submit a clear rationale and supporting information to explain why generally linear progress is not appropriate (*e.g.,* due to the nature of the nonattainment problem, the types of sources contributing to PM2.5 levels in the area and the implementation schedule for control requirements at such sources).

H.1.1 RFP Plan Requirements

Each attainment plan for a PM2.5 nonattainment area shall include an RFP plan that demonstrates that sources in the area will achieve such annual incremental reductions in emissions of direct PM2.5 and PM2.5 plan precursors as are necessary to ensure attainment of the applicable PM2.5 NAAQS as expeditiously as practicable. [6,7]

The RFP plan shall include the following:[8]

1. A schedule describing the implementation of control measures during each year of the applicable attainment Plan.

2. RFP projected emissions for direct PM2.5 and NOx for each applicable milestone year, based on the anticipated implementation schedule for control measures.

[5] 72 FR 20633, codified at 40 CFR 51 Subpart Z §51.1000 (definitions)
[6] 40 CFR §51.1012 Reasonable further progress requirements.
[7] Clean Air Act Section 171(1)
[8] 40 CFR §51.1012

3. An analysis that presents the schedule of control measures and estimated emissions changes to be achieved by each milestone year, and that demonstrates that the control strategy will achieve RFP toward attainment between the base year and the attainment year. The analysis shall rely on information from the base year inventory and the attainment projected inventory for the nonattainment area, in addition to the RFP projected emissions required.

4. An analysis that demonstrates that by the end of the calendar year for each milestone date for the area, pollutant emissions will be at levels that reflect either generally linear progress or stepwise progress in reducing emissions on an annual basis between the base year and the attainment year. A demonstration of stepwise progress must be accompanied by appropriate justification for the selected implementation schedule.

5. At the state's election, an analysis that identifies air quality targets associated with the RFP projected emissions identified for the milestone years at the design value monitor locations.

H.1.2 DETERMINATION OF RFP YEARS

The baseline year for this Plan for all three PM2.5 standards is 2013. Analyses and modeling performed for this Plan demonstrate the following attainment dates to be the most expeditious attainment dates practicable:

- 1997 ~~annual~~ 24-hour PM2.5 standard attainment year is 2020
- 1997 annual PM2.5 standard attainment year is 2023
- 2006 24-hour PM2.5 standard attainment year is 2024
- 2012 annual PM2.5 standard attainment year is 2025

RFP years for an attainment Plan for a particulate matter air quality standard shall be determined by the quantitative milestone deadlines.[9] Refer to the Quantitative Milestone Requirements section below to see how milestone years were determined for each NAAQS.

Table H-1 Summary of Significant RFP and Quantitative Milestone Dates

Federal PM2.5 Standard	Base Year	Attainment Year	RFP and Quantitative Milestone Years
1997 PM2.5 NAAQS 24-hour	2013	2020	2017, 2020, 2023*
1997 PM2.5 NAAQS annual	2013	2023	2017, 2020, 2023, 2026*
2006 PM2.5 NAAQS	2013	2024	2017, 2020, 2023, 2026*
2012 PM2.5 NAAQS	2013	2025	2019, 2022, 2025, 2028*

* ~~2023,~~ 2026~~,~~ and 2028 are not RFP milestone years. They are Quantitative Milestone years only. All other dates are both RFP and Quantitative Milestone years.

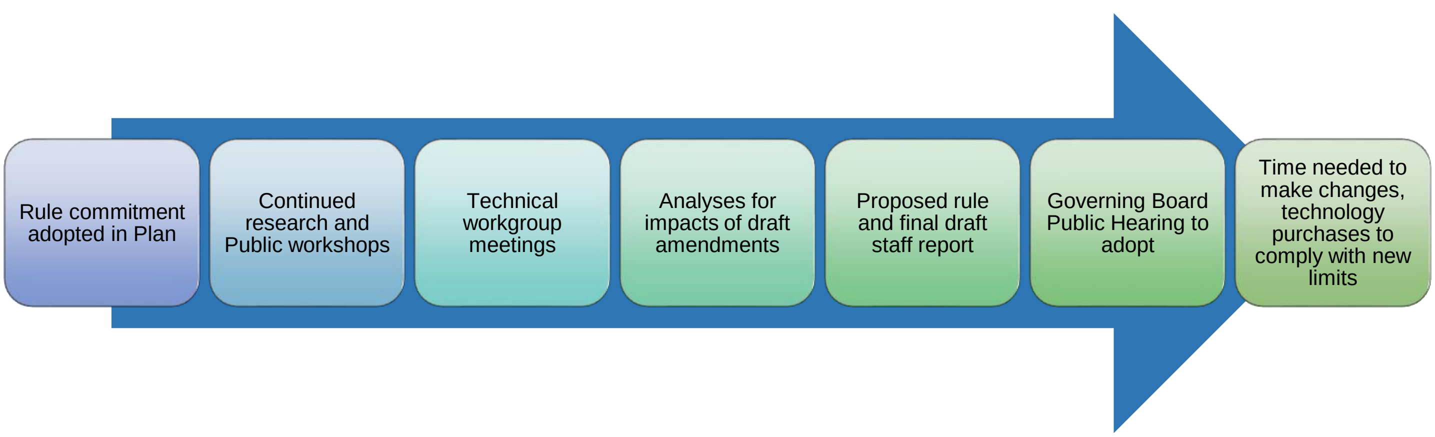
[9] 40 CFR 51.1012(a)(4)

H.1.3 RFP MILESTONE REQUIREMENT TARGETS AND ATTAINMENT DEMONSTRATIONS

As previously stated, RFP means such annual incremental reductions in emissions of the relevant air pollutant as are required or may reasonably be required by EPA for the purpose of ensuring attainment of the applicable national ambient air quality standard by the applicable date. This section of this Plan demonstrates satisfaction of CAA RFP requirements. In concurrence with CAA requirements this demonstration concludes at the attainment year for each NAAQS. The following analysis demonstrates ~~linear RFP for the 1997 PM2.5 standard and~~ stepwise RFP for the 1997, 2006, and 2012 PM2.5 standards. The ~~2006 and 2012 PM2.5~~ RFP demonstration for these standards is stepwise due to the necessary time required by the District and CARB to go through the process necessary to amend rules, develop programs, and for sources in the Valley to implement the emission reduction measures.

Significant time is required for regulatory measures to undergo a robust public rulemaking process after Plan adoption. In these efforts, the District and CARB are committed to a transparent public process that includes stakeholder, industry, and other-agency input at every step possible. As illustrated in Figure H-1, the rule amendment process is a robust process that can take significant time, sometimes years, to complete and implement. This process entails developing a complete understanding of the costs, socioeconomic impacts, and potential technological and economic feasibility issues associated with each proposed control measure. As outlined in Chapter 4, Table 4-4, the District and CARB have committed to an aggressive schedule to adopt rules as expeditiously as possible, while still allowing time for a robust public process.

Figure H-1 Public Process of Rule Development and Implementation



Stepwise Justification

CARB and the District are making progress reducing emissions of NOx and PM2.5 through ongoing implementation of the current control strategy. CARB and the District will reduce NOx emissions by 4.8 percent and PM2.5 emissions by 0.6 percent annually on average between 2013 and 2024 (See Appendix B); however, to attain the 15 $\mu g/m^3$ annual, 35 $\mu g/m^3$ 24-hour and 12 $\mu g/m^3$ annual NAAQS in 2023, 2024, and 2025 respectively, additional emissions reductions beyond those achieved through ongoing implementation of CARB's mobile source control program and the District's stationary source program are needed. Therefore, CARB and the District committed to pursue further measures achieving additional emissions reductions, with the formal emissions reductions commitments being made for 2023, 2024, and 2025, the relevant attainment years.

These new mobile and stationary source control measures will facilitate the emissions reductions commitments for 2023, 2024, and 2025, and either have been, are being, or will be, developed by CARB and the District on the schedule laid out in this plan: the District's commitments in Table 4-4 and Table 4-5 and CARB's commitments in Table 4-8 include dates for both action and implementation for each measure. The action and implementation dates are as expeditious as possible and reflect CARB's and the District's best estimate of the time required for the process of developing and implementing each proposed measure.

To facilitate meeting the emissions reductions commitments for 2023, 2024, and 2025, all the action dates and many of the implementation dates for the measures fall prior to 2024, as indicated in Table 4-4, Table 4-5, and Table 4-8. This means emissions reductions from these measures are expected to occur prior to the attainment year. Because CARB and the District committed to new measures with implementation dates occurring in and before 2024, actual emissions up to 2024 will be lower than the emissions inventory. Actual reductions are already occurring and will continue over the lifetime of this Plan, as will be documented in future Quantitative Milestone Reports. Due to the difficulties associated with adopting measures that go beyond the most stringent measures feasible for implementation in the Valley, emission reductions from CARB and District measures are committed to occur not later than 2024 to allow time for affected sources to implement additional controls. This makes it necessary for CARB and the District to rely on a stepwise demonstration, rather than a linear RFP demonstration, for the 15 $\mu g/m^3$ annual, 35 $\mu g/m^3$ 24-hour, and 12 $\mu g/m^3$ annual NAAQS. Demonstrating linear progress is not feasible for the 15 $\mu g/m^3$ annual, 35 $\mu g/m^3$ 24-hour, and 12 $\mu g/m^3$ annual NAAQS due to the time required—during both the measure development and implementation phases—to resolve feasibility issues for less widely accepted or emerging technologies. Anticipated challenges in the measure development and implementation phases affect both the estimated action and implementation dates, as discussed below.

Action Dates

The action dates CARB and the District committed to in Table 4-4, Table 4-5, and Table 4-8 are based on CARB's and the District's best estimate of the amount of time required for the measure development phase. Time spent in this phase is influenced by the complexity of discussions with stakeholders and partner agencies about the feasibility of applying a control, and on what timeline. Implementation of the measure will be hindered if these issues are not resolved or dealt with during the rule development phase. In some cases, if a technology is not well established or widely adopted, there will need to be increased focus and time spent during the measure development phase on the need to innovate or develop a new or emerging technology. In developing the specifics of the regulation or rule, consideration will have to be given to the time it will take in the implementation phase to bring a technology to readiness for market-scale adoption. In addition, once the proposed measure has been developed, it must be adopted by the relevant agency, either CARB or the District. This process entails procedural requirements with their own timing.

"Implementation Begins" Dates

The "Implementation Begins" dates CARB and the District committed to in Table 4-4, Table 4-5, and Table 4-8 are based on CARB's and the District's best estimate of the amount of time required for measure adoption and procedural elements as well as the implementation phase. CARB regulations, once adopted, undergo a prescribed review process by the State Office of Administrative Law (OAL) to ensure compliance with California's Administrative Procedure Act before the measure can be codified in the California Code of Regulations. The effective date of an OAL-approved regulation can be a year or more from the date of CARB adoption. Following development and adoption, in all cases, the implementation schedule of a measure must account for the time needed by the affected entities to comply with the requirements in the measure. This includes planning for, and investing in, the resources to implement the required controls—to change, buy, or install new technology if applicable.

Some specific challenges related to the timing of implementation of innovative District and CARB measures are described in further detail below.

District Measures

As outlined in Table 4-4 in Chapter 4, the District has committed to take action on each PM2.5 control measure beginning in 2019, and not later than 2022, with the majority of rulemaking for District regulatory actions occurring in 2020. Implementation is set to begin as expeditiously as possible for each measure. Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) was amended in June 2019, with implementation of the rule requirements beginning in the 2019-2020 winter wood burning season. The District's Burn Cleaner incentive program is achieving emission reductions from residential wood combustion on an ongoing basis. Similarly, the District's incentive programs for both commercial charbroiling control unit installation and for the installation of near-zero emissions technology agricultural pump engines to replace older, high-polluting diesel agricultural pump engines are active and already achieving emission reductions in the Valley.

However, other regulatory measures for stationary sources may require multiple years after the rule amendment date to provide the time for affected industries to implement and comply with new control requirements. Please refer to the control measure analyses included in Appendix C of this plan for each proposed District regulatory measure (Table H-2) for a full description of economic and technological feasibility considerations associated with each proposed control measure. Complications affecting the timing of implementation of new rule requirements for different types of stationary sources are further discussed in the following section.

Table H-2_ Stationary Source Regulatory Control Measures

Regulatory Measures	Public Process Begins	Action Date	Imple-mentation Begins	Control Measure Analysis
Rule 4311 Flares	2018	2020	2023	See Pg. C-143 – C-161
Rule 4306 Boilers, Steam Generators, and Process Heaters – Phase 3 **Rule 4320** Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 MMBtu/hr	2019	2020	2023	See Pg. C-68 – C-94
Rule 4702 Internal Combustion Engines	2019	2020	2024	See Pg. C-212 – C-240
Rule 4354 Glass Melting Furnaces	2020	2021	2023	See Pg. C-189 – C-195
Rule 4352 Solid Fuel-Fired Boilers, Steam Generators And Process Heaters	2020	2021	2023	See Pg. C-163 – C-188
Rule 4550 Conservation Management Practices	2021	2022	2024	See Pg. C-196 – C-203
Rule 4692 Commercial Under-fired Charbroiling (Hot-spot Strategy)	2019	2020	2024	See Pg. C-204 – C-211
Rule 4901 Wood Burning Fireplaces and Wood Burning Heaters (Hot-spot Strategy)	2019	2019	2019	See Pg. C-248 – C-282

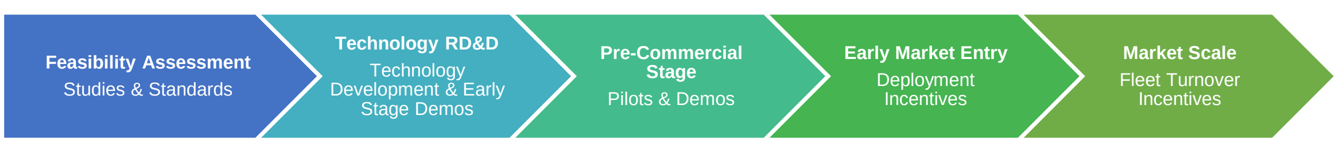
As the regulatory evaluation completed in Appendix C demonstrates, District rules currently require the most stringent measures feasible to implement in the Valley. Further understanding of the applicability of potential further control technologies to Valley operations, the cost-effectiveness of controls, and the socioeconomic impacts of potential regulations is necessary before regulations can be adopted. The market availability of control equipment capable of reducing emissions further than the already stringent limits required by these technology-forcing rules is an additional consideration in implementing new regulatory requirements.

Time after rule adoption will be necessary for unit manufacturers and vendors to make available compliant equipment, and for facility operators to source, purchase, and install new units or compliant retrofit equipment. Dependent on the source category, construction of controls will include engineering, site preparation and infrastructure upgrades, unit installation, and operator training on proper operation. Potential control technologies have significant costs to affected facilities, and these operations will also require time to plan for these investments. Based on these challenges, rule implementation is not expected to be feasible prior to the implementation date listed in Table 4-4 (in Chapter 4). The time necessary for affected industries to comply with potential new regulatory requirements will be further evaluated in the rule amendment process, and a compliance schedule will be adopted as a part of potential rule amendments.

Due to the factors outlined above, and further discussed in the Appendix C control measure analyses for stationary sources, the difficulty of implementing emission reduction measures that will further advance the Valley towards attainment of the 1997, 2006, and 2012 PM2.5 NAAQS has resulted in the District and CARB committing to achieve emission reductions by 2024. This necessitates a stepwise RFP demonstration. The expeditious implementation of some measures, where feasible, may result (or has already resulted) in emission reductions that occur before the committed date of 2023, 2024,/ and 2025. Emission reductions achieved earlier than these commitment dates will be demonstrated and discussed in Quantitative Milestone Reports submitted after identified milestone years (see Table H-12).

CARB Measures
CARB's mobile source control program is designed to facilitate the transformation of California's transportation sector. As discussed in the Valley Supplement to the State SIP Strategy (Attachment A), the objective of many of CARB's new measures is to introduce or advance innovative technologies in early stages of development or market penetration. In the case of technology-forcing regulations, including CARB measures to increase the penetration of zero- and near-zero-emission technologies, time is needed by the affected industry to ready the technologies, including infrastructure, for market-scale adoption, and would have been discussed previously by CARB and stakeholders during the measure development phase. The time required to facilitate new and innovative technologies is a principle driver of the timeline for control measure implementation CARB laid out in Table 4-8. Figure H-2 illustrates stages in the commercialization path for an emerging technology.

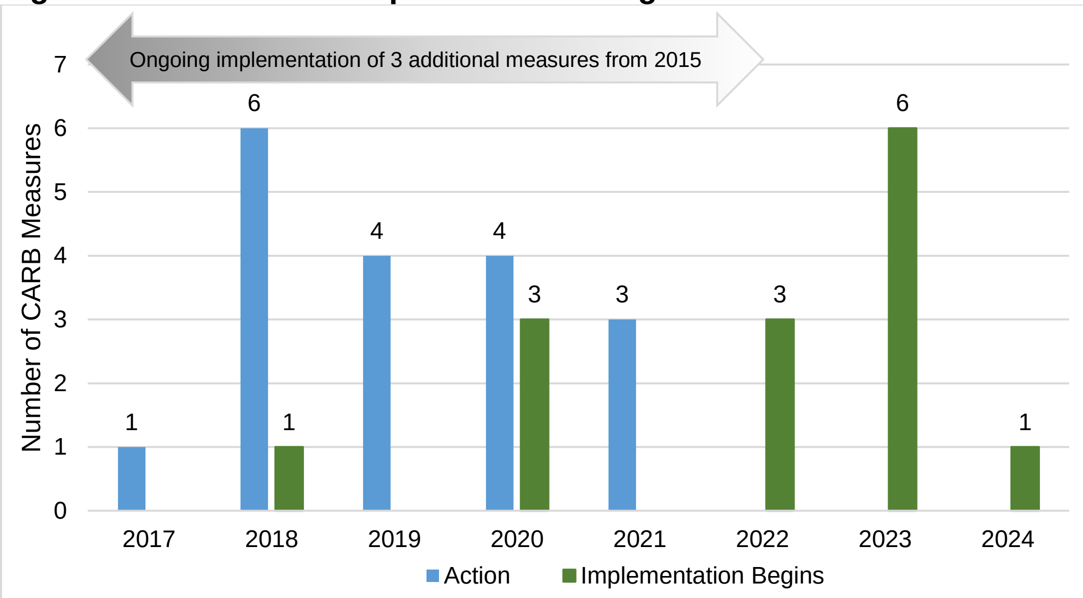
Figure H-2 Stages in the Commercialization Path



CARB conducts technology and fuels assessments[10] as part of this process. These reports discuss in detail the status of the technology and potential challenges with getting the technology to market scale. In spite of the challenges associated with the rulemaking process, CARB has committed to implementation of a suite of measures prior to 2024 in order to achieve emissions reductions as expeditiously as possible. As shown in Figure H-3, all the action dates and the majority of the implementation dates for CARB measures fall prior to 2024.

[10] https://ww2.arb.ca.gov/resources/documents/technology-and-fuels-assessments

Figure H-3 Action and Implementation Begins Dates for CARB Measures



Implementation of three key incentive measures is already ongoing. The Accelerated Turnover of Agricultural Equipment incentive-based measure was adopted by CARB in December 2019, but has been achieving reductions in NOx and PM2.5 since 2015 and will continue to achieve significant reductions annually through the 2025 attainment year. In addition, CARB and the District are already implementing turnover of vehicles for the Accelerated Turnover of Trucks and buses and Accelerated Turnover of Off-Road Equipment incentive measures. The ongoing implementation of these measures illustrates that CARB and the District are achieving continual emissions reductions well in advance of the 2023, 2024, and 2025 attainment dates for which formal emissions reductions commitments exist.

The timing of action and implementation for other key CARB measures is impacted by specific challenges. For example:

- Heavy-Duty Vehicle Inspection and Maintenance Program:
    - Legislation signed in 2019 (SB 210, Leyva) ensures that this program's emissions reductions are maximized.
    - The legislative process took time and influenced the action and implementation dates committed to in the SIP.
    - With the law now in place, CARB is working on program design and establishing the infrastructure for a successful program. CARB has held two public workshops and three public working group meetings on the Heavy-Duty Vehicle Inspection and Maintenance Program since February 2019.

- Low-NOx Engine Standard (California Action):
  - CARB's established action and implementation timelines for this standard were impacted by an ongoing multi-year, three-phase research effort to assess the feasibility of lower NOx emissions.
  - The California Low-NOx Engine Standard for heavy-duty vehicles has been part of an extensive public process with workshops beginning in November 2016.
  - CARB staff is working hard to ensure the California program will meet all of the State's needs while preserving the ability to harmonize with the federal low-NOx program that U.S. EPA has initiated through its Cleaner Trucks Initiative. Coordination on the federal low-NOx rulemaking will also take time.

H.1.4 RFP Calculation Methodology and Demonstration

1. Determine the emissions inventory of the Valley with the Plan control strategy for the baseline year, the RFP years, and the attainment year.

Table H-3 Annual Average Emission Inventory (tpd) (see Appendix B)

Pollutant	2013	2017	2019	2020	2021	2022	2023	2024	2025	2026
Direct PM2.5	62.5	58.9	59.2	59.0	58.5	58.4	58.3	58.3	58.3	58.4
NOx	317.2	233.3	214.5	203.3	191.0	179.8	153.6	148.9	143.7	139.4

2. Identify additional annual average emission reductions from the Plan control measure commitments (see Chapter 4) between the Plan base year and the attainment year.

Table H-4 Annual Average Emissions Reduced from Control Measure Commitments (tpd)

Pollutant	2013	2017	2019	2020	2021	2022	2023	2024	2025	2026
Direct PM2.5	0	0	0.1	0.2	0.2	0.2	0.2	2.2	2.2	2.2
NOx	0	0	0	0	0	0	~~0~~ 3.0	33.9	33.9	33.9

3. Subtract the emission reductions from Plan control measure commitments (Table H-~~3~~4) from the emission inventory (Table H-~~2~~3) to determine the Plan inventory.

Table H-5 Projected Attainment Emissions Inventory after Control Measures (tpd)

Pollutant	2013	2017	2019	2020	2021	2022	2023	2024	2025	2026
Direct PM2.5	62.5	58.9	59.1~~2~~	58~~9~~.8~~0~~	58.3~~5~~	58.2~~4~~	58.1~~3~~	56.1	56.1	56.2
NOx	317.2	233.3	214.5	203.3	191.0	179.8	150~~3~~.6	115.0	109.8	105.5

4. Determine the total reductions from the 2013 baseline emission inventory that must be achieved to reach attainment by subtracting Plan base year (2013) emissions (Table H-3~~2~~) from attainment year emissions after controls (Table H-5~~4~~).

Table H-6 Total Reductions Necessary to Reach Attainment (tpd)*

Pollutant	A	B	C	D	E	F	G
	2013 Plan Base Year Emissions	1997 NAAQS Attainment Emissions (202~~0~~3)	1997 NAAQS Reductions Needed	2006 NAAQS Attainment Emissions (2024)	2006 NAAQS Reductions Needed	2012 NAAQS Attainment Emissions (2025)	2012 NAAQS Reductions Needed
	(Table H-~~2~~3)	(Table H-~~4~~5)	(A – B)	(Table H-~~4~~5)	(A – D)	(Table H-~~4~~5)	(A – F)
Direct PM2.5	62.5	~~59.0~~58.1	~~3.5~~4.4	56.1	6.4	56.1	6.4
NOx	317.2	~~203.3~~150.6	~~114.0~~166.6	115.0	202.2	109.8	207.4

**This table has been updated to include the correct value for NOx NAAQS Attainment Emissions for the 2006 standard (updated in Column D), included in Table H-~~4~~5. This technical correction of an error value results in updated values being included in all subsequent tables.*

5. Determine the fraction of reductions that are achieved in each RFP milestone year. The following Table H-7~~6~~ shows the fraction of emissions reductions to be achieved for each milestone year, ~~assuming a linear reduction in emissions for the 1997 standard, and~~ using the attainment emissions inventory targets established for the 1997, 2006, and 2012 standards. In the RFP demonstrations in the tables that follow, ~~the 1997 NAAQS follows the generally linear method, while~~ the 1997, 2006, and 2012 NAAQS follow the stepwise method, for reasons as described above.

   Where (milestone year – base year) / (attainment year – base year)

Table H-7 Milestone Year Fractions Achieved in Each Milestone Year

	Milestone Years				
	2017	2020	2023	2024	2026
1997 NAAQS (PM2.5 and NOx)	~~57.1~~45.5%	~~100.0~~72.7%	100.0%	100.0%	100.0%
2006 NAAQS (PM2.5)	56.3%	54.7%	65.6%	100.0%	100.0%
2006 NAAQS (NOx)	41.5%	56.3%	81.0%	100.0%	100.0%
	2019	2022	2025		
2012 NAAQS (PM2.5)	51.6%	64.1%	100.0%		
2012 NAAQS (NOx)	49.5%	66.2%	100.0%		

6. ~~Determine the RFP target emissions levels using reduction fractions for linear RFP demonstration (for 1997 PM2.5 NAAQS).~~

~~Table H-8 Target Emissions Levels for RFP Milestone Years (tons per day)~~

-	A	B	C	D	E	F	G	H
-	-	-	2017		2020		2023	
1997 NAAQS	2013 Base Year Emission Inventory	Reductions Needed To Attain NAAQS	Tons to be Reduced	RFP Target Emissions Level	Tons to be Reduced	RFP Target Emissions Level	Tons to be Reduced	RFP Target Emissions Level
	(Table H-2)	(Table H-5)	(B x Table H-6)	(A – C)	(B x Table H-6)	(A – E)	(B x Table H-6)	(A – G)
Direct PM2.5	62.5	3.5	2.0	60.5	3.5	59.0	3.5	59.0
NOx	317.2	114.0	65.1	252.1	114.0	203.3	114.0	203.3

6. Compare RFP target emissions level to the projected emissions inventory to demonstrate RFP.

   ~~Table H-8 demonstrates linear RFP for the 1997 PM2.5 NAAQS.~~ As justified earlier in this chapter, stepwise RFP is demonstrated for ~~both~~ the 1997, 2006, and 2012 PM2.5 NAAQS, as outlined in Tables H-~~9~~8, ~~and~~ H-~~10~~9, and H-10. ~~For Table H-9 and H-10, the "RFP Target Emissions Level" selected is equal to the attainment emissions inventory (calculated in Table H-4).~~ Consistent with EPA's discussion of stepwise methodology included in the 2016 PM2.5 Implementation Rule, the attainment inventory drops significantly in 2024 due to the implementation of District and CARB emission reduction strategies further outlined in Chapter 4 of this plan.

Table H-8 Demonstration of Compliance with ~~Linear~~ Stepwise RFP Targets for 1997 NAAQS

1997 NAAQS	2017			2020			2023			2026		
	RFP target emissions level	Attainment Emissions Inventory	~~Linear~~ Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	~~Linear~~ Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	~~Linear~~ Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?
	(Table H-~~7~~5)	(Table H-45)		(Table H-~~7~~5)	(Table H-45)		(Table H-~~7~~5)	(Table H-45)		(Table H-~~7~~5)	(Table H-45)	
Direct PM2.5	~~60.5~~58.9	58.9	**YES**	589.~~0~~8	589.8~~0~~	**YES**	~~59.0~~58.1	58.1~~3~~	**YES**	56.2	56.2	**YES**
NOx	~~252.1~~233.3	233.3	**YES**	203.3	203.3	**YES**	~~203.3~~150.6	150~~3~~.6	**YES**	105.5	105.5	**YES**

Table H-9 Demonstration of Compliance with Stepwise RFP Targets for 2006 NAAQS

	2017			2020			2023			2026		
2006 NAAQS	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?
	(Table H-45)	(Table H-45)		(Table H-45)	(Table H-45)		(Table H-45)	(Table H-45)		(Table H-45)	(Table H-45)	
Direct PM2.5	58.9	58.9	**YES**	589.80	589.80	**YES**	58.1~~3~~	58.1~~3~~	**YES**	56.2	56.2	**YES**
NOx	233.3	233.3	**YES**	203.3	203.3	**YES**	150~~3~~.6	150~~3~~.6	**YES**	105.5	105.5	**YES**

Table H-10 Demonstration of Compliance with Stepwise RFP Targets for 2012 NAAQS

	2019			2022			2025		
2012 NAAQS	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?	RFP target emissions level	Attainment Emissions Inventory	Stepwise RFP target met?
	(Table H-45)	(Table H-45)		(Table H-45)	(Table H-45)		(Table H-45)	(Table H-45)	
Direct PM2.5	59.12	59.12	**YES**	58.24	58.24	**YES**	56.1	56.1	**YES**
NOx	214.5	214.5	**YES**	179.8	179.8	**YES**	109.8	109.8	**YES**

H.2 Quantitative Milestones

Consistent with CAA §189(c)(1), the state must submit in each attainment Plan for a PM2.5 nonattainment area specific quantitative milestones that demonstrate reasonable further progress toward attainment of the applicable PM2.5 NAAQS in the area.

H.2.1 Quantitative Milestone Requirements

Quantitative milestones in a State Implementation Plan shall meet the following requirements:[11]

1. Nonattainment areas initially classified as Moderate

   a. Milestones achieved no later than a milestone date of 4.5 years and 7.5 years from the date of designation of the area.
   b. Milestones that provide for objective evaluation of reasonable further progress toward timely attainment of the applicable PM2.5 NAAQS in the area. At a minimum, each quantitative milestone Plan must include a milestone for tracking progress achieved in implementing the SIP control measures, including Reasonably Available Control Measures (RACM) and Reasonable Available Control Technology (RACT), by each milestone date.

2. Areas reclassified as Serious

   a. For areas that can attain the NAAQS by the end of the tenth calendar year following the effective date of designation, milestone dates of 7.5 years and 10.5 years respectively, from the date of designation of the area
   b. For areas that cannot attain the NAAQS by the end of the tenth calendar year following the effective date of designation, milestone dates of 7.5 years, 10.5 years, and 13.5 years from the date of designation. If the attainment date is beyond 13.5 years from the date of designation, such Plan shall also contain a quantitative milestone to be achieved no later than milestones dates of 16.5 years, respectively from the date of designation of the area.
   c. Milestones that provide for objective evaluation of RFP toward timely attainment of the NAAQS in the area. At a minimum each quantitative milestone Plan must include a milestone for tracking progress achieved in implementing SIP control measures, including Best Available Control Measure (BACM) and Best Available Control Technology (BACT) by each milestone date.

3. Serious areas that fail to attain by the applicable Serious area attainment date

   a. If the attainment Plan is due prior to a date 13.5 years from designation of the area, then the Plan shall contain milestones to be achieved by no later than a milestone date of 13.5 years from the date of designation of the area, and every three years thereafter, until the milestone date that falls within three years *after* the applicable attainment date.
   b. If the attainment Plan is due later than a date 13.5 years from designation, then the Plan shall contain milestones to be achieved by no later than a

[11] 40 CFR §51.1013 Quantitative milestone requirements.

milestone date of 16.5 years from the date of designation of the area, and every three years thereafter, until the milestone date that falls within three years *after* the applicable attainment date.

c. Milestones that provide for objective evaluation of RFP toward timely attainment of the NAAQS. At a minimum, each quantitative milestone Plan must include a milestone for tracking progress achieved in implementing the SIP control measures by each milestone date.

4. **Areas designated for 1997 and/or 2006 PM2.5 NAAQS before January 15, 2015**
   a. Each attainment Plan submission for an area designated nonattainment for the 1997 and/or 2006 PM2.5 NAAQS before January 15, 2015, shall contain quantitative milestone to be achieved no later than 3 years after December 31, 2014, and every three years thereafter until the milestone date that falls within three years *after* the applicable attainment date.

H.2.1.1 1997 NAAQS

As discussed throughout this Plan, EPA designated the Valley for the 1997 NAAQS on January 5, 2005 (see Chapter 1 for a timeline). Additionally, the Valley failed to attain by the applicable Serious area attainment date. As such, the quantitative milestones for this Plan are guided by requirement 3.c and 4 above. The Valley will attain the 24-hour 1997 NAAQS in 2020 and the annual 1997 NAAQS in 2023. See Table H-11 for milestone years.

H.2.1.2 2006 NAAQS

As discussed throughout this Plan, EPA designated the Valley for the 2006 NAAQS on November 13, 2009 (see Chapter 1 for a timeline). The Valley is designated Serious nonattainment for this standard. As such, the quantitative milestones for this Plan are guided by requirement 2.c and 4 above. The Valley will attain the 2006 NAAQS in 2024. See Table H-11 for milestone years.

H.2.1.3 2012 NAAQS

The Valley is currently designated Moderate for this NAAQS. Moderate area requirements and request for reclassification requirements were satisfied through the District's *2015 Plan for the 1997 PM2.5 Standard,* adopted and submitted to CARB in 2016. The District is proactively satisfying Serious area requirements for this NAAQS in this Plan. The quantitative milestones for this Plan are guided by requirements 1 and 2 above. The Valley will attain the 2012 NAAQS in 2025. See Table H-11 for quantitative milestone years.

Table H-11 Quantitative Milestone Dates and Deadlines

NAAQS	Quantitative Milestone Dates	Milestone Report Due Date
1997 24-hour	December 31: 2017, 2020, 2023	March 31: 2018, 2021, 2024
1997 annual	December 31: 2017, 2020, 2023, 2026	March 31: 2018, 2021, 2024, 2027
2006	December 31: 2017, 2020, 2023, 2026	March 31: 2018, 2021, 2024, 2027
2012	October 15: 2019, 2022, 2025, 2028	January 15: 2020, 2023, 2026, 2029

H.2.2 STATIONARY SOURCES QUANTITATIVE MILESTONE COMMITMENTS

The District will report on milestones for implementation of stationary source reductions set forth in District Board-adopted attainment Plans as well as this this 2018 PM2.5 Plan.

H.2.2.1 1997 NAAQS Quantitative Milestones

The 1997 65 µg/m^3 24-hour and 15 µg/m^3 annual standards have quantitative milestone years in 2017, 2020, and 2023.

2017

For the 2018 milestone report for the 2017 milestone, the District is reporting on the following milestones (see Attachment B):

- Implementation of amendments to the District's residential wood burning program from 2014 through 2017 that required lower No Burn thresholds for high polluting wood burning heaters and fireplaces and enhancements to the District Burn Cleaner incentive program;
- Implementation of Rule 4308 (Boilers, Steam Generators, and Process Heaters (0.075 to <2 MMBtu/hr)) regulation requirements from 2015 through 2017 that required lower NOx emission limits for instantaneous water heaters with a rated heat input of 0.075 to 0.4 MMBtu/hr;
- Implementation of Rule 4354 (Glass Melting Furnaces) regulation requirements from 2013 through 2017 that required lower emission limits for NOx, SOx, and PM10 on glass melting furnaces in the Valley;
- Implementation of Rule 4702 (Internal Combustion Engines) regulation requirements from 2013 through 2017 that required lower NOx and SOx emission limits for various types of engines;
- Implementation of Rule 4902 (Residential Water Heaters) regulation requirements from 2013 through 2017 that required lower NOx emission limits for new residential natural gas-fired water heaters; and
- Implementation of Rule 4905 (Reduction of NOx Emissions from Natural Gas-Fired, Fan-Type Central Furnaces) regulation requirements from 2015 through 2017 that required lower NOx emission limits for natural gas-fired, fan-type, central furnaces.

2020

For the 2020 milestone year, the District is reporting on the following milestones:

- The status of SIP measures adopted between 2017 and 2020 as per the schedule included in the adopted Plan.

2023
For the 2023 milestone year, the District is reporting on the following milestones:

- The status of SIP measures adopted between 2017 and 2020 as per the schedule included in the adopted Plan.

2026
For the 2026 milestone year, the District is reporting on the following milestones:

- Implementation of amendments to *Residential Wood Burning Strategy*, including any regulatory amendments and enhancements to the District Burn Cleaner incentive program;
- Implementation of amendments to the *Commercial Under-Fired Strategy*, including any regulatory amendments and implementation of related incentive-based strategy
- The status of SIP measures adopted between 2023 and 2026 as per the schedule included in the adopted Plan.

H.2.2.2 2006 NAAQS Quantitative Milestones
The 2006 35 µg/m^3 24-hour standard has quantitative milestone years in 2017, 2020, 2023, and 2026.

2017
For the 2017 milestone year, the District is reporting on the following milestones (see Attachment B to this Plan):

- Implementation of amendments to the District's residential wood burning program from 2014 through 2017 that required lower No Burn thresholds for high polluting wood burning heaters and fireplaces and enhancements to the District Burn Cleaner incentive program;
- Implementation of Rule 4308 (Boilers, Steam Generators, and Process Heaters (0.075 to <2 MMBtu/hr)) regulation requirements from 2015 through 2017 that required lower NOx emission limits for instantaneous water heaters with a rated heat input of 0.075 to 0.4 MMBtu/hr;
- Implementation of Rule 4354 (Glass Melting Furnaces) regulation requirements from 2013 through 2017 that required lower emission limits for NOx, SOx, and PM10 on glass melting furnaces in the Valley;
- Implementation of Rule 4702 (Internal Combustion Engines) regulation requirements from 2013 through 2017 that required lower NOx and SOx emission limits for various types of engines;
- Implementation of Rule 4902 (Residential Water Heaters) regulation requirements from 2013 through 2017 that required lower NOx emission limits for new residential natural gas-fired water heaters; and
- Implementation of Rule 4905 (Reduction of NOx Emissions from Natural Gas-Fired, Fan-Type Central Furnaces) regulation requirements from 2015 through

2017 that required lower NOx emission limits for natural gas-fired, fan-type, central furnaces.

2020
For the 2020 milestone year, the District is reporting on the following milestones:

- The status of SIP measures adopted between 2017 and 2020 as per the schedule included in the adopted Plan, including *Residential Wood Burning Strategy* and *Commercial Under-Fired Charbroiler* incentive-based strategy.

2023
For the 2023 milestone year, the District is reporting on the following milestones:

- The status of SIP measures adopted between 2020 and 2023 as per the schedule included in the adopted Plan, including *Residential Wood Burning Strategy* and *Commercial Under-Fired Charbroiler* incentive-based strategy.

2026
For the 2026 milestone year, the District is reporting on the following milestones:

- Implementation of amendments to *Residential Wood Burning Strategy*, including any regulatory amendments and enhancements to the District Burn Cleaner incentive program;
- Implementation of amendments to the *Commercial Under-Fired Strategy*, including any regulatory amendments and implementation of related incentive-based strategy
- The status of SIP measures adopted between 2023 and 2026 as per the schedule included in the adopted Plan.

H.2.2.3 2012 NAAQS Quantitative Milestones
The 2012 12 μg/m^3 annual standard has quantitative milestone years in 2019, 2022, 2025, and 2028.

2019
For the 2019 milestone year, the District is reporting on the following milestones:

- The status of SIP measures adopted between 2017 and 2019 as per the schedule included in the adopted Plan, including *Residential Wood Burning Strategy* and *Commercial Under-Fired Charbroiler* incentive-based strategy.

2022
For the 2022 milestone year, the District is reporting on the following milestones:

- The status of SIP measures adopted between 2019 and 2022 as per the schedule included in the adopted Plan, including *Residential Wood Burning Strategy* and *Commercial Under-Fired Charbroiler* incentive-based strategy.

2025
For the 2025 milestone year, the District is reporting on the following milestones:

- Implementation of amendments to *Residential Wood Burning Strategy*, including any regulatory amendments and enhancements to the District Burn Cleaner incentive program;
- Implementation of amendments to the *Commercial Under-Fired Strategy*, including any regulatory amendments and implementation of related incentive-based strategy
- The status of SIP measures adopted between 2022 and 2025 as per the schedule included in the adopted Plan.

2028
For the 2028 milestone year, the District is reporting on the following milestones:

- Implementation of amendments to *Residential Wood Burning Strategy*, including any regulatory amendments and enhancements to the District Burn Cleaner incentive program;
- Implementation of amendments to the *Commercial Under-Fired Strategy*, including any regulatory amendments and implementation of related incentive-based strategy
- The status of SIP measures adopted between 2023 and 2026 as per the schedule included in the adopted Plan.

H.2.3 Mobile Sources Quantitative Milestone Commitments

[This section provided by the California Air Resources Board]

CARB will report on milestones for implementation of mobile source reductions set forth in the *2016 State Strategy for the State Implementation Plan* (State SIP Strategy) and new measures in the *Proposed San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan* (Valley State SIP Strategy).

The 1997 **65** µg/m^3 24-hour and **15** µg/m^3 annual standards have quantitative milestone years in **2017**, **2020**, and **2023**. <u>In addition, the 15 µg/m^3 annual standard has a quantitative milestone year in **2026**.</u>

2017
For the 2017 milestone year, CARB is reporting on the following three milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2012 and 2017 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses;
2. Implementation of the *Advanced Clean Cars Program* (the ACC Program) between 2014 and 2017 that required manufacturers of new light-duty passenger vehicles sold in California to limit emissions; and

3. Implementation of *In-Use Off-Road Diesel-Fueled Fleets Regulation* (the Off-Road Regulation) that began in 2014 for large fleets and in 2017 for medium fleets and limited emissions from existing off-road diesel vehicles operated in California.

2020

For the 2020 milestone year, CARB is reporting on the following two milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2017 and 2020 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses; and
2. The status of SIP measures adopted between 2017 and 2020, including *Advanced Clean Cars 2* and the *Heavy-Duty Vehicle Inspection and Maintenance Program* as part of the *Lower In-Use Emission Performance Level* measure.

2023

For the 2023 milestone year, CARB is reporting on the following two milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2020 and 2023 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses; and
2. Implementation of the California *Low-NOx Engine Standard* for new on-road heavy-duty engines used in medium- and heavy-duty trucks purchased in California.

2026

For the 2026 milestone year, CARB is reporting on the following two milestones:

1. Identify the number of pieces of agricultural equipment turned over to Tier 4 Final due to the *Accelerated Turnover of Agricultural Tractors Measure* through 2026; and
2. Identify the number of trucks and buses turned over to a low-NOx engine or cleaner due to the *Accelerated Turnover of Trucks and Buses Measure* through 2026.

The 2006 **35** µg/m^3 24-hour standard has quantitative milestone years in **2017**, **2020**, **2023**, and **2026**.

2017

For the 2017 milestone year, CARB is reporting on the following three milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2012 and 2017 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses;
2. Implementation of the *Advanced Clean Cars Program* (the ACC Program) between 2014 and 2017 that required manufacturers of new light-duty passenger vehicles sold in California to limit emissions; and
3. Implementation of *In-Use Off-Road Diesel-Fueled Fleets Regulation* (the Off-Road Regulation) that began in 2014 for large fleets and in 2017 for medium fleets and limited emissions from existing off-road diesel vehicles operated in California.

2020

For the 2020 milestone year, CARB is reporting on the following two milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2017 and 2020 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses; and
2. The status of SIP measures adopted between 2017 and 2020, including *Advanced Clean Cars 2* and the *Heavy-Duty Vehicle Inspection and Maintenance Program*.

2023

For the 2023 milestone year, CARB is reporting on the following two milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2020 and 2023 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses; and
2. Implementation of the California *Low-NOx Engine Standard* for new on-road heavy-duty engines used in medium- and heavy-duty trucks purchased in California.

2026

For the 2026 milestone year, CARB is reporting on the following two milestones:

1. Identify the number of pieces of agricultural equipment turned over to Tier 4 Final due to the *Accelerated Turnover of Agricultural Tractors Measure* through 2026; and
2. Identify the number of trucks and buses turned over to a low-NOx engine or cleaner due to the *Accelerated Turnover of Trucks and Buses Measure* through 2026.

The 2012 **12** µg/m^3 annual standard has quantitative milestone years in **2019**, **2022**, **2025**, and **2028**.

2019

For the 2019 milestone year, CARB is reporting on the following three milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2017 and 2019 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses;
2. Implementation of *In-Use Off-Road Diesel-Fueled Fleets Regulation* (the Off-Road Regulation) that began in 2014 for large fleets and in 2017 for medium fleets and limited emissions from existing off-road diesel vehicles operated in California.
3. The status of SIP measures adopted between 2017 and 2019, including the California *Low-NOx Engine Standard* for new on-road heavy-duty engines used in medium- and heavy-duty trucks purchased in California.

2022

For the 2022 milestone year, CARB is reporting on the following two milestones:

1. Implementation of the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation* (the Truck and Bus Regulation) between 2019 and 2022 that required particulate filters and cleaner engine standards on existing California heavy-duty diesel trucks and buses;
2. The status of SIP measures adopted between 2019 and 2022, including *Advanced Clean Cars 2* and the *Heavy-Duty Vehicle Inspection and Maintenance Program*.

2025

For the 2025 milestone year, CARB is reporting on the following three milestones:

1. Identify the number of pieces of agricultural equipment turned over to Tier 4 Final due to the *Accelerated Turnover of Agricultural Tractors Measure* through 2025;
2. Identify the number of trucks and buses turned over to a low-NOx engine or cleaner due to the *Accelerated Turnover of Trucks and Buses Measure* through 2025; and
3. The status of SIP measures adopted between 2022 and 2025, including the proposed *Cleaner In-Use Agricultural Equipment Measure* to incentivize the penetration of cleaner agricultural equipment used in California.

2028

For the 2028 milestone year, CARB is reporting on the following milestone:

1. Implementation of the *Advanced Clean Cars 2* requirements between 2026 and 2028.

H.3 CONTINGENCY MEASURES

Pursuant to CAA §172(c)(9) and 40 CFR § 51.1014, all PM2.5 attainment plans must contain contingency measures. Contingency measures are additional control measures to be implemented in the event that EPA issues final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure.

Pursuant to the Clean Air Act (Act) §172(c)(9), contingency measures must be fully adopted rules or control measures that are ready to be implemented quickly upon a determination by the EPA that a failure occurred. Contingency measures take effect without significant additional action by the state or local agency or by EPA. Requirements are codified in the code of federal regulations 51 CFR §51.1014. Pursuant to §51.1014(b), contingencies must meet the following requirements:

- The contingency measures shall consist of control measures that are not otherwise included in the control strategy or that achieve emissions reductions not otherwise relied upon in the control strategy for the area,
- Each contingency measure shall specify the timeframe within which its requirements become effective following a determination by EPA,
- The attainment plan submission shall contain a description of any specific trigger mechanisms for the contingency measures and specify a schedule for implementation.

In addition to the above-mentioned requirements, a recent court case, *Bahr v. EPA* (Bahr), has provided further interpretation of implementation requirements. EPA staff has interpreted the decision in Bahr to mean that contingency measures must include a future action that that would be activated (“triggered”) should EPA issue a final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure.

Areas like the Valley that have significant nonattainment challenges have developed several generations of aggressive and far-reaching emission reduction measures to meet various Clean Air Act requirements. When viable emission reductions are identified, they are implemented to contribute to expeditious attainment. Reductions are not usually held in reserve to be used only if an area fails to meet a milestone. As a result, developing contingency measures for District attainment plans is a significant challenge. From extensive analyses and discussions, the District and CARB developed the following contingency commitments for this Plan.

District Contingency Commitment

The District will amend District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) to include a requirement in the rule with a trigger that that would be activated should EPA issue a final rulemaking that the Valley failed to meet a regulatory requirement necessitating implementation of a contingency measure. Effective 60 days after the EPA final action, the trigger would impose lower residential wood burning curtailment levels in any county that has failed to meet the regulatory requirement necessitating implementation of contingency to the following:

Consistent with the proposed Rule 4901 enhancements in hot-spot areas, impose the following requirements:

- No Burn for non-registered units at or above 12 $\mu g/m^3$
- No burn for all devices above 35 $\mu g/m^3$

CARB Contingency Commitment

[This section provided by the California Air Resources Board]

Basic requirements for contingency measures are defined in the Clean Air Act (Act). The Act's General Preamble and U.S. EPA guidance also provide a framework for implementing this provision of the Act. In addition, a recent court case, *Bahr v. U.S. EPA* (*Bahr*), has provided further interpretation of implementation requirements. U.S. EPA staff has interpreted the decision in *Bahr* to mean that contingency measures must include a future action triggered by a failure to attain or failure to make reasonable further progress.

~~Contingency measures are required for all federal PM2.5 standards. CARB approved a contingency measure for the 65 $\mu g/m^3$ 24-hour and 15 $\mu g/m^3$ annual PM2.5 standards as a revision to the SIP on September 28, 2017 (Resolution 17-27). The contingency measure included complementary elements that addressed the contingency measure requirements of the Act as interpreted in *Bahr*, namely a trigger mechanism directing the CARB Executive Officer to allocate resources and enhance enforcement activities in the San Joaquin Valley to provide additional NOx reductions in the event that U.S. EPA determines the San Joaquin Valley failed to attain in 2020, and new NOx emission reductions that provide for approximately one year's worth of progress that will be achieved through ongoing implementation of CARB's mobile source program.~~

~~The *2018 Updates to the California State Implementation Plan* (2018 SIP Update, released by CARB September 21, 2018) addresses the contingency measure requirements of the Act as interpreted by U.S. EPA in response to *Bahr* for the 35 $\mu g/m^3$ 24-hour and 12 $\mu g/m^3$ annual standards in a similar way to the adopted contingency measure mentioned above. The 2018 SIP Update includes a trigger mechanism directing the CARB Executive Officer to allocate resources and enhance enforcement activities in nonattainment areas in the State, including the Valley, to provide additional NOx reductions in the event that U.S. EPA determines the area failed to meet an RFP~~

~~milestone or failed to attain the 35 µg/m^3 24-hour and/or 12 µg/m^3 annual PM2.5 standards.~~

Additional NOx emission reductions that are expected to occur due to ongoing State mobile source control programs, together with emission reductions from ~~the Enhanced Enforcement Activities contingency measures and~~ district contingency measures, provide emissions reductions for attainment contingency. Table H-12 below demonstrates the emission reductions that occur after the attainment year for each applicable standard due to implementation of California's Mobile Source Program to be used for contingency purposes.

Table H-12 Mobile San Joaquin Valley Attainment Contingency Reductions

1997 65 µg/m3 ~~and 15 µg/m3~~ standard (tpd, reductions calculated on annual planning inventory)	2020 Emissions	2021 Emissions	2020 to 2021 Emission Reductions
Mobile Source Direct PM2.5	8.5	8.2	0.3
Mobile Source NOx	166.8	154.7	12.1
1997 15 µg/m3 standard (tpd, reductions calculated on annual planning inventory)	2023 Emissions	2024 Emissions	2023 to 2024 Emission Reductions
Mobile Source Direct PM2.5	7.7	7.6	0.1
Mobile Source NOx	118.0	113.6	4.4
2006 35 µg/m3 standard (tpd, reductions calculated on winter planning inventory)	2024 Emissions	2025 Emissions	2024 to 2025 Emission Reductions
Mobile Source Direct PM2.5	6.8	6.7	0.1
Mobile Source NOx	101.6	97.4	4.2
2012 12 µg/m3 standard (tpd, reductions calculated on annual planning inventory)	2025 Emissions	2026 Emissions	2025 to 2026 Emission Reductions
Mobile Source Direct PM2.5	7.5	7.4	0.1
Mobile Source NOx	108.6	104.5	4.1

APPENDIX E

Updated *2018 PM2.5 Plan* Appendix K: Photochemical Modeling for the 2018 San Joaquin Valley Annual/24-Hour $PM_{2.5}$ State Implementation Plan

Appendix K

Modeling Attainment Demonstration

Updated July 20, 2021

Photochemical Modeling for the 2018 San Joaquin Valley Annual/24-Hour $PM_{2.5}$ State Implementation Plan

Prepared by

California Air Resources Board
San Joaquin Valley Air Pollution Control District

Prepared for

United States Environmental Protection Agency Region IX

Revised July 20, 2021

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ACRONYMS

CARB – California Air Resources Board

BCs – Boundary Conditions

CMAQ Model – Community Multi-scale Air Quality Model

CRPAQS – California Regional Particulate Air Quality Study

CSN – Chemical Speciation Network

DISCOVER-AQ – Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality

DV – Design Value

EC – Elemental Carbon

FEM – Federal Equivalent Method

FRM – Federal Reference Method

GEOS-5 – Goddard Earth Observing System Model, Version 5

GMAO – Global Modeling and Assimilation Office

ICs – Initial Conditions

MEGAN – Model of Emissions of Gases and Aerosols from Nature

MFB – Mean Fractional Bias

MFE – Mean Fractional Error

MOZART – Model for Ozone and Related chemical Tracers

NARR – North American Regional Reanalysis

NASA – National Aeronautics and Space Administration

NCR – National Center for Atmospheric Research

NMB – Normalized Mean Bias

NME – Normalized Mean Error

NO_x – Oxides of Nitrogen

OC – Organic Carbon

OM – Organic Matter

$PM_{2.5}$ – Particulate Matter of Aerodynamic Diameter less than 2.5 micrometers

RMSE – Root Mean Square Error

ROG – Reactive Organic Gases

RRF – Relative Response Factors

SANDWICH – Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance

SAPRC – Statewide Air Pollution Research Center

SIP – State Implementation Plan

SJV – San Joaquin Valley

SOA – Secondary Organic Aerosol

SO_x – Sulfur oxides

U.S. EPA – United States Environmental Protection Agency

VOCs – Volatile Organic Compounds

WRF – Weather and Research Forecasting

1 INTRODUCTION

The purpose of ~~this~~ the original document was ~~is~~ to demonstrate the attainment of multiple National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ in the San Joaquin Valley nonattainment area (SJV or the Valley), which ~~forms~~ formed the scientific basis for the 2018 SJV $PM_{2.5}$ State Implementation Plan (SIP, or the 2018 SJV $PM_{2.5}$ submittal). Specifically, the plan ~~addresses~~ addressed the following $PM_{2.5}$ standards.

1.) 1997 annual $PM_{2.5}$ standard (15 µg/m^3) and 24-hour $PM_{2.5}$ standard (65 µg/m^3) with an attainment deadline of 2020 for both standards.
2.) 2006 24-hour $PM_{2.5}$ standard (35 µg/m^3) with an attainment deadline of 2024.
3.) 2012 annual $PM_{2.5}$ standard (12 µg/m^3) with an attainment deadline of 2025.

Modeling for these standards ~~shows~~ showed that:

1.) In 2020, the highest projected annual $PM_{2.5}$ design value (DV) under a future baseline emissions scenario (i.e., no additional emission reductions beyond what will be achieved by the current regulatory program) is 14.6 µg/m^3 at the Bakersfield-Planz site, and the highest projected 24-hour $PM_{2.5}$ DV is 47.6 µg/m^3 at the Bakersfield-California Avenue site, which demonstrates that SJV will attain the 1997 annual and 24-hour $PM_{2.5}$ standards by 2020.
2.) In 2024, the highest projected 24-hour $PM_{2.5}$ DV under the future attainment emissions scenario (i.e., including additional emission reductions beyond the future baseline emissions) is 35.2 µg/m^3 at the Fresno-Hamilton &Winery site, which demonstrates that SJV will attain the 2006 24-hour $PM_{2.5}$ standard by 2024 (based on the form of the standard, the DV can be as high as 35.4 µg/m^3 and still be in attainment).
3.) In 2025, the highest projected annual $PM_{2.5}$ DV under the future attainment emission scenario is 12.0 µg/m^3 at the Bakersfield-Planz and Madera sites, which demonstrates that SJV will attain the 2012 annual $PM_{2.5}$ standard by 2025.

However, because of adverse meteorological conditions and increased impacts from wildfires, as well as data collection issues at a key monitoring site in Bakersfield that made it challenging to ascertain attainment,, SJV did not attain the 1997 annual $PM_{2.5}$ standard in 2020. This revision is intended to demonstrate that SJV will attain the 1997 annual $PM_{2.5}$ standard in 2023 based on the 2018-2020 baseline design values and the emission reductions that will be achieved in 2023. In 2023, the highest projected annual $PM_{2.5}$ DV under the future attainment emission scenario is 14.7 µg/m^3 at the Bakersfield-Planz site, which is below the 15 µg/m^3 annual standard. Detailed description of the modeling demonstration for the 1997 annual standard in 2023 can be found exclusively in Section 5.4.

The remainder of this document is organized as follows: Section 2 describes the general approach for projecting design values (DVs) to future years (i.e., 2020, 2024, and 2025). Section 3 discusses the meteorological modeling and evaluation. Section 4 describes the emissions inventory. Section 5 shows $PM_{2.5}$ model performance, projected future year DVs (i.e., 2020, 2023, 2024, 2025), $PM_{2.5}$ precursor sensitivities for 2013, 2020, and 2024, and the un-monitored area analysis. A more detailed description of the modeling and development of the model-ready emissions inventory can be found in the Photochemical Modeling Protocol Appendix L and Modeling Emission Inventory Appendix J, respectively.

2 APPROACHES

This section briefly describes the California Air Resources Board's (CARB's) procedures, based on U.S. EPA guidance (U.S. EPA, 2014), for projecting future year annual and 24-hour $PM_{2.5}$ Design Values (DVs) using model output and a Relative Response Factor (RRF) approach.

2.1 METHODOLOGY

The U.S. EPA modeling guidance (U.S. EPA, 2014) outlines the approach for using models to predict future year annual and 24-hour $PM_{2.5}$ DVs. The guidance recommends using model predictions in a "relative" rather than "absolute" sense. In this relative approach, the fractional change (or ratio) in $PM_{2.5}$ concentration between the model future year and model baseline year are calculated for all valid monitors. These ratios are called relative response factors (RRFs). Since $PM_{2.5}$ is comprised of different chemical species, which respond differently to changes in emissions of various pollutants, separate RRFs are calculated for the individual $PM_{2.5}$ species. Baseline DVs are then projected to the future on a species-by-species basis, where the DV is separated into individual $PM_{2.5}$ species and each species is multiplied by its corresponding RRF. The individual species are then summed to obtain the future year $PM_{2.5}$ DV.

A brief summary of the modeling procedures utilized in this attainment analysis, as prescribed by the U.S. EPA modeling guidance (U.S. EPA, 2014), is provided below. A more detailed description can be found in the Photochemical Modeling Protocol Appendix L.

2.2 MODELING PERIOD

Based on analysis of recent years' ambient $PM_{2.5}$ levels and meteorological conditions leading to elevated $PM_{2.5}$ concentrations, the year 2013 was selected for baseline modeling calculations. The National Aeronautics and Space Administration (NASA) launched the DISCOVER-AQ (Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality) field campaign in the SJV from January 16th to Mid-February, 2013. This field study provided unprecedented observations of wintertime $PM_{2.5}$ and its precursors not available in the SJV since the CRPAQS (i.e., California Regional Particulate Air Quality Study) study more than 15 years ago. These observations aided in development of the modeling platform used in this SIP work.

2.3 BASELINE DESIGN VALUES

Specifying the baseline DV is a key consideration in the model attainment test, because this value is projected forward to the future and used to test for future attainment of the standard at each monitor. U.S. EPA guidance (2014) defines the annual $PM_{2.5}$ DV for a given year as the 3-year average (ending in that year) of the annual average $PM_{2.5}$ concentrations, where the annual average is calculated as the average of the quarterly averages for each calendar quarter (e.g., January-March, April-June, July-September, October-December). For example, the 2012 $PM_{2.5}$ DV is the average of the annual $PM_{2.5}$ concentrations from 2010, 2011, and 2012. Similarly, the 24-hour $PM_{2.5}$ DV for a given year is also defined as the 3-year average of the measured 98th percentile concentration from each of those 3 years. For example, the 2012 24-hour $PM_{2.5}$ DV is the average of the 98th percentile 24-hour $PM_{2.5}$ concentrations from years 2010, 2011, and 2012, respectively.

To minimize the influence of year-to-year variability in demonstrating attainment, the U.S. EPA (2014) optionally allows the averaging of three DVs, where one of the years is the baseline emissions inventory and modeling year. This average DV is referred to as the baseline DV. Since each DV represents an average over three years, observational data from 2010, 2011, 2012, 2013, and 2014 will influence the average DV, with each year receiving a different weighting. Table 1 illustrates the observational data from each year that goes into the baseline DV.

Table1. Illustrates the data from each year that are utilized in the baseline DV calculation.

DV Year	Years averaged for the DV				
2012	2010	2011	2012		
2013		2011	2012	2013	
2014			2012	2013	2014

Yearly weighting for the baseline DV calculation*

$$2012 - 2014\ Average = \frac{PM2.5_{2010} + 2 \times PM2.5_{2011} + 3 \times PM2.5_{2012} + 2 \times PM2.5_{2013} + PM2.5_{2014}}{9}$$

*: For annual $PM_{2.5}$, $PM_{2.5}$ for a particular year is the annual average of that year. For 24-hour $PM_{2.5}$, $PM_{2.5}$ for a particular year is the 98th percentile 24-hour concentration from that year.

Table 2 shows the 2012-2014 average annual DVs (or annual baseline DVs) for each Federal Reference Method (FRM) /Federal Equivalent Method (FEM) site in the SJV, which had sufficient data to calculate a DV. For two sites with incomplete data, assumptions were made to calculate the baseline DVs and the assumptions were annotated following Table 2. The highest DV occurred at the Bakersfield – Planz site with a baseline DV of 17.2 µg/m^3.

Table 2. Average baseline DVs for each FRM monitoring site in the SJV, as well as the yearly annual DVs from 2012-2014 utilized in calculating the baseline DVs.**

AQS site ID	Monitoring Site Name	2012	2013	2014	2012-2014 Average Baseline
60290016	Bakersfield - Planz	15.3	16.9	19.3	17.2
60392010	Madera		18.1	15.8	16.9*
60311004	Hanford	15.8	17.0	16.8	16.5
61072002	Visalia	14.8	16.6	17.2	16.2
60195001	Clovis	16.0	16.4	16.0	16.1
60290014	Bakersfield – California Ave.	14.5	16.4	17.2	16.0
60190011	Fresno –Garland	14.2	15.4	15.3	15.0
60990006	Turlock	14.9	15.7	14.1	14.9
60195025	Fresno –Hamilton & Winery	13.9	14.7	14.1	14.2
60771002	Stockton	11.6	13.8	14.1	13.1
60470003	Merced – S Coffee	14.3	13.3	11.7	13.1
60990005	Modesto	12.9	13.6	12.5	13.0
60472510	Merced -Main Street	10.4	11.1	11.4	11.0
60772010	Manteca		10.2	9.9	10.1*
60192009	Tranquility	7.5	7.9	7.7	7.7

* Because of incomplete data at Madera and Manteca, DVs from 2013 and 2014 were averaged to determine the baseline DV for these two sites.
** Note that a design value for the Corcoran monitor cannot be calculated due to missing/incomplete data. The Corcoran monitor will be addressed through the unmonitored area analysis.

Table 3 shows the 2012-2014 average 24-hour DVs (or 24-hour baseline DVs) for each FRM/FEM site in the SJV, which had sufficient data to calculate a DV. For Manteca with incomplete data, assumption was made to calculate the baseline DVs and that assumption was annotated following Table 3. The highest DV occurred at the Bakersfield – California Avenue site with a baseline DV of 64.1 µg/m^3.

Table 3. Average baseline 24-hour DVs for each FRM/FEM monitoring site in the SJV, as well as the yearly 24-hour DVs from 2012-2014 utilized in calculating the baseline DVs.**

AQS site ID	Monitoring Site Name	2012	2013	2014	2012-2014 Average Baseline
60290014	Bakersfield – California Ave.	58.4	64.6	69.4	64.1
60311004	Hanford	53.8	60.2	65.9	60.0
60190011	Fresno –Garland	57.0	62.0	61.0	60.0
60195025	Fresno –Hamilton & Winery	53.0	63.5	61.6	59.3
60195001	Clovis	53.6	57.6	56.3	55.8
60290016	Bakersfield - Planz	43.7	55.8	67.0	55.5
61072002	Visalia	46.9	55.7	63.9	55.5
60392010	Madera	51.0	52.3	49.6	51.0
60990006	Turlock	48.8	52.7	50.7	50.7
60990005	Modesto	44.3	50.6	48.9	47.9
60472510	Merced -Main Street	39.8	49.2	51.7	46.9
60771002	Stockton	36.1	45.0	44.9	42.0
60470003	Merced – S Coffee	41.0	41.8	40.6	41.1
60772010	Manteca		36.7	37.0	36.9*
60192009	Tranquility	27.1	30.0	31.3	29.5

* Due to incomplete data, DVs for 2013 and 2014 are averaged to obtain baseline DV for Manteca.

** Note that a design value for the Corcoran monitor cannot be calculated due to missing/incomplete data. The Corcoran monitor will be addressed through the unmonitored area analysis.

2.4 BASE, REFERENCE, AND FUTURE YEARS

The modeling assessment consists of the following five primary model simulations, which all utilized the same model inputs for meteorology, chemical boundary conditions, and biogenic emissions. The only difference between the simulations was the year represented by the anthropogenic emissions (2013 versus 2020, 2024, and 2025) and certain day-specific emissions.

1. *Base Year (or Base Case) Simulation*
   The base year simulation for 2013 was used to assess model performance and includes as much day-specific detail as possible in the emissions inventory such as hourly adjustments to the motor vehicle and biogenic inventories based on observed local meteorological conditions, as well as known wildfire and agricultural burning events.

2. *Reference (or Baseline) Year Simulation*
   The reference year simulation was identical to the base year simulation, except that certain emissions events which are either random and/or cannot be projected to the future were removed from the emissions inventory. For the 2013 reference year modeling, the only category/emissions source that was excluded was wildfires, which are difficult to predict in the future and can significantly influence the model response to anthropogenic emissions reductions in regions with large fires.

3. *Future Year Simulations*
   The future year simulations are identical to the reference year simulation, except that projected future years' (2020, 2024, and 2025) anthropogenic emission levels were used rather than 2013 emission levels. All other model inputs (e.g., meteorology, chemical boundary conditions, biogenic emissions, and calendar for day-of-week specifications in the inventory) were the same as those used in the reference year simulation.

To summarize (Table 4), the base year 2013 simulation was used for evaluating model performance, while the reference (or baseline) 2013 and future years 2020, 2024, and 2025 simulations were used to project the average DVs to the future as described in the Photochemical Modeling Protocol Appendix L and in subsequent sections of this document.

Table 4. Description of CMAQ model simulations used to evaluate model performance and project baseline design values to the future years.

Simulation	Anthropogenic Emissions	Biogenic Emissions	Meteorology	Chemical Boundary Conditions
Base year (2013)	2013 w/ wildfires	2013 MEGAN	2013 WRF	2013 MOZART
Reference year (2013)	2013 w/o wildfires	2013 MEGAN	2013 WRF	2013 MOZART
Future year (2020)	2020 w/o wildfires	2013 MEGAN	2013 WRF	2013 MOZART
Future year (2024)	2024 w/o wildfires	2013 MEGAN	2013 WRF	2013 MOZART
Future year (2025)	2025 w/o wildfires	2013 MEGAN	2013 WRF	2013 MOZART

2.5 $PM_{2.5}$ SPECIES CALCULATIONS

Since $PM_{2.5}$ consists of different chemical components, it is necessary to assess how each individual component will respond to emission reductions. As a first step in this process, the measured total $PM_{2.5}$ must be separated into its various components. In the SJV, the primary components on the filter based $PM_{2.5}$ measurements include sulfates, nitrates, ammonium, organic carbon (OC), elemental carbon (EC), particle-bound water, other primary inorganic particulate matter, and passively collected mass (blank mass). Species concentrations were obtained from the four chemical speciation network (CSN) sites in the SJV. These four CSN sites are located at: Bakersfield – California Avenue, Fresno – Garland, Visalia – North Church, and Modesto – 14th Street. Chemical species were measured once every three or six days at those sites. Since not all of the 16 FRM/FEM $PM_{2.5}$ sites in the Valley have collocated speciation monitors, it was necessary to utilize the speciated $PM_{2.5}$ measurements at one of the four CSN sites to represent the speciation profile at each of the FRM/FEM sites. The choice of which CSN site to represent the speciation profile at a given FRM monitor (Table 5) was determined based on geographic proximity, analysis of local emission sources, and measurements from previous field studies (e.g., CRPAQS), and is consistent with previous $PM_{2.5}$ SIPs in the Valley.

Table 5. $PM_{2.5}$ speciation data used for each $PM_{2.5}$ design site.

AQS Site ID	$PM_{2.5}$ Design Site (FRM/FEM Monitor)	$PM_{2.5}$ Speciation Site
60290016	Bakersfield – Planz	Bakersfield – California
60392010	Madera	Fresno – Garland
60311004	Hanford	Visalia – Church
61072002	Visalia	Visalia – Church
60195001	Clovis	Fresno – Garland
60290014	Bakersfield – California Ave.	Bakersfield – California
60190011	Fresno – Garland	Fresno – Garland
60990006	Turlock	Modesto – 14th
60195025	Fresno – Hamilton & Winery	Fresno – Garland
60771002	Stockton	Modesto – 14th
60470003	Merced – S Coffee	Modesto – 14th
60990005	Modesto	Modesto – 14th
60472510	Merced – Main Street	Modesto – 14th
60772010	Manteca	Modesto – 14th
60192009	Tranquility	Fresno – Garland

Since the FRM $PM_{2.5}$ monitors do not retain all of the $PM_{2.5}$ mass that is measured by the speciation samplers, the U.S. EPA (2014) recommends using the SANDWICH approach (Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance) described by Frank (2006) to apportion the FRM $PM_{2.5}$ mass to individual $PM_{2.5}$ species based on nearby CSN speciation data. A detailed description of the SANDWICH method can be found in the Modeling Protocol Appendix L and in the U.S. EPA (2014) modeling guidance. In addition, based on completeness of the data, $PM_{2.5}$ speciation data from 2010 – 2013 were utilized. For the annual DV calculation, for each quarter, percent contributions from individual chemical species to FRM $PM_{2.5}$ mass were calculated as the average of the corresponding quarters from 2010-2013. For the 24-hour DV calculation, percent contributions were calculated for each quarter as the average of the top 10% measured $PM_{2.5}$ days from the corresponding quarter from 2010-2013. In general, the inter-annual variability of the species fractions is small compared to the variability in the species concentrations and so the use of average data from 2010 – 2013 is appropriate.

2.6 FUTURE YEAR DESIGN VALUES

The approach to projecting future year annual and 24-hour $PM_{2.5}$ DVs is described briefly below. See U.S. EPA (2014) and the Photochemical Modeling Protocol Appendix L for additional details. Projecting baseline annual $PM_{2.5}$ DVs to the future involves the following steps.

Step 1: Compute observed quarterly weighted average concentrations (consistent with the weighted average DV calculation) at each monitor for the following species: ammonium, nitrate, sulfate, organic carbon, elemental carbon, and other primary PM. This is done by multiplying quarterly weighted average FRM $PM_{2.5}$ concentrations by the fractional composition of $PM_{2.5}$ species for each quarter.

Step 2: Compute the component-specific RRF for each quarter and each species at each monitor based on the reference and future year modeling. The RRF for a specific component *j* is calculated using the following expression:

$$\text{RRF}_j = \frac{[C]_{j,\,\text{future}}}{[C]_{j,\,\text{reference}}} \qquad (1)$$

Where $[C]_{j,\,future}$ is the modeled quarterly mean concentration for component *j* predicted for the future year averaged over the 3x3 array of grid cells surrounding the monitor, and $[C]_{j,reference}$ is the same, but for the reference year simulation. An RRF was calculated for each species in Step 1 and at each monitor and for each quarter.

Step 3: Apply the component specific RRF from Step 2 to the observed quarterly weighted average concentrations from Step 1 to obtain projected quarterly species concentrations.

Step 4: Use the online E-AIM model (http://www.aim.env.uea.ac.uk/aim/aim.php) to calculate future year particle-bound water for each quarter at each monitor based on projected ammonium sulfate and ammonium nitrate concentrations.

Step 5: The projected concentration for each quarter is summed over all species, including particle bound water from Step 4, as well as a blank mass of 0.5 $\mu g/m^3$ to obtain the future quarterly average $PM_{2.5}$ concentration. Finally, the future annual $PM_{2.5}$ DVs are calculated as the average of the projected $PM_{2.5}$ concentrations from the four quarters. If the projected annual DV is ≤ NAAQS, then the attainment test is passed.

Similarly, projecting baseline 24-hour $PM_{2.5}$ DVs to the future involves the steps outlined below. See U.S. EPA (2014) and the Photochemical Modeling Protocol Appendix L for additional details.

Step 1: Determine the top eight days with the highest observed 24-hour $PM_{2.5}$ concentrations in each quarter and year used in the design value calculation (a total of 32 days per year).

Step 2: Calculate quarterly ambient species fractions on "high" $PM_{2.5}$ days for each of the major $PM_{2.5}$ component species (i.e., sulfate, nitrate, ammonium, elemental carbon, organic carbon, other primary $PM_{2.5}$ material). The "high" days are represented by the top 10% of measured days in each quarter. Depending on the sampling frequency, the number of days captured in the top 10% would range from three to nine. The species fractions of $PM_{2.5}$ are calculated using the "SANDWICH" approach which was described previously. These quarter-specific fractions along with the FRM $PM_{2.5}$ concentrations are then used to calculate species concentrations for each of the 32 days per year determined in Step 1.

Step 3: quarterly RRFs are calculated based on the average for each component over the top 10% of modeled days (or the top nine days per quarter) with the highest total 24-hour average $PM_{2.5}$ concentration from the reference year. Peak $PM_{2.5}$ values are selected and averaged using the $PM_{2.5}$ concentration simulated at the single grid cell containing the monitoring site for calculating the 24-hour $PM_{2.5}$ RRF (as opposed to the 3x3 array average used in the annual $PM_{2.5}$ RRF calculation).

Step 4: Apply the component and quarter specific RRF to observed daily species concentrations from Step 2 to obtain future year concentrations of ammonium, sulfate, nitrate, elemental carbon, organic carbon and other primary $PM_{2.5}$.

Step 5: Calculate future year concentrations for particle bound water using the E-AIM model for each of the top days from each quarter. Then, sum the concentration of each of the species components plus a blank mass of 0.5 $\mu g/m^3$ to obtain the total $PM_{2.5}$ concentration for each of the 32 days per year and at each site. Sort the 32 days for each site and year, and calculate the 98th percentile value corresponding to each year.

Step 6: Calculate the future design value at each site based on the 98th percentile concentrations calculated in Step 5 following the standard protocol for calculating design values (see Table 3). Compare the future-year 24-hour design values to the

NAAQS. If the projected design value is ≤ the NAAQS, then the attainment test is passed.

3 METEOROLOGICAL MODELING

California's proximity to the ocean, complex terrain, and diverse climate represent a unique challenge for developing meteorological fields that adequately represent the synoptic and mesoscale features of the regional meteorology. In summertime, the majority of the storm tracks are far to the north of the state and a semi-permanent Pacific high typically sits off the California coast. Interactions between this eastern Pacific subtropical high pressure system and the thermal low pressure further inland over the Central Valley or South Coast lead to conditions conducive to pollution buildup (Fosberg and Schroeder, 1966; Bao et al., 2008). In wintertime, periods of high atmospheric pressure bring light winds and, sometimes, low solar insolation (Daly et al. 2009) to the Central Valley. Because of the topographical features surrounding San Joaquin Valley, under such conditions, a layer of cold and wet air can be overlaid by warm air aloft creating strong and long-lasting stagnation in the area (Whiteman et al. 2001). It is under such conditions that high surface particulate matter concentrations typically occur (Gilles et al. 2010; Baker et al. 2011).

In the past, CARB has utilized both prognostic and diagnostic meteorological models, as well as hybrid approaches in an effort to develop meteorological fields for use in air quality modeling that most accurately represent the meteorological processes which are important to air quality (e.g., Jackson et al., 2006). In this work, the state-of-the-science Weather and Research Forecasting (WRF) prognostic model (Skamarock et al., 2005) version 3.6 was utilized to develop the meteorological fields used in the subsequent photochemical model simulations.

3.1 WRF MODEL SETUP

The WRF meteorological modeling domain consisted of three nested Lambert projection grids of 36-km (D01), 12-km (D02), and 4-km (D03) uniform horizontal grid spacing (Figure 1). WRF was run simultaneously for the three nested domains with two-way feedback between the parent and the nest grids. The D01 and D02 grids were used to resolve the larger scale synoptic weather systems, while the D03 grid resolved the finer details of the atmospheric conditions and was used to drive the air quality model simulations. All three domains utilized 30 vertical sigma layers (defined in Table 6), with the major physics options for each domain listed in Table 7.

Initial and boundary conditions (IC/BCs) for the WRF modeling were based on the 32-km horizontal resolution North American Regional Reanalysis (NARR) data that are archived at the National Center for Atmospheric Research (NCAR). Boundary conditions to WRF were updated at 6-hour intervals for the 36-km grid (D01). In addition, surface and upper air observations obtained from NCAR were used to further refine the analysis data that were used to generate the IC/BCs. Analysis nudging was employed in the outer 36-km grid (D01) to ensure that the simulated meteorological fields were adequately constrained and did not deviate from the observed meteorology. No nudging was used on the two inner domains to allow model physics to work fully without externally imposed forcing (Rogers et al., 2013).

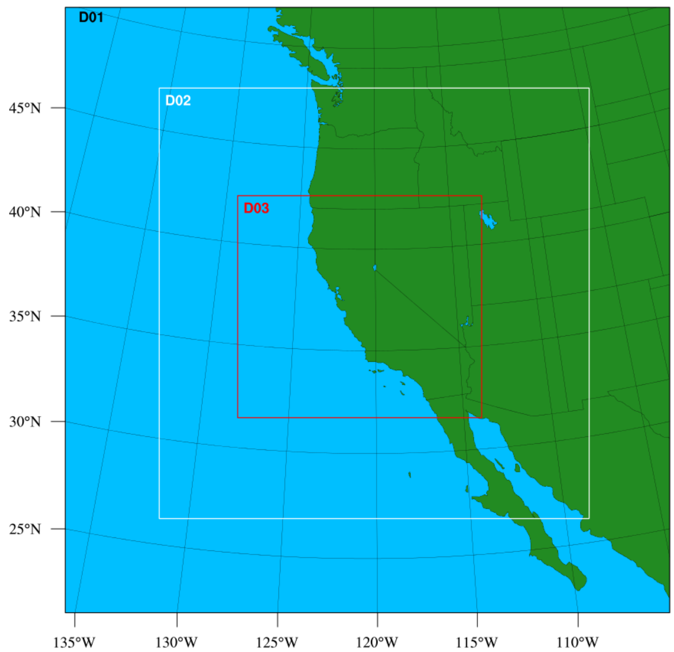


Figure 1. WRF modeling domains (D01 36km; D02 12km; and D03 4km).

Table 6. WRF vertical layer structure.

Layer Number	Height (m)	Layer Thickness (m)	Layer Number	Height (m)	Layer Thickness (m)
30	16082	1192	14	1859	334
29	14890	1134	13	1525	279
28	13756	1081	12	1246	233
27	12675	1032	11	1013	194
26	11643	996	10	819	162
25	10647	970	9	657	135
24	9677	959	8	522	113
23	8719	961	7	409	94
22	7757	978	6	315	79
21	6779	993	5	236	66
20	5786	967	4	170	55
19	4819	815	3	115	46
18	4004	685	2	69	38
17	3319	575	1	31	31
16	2744	482	0	0	0
15	2262	403			

Note: Shaded layers denote the subset of vertical layers used in the CMAQ photochemical model simulations.

Table 7. WRF Physics Options.

Physics Option	Domain		
	D01 (36 km)	D02 (12 km)	D03 (4 km)
Microphysics	WSM 6-class graupel scheme	WSM 6-class graupel scheme	WSM 6-class graupel scheme
Longwave radiation	RRTM	RRTM	RRTM
Shortwave radiation	Dudhia scheme	Dudhia scheme	Dudhia scheme
Surface layer	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov
Land surface	TD Scheme (Jan., Feb., Nov. and Dec.) Pleim-Xiu LSM (others)	TD Scheme (Jan., Feb., Nov. and Dec.) Pleim-Xiu LSM (others)	TD Scheme (Jan., Feb., Nov. and Dec.) Pleim-Xiu LSM (others)
Planetary Boundary Layer	YSU	YSU	YSU
Cumulus Parameterization	Kain-Fritsch scheme	Kain-Fritsch scheme	None

3.2 WRF MODEL RESULTS AND EVALUATION

Simulated surface wind speed, temperature, and relative humidity from the 4 km domain were validated against hourly observations at 77 surface stations in the SJV. Observational data for the surface stations were obtained from CARB's archived meteorological database (http://www.arb.ca.gov/aqmis2/aqmis2.php). Table 8 lists the observational stations and the parameters measured at each station, including wind speed and direction (wind), temperature (T) and relative humidity (RH). The location of each of these sites is shown in Figure 2. Quarterly and annual quantitative performance metrics for 2013 were used to compare hourly surface observations and modeled estimates: mean bias (MB), mean error (ME) and index of agreement (IOA) based on recommendations from Simon et al. (2012). A summary of these statistics by performance region is shown in Tables 9 through 13. The performance regions cover roughly the Modesto, Fresno, Visalia, and Bakersfield regions, as well as one for the entire San Joaquin Valley (SJV), respectively. The region around Modesto includes sites 5737, 2833, and 2080. The region surrounding Fresno encompasses sites 5741, 2449, 2013, and 2844. The region around Visalia includes sites 2032, 5386, and 3250, while the region covering Bakersfield includes sites 5287 and 3146 (note that valid relative humidity observations in the Bakersfield area were only available at site 5287 for the months of January through May 2013). Model performance statistical metrics were calculated using all of the available data. All the sites in the valley are included in the SJV performance region (in addition to the sites mentioned above). The distribution of daily mean bias and mean error are shown in Figures 3 and 4. Figures 5 and 6 show observed vs. modeled scatter plots.

From a valley-wide perspective, the wind speed biases were positive in each quarter of 2013. At Bakersfield the biases turn slightly negative throughout the year, and are mostly less than 0.6 m/s. The annual temperature biases are less than 1 K in all performance regions, with the quarterly temperature biases reaching as high as -1.87 K in Bakersfield during the second quarter of 2013. Simulated temperature is generally in good agreement with the observations in all regions with the index of agreement (IOA) above 0.90 (1.0 represents perfect agreement). Relative humidity biases are positive except in the Modesto region. The annual bias values range from -1.53% to 12.47%, with the largest bias occurring in Visalia. These results are comparable to other recent WRF modeling efforts in California investigating ozone formation in Central California (e.g., Hu et al., 2012) and modeling analysis for the CalNex and CARES field studies (e.g., Fast et al., 2014; Baker et al., 2013; Kelly et al., 2014; Angevine et al., 2012). Detailed hourly time-series of surface temperature, relative humidity, wind speed, and wind direction for SJV can be found in the supplementary material, together with 2013 quarterly mean bias and mean error distributions of these parameters.

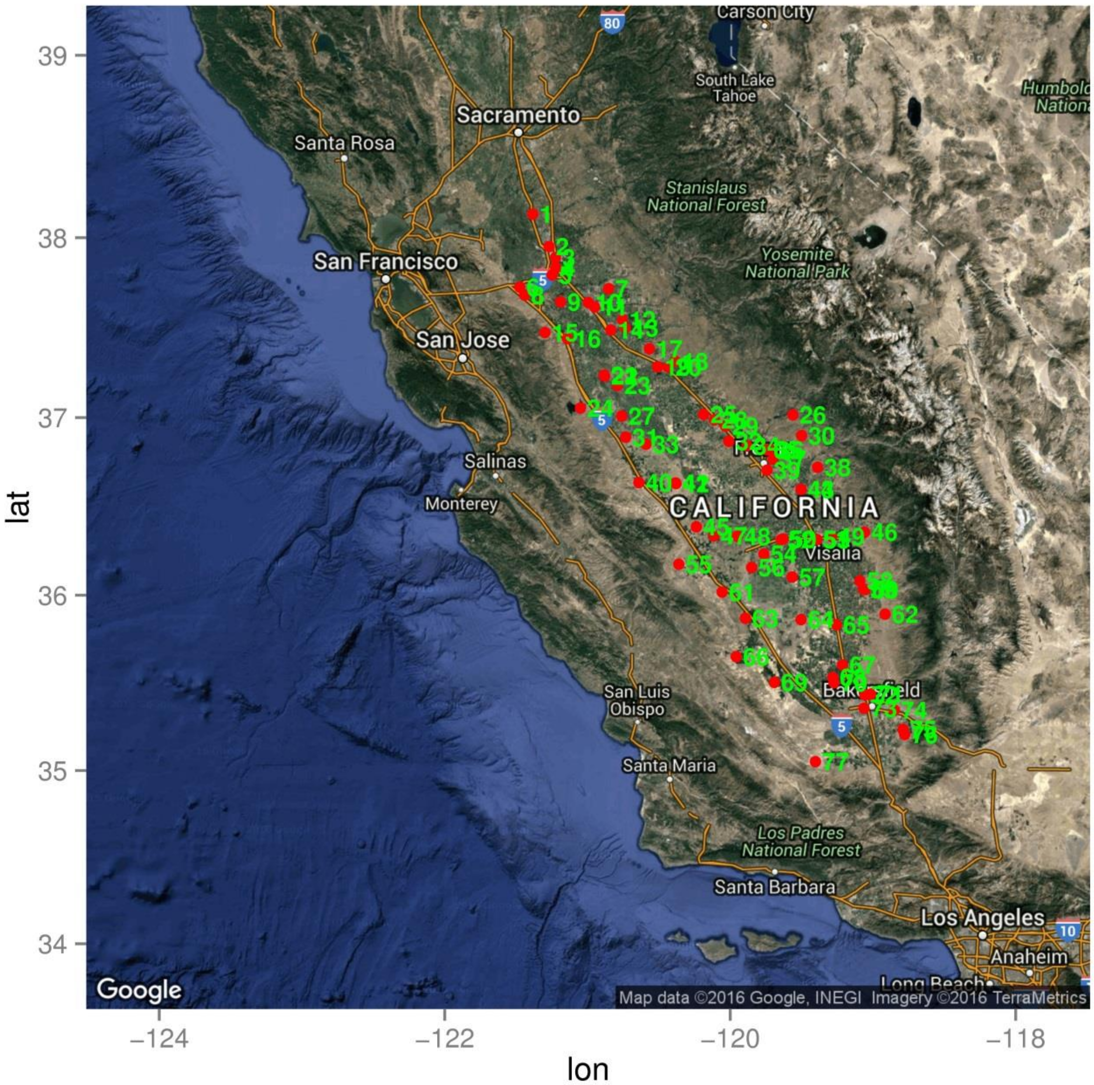


Figure 2. Meteorological observation sites in San Joaquin Valley. The numbers correspond to the sites listed in Table 8.

Table 8. Meteorological monitor location and parameter(s) measured.

Site	Site ID	Site Name	Parameter Measured	Site	Site ID	Site Name	Parameter Measured
1	5809	LodiWest	T, RH	40	3309	PanocheRd	Wind, T, RH
2	2094	Stockton-Haz	Wind, T, RH	41	3759	Tranquility	Wind, T
3	5362	StocktonArpt	Wind, T	42	5757	Westlands	T, RH
4	5736	Manteca	T, RH	43	5723	Parlier2	T, RH
5	3772	Manteca-Fish	Wind, T	44	2114	Parlier	Wind, T, RH
6	5810	Tracy	T, RH	45	5828	FivePointsSW	T, RH
7	5831	Oakdale2	T, RH	46	5746	Lindcove	T, RH
8	3696	Tracy_Air	Wind, T	47	5708	FivePoints2	T, RH
9	5737	Modesto3	T, RH	48	2544	Lemoore-Met	Wind, T
10	2833	Modesto-14th	Wind	49	2032	Visalia-NChu	Wind, T
11	2080	Modesto-Met	Wind, T	50	5308	HanfordMuni	Wind, T
12	7233	DenairII	T, RH	51	5386	VisaliaMuni	Wind, T
13	3303	RosePeak	Wind, T, RH	52	3129	Hanford-Irwn	Wind, T
14	2996	Turlock-SMin	Wind, T	53	3250	Visalia-Airp	Wind, T, RH
15	3449	Pulgas	Wind, T, RH	54	3712	StRosaRnchria	Wind, T
16	5805	Patterson2	T, RH	55	6028	CoalingaCIM	T, RH
17	2814	Merced-AFB	Wind, T	56	5715	Stratford2	T, RH
18	5793	Merced	T, RH	57	3194	Corcoran-Pat	Wind, T
19	5318	MercedMuni	Wind, T	58	5812	Portervl	T, RH
20	3022	Merced-SCofe	Wind, T	59	5351	PortervlMuni	Wind, T
21	6079	MERCED 23WSW	T	60	3763	Portrvlle-Ne	Wind, T
22	5752	Kesterson	T, RH	61	3330	KettlemanHls	Wind, T, RH
23	3647	SanLuisNWR	Wind, T, RH	62	3350	FountnSpr	Wind, T, RH
24	3307	LosBanos	Wind, T, RH	63	5717	Kettleman	T, RH
25	5790	Madera	T, RH	64	6813	Alpaugh	T, RH
26	3522	Hurley1	Wind, T, RH	65	5823	Delano2	T, RH
27	5730	LosBanos2	T, RH	66	5729	BlackwllCnr	T, RH
28	5317	MaderaMuni	Wind, T	67	5783	Famoso	T, RH
29	3771	Madera-Av14	Wind, T, RH	68	5709	ShafterUSDA	T, RH
30	3346	FancherCreek	Wind, T, RH	69	5791	Belridge	T, RH
31	5770	Panoche	T, RH	70	2981	Shafter-Wlkr	Wind, T, RH
32	3211	Madera-Rd29	Wind, T, RH	71	2772	Oildale-3311	Wind, T
33	5711	Firebgh-Tel	T, RH	72	5287	MeadowsFld	Wind, T
34	2844	Fresno-Sky#2	Wind, T	73	3146	Baker-5558Ca	Wind, T, RH
35	5741	FSU2	T, RH	74	2312	Edison	Wind, T
36	3026	Clovis	Wind, T, RH	75	3758	Arvin-DiG	Wind, T
37	2449	Fresno-FAT	Wind, T	76	5771	Arvin-Edison	T, RH
38	5787	OrangeCove	T, RH	77	2919	Maricopa-Stn	Wind, T
39	2013	Fresno-Drmnd	Wind, T				

Table 9. Hourly surface wind speed, temperature and relative humidity statistics in Modesto.

Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
		Wind Speed (m/s)			
Q1	2.08	2.62	0.54	1.16	0.74
Q2	3.04	3.51	0.46	1.43	0.73
Q3	2.64	2.94	0.30	1.18	0.65
Q4	1.66	2.35	0.69	1.23	0.68
Annual	2.41	2.89	0.49	1.26	0.73
		Temperature (K)			
Q1	282.62	282.93	0.31	2.16	0.94
Q2	293.18	292.86	-0.32	2.07	0.96
Q3	295.98	297.06	1.07	2.35	0.93
Q4	283.95	285.73	1.78	2.73	0.93
Annual	288.93	289.65	0.71	2.33	0.97
		Relative Humidity (%)			
Q1	73.52	74.38	0.86	9.14	0.89
Q2	57.03	53.28	-3.75	10.99	0.86
Q3	62.17	55.26	-6.91	13.98	0.72
Q4	67.75	71.40	3.66	11.48	0.85
Annual	65.10	63.57	-1.53	11.40	0.86

Table 10. Hourly surface wind speed, temperature and relative humidity statistics in Fresno.

Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
		Wind Speed (m/s)			
Q1	1.47	1.90	0.43	1.11	0.56
Q2	2.54	3.12	0.58	1.53	0.59
Q3	2.14	2.65	0.51	1.42	0.47
Q4	1.12	1.69	0.57	1.05	0.52
Annual	1.85	2.37	0.52	1.29	0.61
		Temperature (K)			
Q1	283.76	282.90	-0.86	1.79	0.96
Q2	295.23	294.04	-1.19	2.16	0.95
Q3	299.69	299.22	-0.47	2.22	0.94
Q4	285.65	286.01	0.36	1.93	0.96
Annual	291.18	290.65	-0.53	2.03	0.98
		Relative Humidity (%)			
Q1	71.46	76.39	4.93	10.71	0.86
Q2	48.01	53.07	5.06	11.88	0.83
Q3	45.12	51.45	6.33	14.95	0.65
Q4	64.03	70.79	6.77	13.49	0.83
Annual	57.09	62.87	5.78	12.77	0.86

Table 11. Hourly surface wind speed, temperature and relative humidity statistics in Visalia.

Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
		Wind Speed (m/s)			
Q1	1.48	1.64	0.16	0.82	0.55
Q2	2.07	2.53	0.45	1.04	0.65
Q3	1.91	2.22	0.31	0.86	0.59
Q4	1.62	1.58	-0.04	0.73	0.60
Annual	1.77	2.00	0.24	0.88	0.65
		Temperature (K)			
Q1	283.66	282.87	-0.79	1.85	0.95
Q2	294.38	293.09	-1.29	2.23	0.95
Q3	298.73	298.42	-0.31	2.56	0.91
Q4	285.19	286.03	0.84	2.11	0.95
Annual	290.03	289.55	-0.48	2.16	0.97
		Relative Humidity (%)			
Q1	73.28	80.72	7.44	11.11	0.82
Q2	47.80	59.94	12.13	17.23	0.73
Q3	47.08	63.07	15.99	21.49	0.49
Q4	61.22	75.43	14.21	16.36	0.77
Annual	57.37	69.84	12.47	16.56	0.76

Table 12. Hourly surface wind speed, temperature and relative humidity statistics in Bakersfield (valid RH data available from January through May only; statistics are based on the available data).

Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
		Wind Speed (m/s)			
Q1	1.84	1.80	-0.04	0.88	0.59
Q2	2.63	2.47	-0.15	1.03	0.74
Q3	2.12	2.10	-0.02	1.10	0.68
Q4	2.23	1.86	-0.37	0.98	0.61
Annual	2.21	2.09	-0.12	1.00	0.70
		Temperature (K)			
Q1	284.94	283.97	-0.97	1.91	0.95
Q2	295.66	293.78	-1.87	2.44	0.94
Q3	301.17	299.54	-1.63	2.63	0.90
Q4	286.85	286.97	0.12	1.73	0.97
Annual	291.33	290.17	-1.16	2.16	0.97
		Relative Humidity (%)			
Q1	62.65	72.70	10.04	15.15	0.81
Q2	36.94	51.46	14.52	16.82	0.74
Annual	52.27	64.12	11.85	15.83	0.83

Table 13. Hourly surface wind speed, temperature and relative humidity statistics in the San Joaquin Valley.

Quarter	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
		Wind Speed (m/s)			
Q1	2.08	2.62	0.54	1.16	0.74
Q2	3.04	3.51	0.46	1.43	0.73
Q3	2.64	2.94	0.30	1.18	0.65
Q4	1.66	2.35	0.69	1.23	0.68
Annual	2.41	2.89	0.49	1.26	0.73
		Temperature (K)			
Q1	283.31	283.30	-0.01	2.17	0.94
Q2	294.23	293.42	-0.81	2.46	0.94
Q3	298.22	298.21	-0.02	2.82	0.90
Q4	285.08	286.20	1.12	2.65	0.93
Annual	290.19	290.25	0.07	2.52	0.96
		Relative Humidity (%)			
Q1	69.36	71.65	2.29	12.87	0.81
Q2	47.95	52.53	4.57	13.73	0.79
Q3	46.35	54.48	8.12	17.33	0.59
Q4	58.62	68.35	9.72	16.00	0.75
Annual	55.70	61.84	6.14	14.96	0.79

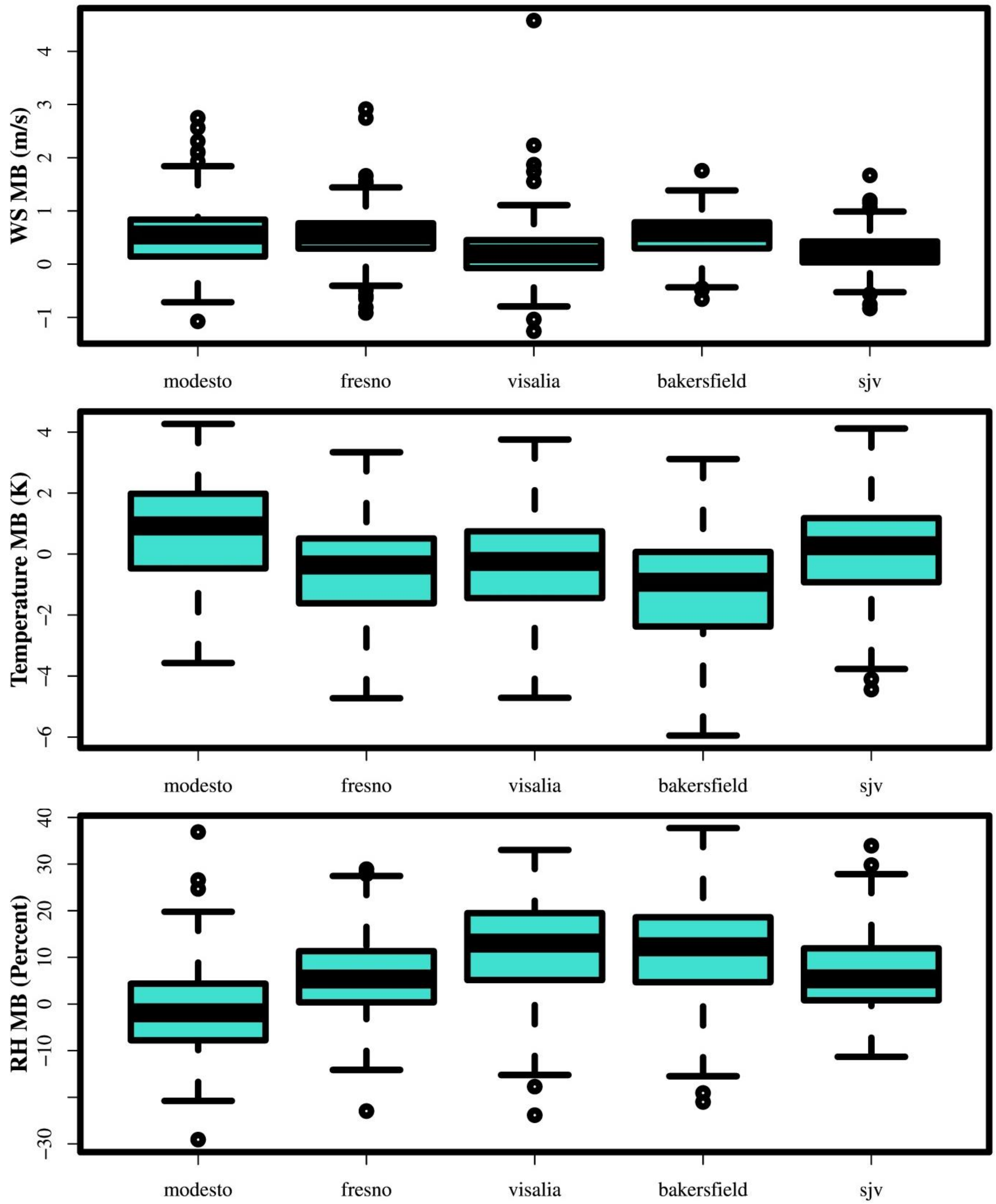


Figure 3. Distribution of model daily mean bias for Modesto, Fresno, Visalia, Bakersfield and SJV. Results are shown for wind speed (top), temperature (middle), and Relative Humidity (bottom).

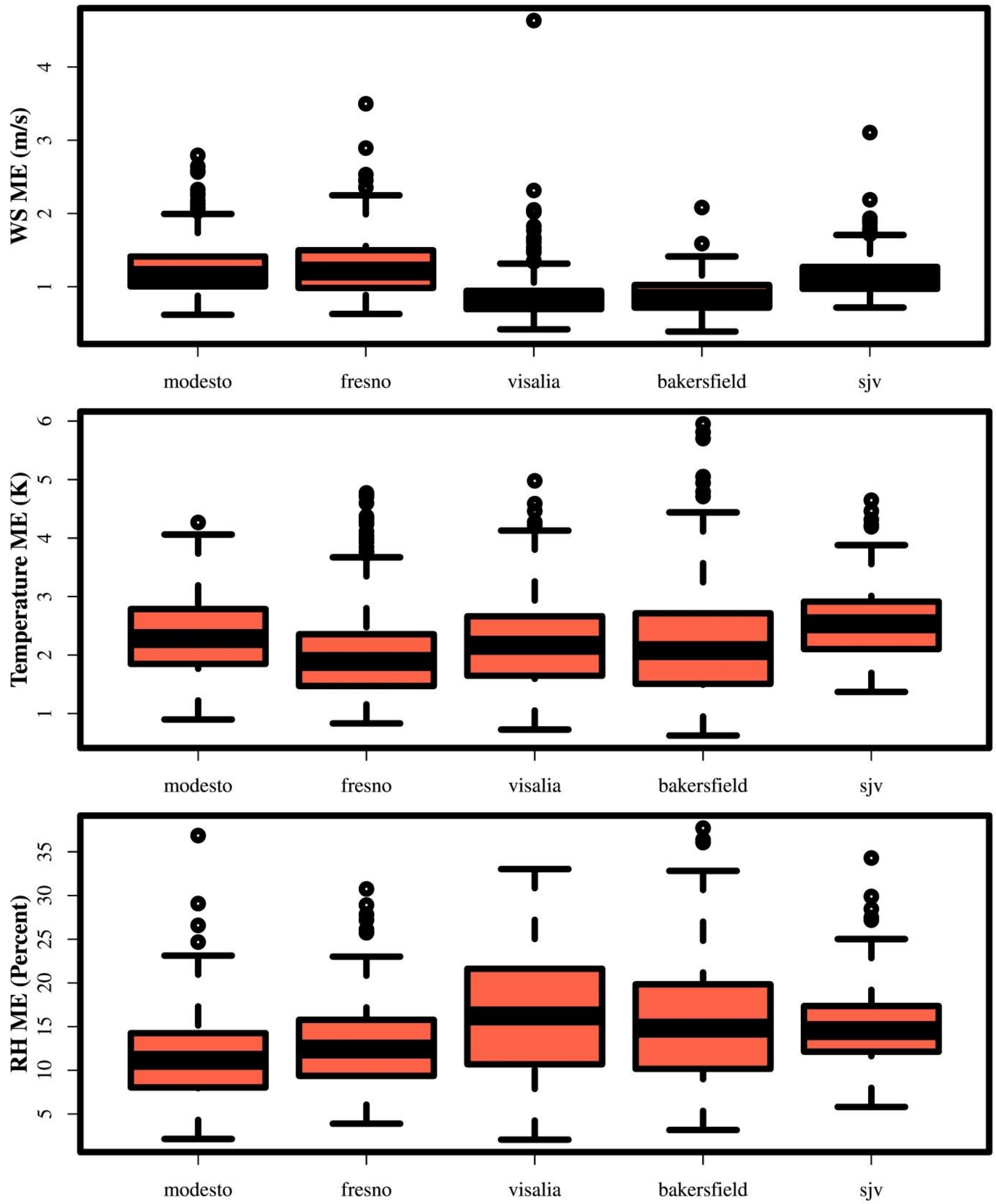


Figure 4. Distribution of model daily mean error for Modesto, Fresno, Visalia, Bakersfield and SJV. Results are shown for wind speed (top), temperature (middle), and Relative Humidity (bottom).

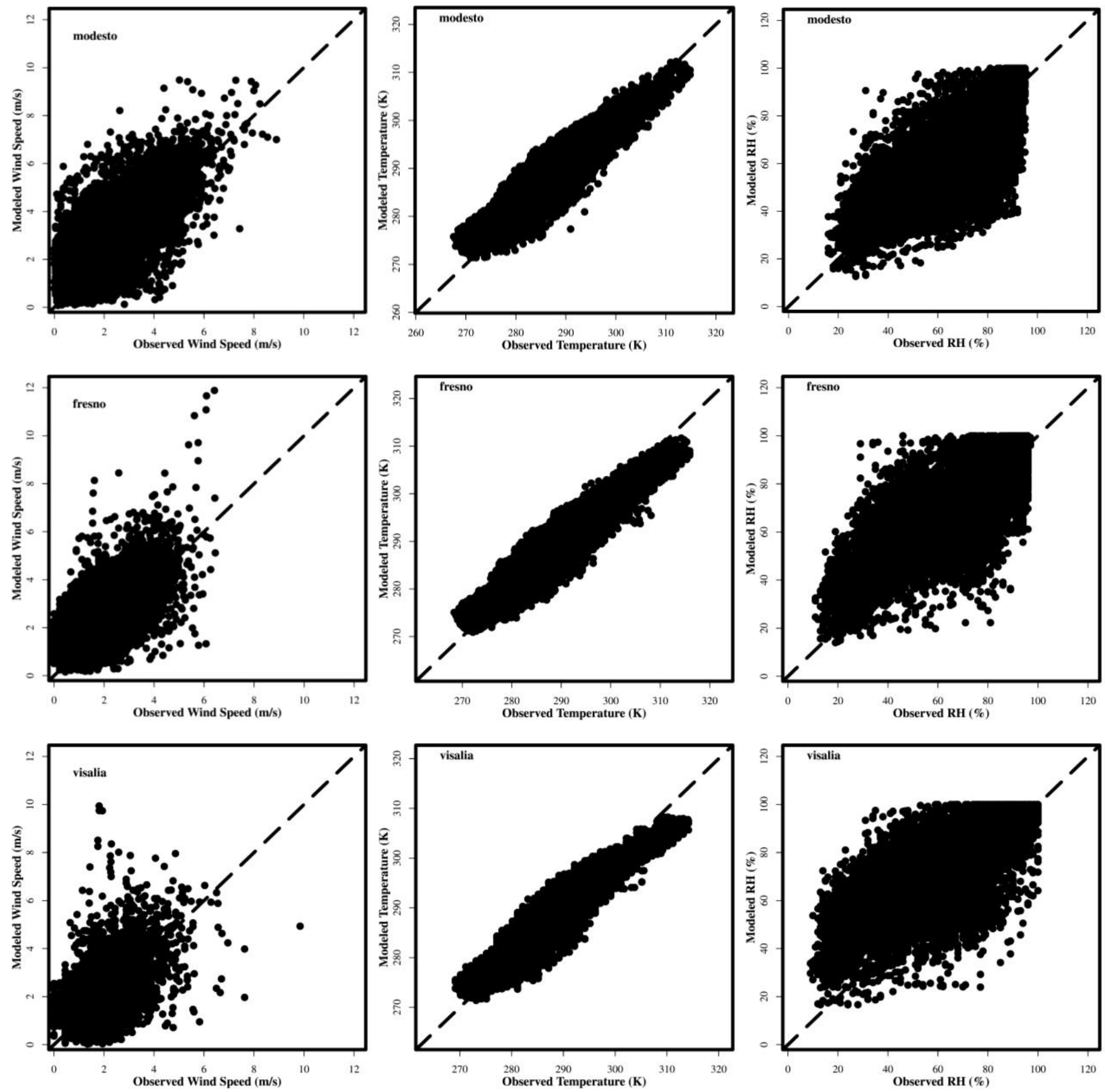


Figure 5. Comparison of modeled and observed hourly wind speed (left column), 2-meter temperature (middle column), and relative humidity (right column). Results for Modesto are shown in the top row, Fresno in the middle row, and Visalia in the bottom row.

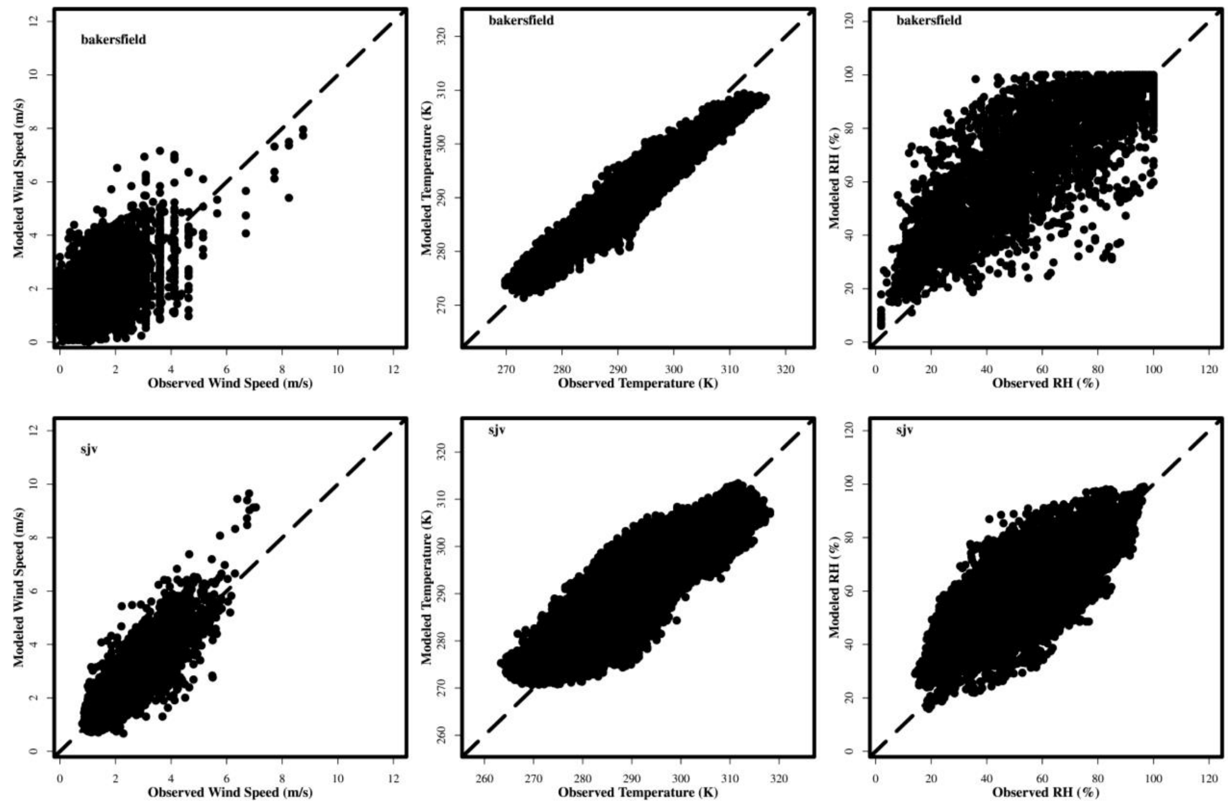


Figure 6. Comparison of modeled and observed hourly wind speed (left column), 2-meter temperature (middle column), and relative humidity (right column). Results for Bakersfield are shown in the top row and SJV in the bottom row.

3.2.1 PHENOMENOLOGICAL EVALUATION

Conducting a detailed phenomenological evaluation for all modeled days can be resource intensive given that the entire year was modeled. However, some insight and confidence that the model is able to reproduce the meteorological conditions leading to elevated particulate matter can be gained by investigating the meteorological conditions during a period of peak PM within the Valley in more detail. The highest $PM_{2.5}$-conducive meteorological conditions in the Valley occurred around January 20, 2013. Surface weather analysis shows that on January 20, the western US was under a typical Great Basin high pressure system. In the 500 hPa map (not shown), a strong high pressure ridge extends from Northern California along the west Pacific coast all the way to Alaska. As shown in Figures 7, 8, and 9, the winds, though weak, are mainly offshore along the northern California coast. Under this type of weather system, conditions in SJV are driven by diurnal cycles of the local winds. Figure 7 shows that at 13:00 PST, January 20, the upslope flows along the eastern side of the Coastal Ranges and the western side of the Sierras, lead to a weak northwesterly flow on the floor of the valley. The downslope winds form at nighttime and in the early morning (Figure 8 and Figure 9). They converge towards the valley and the winds in the center of the valley floor turn southeasterly. At the southern end of the valley, an eddy-like pattern occurs due to the interaction of the katabatic flows. The surface wind distributions of the modeled and observed winds indicate the model was able to capture many of the important features of the meteorological fields in the SJV.

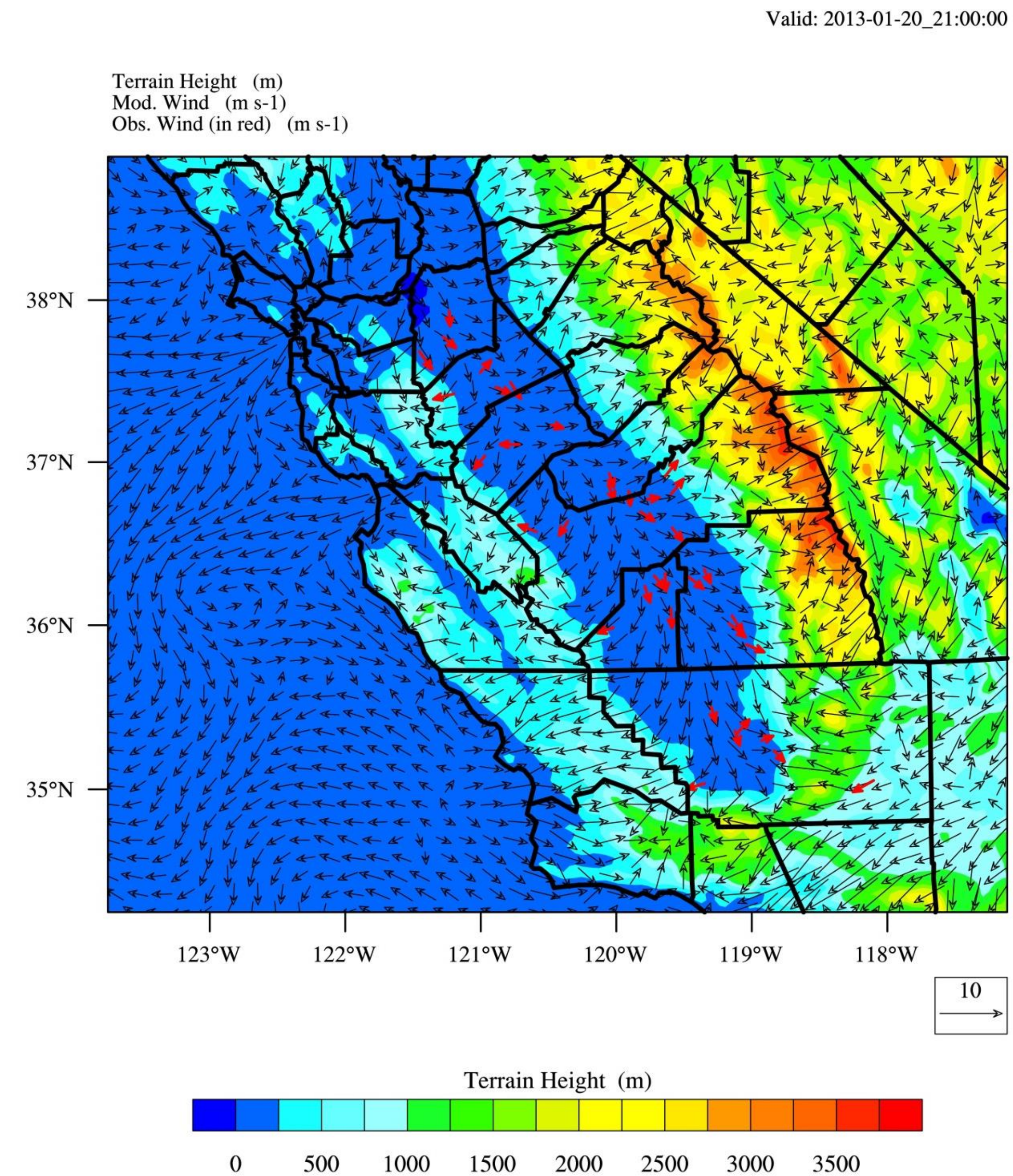


Figure 7. Surface wind field at 13:00 PST January 20, 2013.

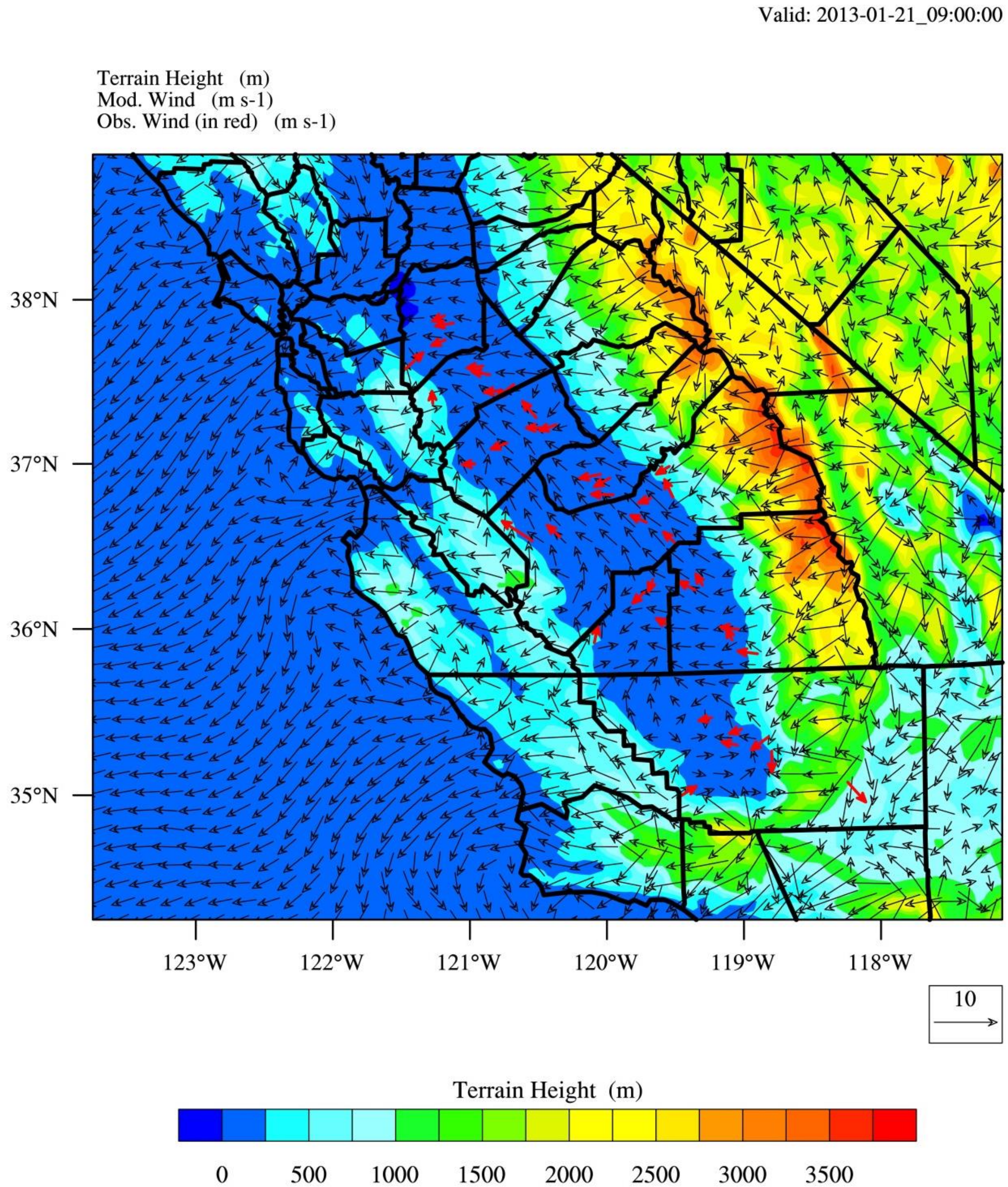


Figure 8. Surface wind field at 01:00 PST January 21, 2013.

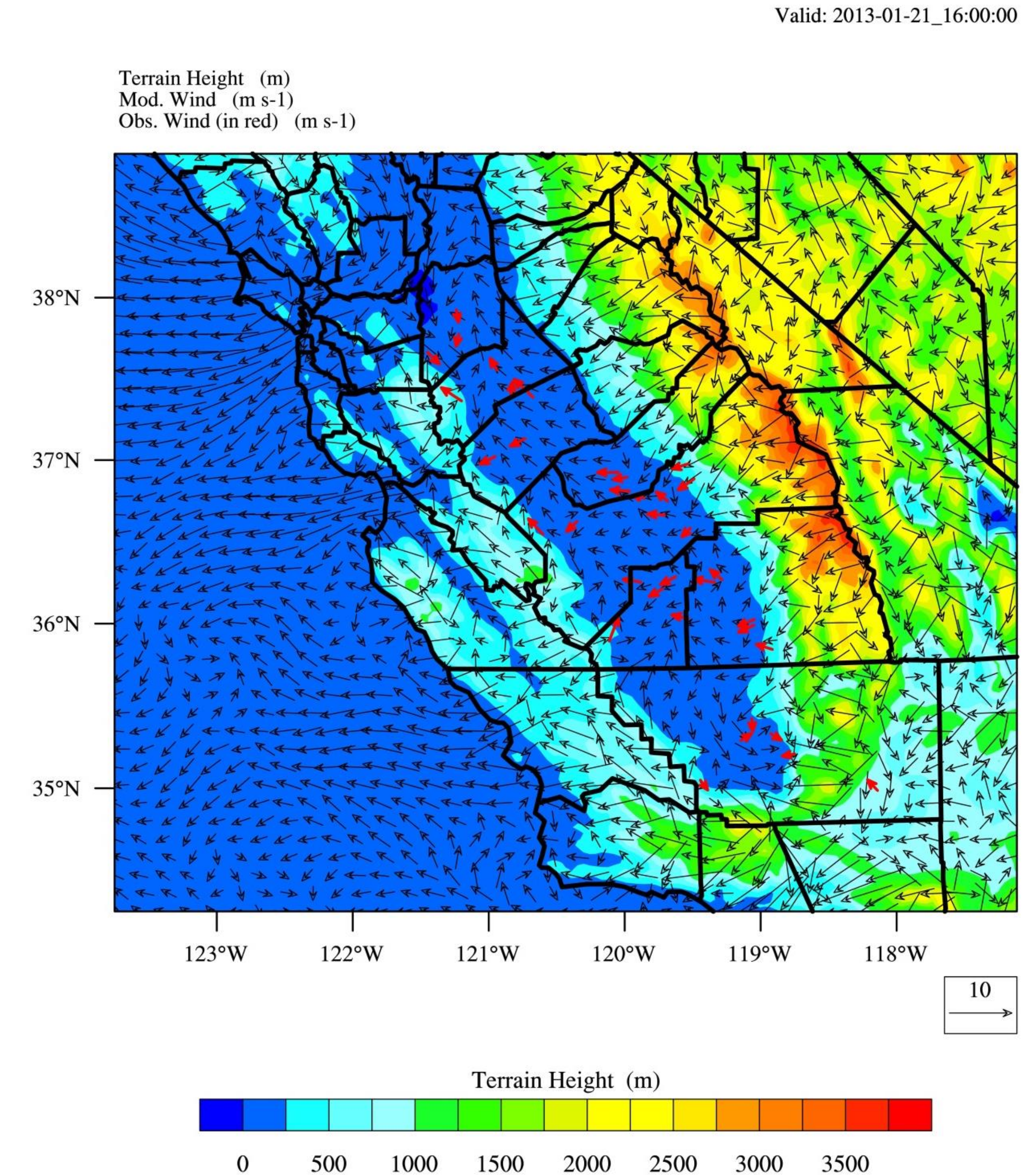


Figure 9. Surface wind field at 08:00 PST January 21, 2013.

4 EMISSIONS

The emissions inventory used in this modeling was based on the most recent inventory submitted to the U.S. EPA, with base year 2012 and projected to 2013 under growth and control conditions (http://www.arb.ca.gov/planning/sip/2012iv/2012iv.htm). For a detailed description of the emissions inventory, updates to the inventory, and how it was processed from the planning totals to a gridded inventory for modeling, see the Modeling Emissions Inventory Appendix J.

4.1 EMISSIONS SUMMARIES

Table 14 summarizes 2013, 2020, 2024, and 2025 SJV annual anthropogenic emissions for the five $PM_{2.5}$ precursors. These emission totals are based on the model-ready emission inventory and are inherently different from the planning emission inventory because the model-ready inventory considers additional factors such as weekday/weekend differences in on-road mobile emissions, day-to-day changes in residential wood burning activity, and the effects of meteorology on ammonia emissions. From 2013 to 2020, anthropogenic emissions in the SJV will drop approximately 35%, 8%, 6%, 8%, and 1% for NO_x, ROG, primary $PM_{2.5}$, SO_x, and NH_3, respectively. Among these five precursors, anthropogenic NO_x emissions show the largest relative reduction, dropping from 288 tons/day in 2013 to 187 tons/day in 2020. Anthropogenic $PM_{2.5}$ emissions will drop from 61 tons/day to 57 tons/day, reflecting a 6% reduction from 2013 to 2020. From 2020 to 2024, NO_x and $PM_{2.5}$ emissions will further drop by 42% and 7%, respectively, while emissions of other pollutants will stay nearly flat. From 2024 to 2025, NO_x emissions will drop a further 3%, while emissions of other pollutants remain relatively constant.

Note that the emission totals presented in Table 14 were calculated from the modeling inventory based on CEPAM version 1.0.5. Since the modeling inventory includes day-specific adjustments not included in the planning inventory, the planning and modeling inventories are expected to be comparable, but not identical. In addition, the 2024 and 2025 emission totals in Table 14 are from the attainment inventory, and so include additional emission reductions beyond the future baseline inventory for the respective year. These additional emission reductions for 2024 and 2025 are summarized in Tables 15-16 for NO_x and $PM_{2.5}$, respectively. Similarly, the amount of reductions in Tables 15-16 are based on modeling inventory and therefore can be different from the reductions based on the planning inventory. A description of these emission control measures can be found in the SIP under Chapter 4 describing the control strategy. Here, only the control factors for under-fired charbroil and residential wood combustion (RWC) are described in more detail.

Table 14. SJV annual modeling emissions for 2013, 2020 (baseline), 2024 (attainment), and 2025 (attainment)*.

Category	NO_x	ROG	$PM_{2.5}$	SO_x	NH_3
2013 (tons/day)					
Stationary	38.5	90.8	8.5	7.2	13.9
Area	8.1	153.3	40.2	0.3	310.0
On-road Mobile	154.6	45.1	5.7	0.6	4.4
Other Mobile	87.1	35.8	6.2	0.3	6.0
Total	288.2	325.0	60.5	8.4	334.3
2020 (tons/day)					
Stationary	28.5	95.1	8.4	6.5	15.2
Area	7.8	151.8	40.0	0.3	306.9
On-road Mobile	81.0	22.4	3.2	0.6	3.6
Other Mobile	69.8	28.7	5.4	0.3	6.0
Total	187.1	298.0	57.0	7.7	331.7
2024 (tons/day)					
Stationary	26.1	99.2	8.5	6.7	16.2
Area	6.9	152.5	38.1	0.3	304.7
On-road Mobile	32.1	17.5	3.1	0.6	3.4
Other Mobile	42.5	25.9	3.8	0.3	6.0
Total	107.6	295.1	53.5	7.9	330.2
2025 (tons/day)					
Stationary	26.0	100.3	8.6	6.8	16.4
Area	6.8	152.9	38.3	0.3	304.1
On-road Mobile	30.5	16.9	3.1	0.6	3.4
Other Mobile	41.2	25.3	3.6	0.3	6.0
Total	104.6	295.4	53.6	7.9	330.0

*: Note: emissions here are based on the model-ready inventory, which considers additional factors such as weekday/weekend difference in on-road mobile emissions. Therefore, emission values here are different from planning inventory presented in Appendix B.

Table 15: Additional NO_x emission reductions (tons/day) implemented in the 2024 and 2025 attainment inventories.*

Emission Reduction	2024	2025
Electrification of agricultural combustion engines	0.79	0.77
Stationary source fuel combustion	1.04	1.04
Agricultural equipment	11.50	10.00
Off-road equipment	2.10	1.70
Locomotives	1.40	1.30
Heavy duty diesel trucks	18.20	18.90
Flaring operations	0.05	0.05

*: Note: emission reductions here are based on the model-ready inventory and can be different from reductions based on planning inventory presented in other documents.

Table 16: Additional $PM_{2.5}$ emission reductions (tons/day) implemented in the 2024 and 2025 attainment inventories.*

Emission Reduction	2024	2025
Residential wood combustion	0.42	0.42
Under-fired charbroils	0.52	0.53
Electrification of agricultural combustion engines	0.025	0.024
Agricultural equipment	0.80	0.80
Enhanced conservation management practices (tillage)	0.23	0.23
Enhanced conservation management practices (fallow land)	0.09	0.09

*: Note: emission reductions here are based on the model-ready inventory and can be different from reductions based on planning inventory presented in other documents.

In an effort to achieve the emission reductions needed to attain the $PM_{2.5}$ standards, a control strategy has been developed to reduce Valley total $PM_{2.5}$ emissions from under-fired charbroilers by approximately 15%. The strategy includes $PM_{2.5}$ emission reductions from large new restaurants and existing restaurants with charbroilers in hot spot areas. The reduction in direct $PM_{2.5}$ emissions from under-fired charbroilers for each hot spot area is given in Table 17. In addition, Figure 10 shows the hot spot areas in which the under-fired charbroiling $PM_{2.5}$ reductions will be applied.

Table 17. $PM_{2.5}$ reductions from under-fired charbroiling controls in 2024 and 2025

County / City	Reductions in 2024 (tpd)	Reductions in 2025 (tpd)
Fresno County	0.280	0.283
Kern County	0.225	0.229
City of Madera	0.018	0.019

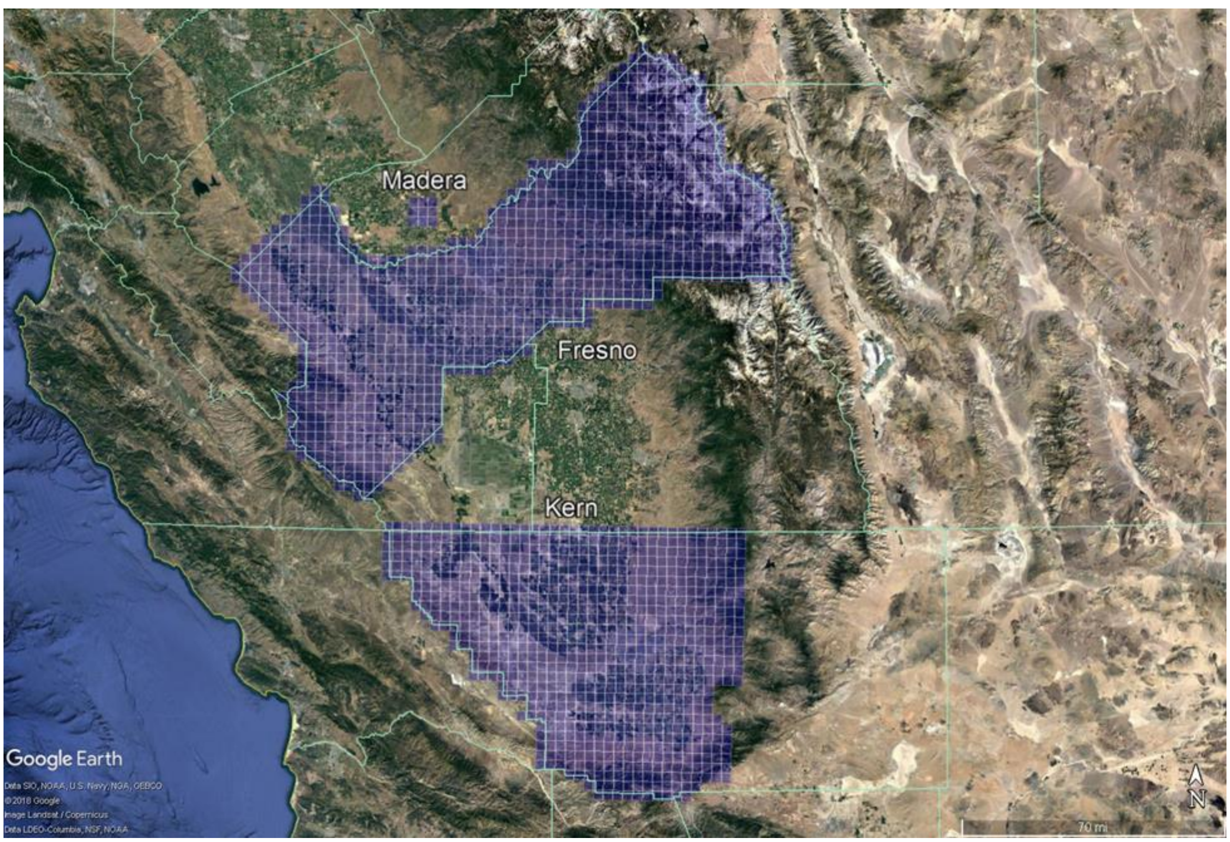


Figure 10. Hot spot areas for application of under-fired charbroiling and residential wood combustion (RWC) $PM_{2.5}$ reductions (note: for RWC, the Madera hotspot encompasses the entire county and not just the city).

In 2024 and 2025, RWC emissions are subject to more stringent control. First, RWC emissions are reduced through the enhanced Burn Cleaner program, which focuses on changing out old high emitting wood stoves with cleaner burning stoves (a description of the Burn Cleaner program can be found in Chapter 4 describing the control strategy). Table 18 shows the county-specific Burn Cleaner reductions (expressed as retention factors) for each county, which was provided by the San Joaquin Valley Air Pollution Control District. The RWC hot spot zones expand on those defined for charbroiling (Fresno and Kern counties and Madera city) to include the entire county of Madera. No hot spot area is specified for the counties of Kings, Merced, San Joaquin, and Stanislaus, and Tulare.

Table 18: County-specific burn cleaner retention factors for 2024 (the same retention factors were applied for 2025).

County	Hot spot area retention factor	Non-hot spot area retention factor
Fresno	0.564	N/A
Kern	0.635	N/A
Kings	N/A	0.900
Madera	0.855	N/A
Merced	N/A	0.922
San Joaquin	N/A	0.812
Stanislaus	N/A	0.872
Tulare	N/A	0.900

In addition to the Burn Cleaner program, the current RWC curtailment program implemented in the SJV will be strengthened. Currently, the SJV has the following RWC curtailment program:

1.) Level 0 – burning allowed if forecasted $PM_{2.5}$ concentration is less than 20 µg/m^3
2.) Level 1 – burning permitted by registered, clean-burning devices if forecasted $PM_{2.5}$ concentration is between 20 µg/m^3 and 65 µg/m^3
3.) Level 2 – no burning is allowed if forecasted $PM_{2.5}$ concentration is higher than 65 µg/m^3

The curtailment program is applied on a county-specific basis (i.e., curtailment only applies to that county where forecasted $PM_{2.5}$ is above the threshold) and only applies to areas with access to natural gas service. For 2024/2025, the hot spot areas (i.e., Fresno/Kern/Madera counties), Level 1 threshold of the curtailment program is strengthened and will be triggered when forecasted $PM_{2.5}$ is greater than 12 µg/m^3, while Level 2 is triggered when forecasted $PM_{2.5}$ is greater than 35 µg/m^3. For non-hotspot areas, the current triggering thresholds are maintained. A compliance rate of 97% is assumed in 2024/2025 when curtailment is triggered. Finally, RWC emission reductions are assumed to be the same for 2024 and 2025 given the lack of growth in RWC emissions and the application of the same curtailment program. In summary, as given in Table 16, with the Burn Cleaner program and the strengthened curtailment program in hotspot areas, Valley total RWC emissions will be reduced by 0.42 tons per day in 2024/2025 when compared to the baseline emissions subject only to the current curtailment program.

Monthly biogenic ROG totals for 2013 in the SJV are shown in Figure 11 (note that the 2013 biogenic emissions were used for all model runs). Biogenic ROG emissions are highest in the summer at nearly 1800 tons/day in July when temperature, insolation, and leaf area are generally at their peak, and drop to near zero during winter months.

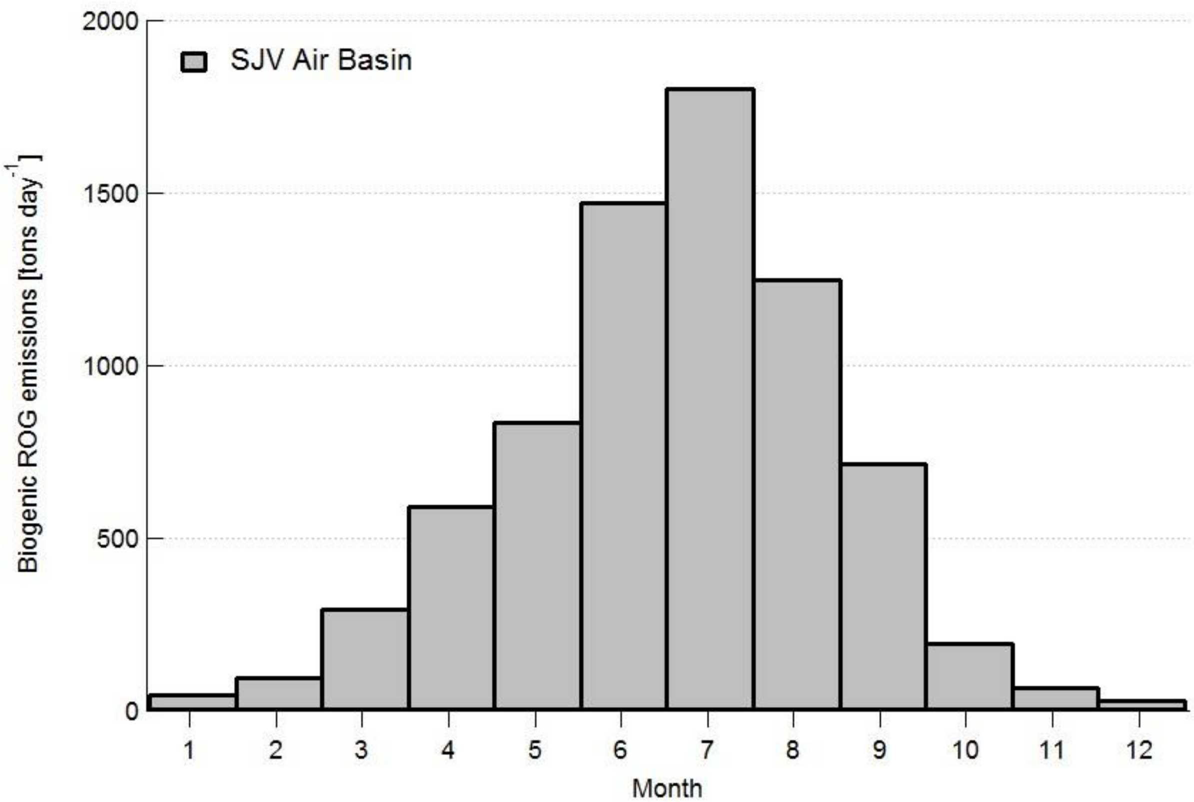


Figure 11. Monthly average biogenic ROG emissions for 2013.

5 $PM_{2.5}$ MODELING

5.1 CMAQ MODEL SETUP

Figure 12 shows the CMAQ modeling domains used in this work. The larger domain covering all of California has a horizontal grid resolution of 12 km with 107 x 97 lateral grid cells for each vertical layer and extends from the Pacific Ocean in the west to Eastern Nevada in the east and runs from the U.S.-Mexico border in the south to the California-Oregon border in the north. The smaller nested domain covering the SJV region has a finer scale 4 km grid resolution and includes 87 x 103 lateral grid cells. While the nested domain is smaller than that used for ozone modeling in the Valley (see the Photochemical Modeling Protocol Appendix L), as long as the larger statewide 12 km domain is utilized to provide dynamic boundary condition inputs to the smaller 4 km domain, there is no appreciable difference in simulated $PM_{2.5}$ predictions between the smaller domain utilized for $PM_{2.5}$ modeling and the larger domain used for ozone modeling. Both the 12 km and 4 km domains are based on a Lambert Conformal Conic projection with reference longitude at – 120.5ºN and 60ºN, which is consistent with WRF domain settings. The 30 vertical layers from WRF were mapped onto 18 vertical layers for CMAQ, extending from the surface to 100 mb such that a majority of the vertical layers fall within the planetary boundary layer (see the Photochemical Modeling Protocol Appendix L for details).

The CMAQ model version 5.0.2 (http://www.airqualitymodeling.org/cmaqwiki/index.php?title=CMAQ_version_5.0.2_%28April_2014_release%29_Technical_Documentation) released by the U.S. EPA in May 2014 was used for all air quality model simulations, consistent with the 2016 SJV $PM_{2.5}$ SIP (CARB, 2016). The SAPRC07 chemical mechanism and aerosol module aero6 were selected as the gas-phase and aerosol modules, respectively. Further details of the CMAQ configuration can be found in Table 19 and in the Photochemical Modeling Protocol Appendix L. The same configuration was used for all simulations.

Annual simulations were conducted on a simultaneous month-by-month basis, rather than one single continuous simulation. For each month, the CMAQ simulations included a seven day spin-up period (i.e., the last seven days of the previous month) for the outer 12 km domain, where initial conditions were set to the default CMAQ initial conditions. These outer domain simulations were used to provide initial and lateral boundary conditions for the inner 4 km simulation, which utilized a three day spin-up period.

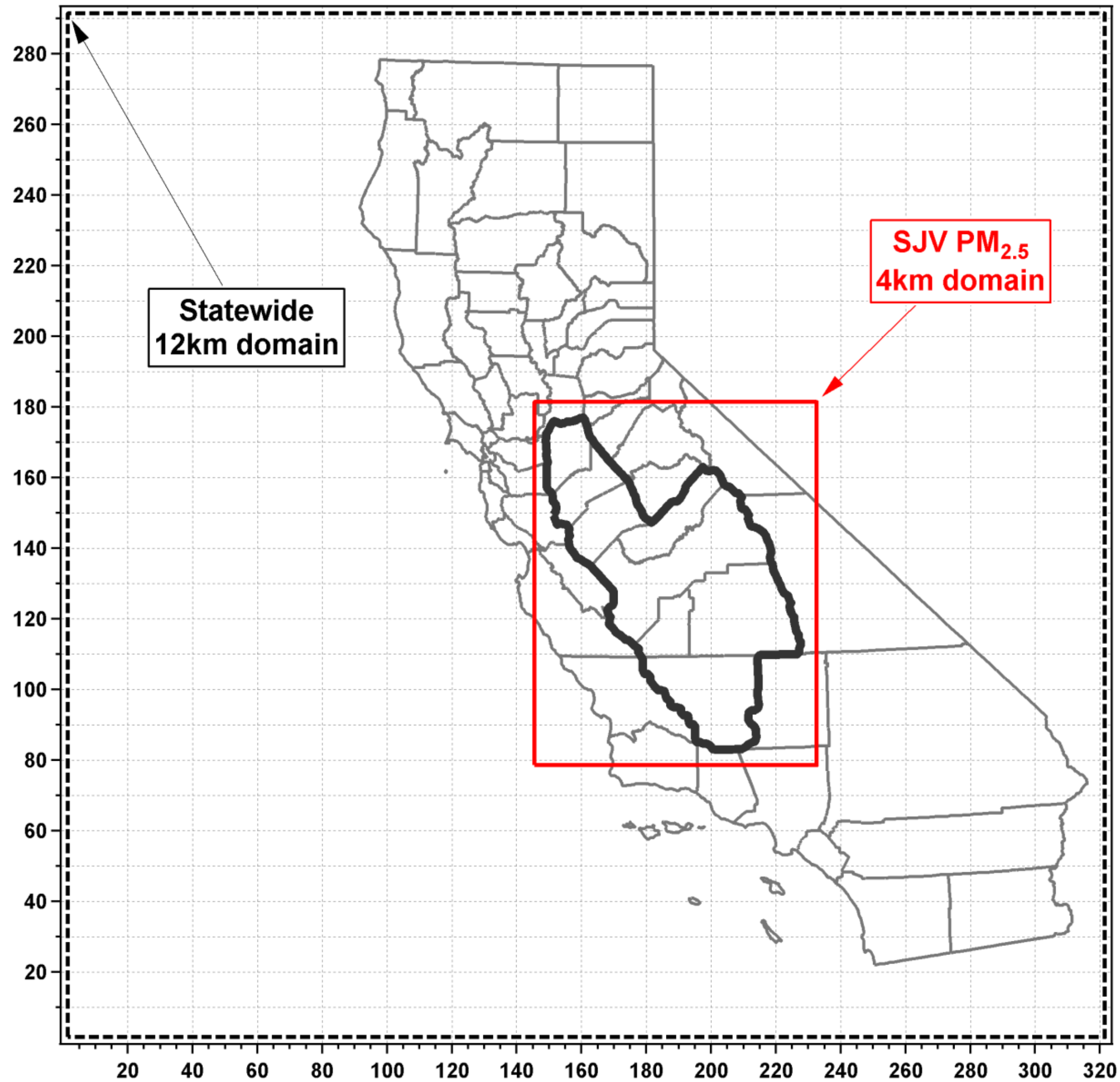


Figure 12. CMAQ modeling domains utilized in the modeling assessment.

Chemical boundary conditions for the outer 12 km domain were extracted from the global chemical transport Model for Ozone and Related chemical Tracers, version 4 (MOZART-4; Emmons et al., 2014). The MOZART-4 model output for 2013 was obtained from the National Center for Atmospheric Research (NCAR; https://www2.acom.ucar.edu/gcm/mozart) using the simulations driven by meteorological fields from the NASA GMAO GEOS-5 model. The same MOZART derived BCs for the 12 km outer domain were used in all simulations.

Table 19. CMAQ configuration and settings.

Process	Scheme
Horizontal advection	Yamo (Yamartino scheme for mass-conserving advection)
Vertical advection	WRF-based scheme for mass-conserving advection
Horizontal diffusion	Multi-scale
Vertical diffusion	ACM2 (Asymmetric Convective Model version 2)
Gas-phase chemical mechanism	SAPRC-07 gas-phase mechanism version “B”
Chemical solver	EBI (Euler Backward Iterative solver)
Aerosol module	Aero6 (the sixth-generation CMAQ aerosol mechanism with extensions for sea salt emissions and thermodynamics; includes a new formulation for secondary organic aerosol yields)
Cloud module	ACM_AE6 (ACM cloud processor that uses the ACM methodology to compute convective mixing with heterogeneous chemistry for AERO6)
Photolysis rate	phot_inline (calculate photolysis rates in-line using simulated aerosols and ozone concentrations)

5.2 CMAQ MODEL EVALUATION

CMAQ model performance was evaluated for $PM_{2.5}$ mass, individual $PM_{2.5}$ chemical species, as well as a number of gas-phase species based on observations from an extensive network of monitors in the SJV.

Time series of observed and modeled $PM_{2.5}$ chemical species based on CSN measurements are shown in the supplemental material (Figures S37-S40 of the supplemental materials for Bakersfield, Fresno, Modesto, and Visalia, respectively). $PM_{2.5}$ species are measured every 3 or 6 days at these sites. Observed $PM_{2.5}$ concentrations are higher in winter months and are much lower in summer months.

During winter months, $PM_{2.5}$ in the SJV is dominated by ammonium nitrate and directly emitted OC. The CMAQ model was able to reasonably reproduce these key characteristics of $PM_{2.5}$ pollution in the SJV, including successfully capturing many elevated wintertime nitrate events, which is key for accurately simulating both peak wintertime $PM_{2.5}$ as well as annual average $PM_{2.5}$ in the SJV.

Tables 20-23 summarize the key model performance metrics for major $PM_{2.5}$ chemical species at the four CSN sites. Model performance was evaluated on a quarterly basis for each species at each monitor. Average observations, average modeled values, mean bias, mean error, mean fractional bias (MFB), and mean fractional error (MFE) are given for individual $PM_{2.5}$ species at these four sites. Detailed definitions for these metrics can be found in the Photochemical Modeling Protocol Appendix L. In general, model performance was similar at different monitors. Modeling somewhat over predicted $PM_{2.5}$ concentrations for quarter one, but in general under predicted $PM_{2.5}$ concentrations for other quarters. Boylan and Russell (2006) proposed two criteria for model performance evaluation: Model performance goals are considered as the level of accuracy that is close to the best a model can be expected to achieve. Model performance criteria are considered as the level of accuracy that is acceptable for modeling applications. For more abundant species (e.g., concentrations $\geqslant$ 3 µg/m^3), model performance criteria are met when MFE $\leqslant$ 75% and MFB $\leqslant$ ±60%; model performance goals are met when MFE $\leqslant$ 50% and MFB $\leqslant$ ± 30%. For less abundant species, the performance criteria and goals are less stringent. A graphical representation of the quarterly MFB and MFE values in Tables 20-23 is shown in Figure 13 for each CSN site, along with suggested model performance goals and criteria (green and red lines, respectively) from Boylan and Russell (2006). Based on these metrics, the current CMAQ modelling system met the model performance criteria and in many instances exceeded model performance goals.

Table 20. Quarterly $PM_{2.5}$ model performance based on CSN measurement at Fresno – Garland.

Quarter	Species	# of Obs.	Avg. Obs. (µg/m^3)	Avg. Mod. (µg/m^3)	Mean bias (µg/m^3)	Mean error (µg/m^3)	MFB	MFE
1	$PM_{2.5}$	30	21.1	23.6	2.5	7.2	0.24	0.40
1	Ammonium	30	1.7	2.3	0.6	1.0	0.36	0.62
1	Nitrate	30	5.8	7.7	1.9	3.1	0.25	0.55
1	Sulfate	30	0.8	0.9	0.1	0.3	0.18	0.41
1	OC	28	4.9	5.4	0.4	1.9	0.22	0.41
1	EC	28	1.2	1.9	0.7	0.8	0.58	0.62
2	$PM_{2.5}$	30	7.8	6.0	-1.8	2.5	-0.29	0.39
2	Ammonium	30	0.4	0.2	-0.3	0.3	-0.81	0.87
2	Nitrate	30	0.9	0.4	-0.5	0.5	-0.94	0.97
2	Sulfate	30	1.1	0.6	-0.5	0.5	-0.50	0.56
2	OC	29	1.8	1.7	0.0	0.4	-0.06	0.26
2	EC	29	0.3	0.6	0.3	0.3	0.65	0.65
3	$PM_{2.5}$	30	9.4	6.3	-3.1	3.7	-0.36	0.44
3	Ammonium	30	0.4	0.1	-0.2	0.3	-0.83	0.94
3	Nitrate	30	0.7	0.2	-0.6	0.6	-1.41	1.45
3	Sulfate	30	0.9	0.7	-0.2	0.3	-0.19	0.36
3	OC	30	2.4	1.7	-0.8	0.9	-0.31	0.39
3	EC	30	0.5	0.6	0.1	0.2	0.25	0.34
4	$PM_{2.5}$	29	25.8	22.9	-2.9	8.9	-0.03	0.36
4	Ammonium	29	2.9	2.0	-0.9	1.6	-0.23	0.64
4	Nitrate	28	9.0	7.2	-1.8	4.3	-0.27	0.55
4	Sulfate	28	1.0	0.8	-0.2	0.3	-0.19	0.32
4	OC	29	6.0	4.7	-1.3	1.9	-0.16	0.36
4	EC	29	1.6	1.8	0.2	0.6	0.22	0.40

Table 21. Quarterly $PM_{2.5}$ model performance based on CSN measurement at Visalia.

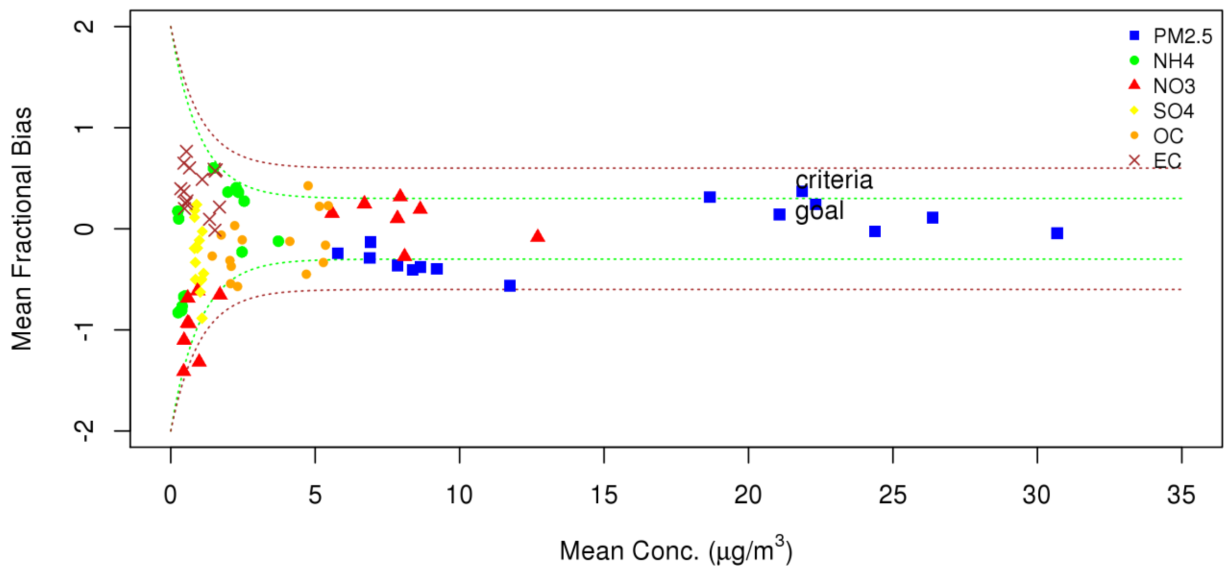
Quarter	Species	# of Obs.	Avg. Obs. (µg/m³)	Avg. Mod. (µg/m³)	Mean bias (µg/m³)	Mean error (µg/m³)	MFB	MFE
1	$PM_{2.5}$	15	20.5	21.7	1.2	5.6	0.14	0.32
1	Ammonium	15	2.0	2.7	0.8	1.1	0.36	0.59
1	Nitrate	15	6.7	9.2	2.6	3.3	0.32	0.50
1	Sulfate	15	1.0	0.7	-0.4	0.4	-0.33	0.46
1	OC	15	4.6	3.7	-0.9	1.6	-0.12	0.34
1	EC	15	0.9	1.3	0.4	0.5	0.49	0.52
2	$PM_{2.5}$	15	9.8	7.0	-2.8	2.8	-0.41	0.41
2	Ammonium	15	0.7	0.3	-0.3	0.3	-0.66	0.73
2	Nitrate	10	2.2	1.3	-0.9	0.9	-0.65	0.66
2	Sulfate	15	1.6	0.6	-1.0	1.0	-0.88	0.88
2	OC	17	2.6	1.6	-1.0	1.0	-0.54	0.54
2	EC	17	0.4	0.5	0.2	0.2	0.37	0.38
3	$PM_{2.5}$	17	10.5	6.7	-3.8	4.1	-0.38	0.45
3	Ammonium	17	0.6	0.2	-0.4	0.4	-0.77	0.81
3	Nitrate	17	1.6	0.3	-1.3	1.3	-1.32	1.32
3	Sulfate	17	1.4	0.8	-0.6	0.6	-0.50	0.51
3	OC	17	2.9	1.7	-1.2	1.4	-0.57	0.60
3	EC	17	0.5	0.6	0.2	0.2	0.28	0.31
4	$PM_{2.5}$	16	33.1	28.2	-4.9	12.5	-0.04	0.35
4	Ammonium	16	4.3	3.1	-1.2	2.1	-0.12	0.46
4	Nitrate	16	14.3	11.1	-3.2	6.6	-0.08	0.44
4	Sulfate	16	1.4	0.8	-0.6	0.7	-0.44	0.51
4	OC	16	5.8	3.6	-2.2	2.3	-0.45	0.49
4	EC	16	1.3	1.4	0.2	0.5	0.09	0.31

Table 22. Quarterly $PM_{2.5}$ model performance based on CSN measurement at Bakersfield.

Quarter	Species	# of Obs.	Avg. Obs. (μg/m³)	Avg. Mod. (μg/m³)	Mean bias (μg/m³)	Mean error (μg/m³)	MFB	MFE
1	$PM_{2.5}$	21	20.5	23.2	2.7	9.6	0.37	0.54
1	Ammonium	21	2.2	2.4	0.2	1.4	0.41	0.69
1	Nitrate	19	7.9	7.8	0.0	3.6	0.10	0.45
1	Sulfate	21	0.9	0.8	-0.1	0.4	0.11	0.52
1	OC	22	3.9	5.6	1.7	2.2	0.43	0.49
1	EC	22	1.1	1.9	0.8	0.8	0.59	0.59
2	$PM_{2.5}$	25	11.0	7.4	-3.6	4.1	-0.40	0.46
2	Ammonium	25	0.6	0.3	-0.3	0.3	-0.67	0.71
2	Nitrate	25	1.1	0.8	-0.3	0.6	-0.61	0.80
2	Sulfate	25	1.4	0.7	-0.7	0.7	-0.63	0.64
2	OC	22	2.2	2.3	0.1	0.5	0.03	0.23
2	EC	22	0.4	0.7	0.4	0.4	0.77	0.77
3	$PM_{2.5}$	19	15.5	8.0	-7.5	8.0	-0.56	0.60
3	Ammonium	19	0.5	0.2	-0.3	0.3	-0.81	0.86
3	Nitrate	19	0.8	0.4	-0.4	0.5	-0.93	1.04
3	Sulfate	19	1.3	0.8	-0.6	0.6	-0.51	0.51
3	OC	17	2.6	2.4	-0.2	0.9	-0.11	0.34
3	EC	17	0.5	0.9	0.4	0.4	0.60	0.60
4	$PM_{2.5}$	0	NA	NA	NA	NA	NA	NA
4	Ammonium	0	NA	NA	NA	NA	NA	NA
4	Nitrate	0	NA	NA	NA	NA	NA	NA
4	Sulfate	0	NA	NA	NA	NA	NA	NA
4	OC	0	NA	NA	NA	NA	NA	NA
4	EC	0	NA	NA	NA	NA	NA	NA

Table 23. Quarterly $PM_{2.5}$ model performance based on CSN measurement at Modesto.

Quarter	Species	# of Obs.	Avg. Obs. (µg/m^3)	Avg. Mod. (µg/m^3)	Mean bias (µg/m^3)	Mean error (µg/m^3)	MFB	MFE
1	$PM_{2.5}$	15	17.3	20.0	2.7	5.6	0.31	0.41
1	Ammonium	15	1.0	2.0	1.0	1.0	0.60	0.70
1	Nitrate	15	5.0	6.2	1.2	1.6	0.15	0.39
1	Sulfate	15	0.8	1.0	0.2	0.4	0.24	0.39
1	OC	14	5.5	5.5	0.0	2.2	0.23	0.44
1	EC	14	1.2	1.8	0.6	0.7	0.57	0.61
2	$PM_{2.5}$	15	6.5	5.0	-1.5	2.5	-0.24	0.40
2	Ammonium	15	0.3	0.3	0.0	0.1	0.10	0.44
2	Nitrate	13	0.7	0.5	-0.2	0.4	-0.68	0.81
2	Sulfate	15	1.0	0.8	-0.2	0.3	-0.18	0.36
2	OC	15	1.6	1.2	-0.4	0.6	-0.27	0.36
2	EC	15	0.3	0.4	0.1	0.1	0.40	0.40
3	$PM_{2.5}$	14	7.9	6.0	-1.9	3.1	-0.13	0.35
3	Ammonium	15	0.3	0.2	0.0	0.1	0.17	0.48
3	Nitrate	15	0.7	0.2	-0.5	0.5	-1.10	1.10
3	Sulfate	15	1.1	0.9	-0.2	0.3	-0.11	0.28
3	OC	15	2.6	1.5	-1.1	1.2	-0.37	0.40
3	EC	15	0.4	0.5	0.1	0.2	0.20	0.35
4	$PM_{2.5}$	17	25.6	27.1	1.5	4.1	0.11	0.21
4	Ammonium	17	2.4	2.6	0.2	0.6	0.27	0.38
4	Nitrate	17	8.2	9.0	0.8	2.2	0.19	0.32
4	Sulfate	17	1.1	1.1	-0.1	0.3	-0.02	0.25
4	OC	17	6.2	4.3	-1.9	1.9	-0.33	0.33
4	EC	17	1.6	1.5	-0.1	0.3	-0.01	0.22



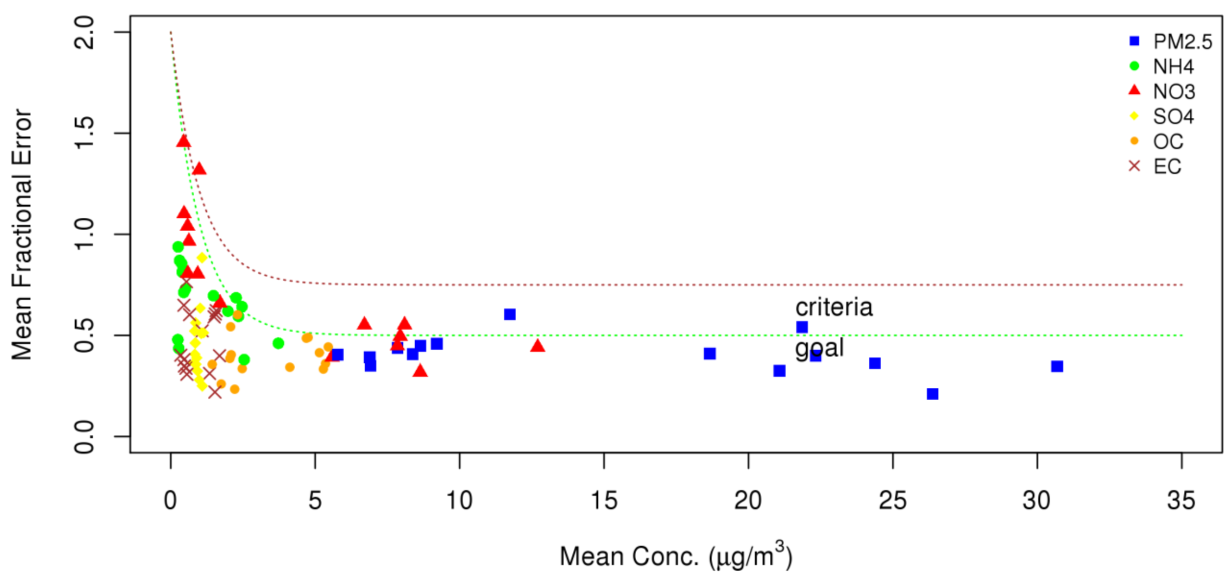


Figure 13. Bugle plot of quarterly $PM_{2.5}$ model performance in terms of MFB and MFE at the four CSN sites in the SJV (i.e., Bakersfield, Fresno, Modesto, and Visalia).

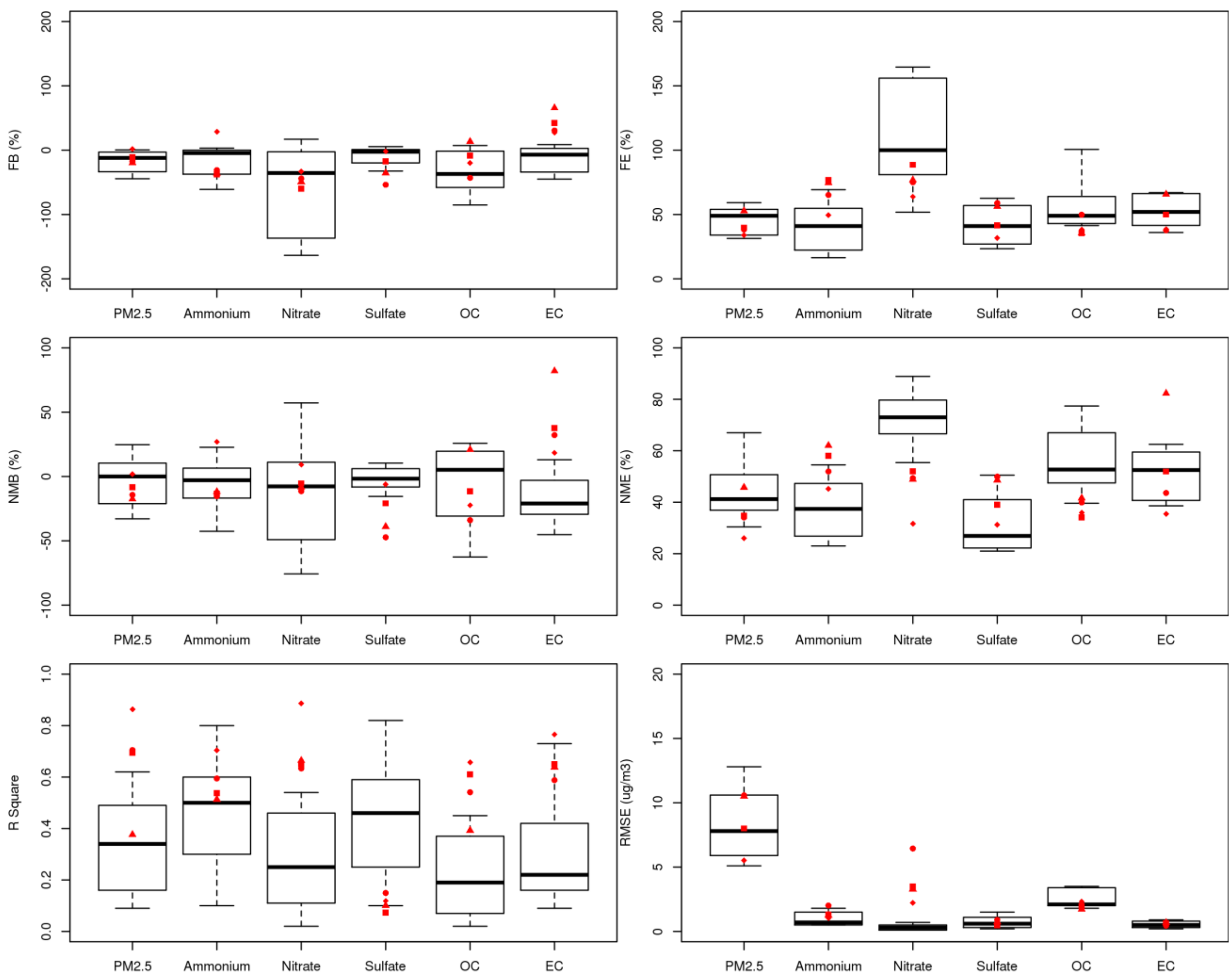


Figure 14. Comparison of annual $PM_{2.5}$ model performance to other modeling studies in Simon et al. (2012). Red symbols represent performance at the four CSN sites in the SJV.

In addition to evaluating the standard statistical performance metrics, it is also informative to put these performance statistics in the context of other studies published in the scientific literature. Figure 14 compares key performance statistics from the modeling platform presented in this document to the range of published performance statistics from 2006 to 2012 and summarized in Simon et al. (2012). In Figure 14, the black centerline shows the median value (i.e., median model performance) from those studies, the boxes outline the 25th and 75th percentile values, and the whiskers show the 10th and 90th percentile values. The model performance for each of the four CSN sites in the SJV is shown in red. Performance metrics including MFB, MFE, normalized mean bias (NMB), normalized mean error (NME), R squared, and root mean square error (RMSE) are compared. Definitions for these statistics can be found in the

Photochemical Modeling Protocol Appendix L or Simon et al. (2012). Model performance metrics in the SJV are typically equal to or better than the corresponding statistics from other studies. One exception is the higher RMSE for nitrate in the SJV, which is simply a reflection of the higher nitrate concentrations in the SJV compared to other regions. In fact, MFB, MFE, NME, and R squared for nitrate in the SJV is consistently better than the majority of the model studies summarized in Simon et al. (2012). Finally, the model performance is also comparable to that of the 2012 SJV $PM_{2.5}$ SIP (Chen et al., 2014).

Since CSN monitors do not measure $PM_{2.5}$ on a daily basis, it is also advantageous to compare modeled 24-hour average $PM_{2.5}$ concentrations to observations from continuous $PM_{2.5}$ samplers, which typically report 24-hour average $PM_{2.5}$ concentrations on a daily basis. Figures S-41 – S-52 show the time series of modeled and observed 24-hour average $PM_{2.5}$ concentrations at these sites located throughout the SJV. Distinct seasonal variations in $PM_{2.5}$ concentrations are observed throughout the Valley, and are also reasonably captured by the model. Of particular importance, the modeling system was able to capture the elevated $PM_{2.5}$ events during the winter months and the lower $PM_{2.5}$ which is common in the summer months. In addition, Table 24 summarizes the corresponding model performance statistics at these sites. All the sites met or exceeded the $PM_{2.5}$ model performance criteria defined in Boyland and Russell (2006).

In addition to the $PM_{2.5}$ performance evaluation, gas phase model performance was also evaluated for nitrogen dioxide (NO_2) and ozone, which are key products of the photochemical processes in the atmosphere. Scatter plots of observed and modeled one-hour NO_2 mixing ratios at 16 sites are shown in Figures S-53 to S-68 in the supplemental materials. On average, there is good agreement between observed and modeled NO_2 mixing ratios. The slope of the regression line between the observed and modeled hourly NO_2 mixing ratios is within ±30% of the 1:1 correlation line at most of the sites. Scatter plots of observed and modeled hourly O_3 mixing ratios at 25 sites are shown in Figures S-69 to S-93 in the supplemental materials. Modeled O_3 mixing ratios show excellent agreement with observed mixing ratios and the slopes of the regression lines between observed and modeled O_3 are all within ±15% of the 1:1 correlation line.

Table 24. Model performance for 24-hour $PM_{2.5}$ concentrations measured from continuous $PM_{2.5}$ monitors.

Sites	# of Obs.	Avg. Obs. (µg/m³)	Avg. Mod. (µg/m³)	Mean bias (µg/m³)	Mean error (µg/m³)	MFB	MFE
Fresno-Drummond Street	246	14.8	13.0	-1.8	4.9	-0.20	0.40
Clovis	300	16.4	13.6	-2.7	6.1	-0.26	0.46
Bakersfield-California Avenue	267	20.2	15.7	-4.4	7.7	-0.31	0.47
Tranquility	301	8.5	8.6	0.1	4.1	-0.19	0.51
Fresno-Garland	312	19.3	15.0	-4.3	6.7	-0.36	0.47
Stockton	302	18.0	13.2	-4.8	7.5	-0.54	0.63
Merced	326	13.2	12.7	-0.6	5.3	-0.19	0.46
Hanford	329	18.0	14.6	-3.4	6.3	-0.33	0.49
Madera	323	18.0	12.0	-6.0	8.1	-0.57	0.67
Manteca	325	11.7	13.1	1.4	6.0	-0.13	0.56
Visalia	309	18.6	17.0	-1.7	6.6	-0.19	0.43
Modesto	315	14.4	14.3	-0.1	5.1	-0.06	0.43
Turlock	316	14.8	14.2	-0.6	4.5	-0.08	0.43

5.3 FUTURE YEAR 2020 DESIGN VALUES (ADDRESSING THE 1997 24-HOUR $PM_{2.5}$ STANDARD)

Projected future year 2020 ~~annual $PM_{2.5}$ and~~ 24-hour $PM_{2.5}$ DVs for each site is~~are~~ given in Table~~s~~ 25~~ and 26, respectively.~~ ~~For the annual standard, the Bakersfield-Planz site has the highest projected DV at 14.6 µg/m^3, which is below the 15 µg/m^3 annual $PM_{2.5}$ standard established by the U.S. EPA in 1997.~~ For the 24-hour standard, the Bakersfield-California Avenue site has the highest projected DV at 47.6 µg/m^3, which is ~~also~~ below the 65 µg/m^3 24-hour $PM_{2.5}$ standard established by the U.S. EPA in 1997.

The Corresponding Relative Response Factors (RRFs) for the ~~both the annual $PM_{2.5}$ and~~ 24-hour $PM_{2.5}$ are given in Table 26~~ Tables 27-28, respectively (Note, RRF is calculated on a quarterly basis in the actual DV calculation, so the annual RRF is shown for illustrative purposes only)~~. From 2013 to 2020, there are decent ~~modest~~ reductions projected for ammonium nitrate, EC, and organic matter (OM), a slight decrease in sulfate, but a slight increase in crustal material (i.e., other primary $PM_{2.5}$ such as fugitive dust emissions). The reduction in ammonium nitrate is a direct result of NO_x emission reductions in 2020 compared to 2013, while EC and OM reductions are primarily tied to the reduction in primary $PM_{2.5}$ emissions. Because future year projection is performed for each individual $PM_{2.5}$ specie, the base year ~~annual and~~ 24-hour based $PM_{2.5}$ compositions are given in Table 27.~~Tables 29-30, respectively.~~ In addition, the projected 2020 ~~annual and~~ 24-hour $PM_{2.5}$ compositions are shown in Table 28.~~Tables 31-32, respectively.~~ In 2020, ~~for the annual $PM_{2.5}$ standard, OM is the dominant $PM_{2.5}$ component followed by ammonium nitrate, while for the 24-hour $PM_{2.5}$ standard,~~ ammonium nitrate and OM are roughly equivalent in terms of their contribution to total $PM_{2.5}$.

~~Table 25. Projected future year 2020 annual $PM_{2.5}$ DVs at each monitor.~~

~~Site AQS ID~~	~~Name~~	~~Base DV ($\mu g/m^3$)~~	~~2020 Annual DV ($\mu g/m^3$)~~
~~60290016~~	~~Bakersfield - Planz~~	~~17.2~~	~~14.6~~
~~60392010~~	~~Madera~~	~~16.9~~	~~14.2~~
~~60311004~~	~~Hanford~~	~~16.5~~	~~13.3~~
~~61072002~~	~~Visalia~~	~~16.2~~	~~13.5~~
~~60195001~~	~~Clovis~~	~~16.1~~	~~13.4~~
~~60290014~~	~~Bakersfield - California~~	~~16.0~~	~~13.5~~
~~60190011~~	~~Fresno - Garland~~	~~15.0~~	~~12.4~~
~~60990006~~	~~Turlock~~	~~14.9~~	~~12.5~~
~~60195025~~	~~Fresno - Hamilton & Winery~~	~~14.2~~	~~11.9~~
~~60771002~~	~~Stockton~~	~~13.1~~	~~11.4~~
~~60470003~~	~~Merced - S Coffee~~	~~13.1~~	~~10.9~~
~~60990005~~	~~Modesto~~	~~13.0~~	~~11.0~~
~~60472510~~	~~Merced - Main Street~~	~~11.0~~	~~9.3~~
~~60772010~~	~~Manteca~~	~~10.1~~	~~8.7~~
~~60192009~~	~~Tranquility~~	~~7.7~~	~~6.4~~

Table 25~~6~~. Projected future year 2020 24-hour $PM_{2.5}$ DVs at each monitor.

Site AQS ID	Name	Base DV ($\mu g/m^3$)	2020 24-hour DV ($\mu g/m^3$)
60290014	Bakersfield – California	64.1	47.6
60190011	Fresno – Garland	60.0	44.3
60311004	Hanford	60.0	43.7
60195025	Fresno – Hamilton & Winery	59.3	45.6
60195001	Clovis	55.8	41.1
61072002	Visalia	55.5	42.8
60290016	Bakersfield – Planz	55.5	41.2
60392010	Madera	51.0	38.9
60990006	Turlock	50.7	37.8
60990005	Modesto	47.9	35.8
60472510	Merced – Main Street	46.9	32.9
60771002	Stockton	42.0	33.5
60470003	Merced – S Coffee	41.1	30.0
60772010	Manteca	36.9	30.1
60192009	Tranquility	29.5	21.5

~~Table 27. 2020 Annual RRFs for $PM_{2.5}$ components.~~

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield - Planz	0.85	0.67	0.69	0.98	0.88	0.52	1.05
Madera	0.84	0.74	0.70	0.99	0.89	0.67	1.05
Hanford	0.80	0.71	0.67	1.02	0.91	0.70	1.00
Visalia	0.83	0.68	0.70	1.00	0.86	0.62	1.04
Clovis	0.83	0.71	0.71	1.00	0.84	0.61	1.08
Bakersfield - California	0.84	0.66	0.67	0.98	0.88	0.52	1.06
Fresno - Garland	0.83	0.73	0.72	0.99	0.84	0.57	1.07
Turlock	0.84	0.75	0.73	0.98	0.89	0.65	1.06
Fresno - H&W	0.83	0.75	0.75	1.00	0.84	0.55	1.06
Stockton	0.87	0.80	0.75	1.01	0.92	0.69	1.08
Merced - S Coffee	0.83	0.73	0.70	0.99	0.89	0.66	1.05
Modesto	0.84	0.75	0.73	0.98	0.90	0.65	1.06
Merced - Main St	0.85	0.72	0.70	0.99	0.88	0.66	1.06
Manteca	0.86	0.79	0.76	0.98	0.90	0.68	1.06
Tranquility	0.83	0.71	0.63	1.00	0.93	0.73	1.03

Table 26~~8~~. 2020 24-hour RRFs for $PM_{2.5}$ components.

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield - California	0.74	0.70	0.70	0.98	0.77	0.45	1.07
Fresno – Garland	0.74	0.75	0.75	0.99	0.71	0.50	1.07
Hanford	0.73	0.67	0.68	1.04	0.84	0.65	1.02
Fresno - H&W	0.78	0.78	0.79	0.99	0.75	0.51	1.07
Clovis	0.73	0.72	0.73	1.00	0.72	0.54	1.08
Visalia	0.77	0.77	0.77	1.01	0.73	0.53	1.05
Bakersfield – Planz	0.73	0.73	0.73	0.97	0.66	0.42	1.05
Madera	0.76	0.75	0.75	0.99	0.76	0.60	1.07
Turlock	0.74	0.71	0.72	0.97	0.77	0.58	1.06
Modesto	0.75	0.73	0.72	0.98	0.75	0.58	1.07
Merced – Main St	0.70	0.71	0.71	0.97	0.65	0.53	1.06
Stockton	0.80	0.74	0.74	1.00	0.88	0.67	1.07
Merced – S Coffee	0.72	0.72	0.72	0.97	0.67	0.54	1.06
Manteca	0.82	0.80	0.80	0.97	0.82	0.68	1.07
Tranquility	0.72	0.61	0.61	1.05	0.85	0.72	1.08

Table 29. Base year Annual $PM_{2.5}$ compositions.*

Name	Base $PM_{2.5}$ (µg/m³)	Base NH_4 (µg/m³)	Base NO_3 (µg/m³)	Base SO_4 (µg/m³)	Base OM (µg/m³)	Base EC (µg/m³)	Base Crustal (µg/m³)
Bakersfield - Planz	17.2	1.38	2.61	1.66	6.65	0.99	2.53
Madera	16.9	1.74	4.07	1.49	6.06	0.91	1.22
Hanford	16.5	2.15	5.47	1.50	3.84	0.70	1.21
Visalia	16.2	1.41	2.99	1.45	7.13	0.68	1.15
Clovis	16.1	1.11	2.14	1.30	8.43	0.88	1.06
Bakersfield – Cali.	16.0	1.31	2.60	1.48	6.19	0.92	2.22
Fresno – Garland	15.0	1.04	2.15	1.11	7.80	0.82	0.90
Turlock	14.9	1.60	3.94	1.22	5.11	0.77	0.87
Fresno - H&W	14.2	0.99	2.05	1.05	7.39	0.78	0.85
Stockton	13.1	1.38	3.29	1.13	4.61	0.66	0.82
Merced - S Coffee	13.1	1.38	3.31	1.13	4.56	0.66	0.81
Modesto	13.0	1.39	3.41	1.08	4.46	0.67	0.77
Merced - M Street	11.0	0.82	1.70	0.88	5.40	0.56	0.62
Manteca	10.1	1.06	2.59	0.83	3.42	0.51	0.59
Tranquility	7.7	0.77	1.85	0.61	2.67	0.40	0.50

*: $PM_{2.5}$ compositions were based on CSN speciation measurement adjusted by the EPA SANDWICH method. Particle-bound water and blank mass are not shown. The same applies to the base year 24-hour DV compositions.

Table 2730. Base year 24-hour $PM_{2.5}$ standard DV compositions.

Name	Base $PM_{2.5}$ (µg/m³)	Base NH_4 (µg/m³)	Base NO_3 (µg/m³)	Base SO_4 (µg/m³)	Base OM (µg/m³)	Base EC (µg/m³)	Base Crustal (µg/m³)
Bakersfield – Cali.	64.1	7.6	21.9	3.2	18.9	2.7	4.7
Fresno – Garland	60.0	6.7	20.8	1.7	22.9	2.5	0.9
Hanford	60.0	9.1	28.6	2.2	11.2	1.7	1.1
Fresno – H&W	59.3	6.4	20.3	1.4	23.2	2.7	0.9
Clovis	55.8	6.1	19.1	1.3	21.8	2.5	0.8
Visalia	55.5	7.6	23.5	2.1	14.7	1.6	1.0
Bakersfield - Planz	55.5	6.5	18.1	3.4	17.9	2.5	2.8
Madera	51.0	6.1	19.3	1.2	17.1	2.3	0.8
Turlock	50.7	6.5	20.0	1.9	14.6	2.4	1.0
Modesto	47.9	6.1	18.9	1.8	13.8	2.3	0.9
Merced - M Street	46.9	5.3	16.1	1.7	17.1	2.2	0.9
Stockton	42.0	5.4	15.9	2.1	11.8	2.2	1.0
Merced - S Coffee	41.1	5.4	16.1	1.8	11.6	1.8	0.8
Manteca	36.8	4.7	14.5	1.4	10.5	1.7	0.7
Tranquility	29.5	3.5	10.8	0.9	10.0	1.4	0.4

~~Table 31. Projected 2020 Annual $PM_{2.5}$ compositions.~~

Name	Future $PM_{2.5}$ (µg/m^3)	Future NH_4 (µg/m^3)	Future NO_3 (µg/m^3)	Future SO_4 (µg/m^3)	Future OM (µg/m^3)	Future EC (µg/m^3)	Future Crustal (µg/m^3)	Future Water (µg/m^3)	Blank (µg/m^3)
Bakersfield – Planz	14.6	0.92	1.81	1.62	5.84	0.51	2.66	0.72	0.5
Madera	14.2	1.30	2.85	1.47	5.40	0.61	1.28	0.75	0.5
Hanford	13.3	1.53	3.68	1.53	3.50	0.49	1.21	0.86	0.5
Visalia	13.5	0.96	2.09	1.45	6.16	0.42	1.20	0.72	0.5
Clovis	13.4	0.78	1.52	1.29	7.06	0.54	1.15	0.60	0.5
Bakersfield - California	13.5	0.86	1.75	1.44	5.45	0.48	2.34	0.65	0.5
Fresno – Garland	12.4	0.76	1.55	1.10	6.54	0.47	0.96	0.54	0.5
Turlock	12.5	1.20	2.90	1.20	4.56	0.50	0.92	0.69	0.5
Fresno – H &W	11.9	0.74	1.53	1.05	6.20	0.43	0.90	0.52	0.5
Stockton	11.4	1.10	2.48	1.14	4.27	0.46	0.88	0.61	0.5
Merced - S Coffee	10.9	1.00	2.30	1.12	4.07	0.44	0.85	0.58	0.5
Modesto	11.0	1.05	2.49	1.05	4.03	0.44	0.82	0.60	0.5
Merced - Main St	9.3	0.59	1.19	0.88	4.77	0.37	0.65	0.40	0.5
Manteca	8.7	0.84	1.98	0.81	3.09	0.35	0.63	0.47	0.5
Tranquility	6.4	0.54	1.16	0.61	2.47	0.29	0.51	0.30	0.5

Table 28~~32~~. Projected 2020 24-hour $PM_{2.5}$ compositions

Name	Future $PM_{2.5}$ (µg/m^3)	Future NH_4 (µg/m^3)	Future NO_3 (µg/m^3)	Future SO_4 (µg/m^3)	Future OM (µg/m^3)	Future EC (µg/m^3)	Future Crustal (µg/m^3)	Future Water (µg/m^3)	Blank (µg/m^3)
Bakersfield – California	47.6	5.8	17.8	2.3	12.6	1.2	4.1	3.5	0.5
Fresno - Garland	44.3	4.9	15.4	1.4	16.7	1.4	1.0	3.0	0.5
Hanford	43.7	6.1	19.3	2.3	9.5	1.2	1.1	3.8	0.5
Fresno – H&W	45.6	4.9	15.0	1.9	17.5	1.3	1.5	3.1	0.5
Clovis	41.1	3.8	12.0	1.4	18.4	1.6	1.0	2.3	0.5
Visalia	42.8	5.9	18.2	2.1	10.7	0.9	1.0	3.5	0.5
Bakersfield – Planz	41.2	5.3	14.9	3.5	10.8	1.0	2.3	3.0	0.5
Madera	38.9	4.5	14.5	1.2	13.1	1.4	0.8	2.8	0.5
Turlock	37.8	4.6	14.4	1.8	11.2	1.4	1.1	2.8	0.5
Modesto	35.8	4.5	13.3	2.1	10.0	1.4	1.3	2.6	0.5
Merced-Main St	32.9	3.8	11.5	1.6	11.2	1.2	1.0	2.2	0.5
Stockton	33.5	3.8	11.3	1.8	11.4	1.3	1.1	2.2	0.5
Merced – S Coffee	30.0	3.9	11.6	2.0	7.9	1.0	0.8	2.3	0.5
Manteca	30.1	3.8	11.7	1.3	8.7	1.2	0.8	2.3	0.5
Tranquility	21.5	2.1	6.6	0.9	8.6	1.0	0.5	1.3	0.5

5.4 FUTURE YEAR 2023 DESIGN VALUES (ADDRESSING THE 1997 ANNUAL $PM_{2.5}$ STANDARD)

The purpose of this section is to demonstrate that SJV will attain the 1997 annual $PM_{2.5}$ standard in 2023 based on the 2018-2020 baseline design values and emission reductions in 2023 compared to 2018. SJV did not attain the 1997 annual $PM_{2.5}$ standard in 2020 because of adverse meteorological conditions, increased impacts from wildfires, and data collection issues at a key air monitoring site in Bakersfield (Bakersfield-Planz). However, among the 17 monitors, only the Bakersfield-Planz site has 2020 DV greater than 15 µg/m^3. All other sites have DVs below 15 µg/m^3, which is a significant improvement compared to the DVs during 2012 and 2014 as shown in Table 2. Methodology and results to show attainment to the 1997 annual $PM_{2.5}$ standard are described below.

Baseline design values

U.S. EPA guidance (2014) defines the annual $PM_{2.5}$ DV for a given year as the 3-year average (ending in that year) of the annual average $PM_{2.5}$ concentrations, where the annual average is calculated as the average of the quarterly averages for each calendar quarter (e.g., January-March, April-June, July-September, October-December). In addition, to minimize the influence of year-to-year variability in demonstrating attainment, the U.S. EPA (2014) recommends the averaging of three DVs, where one of the years is the same as the baseline emissions inventory year. This average DV is referred to as the baseline DV. For this revision, the baseline DV is the average of the 2018, 2019, and 2020 DVs (i.e., as shown in the equation for the 2018-2020 average). Table 29 shows the 2018-2020 average annual DVs (or annual baseline DVs) for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) site in the SJV. The Bakersfield – Planz site has the highest baseline DV at 16.3 µg/m^3.

$$2018-2020\ Average = \frac{PM2.5_{2016} + 2 \times PM2.5_{2017} + 3 \times PM2.5_{2018} + 2 \times PM2.5_{2019} + PM2.5_{2020}}{9}$$

Because the year 2020 is an unusual year with the impact from Covid-19 shutdown, two alternative methodologies for the baseline DVs were also considered by excluding the year 2020 from the baseline DV calculation. Those two alternative methods (i.e., referred as 2018-2019 Average_V1 and 2018-2019 Average_V2, respectively) were shown in the equations below. Based on these calculations, the Bakersfield-Planz site still has the highest DVs at 16.2 and 16.4 µg/m^3, respectively. Future year DV calculation showed that it attains the 1997 annual standard in 2023 using either of these methods to calculate baseline DVs. For the remaining part of this section, we focus on the modeling demonstration based on baseline DVs including the year 2020. The baseline DV at Bakersfield-Planz is 16.3 µg/m³.

$$2018-2019\ Average\ V1 = \frac{PM2.5_{2016} + 2 \times PM2.5_{2017} + 3 \times PM2.5_{2018} + 2 \times PM2.5_{2019} + \frac{(PM2.5_{2018} + PM2.5_{2019})}{2}}{9}$$

$$2018-2019\ Average\ V2 = \frac{PM2.5_{2016} + 2 \times PM2.5_{2017} + 3 \times PM2.5_{2018} + 2 \times PM2.5_{2019}}{8}$$

Table 29: Average baseline DVs for each monitor in the SJV, as well as the yearly annual DVs from 2018 -2020 utilized in calculating the baseline DVs.

AQS site ID	**Monitoring Site**	**2018**	**2019**	**2020**	**2018-2020 Average Baseline**
60290016	Bakersfield-Planz	17.3	16.2	15.4	16.3
61072002	Visalia	15.7	15.1	14.7	15.2
60290010	Bakersfield-Golden State	15.7	14.9	14.6	15.1
60311004	Hanford	15.9	14.7	13.8	14.8
60290014	Bakersfield - California Ave.	15.4	14.4	14.1	14.6
60310004	Corcoran	15.1	14.2	13.5	14.3
60195025	Fresno - Hamilton & Winery	14.5	13.9	13.3	13.9
60190011	Fresno - Garland	13.8	13.2	12.9	13.3
60990006	Turlock	12.9	12.2	11.5	12.2
60195001	Clovis	12.8	12.1	11.7	12.2
60771002	Stockton	12.5	11.6	11.0	11.7
60470003	Merced - S Coffee	12.5	11.6	10.4	11.5
60392010	Madera	12.1	11.2	10.5	11.3
60472510	Merced - Main Street	11.8	11.3	10.7	11.3
60990005	Modesto	11.7	10.5	9.6	10.6
60772010	Manteca	10.3	9.8	9.4	9.9
60192009	Tranquility	8.2	7.5	6.7	7.5

$PM_{2.5}$ species calculation

Measured total $PM_{2.5}$ is separated into various chemical components. In the SJV, the primary chemical components on the filter based $PM_{2.5}$ measurements include sulfates, nitrates, ammonium, organic carbon (OC), elemental carbon (EC), particle-bound water, other primary inorganic particulate matter, and passively collected mass (blank mass). Species concentrations were obtained from the four chemical speciation network (CSN) sites in the SJV. These four CSN sites are located at: Bakersfield – California Avenue, Fresno – Garland, Visalia – North Church, and Modesto – 14th Street. Since not all of the 17 FRM/FEM $PM_{2.5}$ sites in the Valley have collocated speciation monitors, it was necessary to utilize the speciated $PM_{2.5}$ measurements at one of the four CSN sites to represent the speciation profile at each of the FRM/FEM sites. Table 30 shows the choice of which CSN site to represent the speciation profile at a given FRM monitor, consistent with Table 5. There are two additional FRM/FEM sites (i.e., Bakersfield – Golden State and Corcoran) that were not shown in Table 5 and their speciation profiles were assigned to be same as Bakersfield – California Avenue and Visalia – North Church, respectively.

Since the FRM $PM_{2.5}$ monitors do not retain all of the $PM_{2.5}$ mass that is measured by the speciation samplers, the U.S. EPA (2014) recommends using the SANDWICH approach (Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance) described by Frank (2006) to apportion the FRM $PM_{2.5}$ mass to individual $PM_{2.5}$ species based on nearby CSN speciation data. Based on data availability and completeness associated with $PM_{2.5}$ speciation and temperature/relative humidity measurements, speciation data from 2016-2019 were utilized for Bakersfield, Visalia, and Modesto and speciation data from 2017-2019 were utilized for Fresno. For each quarter, percent contributions from individual chemical species to FRM $PM_{2.5}$ mass were calculated as the average of the corresponding quarters from 2017-2019 for Fresno and from 2016-2019 for the other three sites.

Table 30: 2016-2019 $PM_{2.5}$ speciation data used for each $PM_{2.5}$ design site.

AQS Site ID	$PM_{2.5}$ Design Site	$PM_{2.5}$ Speciation Site
60290016	Bakersfield - Planz	Bakersfield – California
61072002	Visalia	Visalia – Church
60290010	Bakersfield- Golden State	Bakersfield – California
60311004	Hanford	Visalia – Church
60290014	Bakersfield - California Ave.	Bakersfield – California
60310004	Corcoran	Visalia – Church
60195025	Fresno - Hamilton & Winery	Fresno – Garland
60190011	Fresno - Garland	Fresno – Garland
60990006	Turlock	Modesto – 14th
60195001	Clovis	Fresno – Garland
60771002	Stockton	Modesto – 14th
60470003	Merced - S Coffee	Modesto – 14th
60392010	Madera	Fresno – Garland
60472510	Merced - Main Street	Modesto – 14th
60990005	Modesto	Modesto – 14th
60772010	Manteca	Modesto – 14th
60192009	Tranquility	Fresno – Garland

Calculation of relative response factors

Due to the differences in modeled years, the RRFs in the original 2018 SJV $PM_{2.5}$ SIP submittal cannot be directly used in the revision. The 2018 SJV $PM_{2.5}$ SIP involved the modeling of years 2013, 2020, 2024, and 2025. Given that the current revision involved base year 2018 and future year 2023, using modeling response (i.e., relative response factors) from 2020 to 2024 from the 2018 plan would be most appropriate to derive the modeling response from 2018 to 2023 given that emissions differences between 2018 and 2020, and 2023 and 2024 are smallest compared to other years. The RRFs from 2018 to 2023 involved scaling of RRFs from 2020 to 2024 based on the following equations:

$$RRF = 1 - (1 - RRF') \times Scaling\ factor$$

$$Scaling\ factor = \frac{\frac{(E_F - E_B)}{E_B}}{\frac{(E_{F'} - E_{B'})}{E_{B'}}}$$

Where: *RRF* is the new RRF from 2018 to 2023 that is used to project the 2023 DV; *RRF'* is the old RRF from 2020 to 2024; *Scaling_factor* is calculated by the ratios of emissions reductions/changes and is specific to each $PM_{2.5}$ component; E_F is the 2023 emissions; E_B is the 2018 emissions; E_F' is the 2024 emissions; and the E_B' is the 2020 emissions. RRFs are calculated for nitrate, sulfate, OC, EC, and crustal materials. For nitrate, the new RRF is scaled based on NOx emissions reductions; for sulfate, the new RRF is scaled using SOx emissions change; for OC, EC, and crustal materials, source level emissions speciation profiles were applied to the $PM_{2.5}$ emission inventory to calculate specific emissions of those compounds. Then, the new RRFs for OC, EC, and crustal materials were scaled based on emissions change of OC, EC, and other $PM_{2.5}$ components, respectively. In addition, for scaling RRFs of sulfate and crustal materials, basin-wide emissions can slightly increase while RRFs at certain sites can be smaller than 1. The use of equations above can lead to new RRF being smaller than the old RRF despite emission increase. Under that condition, to be conservative, an additional constraint is imposed so that the new RRF cannot be smaller than the old RRF (i.e., RRF'). Ammonium is assumed to fully neutralize sulfate and nitrate given that RRF for ammonium cannot be scaled based on ammonia emissions as ammonia is not the limiting precursor for ammonium nitrate and ammonium sulfate formation in the SJV.

Emission summary

Table 31 summarizes the 2018 baseline and 2023 attainment SJV annual anthropogenic emissions for the five $PM_{2.5}$ precursors. Noting that the 2018 emissions are based on the 2016 CEPAM1.0.5 baseline emissions; and the 2023 attainment emissions are the 2016 CEPAM1.0.5 2023 baseline emissions minus the emission reductions achieved through the control measures shown in Table 32. From 2018 to 2023, there is a 32% reduction in NOx emissions, 1.4% reduction in primary $PM_{2.5}$ emissions, and 1.7% reduction in ROG emissions between 2018 and the 2023 attainment inventory, while NH_3 emissions are almost flat and there is a slight increase in SOx emissions.

Table 31: SJV annual planning emissions for 2018 (baseline) and 2023 (attainment).*

Category	NOx	ROG	$PM_{2.5}$	SOx	NH_3
			2018 (baseline)		
Stationary	29.1	89.8	8.7	6.4	14.8
Area	8.0	152.0	41.6	0.3	308.1
On-road Mobile	110.7	28.9	3.6	0.6	3.8
Other Mobile	73.6	28.0	5.0	0.3	0.03
Total	221.4	298.7	58.8	7.7	326.7
			2023 (Attainment)		
Stationary	28.1	94.2	8.9	6.7	15.9
Area	7.5	154.1	41.5	0.3	305.4
On-road Mobile	54.9	20.4	3.1	0.6	3.5
Other Mobile	60.1	25.1	4.5	0.3	0.04
Total	150.6	293.7	58.0	8.0	324.9

*: the 2023 attainment emissions are 2016 CEPAM1.0.5 2023 baseline emissions minus emission reductions shown in Table 32.

Table 32: Additional NOx and primary $PM_{2.5}$ emission reductions in 2023 (in addition to the CEPAM1.0.5 baseline emission reductions).

NOx emissions reduction measures	Emission reductions in 2023 (tpd)
Heavy-duty diesel trucks I/M program	3
Warranty requirements for heavy-duty vehicles	0.01
Primary $PM_{2.5}$ emission reduction measures	Emission reductions in 2023 (tpd)
Residential wood combustion	0.2
Heavy-duty diesel trucks I/M program	0.04
Lower opacity limits for heavy-duty vehicles	0.09

Calculation of future year design values

Projecting baseline annual $PM_{2.5}$ DVs to the future year involves the following five steps.

Step 1: Compute observed quarterly weighted average concentrations (consistent with the weighted average DV calculation) at each monitor for the following species: ammonium, nitrate, sulfate, organic carbon, elemental carbon, and other primary PM. This is done by multiplying quarterly weighted average FRM $PM_{2.5}$ concentrations by the fractional composition of $PM_{2.5}$ species for each quarter.

Step 2: Compute the $PM_{2.5}$ component specific RRFs for each quarter and each species at each monitor based on the approach outlined in the RRF calculation section.

Step 3: Apply the component specific RRFs from Step 2 to the observed quarterly weighted average concentrations from Step 1 to obtain projected quarterly species concentrations.

Step 4: Use the online E-AIM model (http://www.aim.env.uea.ac.uk/aim/aim.php) to calculate future year particle-bound water for each quarter at each monitor based on projected ammonium sulfate and ammonium nitrate concentrations.

Step 5: The projected concentration for each quarter is summed over all species, including particle bound water from Step 4, as well as a blank mass of 0.5 µg/m^3 to obtain the future quarterly average $PM_{2.5}$ concentration. Finally, the future annual $PM_{2.5}$ DVs are calculated as the average of the projected $PM_{2.5}$ concentrations from the four quarters. If the projected annual DV is ≤ NAAQS, then the attainment test is passed.

Results: Projected 2023 annual $PM_{2.5}$ DVs

Projected future year 2023 annual $PM_{2.5}$ DVs for each monitor are given in Table 33. For the 1997 annual standard, the Bakersfield-Planz site has the highest projected DV at 14.7 µg/m^3, which is below the 15 µg/m^3 annual $PM_{2.5}$ standard established by the U.S. EPA in 1997.

The Corresponding RRFs for the annual $PM_{2.5}$ are given in Table 34 (Note, the RRF is calculated on a quarterly basis in the actual DV calculation, so the annual RRF is shown for illustrative purposes only). From 2018 to 2023, there are decent reductions projected for ammonium nitrate and EC. Small reduction is projected for organic matter. The reduction in ammonium nitrate is a direct result of NO_x emission reductions in 2023 compared to 2018 (i.e., ~32% reduction), while EC and OM reductions are tied to the reduction in primary $PM_{2.5}$ emissions. Since future year projection is performed for each individual $PM_{2.5}$ specie, the base year annual $PM_{2.5}$ compositions are given in Table 35. In addition, the projected 2023 annual $PM_{2.5}$ compositions are shown in Table 36. In 2023, OM is the dominant $PM_{2.5}$ component followed by contributions from ammonium nitrate, ammonium sulfate, and crustal material.

Table 33: Projected 2023 Annual $PM_{2.5}$ DVs.

Site AQS ID	Name	Base DV (µg/m^3)	2023 Annual DV (µg/m^3)
60290016	Bakersfield - Planz	16.3	14.7
61072002	Visalia	15.2	14.0
60290010	Bakersfield – Golden State	15.1	13.6
60311004	Hanford	14.8	12.8
60290014	Bakersfield – California Ave.	14.6	13.2
60310004	Corcoran	14.3	13.3
60195025	Fresno – Hamilton & Winery	13.9	13.0
60190011	Fresno - Garland	13.3	12.4
60195001	Clovis	12.2	11.4
60990006	Turlock	12.2	11.3
60771002	Stockton	11.7	11.1
60470003	Merced - S Coffee	11.5	10.6
60392010	Madera	11.3	10.2
60472510	Merced - Main Street	11.3	10.8
60990005	Modesto	10.6	9.9
60772010	Manteca	9.9	9.4
60192009	Tranquility	7.5	6.8

Table 34: 2023 Annual RRFs for $PM_{2.5}$ components.

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield-Planz	0.90	0.79	0.63	0.98	0.96	0.82	1.01
Visalia	0.92	0.82	0.66	1.00	0.98	0.85	1.01
Bakersfield-Golden State	0.90	0.78	0.62	0.98	0.96	0.84	1.01
Hanford	0.87	0.77	0.68	0.99	0.98	0.87	1.04
Bakersfield - California Ave.	0.90	0.78	0.63	0.98	0.96	0.82	1.01
Corcoran	0.93	0.82	0.67	1.00	0.98	0.88	1.03
Fresno - Hamilton & Winery	0.93	0.85	0.72	0.99	0.97	0.86	1.02
Fresno - Garland	0.93	0.84	0.71	0.99	0.96	0.86	1.02
Clovis	0.93	0.85	0.70	0.99	0.96	0.87	1.02
Turlock	0.93	0.86	0.80	1.01	1.00	0.90	1.02
Stockton	0.95	0.90	0.85	1.02	1.00	0.94	1.02
Merced - S Coffee	0.92	0.84	0.77	1.01	1.00	0.91	1.02
Madera	0.90	0.81	0.72	1.00	0.98	0.87	1.01
Merced - Main Street	0.96	0.89	0.75	1.01	1.00	0.91	1.02
Modesto	0.94	0.87	0.81	1.01	1.00	0.92	1.02
Manteca	0.95	0.90	0.84	1.03	1.00	0.92	1.01
Tranquility	0.91	0.81	0.70	1.00	0.99	0.88	1.00

Table 35: 2018-2020 Baseline Annual $PM_{2.5}$ composition.

Site	Base $PM_{2.5}$ (µg/m³)	Base NH_4 (µg/m³)	Base NO_3 (µg/m³)	Base SO_4 (µg/m³)	Base OM (µg/m³)	Base EC (µg/m³)	Base Crustal (µg/m³)
Bakersfield-Planz	16.3	1.03	1.91	1.27	8.07	0.88	1.94
Visalia	15.2	1.02	1.90	1.24	7.90	0.60	1.36
Bakersfield-Golden State	15.1	0.97	1.85	1.14	7.44	0.82	1.72
Hanford	14.8	1.59	3.90	1.21	4.85	0.59	1.31
Bakersfield - California Ave.	14.6	0.94	1.83	1.10	7.24	0.79	1.66
Corcoran	14.3	0.95	1.77	1.17	7.42	0.57	1.29
Fresno - Hamilton & Winery	13.9	0.76	1.34	1.00	7.84	0.80	1.21
Fresno - Garland	13.3	0.73	1.34	0.92	7.46	0.77	1.11
Clovis	12.2	0.66	1.13	0.88	6.82	0.69	1.08
Turlock	12.2	1.15	2.76	0.95	4.58	0.66	0.98
Stockton	11.7	1.11	2.64	0.92	4.36	0.62	0.94
Merced - S Coffee	11.5	1.08	2.53	0.93	4.34	0.61	0.95
Madera	11.3	0.97	2.27	0.82	4.59	0.64	0.99
Merced - Main Street	11.3	0.62	1.03	0.86	6.34	0.60	0.90
Modesto	10.6	1.00	2.40	0.81	3.93	0.57	0.84
Manteca	9.9	0.91	2.13	0.78	3.70	0.52	0.82
Tranquility	7.5	0.61	1.35	0.57	3.02	0.40	0.70

Table 36: Projected 2023 Annual $PM_{2.5}$ composition.

Site	Future $PM_{2.5}$ (µg/m³)	Future NH_4 (µg/m³)	Future NO_3 (µg/m³)	Future SO_4 (µg/m³)	Future OM (µg/m³)	Future EC (µg/m³)	Future Crustal (µg/m³)	Future Water (µg/m³)	Blank (µg/m³)
Bakersfield-Planz	14.7	0.82	1.21	1.25	7.73	0.73	1.97	0.53	0.5
Visalia	14.0	0.83	1.26	1.24	7.77	0.52	1.37	0.53	0.5
Bakersfield-Golden State	13.6	0.75	1.15	1.12	7.16	0.68	1.75	0.48	0.5
Hanford	12.8	1.22	2.64	1.20	4.76	0.51	1.37	0.64	0.5
Bakersfield - California Ave.	13.2	0.74	1.15	1.08	6.92	0.65	1.68	0.47	0.5
Corcoran	13.3	0.78	1.19	1.16	7.30	0.50	1.32	0.50	0.5
Fresno - Hamilton & Winery	13.0	0.65	0.96	0.99	7.56	0.68	1.23	0.42	0.5
Fresno - Garland	12.4	0.62	0.96	0.91	7.18	0.66	1.12	0.40	0.5
Clovis	11.4	0.56	0.80	0.88	6.58	0.60	1.10	0.37	0.5
Turlock	11.3	1.00	2.19	0.95	4.57	0.59	1.00	0.53	0.5
Stockton	11.1	1.00	2.24	0.94	4.36	0.59	0.96	0.53	0.5
Merced - S Coffee	10.6	0.91	1.93	0.93	4.33	0.56	0.97	0.48	0.5
Madera	10.2	0.78	1.64	0.82	4.48	0.55	0.99	0.43	0.5
Merced - Main Street	10.8	0.55	0.78	0.87	6.31	0.55	0.92	0.36	0.5
Modesto	9.9	0.87	1.94	0.82	3.93	0.52	0.86	0.46	0.5
Manteca	9.4	0.82	1.80	0.81	3.69	0.48	0.83	0.44	0.5
Tranquility	6.8	0.49	0.95	0.57	2.98	0.35	0.70	0.26	0.5

5.5 FUTURE YEAR 2024 DESIGN VALUES (ADDRESSING THE 2006 24-HOUR $PM_{2.5}$ STANDARD)

Projected future year 2024 annual $PM_{2.5}$ DVs and 24-hour $PM_{2.5}$ DVs for each site are given in Tables 37~~3~~ and 38~~4~~, respectively. For the 24-hour standard, the Fresno – Hamilton & Winery site has the highest projected DV at 35.2 µg/m^3, which meets the 35 µg/m^3 24-hour $PM_{2.5}$ standard established by the U.S. EPA in 2006 (technically, the form of the 24-hour $PM_{2.5}$ standard means that a DV needs to be less than 35.5 µg/m^3 to demonstrate attainment). The Bakersfield-Planz monitor has the highest projected 2024 annual DV of 12.1 µg/m^3, which will be decreased to 12.0 µg/m^3 in 2025 as shown in Section 5.5.

Correspondingly, RRFs for both the annual $PM_{2.5}$ and 24-hour $PM_{2.5}$ are provided in Tables 39~~5~~-40~~36~~, respectively (note that the RRF is calculated on a quarterly basis in the actual DV calculation, so the annual RRFs are given for illustrative purposes only). From 2013 to 2024, there are significant reductions projected for ammonium nitrate and EC, modest reductions in OM, almost no change in sulfate, and a slight increase in crustal material (i.e., other primary $PM_{2.5}$ such as fugitive dust emissions). Again, because of the significant reduction in NO_x emissions from 2013 to 2024, there is a significant reduction projected for ammonium nitrate. The larger reductions in EC and modest reductions in OM are primarily due to emission reductions associated with primary $PM_{2.5}$ emission sources such as residential wood combustion and commercial cooking. Since future year projections are performed for each individual $PM_{2.5}$ species and then summed to obtain total $PM_{2.5}$, the projected 2024 annual and 24-hour $PM_{2.5}$ composition is shown in Tables 41~~37~~-42~~38~~, respectively. In 2024, for the 24-hour standard, OM and ammonium nitrate remain the two largest components. In contrast, for the annual standard, OM is the dominant component.

Table 3~~3~~7. Projected future year 2024 annual $PM_{2.5}$ DVs at each monitor

Site AQS ID	Name	Base DV (µg/m³)	2024 Annual DV (µg/m³)
60290016	Bakersfield - Planz	17.2	12.1
60392010	Madera	16.9	12.0
60311004	Hanford	16.5	10.6
61072002	Visalia	16.2	11.6
60195001	Clovis	16.1	11.4
60290014	Bakersfield - California	16.0	11.0
60190011	Fresno-Garland	15.0	10.4
60990006	Turlock	14.9	11.2
60195025	Fresno - Hamilton & Winery	14.2	10.0
60771002	Stockton	13.1	10.7
60470003	Merced - S Coffee	13.1	9.7
60990005	Modesto	13.0	10.0
60472510	Merced - Main Street	11.0	8.6
60772010	Manteca	10.1	8.0
60192009	Tranquility	7.7	5.6

Table 3~~4~~8. Projected future year 2024 24-hour $PM_{2.5}$ DVs at each monitor

Site AQS ID	Name	Base DV (µg/m³)	2024 24-hour DV (µg/m³)
60290014	Bakersfield – California	64.1	33.5
60190011	Fresno – Garland	60.0	32.9
60311004	Hanford	60.0	30.3
60195025	Fresno – Hamilton & Winery	59.3	35.2
60195001	Clovis	55.8	30.8
61072002	Visalia	55.5	31.3
60290016	Bakersfield – Planz	55.5	30.1
60392010	Madera	51.0	30.3
60990006	Turlock	50.7	30.2
60990005	Modesto	47.9	29.1
60472510	Merced – Main Street	46.9	27.5
60771002	Stockton	42.0	28.6
60470003	Merced – S Coffee	41.1	24.3
60772010	Manteca	36.9	25.8
60192009	Tranquility	29.5	16.2

Table 395. 2024 Annual RRFs for $PM_{2.5}$ components

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield - Planz	0.70	0.36	0.36	0.96	0.74	0.38	1.06
Madera	0.71	0.55	0.45	0.99	0.81	0.53	1.03
Hanford	0.64	0.48	0.38	1.01	0.85	0.55	0.93
Visalia	0.71	0.39	0.39	1.00	0.81	0.48	1.05
Clovis	0.71	0.46	0.43	0.99	0.72	0.49	1.11
Bakersfield - California	0.69	0.36	0.34	0.96	0.73	0.38	1.07
Fresno - Garland	0.70	0.49	0.45	0.98	0.72	0.45	1.09
Turlock	0.75	0.57	0.53	0.99	0.88	0.55	1.08
Fresno - H&W	0.71	0.50	0.47	0.99	0.73	0.43	1.08
Stockton	0.81	0.68	0.60	1.02	0.93	0.63	1.10
Merced - S Coffee	0.74	0.54	0.48	1.00	0.88	0.57	1.07
Modesto	0.77	0.60	0.54	0.99	0.90	0.57	1.09
Merced - Main St	0.79	0.52	0.47	1.00	0.87	0.58	1.07
Manteca	0.79	0.66	0.60	1.00	0.89	0.60	1.07
Tranquility	0.72	0.51	0.38	1.00	0.88	0.60	1.03

Table 4036. 2024 24-hour RRF for $PM_{2.5}$ components

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield - California	0.53	0.35	0.37	0.96	0.70	0.37	1.06
Fresno – Garland	0.55	0.46	0.47	0.96	0.61	0.39	1.09
Hanford	0.50	0.37	0.38	1.03	0.81	0.53	0.91
Fresno - H&W	0.59	0.50	0.51	0.99	0.66	0.42	1.10
Clovis	0.60	0.43	0.45	0.99	0.70	0.46	1.11
Visalia	0.56	0.44	0.46	1.04	0.72	0.44	1.06
Bakersfield – Planz	0.58	0.37	0.39	0.96	0.68	0.35	1.06
Madera	0.59	0.47	0.49	1.00	0.72	0.53	1.06
Turlock	0.60	0.46	0.47	0.97	0.77	0.52	1.08
Modesto	0.62	0.50	0.50	0.98	0.76	0.53	1.09
Merced – Main St	0.59	0.48	0.49	0.97	0.66	0.49	1.08
Stockton	0.69	0.53	0.53	1.00	0.89	0.62	1.09
Merced – S Coffee	0.58	0.48	0.50	0.97	0.68	0.49	1.07
Manteca	0.69	0.59	0.60	0.99	0.82	0.61	1.07
Tranquility	0.54	0.31	0.31	1.05	0.82	0.61	1.11

Table 41~~37~~. Projected 2024 Annual $PM_{2.5}$ compositions

Name	Future $PM_{2.5}$ (µg/m³)	Future NH_4 (µg/m³)	Future NO_3 (µg/m³)	Future SO_4 (µg/m³)	Future OM (µg/m³)	Future EC (µg/m³)	Future Crustal (µg/m³)	Future Water (µg/m³)	Blank (µg/m³)
Bakersfield – Planz	12.1	0.50	0.93	1.59	4.91	0.37	2.69	0.57	0.50
Madera	12.0	0.96	1.82	1.47	4.91	0.48	1.26	0.61	0.50
Hanford	10.6	1.03	2.11	1.52	3.28	0.39	1.12	0.62	0.50
Visalia	11.6	0.55	1.16	1.45	5.80	0.33	1.21	0.56	0.50
Clovis	11.4	0.51	0.92	1.28	6.08	0.43	1.18	0.50	0.50
Bakersfield - California	11.0	0.47	0.89	1.41	4.54	0.35	2.37	0.51	0.50
Fresno – Garland	10.4	0.51	0.96	1.09	5.60	0.36	0.98	0.44	0.50
Turlock	11.2	0.91	2.10	1.21	4.51	0.42	0.94	0.56	0.50
Fresno – H &W	10.0	0.50	0.96	1.04	5.37	0.33	0.92	0.42	0.50
Stockton	10.7	0.94	1.97	1.15	4.27	0.42	0.90	0.53	0.50
Merced - S Coffee	9.7	0.74	1.58	1.12	4.01	0.38	0.86	0.47	0.50
Modesto	10.0	0.83	1.85	1.06	4.02	0.38	0.83	0.49	0.50
Merced - Main St	8.6	0.43	0.80	0.88	4.69	0.32	0.66	0.34	0.50
Manteca	8.0	0.70	1.55	0.83	3.06	0.30	0.63	0.40	0.50
Tranquility	5.6	0.39	0.70	0.61	2.36	0.24	0.51	0.23	0.50

Table 42~~38~~. Projected 2024 24-hour $PM_{2.5}$ compositions

Name	Future $PM_{2.5}$ (µg/m³)	Future NH_4 (µg/m³)	Future NO_3 (µg/m³)	Future SO_4 (µg/m³)	Future OM (µg/m³)	Future EC (µg/m³)	Future Crustal (µg/m³)	Future Water (µg/m³)	Blank (µg/m³)
Bakersfield – California	33.5	2.7	8.7	2.4	12.8	1.1	3.5	1.8	0.5
Fresno - Garland	32.9	3.0	9.7	1.3	14.4	1.0	1.0	1.9	0.5
Hanford	30.3	3.4	10.9	2.3	9.1	1.0	1.0	2.2	0.5
Fresno – H&W	35.2	3.2	10.4	1.4	15.5	1.1	1.0	2.0	0.5
Clovis	30.8	2.2	6.7	1.9	15.1	1.0	1.7	1.6	0.5
Visalia	31.3	3.4	10.7	2.1	10.6	0.7	1.0	2.2	0.5
Bakersfield – Planz	30.1	2.3	6.1	4.3	11.6	0.7	2.6	1.9	0.5
Madera	30.3	2.9	9.4	1.2	12.4	1.2	0.8	1.8	0.5
Turlock	30.2	3.0	9.4	2.1	11.1	1.2	1.1	1.9	0.5
Modesto	29.1	3.0	9.0	2.1	10.0	1.3	1.3	1.8	0.5
Merced – Main Street	27.5	2.5	7.8	1.6	11.3	1.1	1.0	1.6	0.5
Stockton	28.6	2.7	8.1	1.8	11.5	1.2	1.1	1.7	0.5
Merced – S Coffee	24.3	2.6	8.0	1.7	8.2	1.0	0.8	1.6	0.5
Manteca	25.8	2.8	8.8	1.4	8.8	1.1	0.8	1.7	0.5
Tranquility	16.2	1.1	3.4	0.9	8.3	0.9	0.5	0.7	0.5

5.6 FUTURE YEAR 2025 DESIGN VALUES (ADDRESSING THE 2012 ANNUAL $PM_{2.5}$ STANDARD)

Projected future year 2025 annual $PM_{2.5}$ and 24-hour $PM_{2.5}$ DVs for each site are given in Tables 4339 and 440, respectively. For the annual standard, the Bakersfield-Planz and Madera sites have the highest projected DV at 12.0 µg/m^3, which meets the 12 µg/m^3 annual $PM_{2.5}$ standard established by the U.S. EPA in 2012 (technically, the form of the annual $PM_{2.5}$ standard means that a DV needs to be less than 12.05 µg/m^3 to demonstrate attainment). For reference and to illustrate the effect of emission reductions on 24-hour $PM_{2.5}$ from 2024 to 2025, the Fresno – Hamilton & Winery monitor had the highest 24-hour $PM_{2.5}$ levels in 2025 and showed a reduction in DV from 35.2 µg/m^3 in 2024 to 34.8 µg/m^3 in 2025, with all of the reduction coming from lower ammonium nitrate levels resulting from NO_x reductions.

RRFs corresponding to the future DVs for both annual and 24-hour $PM_{2.5}$ are provided in Tables 451-462, respectively (as noted above, the RRF is actually calculated on a quarterly basis and the annual RRF is shown for illustrative purposes only). From 2013 to 2025, there were significant reductions projected for ammonium nitrate and EC, modest reductions in OM, almost no change in sulfate, and a slight increase in crustal material (i.e., other primary $PM_{2.5}$ such as fugitive dust emissions). As discussed previously, reductions in ammonium nitrate are a direct result of dramatic NO_x emission reductions from 2013 to 2025. Reductions in EC and OM are primarily due to emission reductions from primary $PM_{2.5}$ sources, such as residential wood combustion, commercial cooking and mobile sources. Because the future year projection is performed for each individual $PM_{2.5}$ species, the projected 2025 annual and 24-hour $PM_{2.5}$ composition is given in Tables 473 and 484, respectively. In 2025, OM will be the dominant component for the annual standard, and for the 24-hour standard, OM and ammonium nitrate remain the two largest components.

Table 43~~39~~. Projected future year 2025 annual $PM_{2.5}$ DVs at each monitor.

Site AQS ID	Name	Base DV (µg/m^3)	2025 Annual DV (µg/m^3)
60290016	Bakersfield - Planz	17.2	12.0
60392010	Madera	16.9	12.0
60311004	Hanford	16.5	10.5
61072002	Visalia	16.2	11.5
60195001	Clovis	16.1	11.4
60290014	Bakersfield - California	16.0	11.0
60190011	Fresno-Garland	15.0	10.4
60990006	Turlock	14.9	11.1
60195025	Fresno - Hamilton & Winery	14.2	10.0
60771002	Stockton	13.1	10.6
60470003	Merced - S Coffee	13.1	9.6
60990005	Modesto	13.0	9.9
60472510	Merced - Main Street	11.0	8.6
60772010	Manteca	10.1	8.0
60192009	Tranquility	7.7	5.5

Table 44~~0~~. Projected future year 2025 24-hour $PM_{2.5}$ DVs at each monitor.

Site AQS ID	Name	Base DV (µg/m^3)	2025 24-hour DV (µg/m^3)
60290014	Bakersfield – California	64.1	33.0
60190011	Fresno – Garland	60.0	32.5
60311004	Hanford	60.0	29.6
60195025	Fresno – Hamilton & Winery	59.3	34.8
60195001	Clovis	55.8	30.5
61072002	Visalia	55.5	30.8
60290016	Bakersfield – Planz	55.5	29.8
60392010	Madera	51.0	29.8
60990006	Turlock	50.7	29.7
60990005	Modesto	47.9	28.6
60472510	Merced – Main Street	46.9	27.1
60771002	Stockton	42.0	28.2
60470003	Merced – S Coffee	41.1	23.9
60772010	Manteca	36.9	25.4
60192009	Tranquility	29.5	16.0

Table 45~~1~~. 2025 Annual RRFs for $PM_{2.5}$ components.

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield – Planz	0.70	0.35	0.34	0.96	0.74	0.37	1.07
Madera	0.71	0.54	0.43	0.99	0.81	0.52	1.04
Hanford	0.63	0.47	0.37	1.02	0.85	0.54	0.93
Visalia	0.71	0.38	0.37	1.00	0.82	0.47	1.05
Clovis	0.71	0.45	0.42	1.00	0.73	0.49	1.12
Bakersfield – California	0.69	0.35	0.33	0.96	0.74	0.37	1.07
Fresno - Garland	0.70	0.47	0.43	0.99	0.72	0.44	1.10
Turlock	0.74	0.56	0.52	0.99	0.89	0.54	1.09
Fresno - H&W	0.70	0.49	0.45	0.99	0.73	0.42	1.09
Stockton	0.81	0.67	0.58	1.02	0.93	0.62	1.10
Merced - S Coffee	0.73	0.53	0.46	1.00	0.88	0.56	1.08
Modesto	0.76	0.59	0.53	0.99	0.90	0.57	1.09
Merced - Main St	0.78	0.51	0.46	1.00	0.87	0.57	1.08
Manteca	0.79	0.65	0.58	1.01	0.90	0.59	1.08
Tranquility	0.72	0.50	0.36	1.00	0.89	0.59	1.03

Table 46~~2~~. 2025 24-hour RRFs for $PM_{2.5}$ components.

Site	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield - California	0.52	0.34	0.35	0.96	0.71	0.36	1.06
Fresno – Garland	0.54	0.44	0.45	0.96	0.61	0.39	1.09
Hanford	0.51	0.36	0.36	1.03	0.82	0.52	0.91
Fresno - H&W	0.58	0.48	0.49	1.00	0.66	0.41	1.11
Clovis	0.55	0.41	0.43	1.01	0.65	0.45	1.14
Visalia	0.55	0.43	0.44	1.04	0.72	0.44	1.07
Bakersfield – Planz	0.57	0.36	0.37	0.97	0.68	0.35	1.06
Madera	0.59	0.46	0.47	1.00	0.73	0.52	1.07
Turlock	0.59	0.44	0.45	0.97	0.77	0.52	1.09
Modesto	0.61	0.48	0.48	0.98	0.76	0.53	1.10
Merced – Main St	0.58	0.46	0.47	0.98	0.67	0.49	1.08
Stockton	0.66	0.51	0.51	1.01	0.87	0.62	1.10
Merced – S Coffee	0.57	0.46	0.48	0.98	0.68	0.49	1.07
Manteca	0.68	0.57	0.58	1.00	0.82	0.61	1.08
Tranquility	0.54	0.30	0.30	1.06	0.82	0.61	1.12

Table 473. Projected 2025 Annual $PM_{2.5}$ composition.

Name	Future $PM_{2.5}$ (µg/m³)	Future NH_4 (µg/m³)	Future NO_3 (µg/m³)	Future SO_4 (µg/m³)	Future OM (µg/m³)	Future EC (µg/m³)	Future Crustal (µg/m³)	Future Water (µg/m³)	Blank (µg/m³)
Bakersfield – Planz	12.0	0.49	0.90	1.59	4.93	0.36	2.70	0.57	0.50
Madera	12.0	0.94	1.77	1.48	4.92	0.48	1.26	0.60	0.50
Hanford	10.5	1.00	2.04	1.53	3.28	0.38	1.12	0.61	0.50
Visalia	11.5	0.54	1.12	1.46	5.82	0.32	1.22	0.55	0.50
Clovis	11.4	0.49	0.89	1.29	6.12	0.43	1.19	0.50	0.50
Bakersfield - California	11.0	0.46	0.85	1.41	4.56	0.34	2.38	0.50	0.50
Fresno – Garland	10.4	0.49	0.93	1.10	5.62	0.36	0.99	0.43	0.50
Turlock	11.1	0.89	2.04	1.21	4.53	0.42	0.95	0.55	0.50
Fresno – H &W	10.0	0.49	0.93	1.04	5.38	0.33	0.92	0.42	0.50
Stockton	10.6	0.93	1.92	1.16	4.28	0.41	0.90	0.52	0.50
Merced - S Coffee	9.6	0.73	1.53	1.13	4.02	0.37	0.87	0.47	0.50
Modesto	9.9	0.82	1.80	1.07	4.03	0.38	0.84	0.49	0.50
Merced - Main St	8.6	0.42	0.77	0.89	4.70	0.32	0.67	0.34	0.50
Manteca	8.0	0.69	1.52	0.83	3.07	0.30	0.64	0.40	0.50
Tranquility	5.5	0.39	0.67	0.61	2.36	0.24	0.52	0.23	0.50

Table 484. Projected 2025 24-hour $PM_{2.5}$ composition.

Name	Future $PM_{2.5}$ (µg/m³)	Future NH_4 (µg/m³)	Future NO_3 (µg/m³)	Future SO_4 (µg/m³)	Future OM (µg/m³)	Future EC (µg/m³)	Future Crustal (µg/m³)	Future Water (µg/m³)	Blank (µg/m³)
Bakersfield – California	33.0	2.6	8.3	2.4	12.9	1.1	3.5	1.7	0.5
Fresno - Garland	32.5	2.9	9.4	1.4	14.5	1.0	1.0	1.8	0.5
Hanford	29.6	3.0	9.4	2.5	9.8	1.0	1.4	2.0	0.5
Fresno – H&W	34.8	3.1	10.1	1.4	15.6	1.1	1.0	2.0	0.5
Clovis	30.5	2.6	8.3	1.6	13.8	1.1	0.9	1.7	0.5
Visalia	30.8	3.3	10.4	2.2	10.6	0.7	1.1	2.1	0.5
Bakersfield - Planz	29.8	2.2	5.9	4.3	11.7	0.7	2.6	1.9	0.5
Madera	29.8	2.8	9.1	1.2	12.5	1.2	0.8	1.8	0.5
Turlock	29.7	2.9	9.0	2.1	11.1	1.2	1.1	1.8	0.5
Modesto	28.6	2.9	8.7	2.1	10.1	1.3	1.3	1.8	0.5
Merced – Main Street	27.1	2.4	7.5	1.6	11.4	1.1	1.0	1.5	0.5
Stockton	28.2	2.8	8.4	2.0	10.7	1.2	0.8	1.7	0.5
Merced – S Coffee	23.9	2.5	7.7	1.7	8.2	1.0	0.8	1.6	0.5
Manteca	25.4	2.8	8.5	1.4	8.8	1.0	0.8	1.7	0.5
Tranquility	16.0	1.0	3.2	0.9	8.3	0.8	0.5	0.7	0.5

5.7 $PM_{2.5}$ PRECURSOR SENSITIVITY ANALYSIS

To evaluate the impact of reducing emissions of different $PM_{2.5}$ precursors on $PM_{2.5}$ DVs, a series of model sensitivity simulations were performed, for which anthropogenic emissions of the precursor species were reduced by a certain percentage from the baseline emissions. The U.S. EPA (USEPA, 2016) recommends a range of 30-70% reduction in precursor emissions in the nonattainment area, and that recommendation is followed here.

Comparing the difference in $PM_{2.5}$ DVs from the precursor reduction simulations and the baseline modeling shows the sensitivity of the $PM_{2.5}$ DVs to changes in baseline precursor emissions. Given the nature of $PM_{2.5}$ formation, the effect of reductions in the following $PM_{2.5}$ precursors were investigated: direct $PM_{2.5}$ (or primary $PM_{2.5}$), nitrogen oxides (NO_x), sulfur oxides (SO_x), ammonia (NH_3), and volatile organic compounds (VOCs). For each precursor sensitivity, only anthropogenic emissions in the San Joaquin Valley were reduced. Natural emissions and emissions outside of SJV were kept constant. Since it is known that NO_x and direct $PM_{2.5}$ contribute significantly to $PM_{2.5}$ formation in the SJV (Pusede et al., 2016) and the current control program already relies heavily on NO_x and direct $PM_{2.5}$ emission reductions, for NO_x and direct $PM_{2.5}$ only sensitivity runs for a 30% emission reduction were performed. Given the lower contribution of other precursor species to total $PM_{2.5}$ (i.e., ammonia, VOCs, and SO_x), both 30% and 70% emission reductions were performed for those species.

The precursor sensitivity modeling was performed for the 2013 base year, as well as future years 2020 and 2024. Given the small change in emissions between 2024 and 2025, precursor reduction simulations were not performed for 2025 because $PM_{2.5}$ sensitivity to precursor reductions is expected to be very similar between 2024 and 2025.

Tables 4~~9~~5 and 50~~46~~ show the impact from precursor reductions on annual and 24-hour $PM_{2.5}$ DVs for 2013, respectively. 30% PM and 30% NO_x reductions clearly show significant impact on $PM_{2.5}$ DVs. Direct PM reduction is more effective than NO_x for the annual standard, while their impacts are roughly comparable for the 24-hour standard. Although both NO_x and ammonia contribute to ammonium nitrate formation, the impact on $PM_{2.5}$ DVs from ammonia reduction is less than that from NO_x reductions, because ammonium nitrate formation in the SJV is limited by the availability of nitric acid instead of by ammonia (Lurmann et al., 2006; Markovic, 2014; Parworth, et al., 2017; Prabhakar et al., 2017), and so ammonia reduction is less effective than NO_x reductions in reducing ammonium nitrate concentrations. This is consistent with previous modeling studies (Chen et al., 2014; Kleeman et al., 2005; Pun et al., 2009). Reducing SO_x emissions has a very small impact on annual DVs, and may have dis-benefit for 24-hour

DVs at many sites. The negative impact on 24-hour DVs from SO_x emission reductions is due to the non-linearity in inorganic thermodynamics that governs the partitioning of ammonium and nitrate onto particles (e.g., West et al., 2011). Reducing VOC emissions has a small positive impact on both annual and 24-hour DVs. In 2013, reducing VOC emissions reduced secondary organic aerosol (SOA) formation as well as slightly lowering ammonium nitrate formation, as demonstrated in Kleeman et al. (2005) and Pun et al. (2009).

Tables 51~~47~~ and 52~~48~~ show the impact on annual and 24-hour DVs from precursor reductions in 2020, respectively. Similar to 2013, 30% PM and 30% NO_x reductions lead to substantial reductions in both annual and 24-hour $PM_{2.5}$ DVs in 2020. While ammonia reduction also leads to reductions in both annual and 24-hour $PM_{2.5}$ DVs, an equivalent percentage of ammonia reduction is typically less effective than NO_x reductions, due to the excess of ammonia in the SJV (Parworth et al., 2017; Prabhaker et al., 2017). While NO_x emissions in 2020 exhibit substantial reductions from 2013 levels, ammonia emission tends are relatively flat, meaning ammonia is even more in excess in 2020 (i.e., NH_3 reductions will be even less effective at reducing $PM_{2.5}$ in 2020). Reducing SO_x emissions leads to a slight decrease in annual DVs but a slight increase in 24-hour DVs at most sites, which is consistent with the 2013 results. Reducing VOC emissions has a very small impact on annual DVs but do result in a small reduction in the 24-hour DVs.

Tables 53~~49~~ and 54~~0~~ show the impact on annual and 24-hour DVs from precursor reductions in 2024, respectively. For both PM and NO_x emissions, a 30% reduction leads to significant reductions in both annual and 24-hour DVs, similar to years 2013 and 2020. Ammonia reduction is less effective than the same percent reduction in NO_x emissions. As previously stated, in the SJV ammonia is in excess and as NO_x emissions decrease further into the future, ammonia becomes even more in excess. This means that ammonium nitrate formation is even more limited by the availability of nitric acid than by ammonia in 2024 compared to 2013. Similar to 2013 and 2020, reducing SO_x emissions also has a slightly negative impact on 24-hour DVs at several sites due to the non-linearity of inorganic aerosol thermodynamics (e.g., West et al., 2011). The impact of SO_x emission reductions on the annual DVs is fairly small, primarily because of the limited amount of SO_x emissions in the SJV. Reducing VOC emissions has essentially no effect on the annual DVs, and a slightly negative impact on 24-hour DVs. Reducing VOC emissions can reduce SOA formation. However, under 2024 emission levels, reducing VOC emissions can slightly increase ammonium nitrate formation in the wintertime. This is different from the reference year 2013, because modeled ammonium nitrate concentration is much smaller in 2024 than in 2013, such that the response in ammonium nitrate formation to VOC emission reductions is reversed. A previous modeling study by CARB (2016) utilizing the Integrated Reaction Rate (IRR) technique in the CMAQ model shows that reduced VOC emissions can lead to less peroxyacetyle nitrate (PAN) formation (Meng et al., 1997), increased availability of nitrogen dioxide and more nighttime nitric acid formation. However, since lower VOC levels also reduce daytime hydroxyl radical concentrations and result in less daytime nitric acid formation, these processes compete with each other and lead to a different net impact on ammonium nitrate formation depending on the NO_x and VOC emission levels.

Table 495. Difference in Annual $PM_{2.5}$ DVs between the 2013 baseline run and precursor emission reduction runs.

Sites	Baseline DV	30% PM*	30% NO_x	30% NH_3	70% NH_3	30%ROG	70%ROG	30% SO_x	70% SO_x
Bakersfield - Planz	17.2	2.7	0.9	0.4	1.5	0.1	0.3	0.0	0.1
Madera	16.9	1.7	0.9	0.6	2.1	0.1	0.2	0.0	0.0
Hanford	16.5	1.4	1.7	0.7	2.3	0.1	0.2	0.0	0.0
Visalia	16.2	2.1	0.9	0.4	1.4	0.2	0.4	0.1	0.1
Clovis	16.1	2.5	0.6	0.3	1.2	0.1	0.3	0.0	0.0
Bakersfield - California	16.0	2.5	0.9	0.4	1.6	0.1	0.3	0.0	0.1
Fresno - Garland	15.0	2.3	0.5	0.3	1.1	0.1	0.3	0.0	0.1
Turlock	14.9	1.4	0.6	0.4	1.4	0.1	0.2	0.1	0.1
Fresno - H&W	14.2	2.2	0.4	0.3	1.1	0.1	0.3	0.0	0.1
Stockton	13.1	0.9	0.3	0.3	1.0	0.1	0.1	0.1	0.2
Merced - S Coffee	13.1	1.2	0.7	0.4	1.5	0.1	0.1	0.0	0.0
Modesto	13.0	1.2	0.5	0.4	1.3	0.1	0.1	0.1	0.1
Merced - M Street	11.0	1.2	0.4	0.2	0.7	0.1	0.1	0.0	0.0
Manteca	10.1	0.6	0.2	0.2	0.8	0.1	0.1	0.1	0.1
Tranquility	7.7	0.5	0.6	0.4	1.3	0.0	0.0	0.0	0.0

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

Table <u>50</u>~~46~~. Difference in 24-hour $PM_{2.5}$ DVs between the 2013 baseline run and precursor emission reduction runs.

Sites	Baseline DV	30% PM*	30% NO_x	30% NH_3	70% NH_3	30%ROG	70%ROG	30% SO_x	70% SO_x
Bakersfield – California	64.1	8.1	6.8	3.3	12.4	1.4	3.6	-0.4	-1.1
Fresno – Garland	60.0	7.6	3.5	2.0	7.5	0.9	2.2	-0.1	-0.6
Hanford	60.0	4.5	7.8	2.1	9.4	1.1	3.0	-0.4	-1.4
Fresno – H&W	59.3	7.2	2.5	1.9	9.6	1.1	2.7	-0.1	-0.5
Clovis	55.8	7.6	3.8	1.9	8.8	0.9	2.2	-0.2	-0.6
Visalia	55.5	5.4	3.5	2.0	9.7	1.9	4.8	-0.3	-0.8
Bakersfield – Planz	55.5	7.6	4.2	2.2	9.0	1.2	3.0	-0.4	-1.0
Madera	51.0	5.2	3.0	1.7	7.6	0.9	2.1	-0.3	-1.2
Turlock	50.7	3.8	3.6	1.5	6.3	0.7	1.6	-0.1	-0.4
Modesto	47.9	3.6	3.1	1.5	6.4	0.6	1.3	0.1	-0.1
Merced – M Street	46.9	5.0	2.7	1.0	5.0	0.4	1.0	-0.1	-0.3
Stockton	42.0	2.6	2.0	1.0	4.1	0.5	1.3	0.2	0.2
Merced – S Coffee	41.1	3.3	2.9	1.1	4.5	0.4	1.0	-0.1	-0.3
Manteca	36.9	1.9	1.1	0.9	3.5	0.5	1.2	0.2	0.5
Tranquility	29.5	2.1	3.9	2.2	8.8	0.1	0.2	0.0	-0.2

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

Table 5147. Difference in Annual $PM_{2.5}$ DVs between the 2020 baseline run and precursor emission reduction runs.

Sites	Baseline DV	30% PM*	30% NO_x	30% NH_3	70% NH_3	30%ROG	70%ROG	30% SO_x	70% SO_x
Bakersfield - Planz	14.6	2.3	0.8	0.2	0.8	0.0	0.1	0.0	0.1
Madera	14.2	1.4	0.9	0.4	1.2	0.0	0.1	0.0	0.0
Hanford	13.3	1.2	1.4	0.4	1.3	0.0	-0.1	0.0	0.0
Visalia	13.5	1.8	0.9	0.2	0.8	0.0	0.1	0.1	0.1
Clovis	13.4	2.0	0.6	0.2	0.6	0.1	0.2	0.0	0.0
Bakersfield - California	13.5	2.2	0.8	0.2	0.8	0.0	0.0	0.0	0.1
Fresno - Garland	12.4	1.9	0.5	0.2	0.6	0.1	0.1	0.0	0.1
Turlock	12.5	1.1	0.7	0.3	0.9	0.0	0.0	0.1	0.1
Fresno - H&W	11.9	1.7	0.5	0.2	0.6	0.1	0.1	0.0	0.1
Stockton	11.4	0.8	0.4	0.2	0.7	0.0	0.0	0.1	0.2
Merced - S Coffee	10.9	1.0	0.6	0.3	0.8	0.0	0.0	0.0	0.0
Modesto	11.0	1.0	0.5	0.2	0.8	0.0	0.0	0.1	0.1
Merced - M Street	9.3	1.0	0.3	0.1	0.4	0.0	0.0	0.0	0.1
Manteca	8.7	0.5	0.3	0.2	0.5	0.0	0.0	0.1	0.1
Tranquility	6.4	0.4	0.4	0.2	0.6	0.0	0.0	0.0	0.0

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

Table 5248. Difference in 24-hour $PM_{2.5}$ DVs between the 2020 baseline run and precursor emission reduction runs.

Sites	Baseline DV	30% PM*	30% NO_x	30% NH_3	70% NH_3	30%ROG	70%ROG	30% SO_x	70% SO_x
Bakersfield – California	47.6	5.8	7.4	1.9	6.4	0.1	0.5	-0.2	-0.9
Fresno – Garland	44.3	5.0	4.8	1.1	4.6	0.3	0.8	-0.1	-0.5
Hanford	43.7	3.2	7.3	1.4	4.6	0.0	0.2	-0.5	-1.3
Fresno – H&W	45.6	4.9	4.3	1.1	5.8	0.4	1.0	-0.1	-0.2
Clovis	41.1	4.9	4.5	0.9	4.7	0.3	0.7	-0.1	-0.4
Visalia	42.8	3.7	6.5	1.3	5.8	0.6	1.5	-0.2	-0.5
Bakersfield – Planz	41.2	5.2	6.0	1.4	5.4	0.3	1.0	-0.1	-0.3
Madera	38.9	3.3	4.1	1.0	3.6	0.2	0.6	-0.3	-0.9
Turlock	37.8	2.4	4.2	1.0	3.2	0.1	0.2	0.0	-0.2
Modesto	35.8	2.2	3.6	0.9	3.3	0.1	0.2	0.2	0.0
Merced – M Street	32.9	2.7	2.9	0.6	2.3	0.0	0.1	-0.1	-0.2
Stockton	33.5	2.0	2.5	0.7	2.1	0.1	0.3	0.2	0.4
Merced – S Coffee	30.0	2.1	2.9	0.5	2.2	0.0	0.1	-0.1	-0.2
Manteca	30.1	1.1	1.9	0.5	1.6	0.1	0.3	0.2	0.5
Tranquility	21.5	1.4	3.0	1.2	4.0	-0.1	-0.2	0.0	0.0

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

Table 5349. Difference in Annual $PM_{2.5}$ DVs between the 2024 baseline run and precursor emission reduction runs

Sites	Baseline DV	30% PM*	30% NO_x	30% NH_3	70% NH_3	30%ROG	70%ROG	30% SO_x	70% SO_x
Bakersfield - Planz	12.1	1.9	0.5	0.1	0.4	0.0	0.0	0.1	0.1
Madera	12.0	1.2	0.6	0.2	0.7	0.0	0.0	0.0	0.1
Hanford	10.6	1.0	0.8	0.3	0.8	-0.1	-0.2	0.0	0.1
Visalia	11.6	1.5	0.6	0.1	0.4	0.0	0.0	0.1	0.2
Clovis	11.4	1.6	0.4	0.1	0.3	0.0	0.1	0.0	0.1
Bakersfield - California	11.0	1.8	0.5	0.1	0.4	0.0	0.0	0.1	0.1
Fresno - Garland	10.4	1.5	0.4	0.1	0.3	0.0	0.1	0.0	0.1
Turlock	11.2	1.1	0.5	0.2	0.6	0.0	0.0	0.1	0.1
Fresno - H&W	10.0	1.4	0.4	0.1	0.3	0.0	0.1	0.1	0.1
Stockton	10.7	0.8	0.3	0.2	0.5	0.0	0.0	0.1	0.2
Merced - S Coffee	9.7	0.9	0.4	0.2	0.5	0.0	0.0	0.0	0.1
Modesto	10.0	1.0	0.4	0.2	0.6	0.0	0.0	0.1	0.2
Merced - M Street	8.6	0.9	0.2	0.1	0.3	0.0	0.0	0.0	0.1
Manteca	8.0	0.4	0.3	0.1	0.4	0.0	0.0	0.1	0.1
Tranquility	5.6	0.3	0.2	0.1	0.4	0.0	0.0	0.0	0.0

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

Table 540. Difference in 24-hour $PM_{2.5}$ DVs between the 2024 baseline run and precursor emission reduction runs

Sites	Baseline DV	30% PM*	30% NO_x	30% NH_3	70% NH_3	30%ROG	70%ROG	30% SO_x	70% SO_x
Bakersfield – California	33.5	5.0	4.0	1.0	2.8	-0.4	-0.9	-0.3	-0.7
Fresno – Garland	32.9	3.8	3.3	0.7	1.9	-0.1	-0.2	-0.1	-0.3
Hanford	30.3	2.7	4.5	1.0	3.0	-0.4	-1.0	-0.3	-1.1
Fresno – H&W	35.2	4.0	4.0	0.8	2.9	0.0	-0.1	0.0	-0.1
Clovis	30.8	4.2	3.4	0.7	2.3	0.0	0.0	0.0	0.0
Visalia	31.3	3.0	5.1	0.8	2.5	-0.3	-0.5	-0.1	-0.2
Bakersfield – Planz	30.1	4.0	3.6	0.7	2.2	-0.2	-0.5	0.1	0.2
Madera	30.3	2.9	2.6	0.7	1.6	-0.1	-0.3	-0.1	-0.6
Turlock	30.2	2.3	2.6	0.7	2.1	-0.1	-0.3	0.1	0.0
Modesto	29.1	2.3	2.6	0.6	2.2	-0.1	-0.2	0.2	0.2
Merced – M Street	27.5	2.6	2.1	0.5	1.4	-0.1	-0.3	0.0	-0.1
Stockton	28.6	2.1	2.1	0.5	1.5	-0.1	-0.1	0.3	0.6
Merced – S Coffee	24.3	2.1	1.9	0.4	1.2	-0.1	-0.3	-0.1	-0.1
Manteca	25.8	1.1	1.8	0.4	1.4	0.0	-0.1	0.3	0.6
Tranquility	16.2	1.2	1.5	0.6	1.8	-0.1	-0.4	0.0	0.1

*: 30% PM means that anthropogenic PM emissions within SJV are reduced by 30% from the baseline emissions inventory. Same meaning applies to other precursor reduction runs.

5.8 UNMONITORED AREA ANALYSIS

The unmonitored area analysis is performed to ensure that there are no regions outside of the existing monitoring network that could exceed the NAAQS if a monitor was present at that location (U.S. EPA, 2014). The U.S. EPA recommends combining spatially interpolated design value fields with modeled gradients for the pollutant of interest and grid-specific RRFs in order to generate gridded future year gradient adjusted design values. The spatial Interpolation of the observed design values is done only within the geographic region constrained by the monitoring network, since extrapolating to outside of the monitoring network is inherently uncertain. This analysis can be done using the Model Attainment Test Software (MATS) (Abt, 2014). However, this software is not open source and comes as a precompiled software package. To maintain transparency and flexibility in the analysis, in-house R codes (https://www.r-project.org/) developed at CARB are utilized in this analysis.

For annual $PM_{2.5}$ standards, the unmonitored area analysis involves the following steps:

Step 1: At each grid cell, the annual average $PM_{2.5}$ (total and by species) is calculated as the average of the 3x3 surrounding grid cells (i.e., consistent with the way that annual RRF is calculated) from the future year simulation, and a gradient in the annual averages between each grid cell and grid cells which contain a monitor is calculated.

Step 2: The annual future year speciated $PM_{2.5}$ design values are obtained for each design site from the attainment test. For each grid cell, the monitors within its Voronoi Region are identified, and the speciated $PM_{2.5}$ values are then interpolated using normalized inverse distance squared weightings for all monitors within a grid cell's Voronoi Region. The interpolated speciated $PM_{2.5}$ fields are further adjusted based on the appropriate gradients from Step 1.

Step 3: The concentration of each of the component $PM_{2.5}$ species are summed to calculate the total $PM_{2.5}$ concentration (or DV) for each grid cell.

Step 4: The future year gridded annual average $PM_{2.5}$ estimates are then compared to the annual $PM_{2.5}$ NAAQS to determine compliance.

The unmonitored area analysis for the 24-hour $PM_{2.5}$ standard include the following steps:

Step 1: At each grid cell, the quarterly average of the top 10% of the modeled days for 24-hour $PM_{2.5}$ (total and by species for the same top 10% of days) is calculated from the future year simulation, and a gradient in these quarterly speciated averages between each grid cell and grid cells which contain a monitor is calculated.

Step 2: The 24-hour future year speciated $PM_{2.5}$ design values are obtained for each design site from the attainment test. For each grid cell, the monitors within its Voronoi Region are identified, and the speciated $PM_{2.5}$ values are then interpolated using normalized inverse distance squared weightings for all monitors within a grid cell's Voronoi Region. The interpolated speciated $PM_{2.5}$ fields are further adjusted based on the appropriate gradients from Step 1.

Step 3: The concentration of each of the component $PM_{2.5}$ species are summed to calculate the total $PM_{2.5}$ concentration (or DV) for each grid cell.

Step 4: The future year gridded 24-hour average $PM_{2.5}$ estimates are then compared to the 24-hour $PM_{2.5}$ NAAQS to determine compliance.

For the year 2020, an unmonitored area analysis was performed for the USEPA 1997 annual and 24-hour $PM_{2.5}$ standards. For the year 2024, an unmonitored area analysis was performed for the USEPA 2006 24-hour $PM_{2.5}$ standard only, and for the year 2025, an unmonitored area analysis was performed for the USEPA 2012 annual $PM_{2.5}$ standard only.

Figure 15 shows the spatial distribution of projected 2020 annual $PM_{2.5}$ DVs in the SJV nonattainment area. Projected 2020 annual $PM_{2.5}$ DVs at every grid cell are below the threshold needed for attainment (15.04 µg/m^3), except for a few cells surrounding the Lemoore military facility, where the greater $PM_{2.5}$ levels are due to localized emissions associated with that facility. A similar $PM_{2.5}$ hotspot associated with the Lemoore military facility was observed in past SJV $PM_{2.5}$ SIPs as well. This demonstrates that all unmonitored areas within the SJV will attain the 15 µg/m^3 annual $PM_{2.5}$ standard (technically, DVs not greater than 15.04 µg/m^3 are considered as attainment) established by the USEPA in 1997, except for a small area surrounding the Lemoore military facility.

Figure 16 shows the spatial distribution of projected 2020 24-hour $PM_{2.5}$ DVs in the SJV nonattainment area. Projected 2020 24-hour $PM_{2.5}$ DVs within the SJV do not exceed 65.4 µg/m^3 except for a few grid cells surrounding the Lemoore military facility, again due to the localized emissions associated with that facility. This demonstrates that all unmonitored areas within the SJV will attain the 65 µg/m^3 24-hour $PM_{2.5}$ standard (technically, DVs not greater than 65.4 µg/m^3 are considered as attainment) established by the USEPA in 1997, except for a small area surrounding the Lemoore military facility.

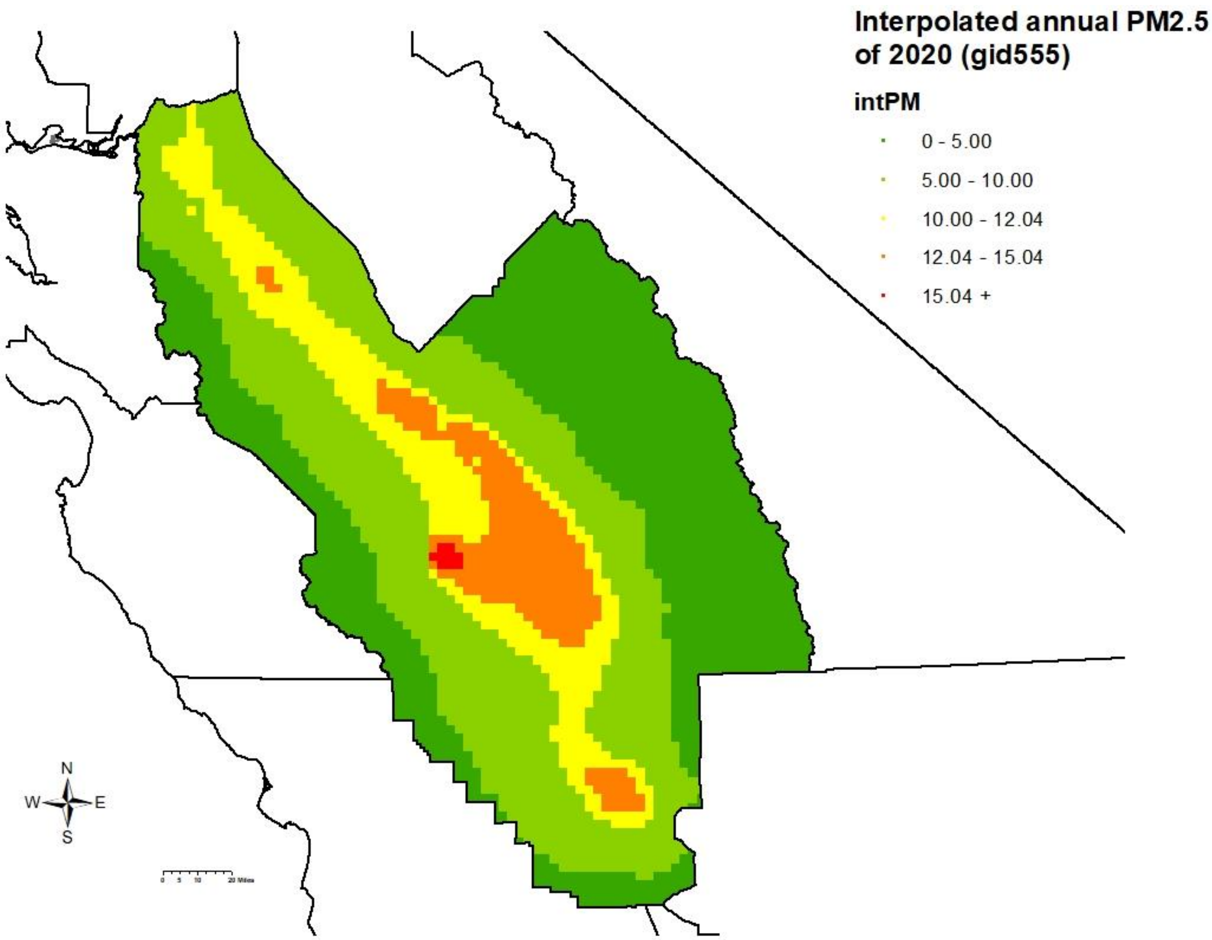


Figure 15. Spatial distribution of projected 2020 annual $PM_{2.5}$ DVs within the SJV nonattainment area. All grid cells have DVs not greater than 15.04 µg/m^3 except for a few cells surrounding the Lemoore Naval facility.

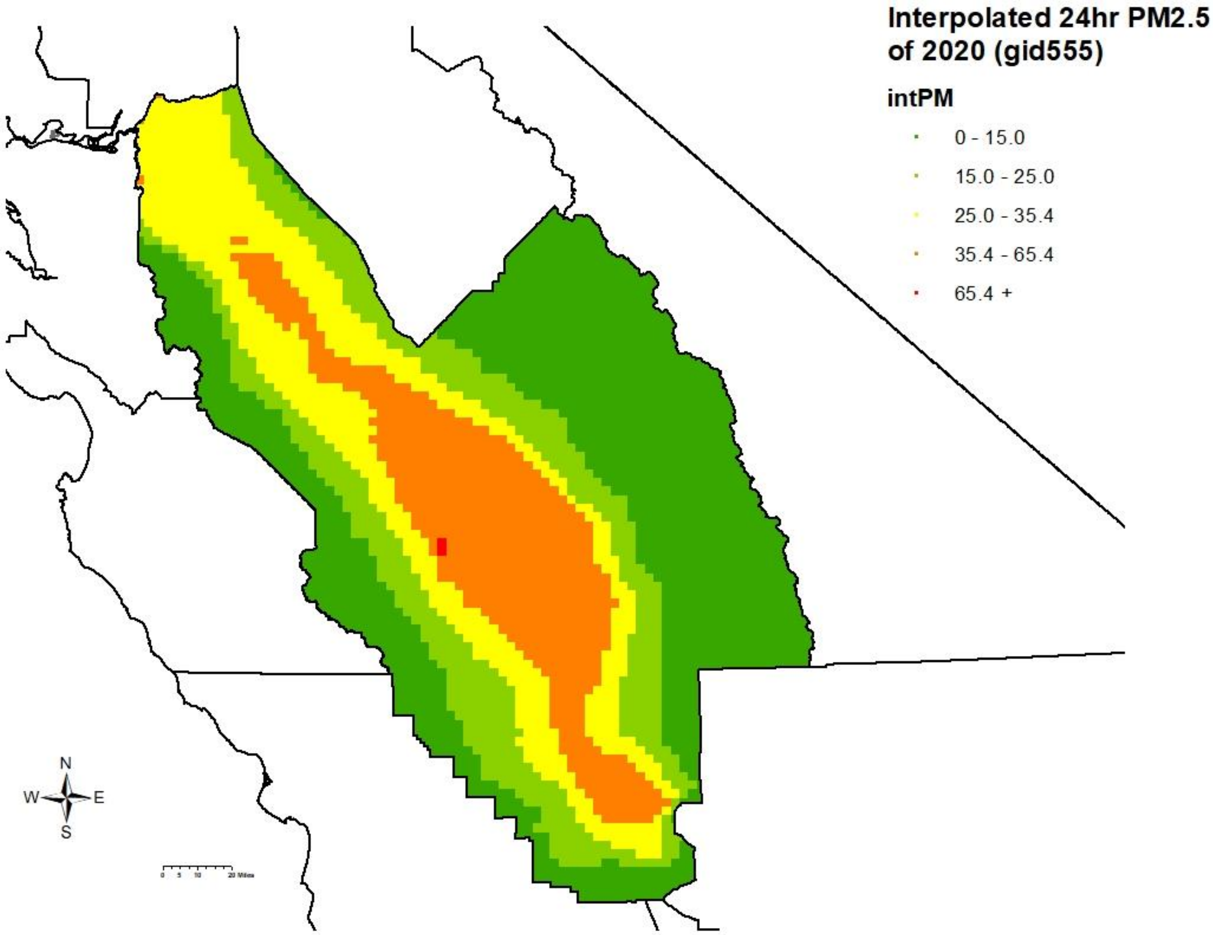


Figure 16. Spatial distribution of projected 2020 24-hour $PM_{2.5}$ DVs within the SJV nonattainment area. All grid cells have DVs not greater than 65.4 μg/m^3 except a few cells surrounding the Lemoore Naval facility.

Figure 17 shows the spatial distribution of projected 2024 24-hour $PM_{2.5}$ DVs in the SJV nonattainment area. Projected 2024 24-hour $PM_{2.5}$ DVs within the SJV do not exceed 35.4 µg/m^3 (technically, DVs not greater than 35.4 µg/m^3 are considered attainment for the 2006 35 µg/m^3 24-hour $PM_{2.5}$ standard), except for a few grid cells located to the southeast of the Fresno metropolitan area as well as a few grid cells surrounding the Lemoore Navy facility. Again, the elevated concentrations surrounding the Lemoore Naval facility are due to localized emissions associated with military operations. The area exceeding the standard to the southeast of the main Fresno metropolitan area is primarily due to elevated ammonium nitrate and organic carbon levels in the modeling system, which are likely due to a combination of transport of polluted air masses and some local emissions within the exceedance area in 2024. CARB plans to assess the elevated ammonium nitrate and organic carbon levels in the region and if appropriate, monitor $PM_{2.5}$ air quality levels.

Figure 18 shows the spatial distribution of projected 2025 annual $PM_{2.5}$ DVs in the SJV nonattainment area. Projected 2025 annual $PM_{2.5}$ DVs within the SJV are not greater than 12.04 µg/m^3 (technically, DVs not greater than 12.04 µg/m^3 are considered attainment for the 2012 12 µg/m^3 annual $PM_{2.5}$ standard) except for a few cells surrounding the Lemoore Navy facility and Visalia. Again, grid cells exceeding the standard surrounding the Lemoore Navy facility are due to localized emissions associated with the operations of that facility.

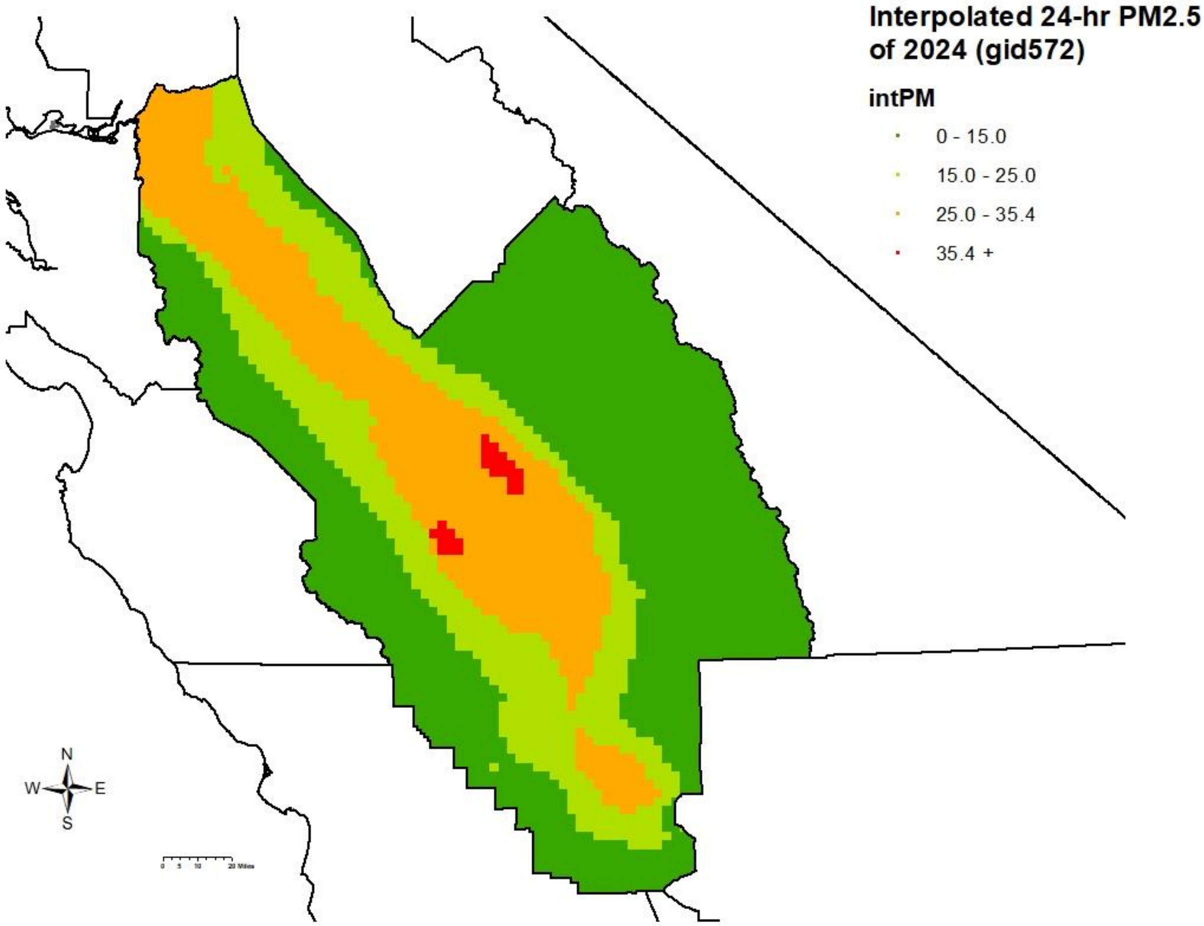


Figure 17. Spatial distribution of projected 2024 24-hour $PM_{2.5}$ DVs within the SJV nonattainment area. All grid cells have DVs not greater than 35.4 µg/m^3 except for a few cells located to the southeast of the main Fresno metropolitan area, as well as surrounding the Lemoore Naval facility.

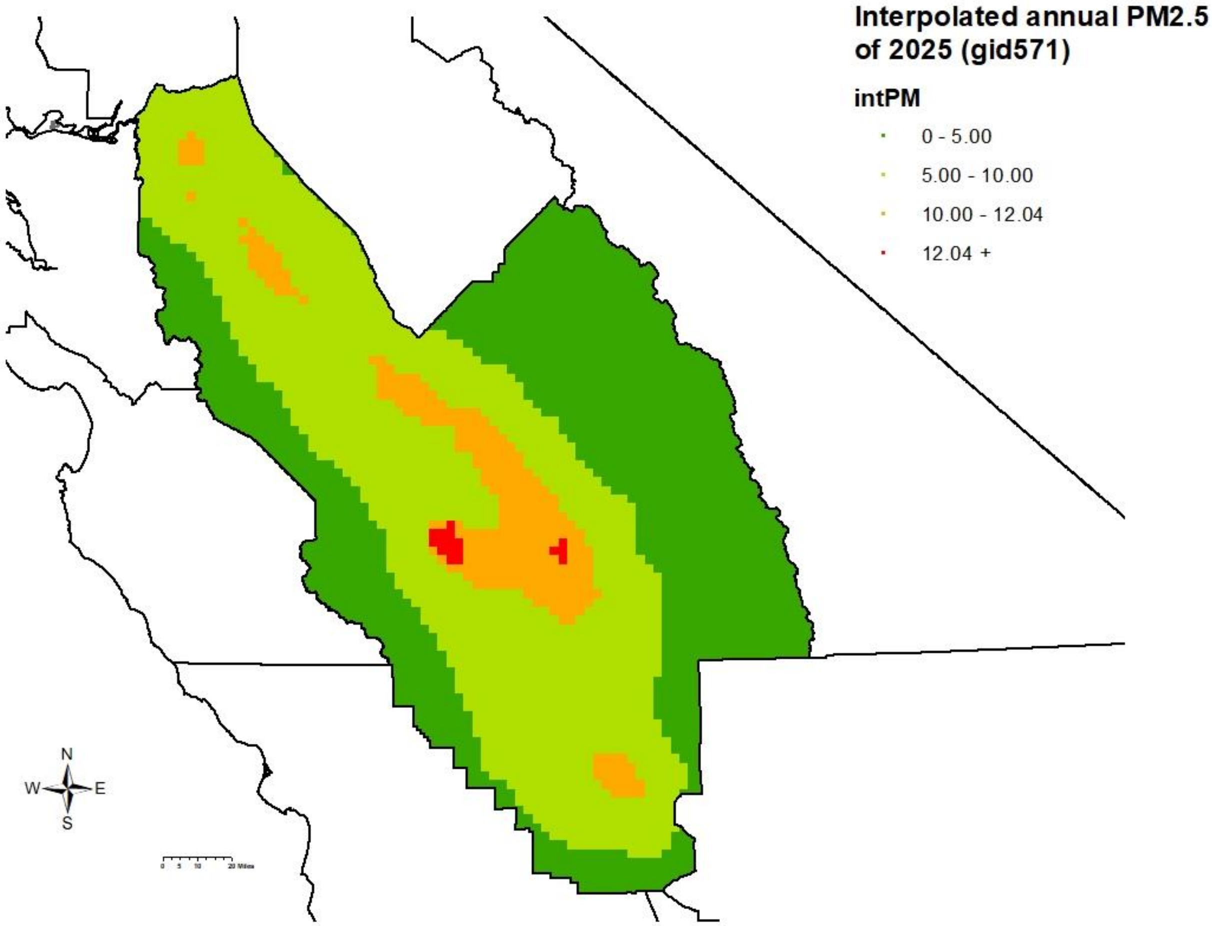


Figure 18. Spatial distribution of projected 2025 annual $PM_{2.5}$ DVs within the SJV nonattainment area. All grid cells have DVs not greater than 12.04 µg/m^3 except for a few cells surrounding the Lemoore Naval facility and Visalia.

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SUPPLEMENTAL MATERIALS

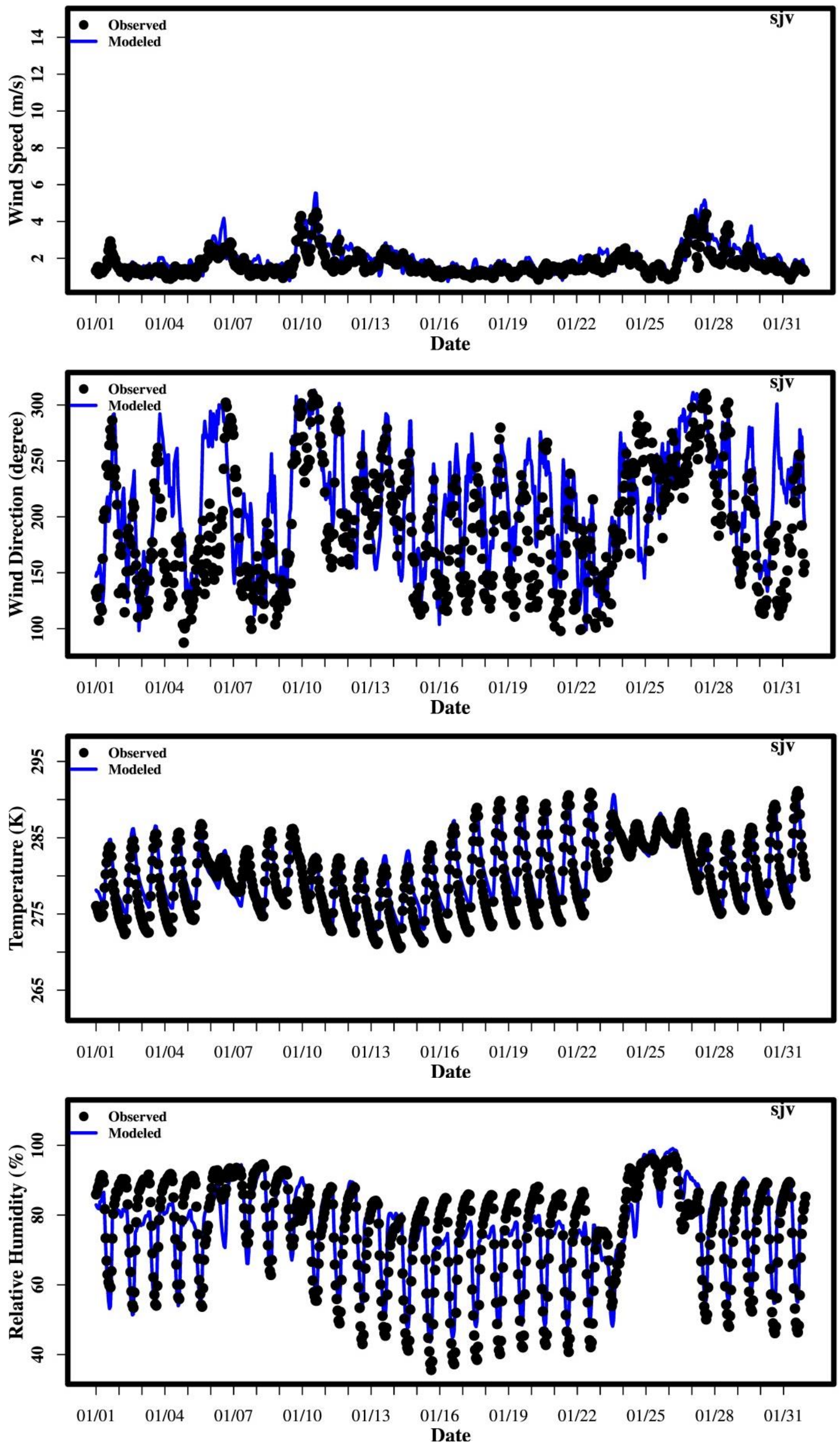


Figure S. 1 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in January 2013.

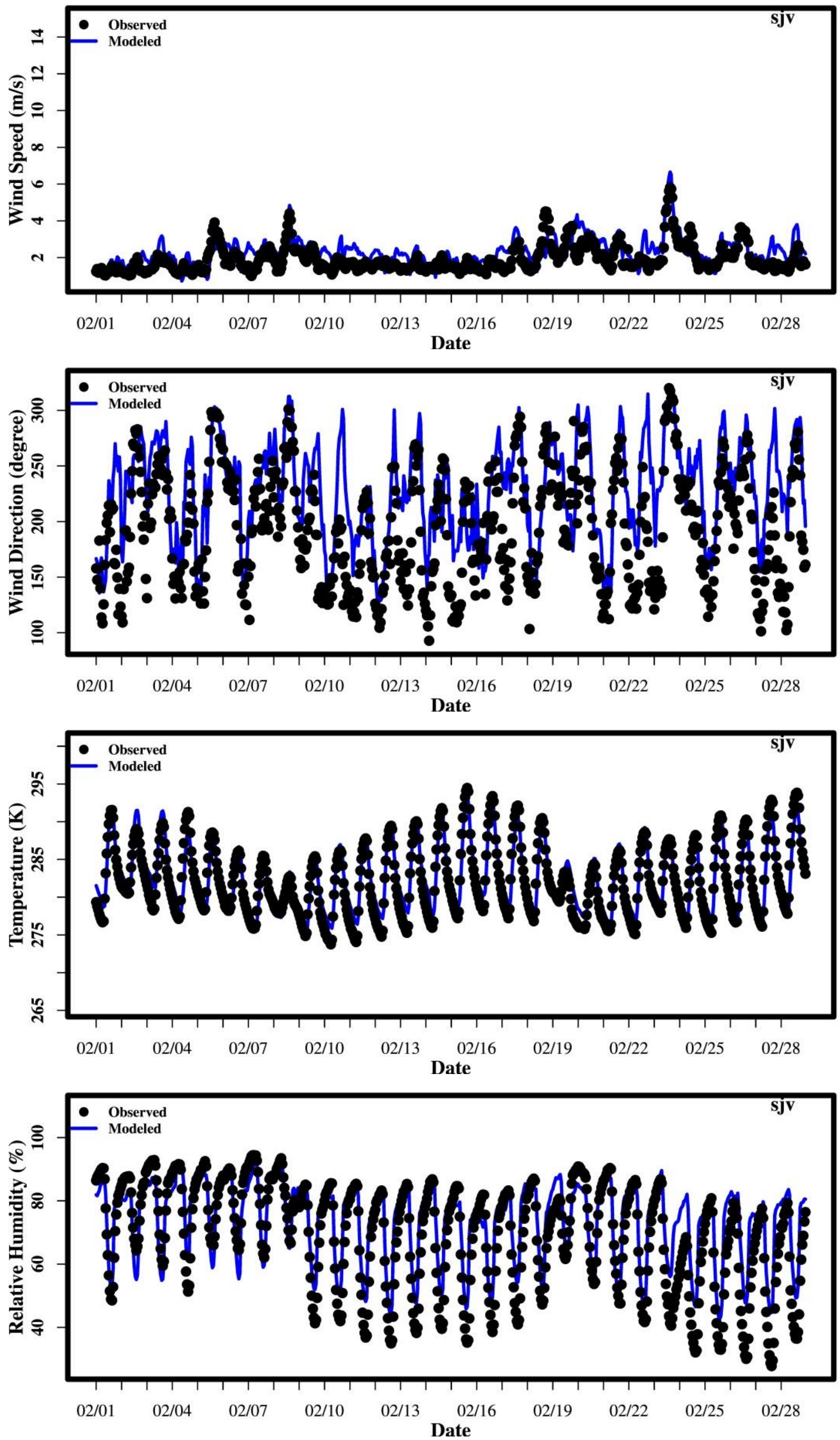


Figure S. 2 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in February 2013.

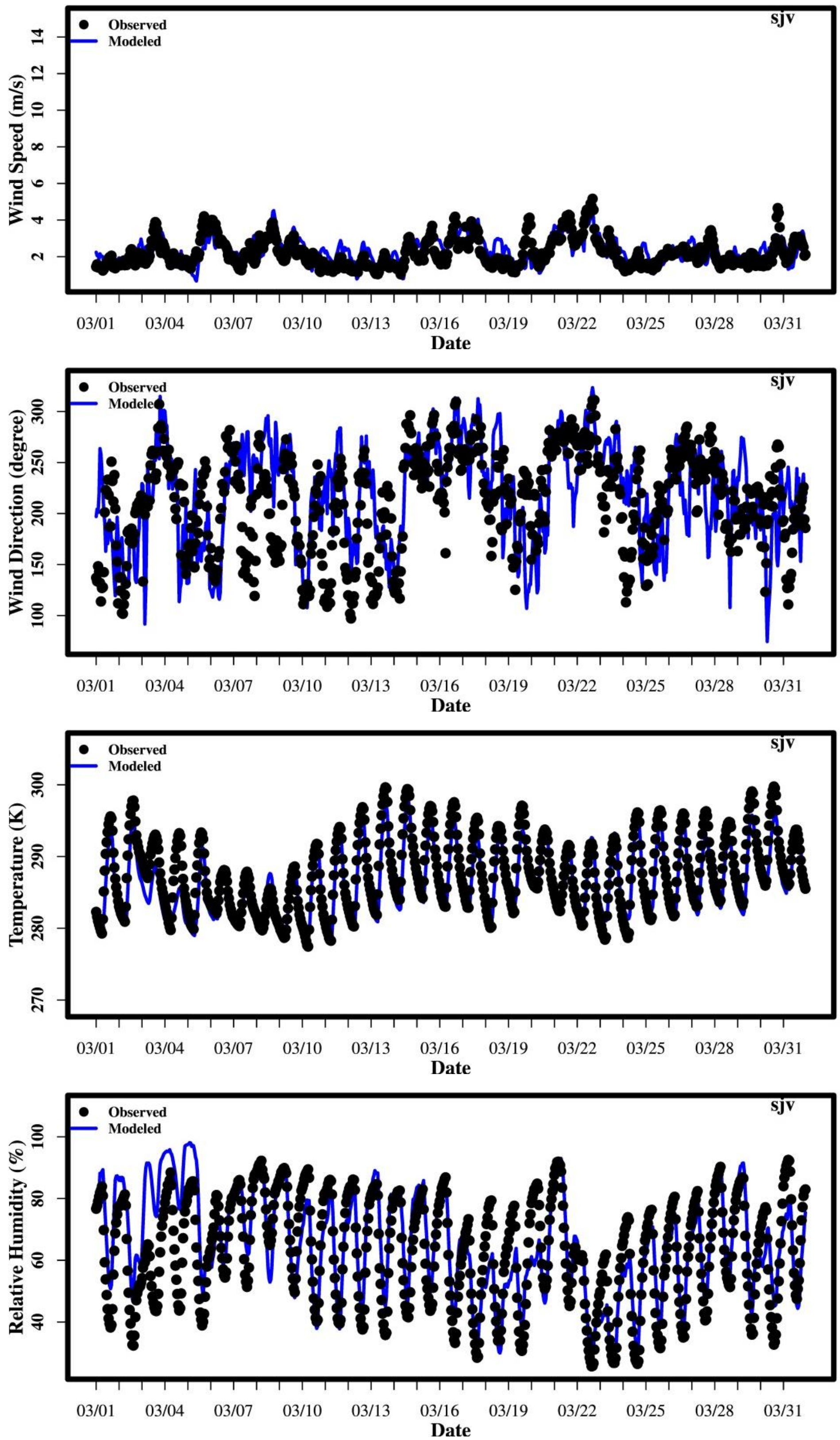


Figure S. 3 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in March 2013.

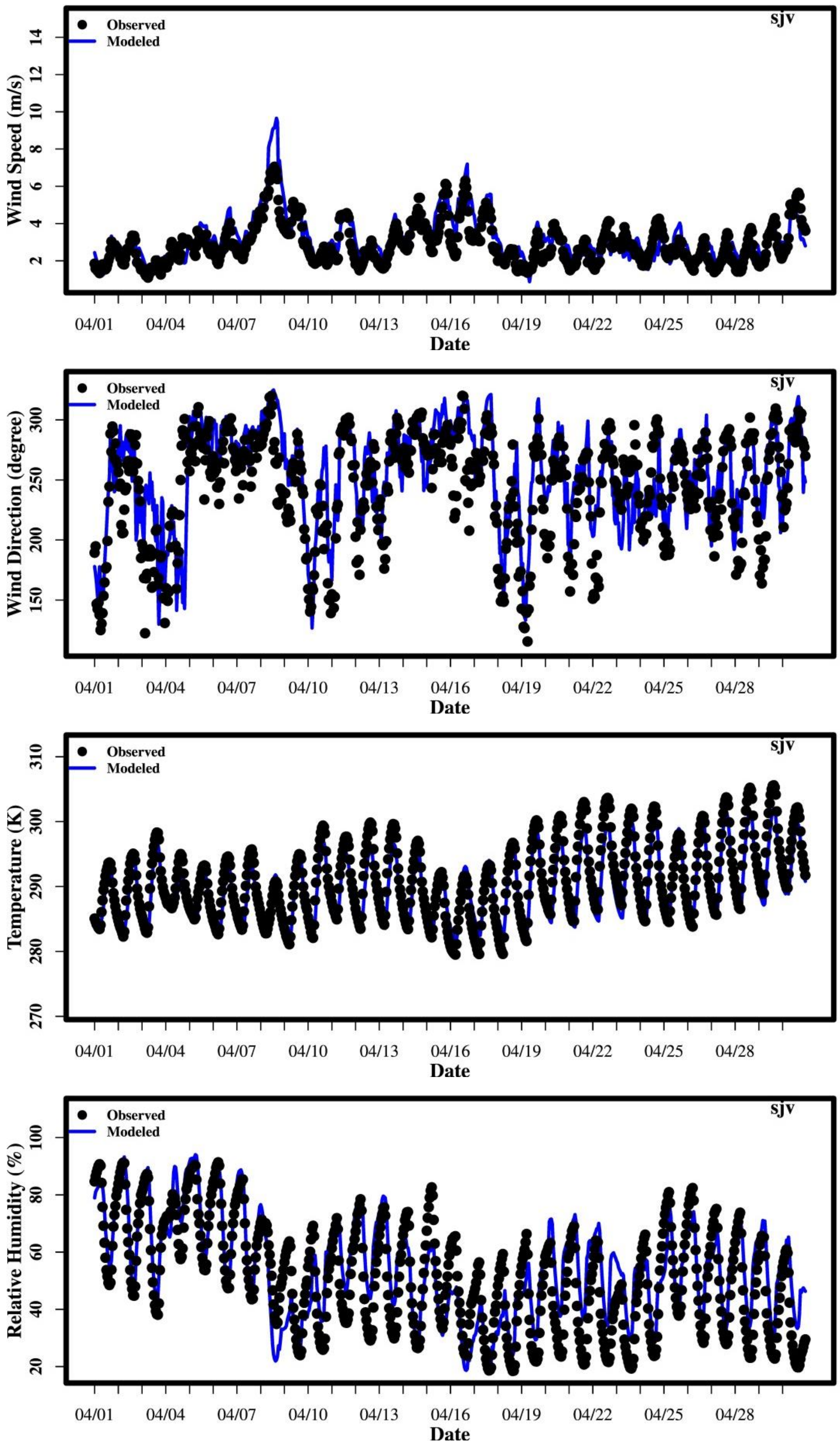


Figure S. 4 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in April 2013.

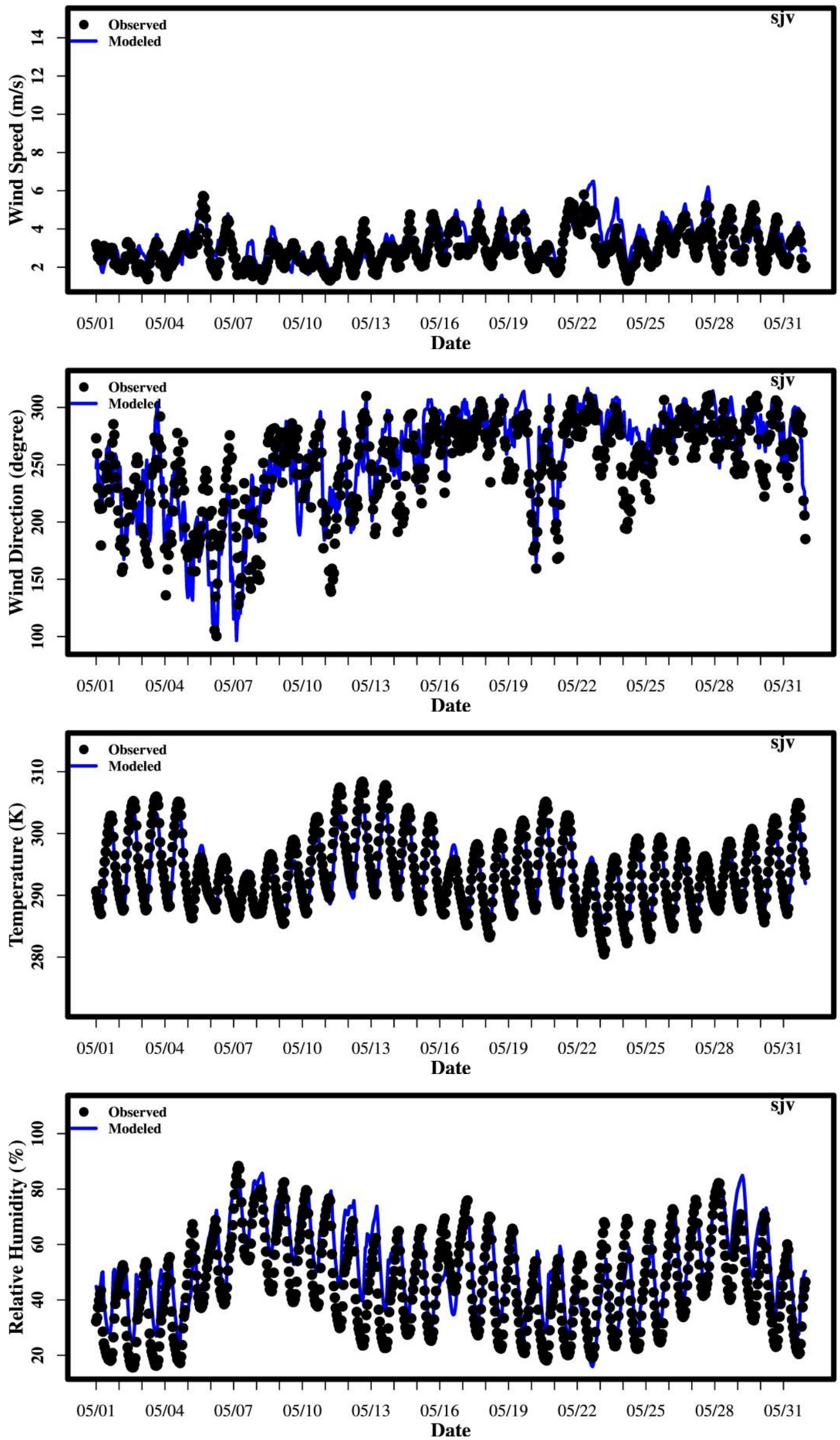


Figure S. 5 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in May 2013.

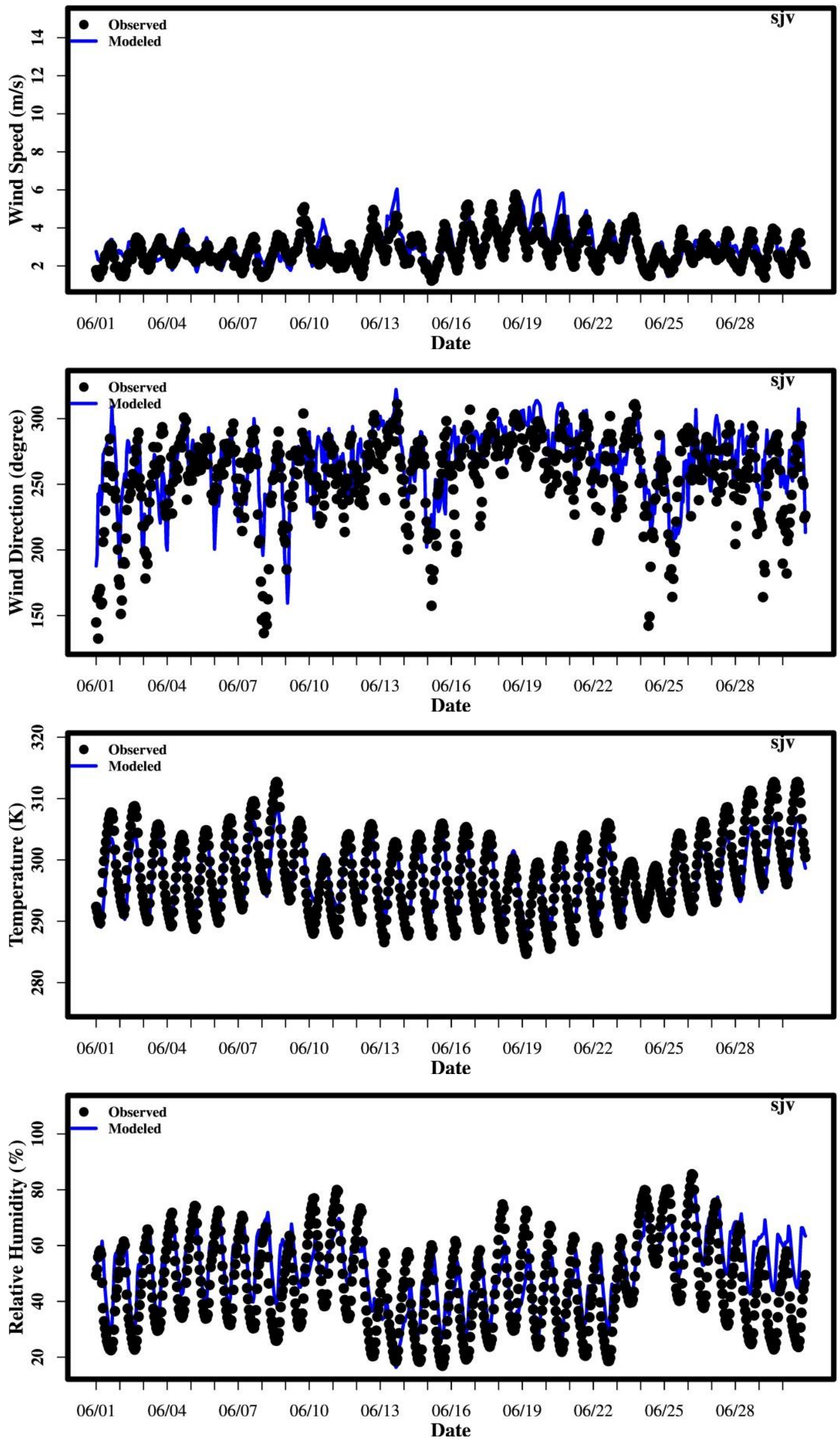


Figure S. 6 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in June 2013.

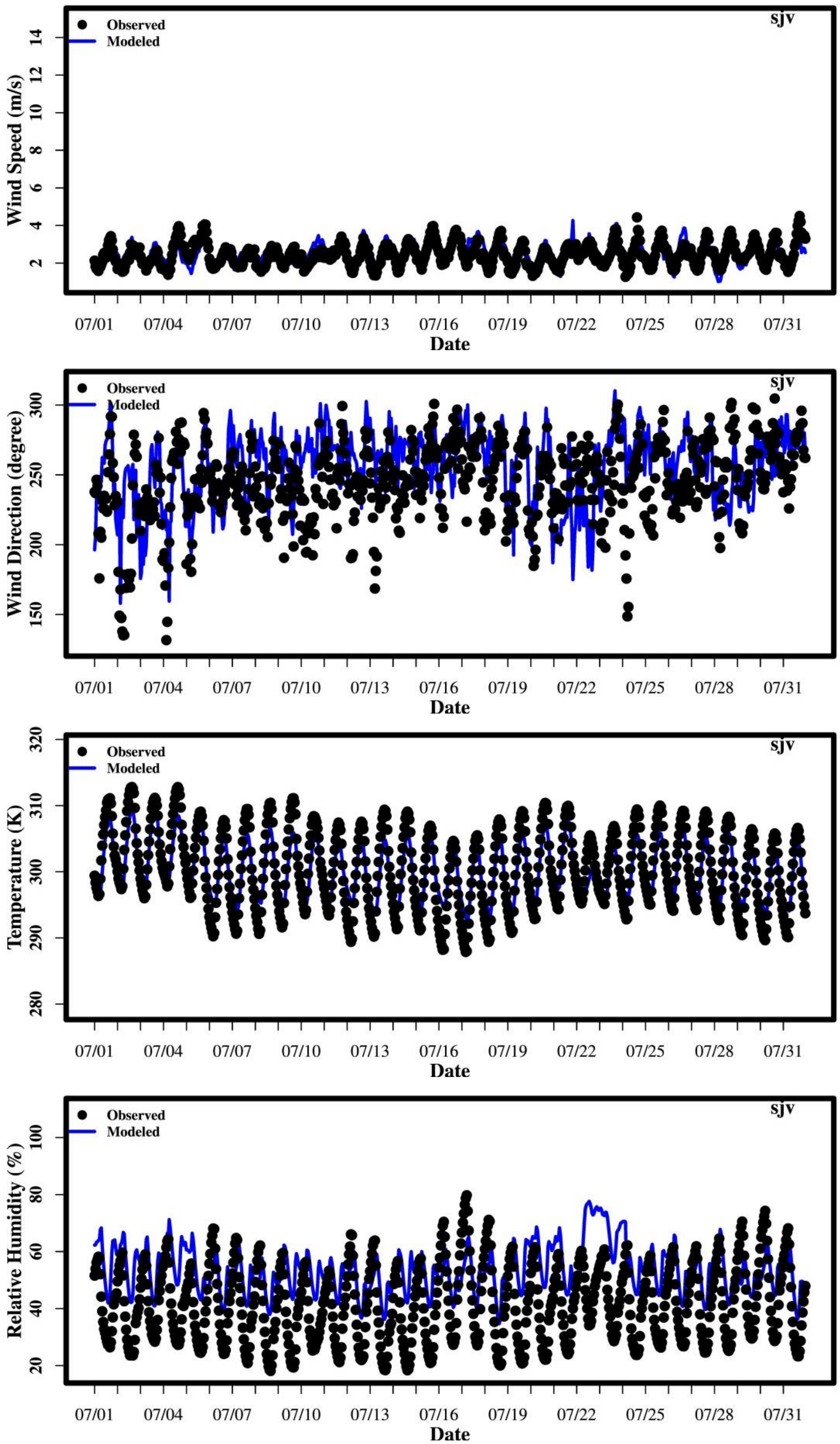


Figure S. 7 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in July 2013.

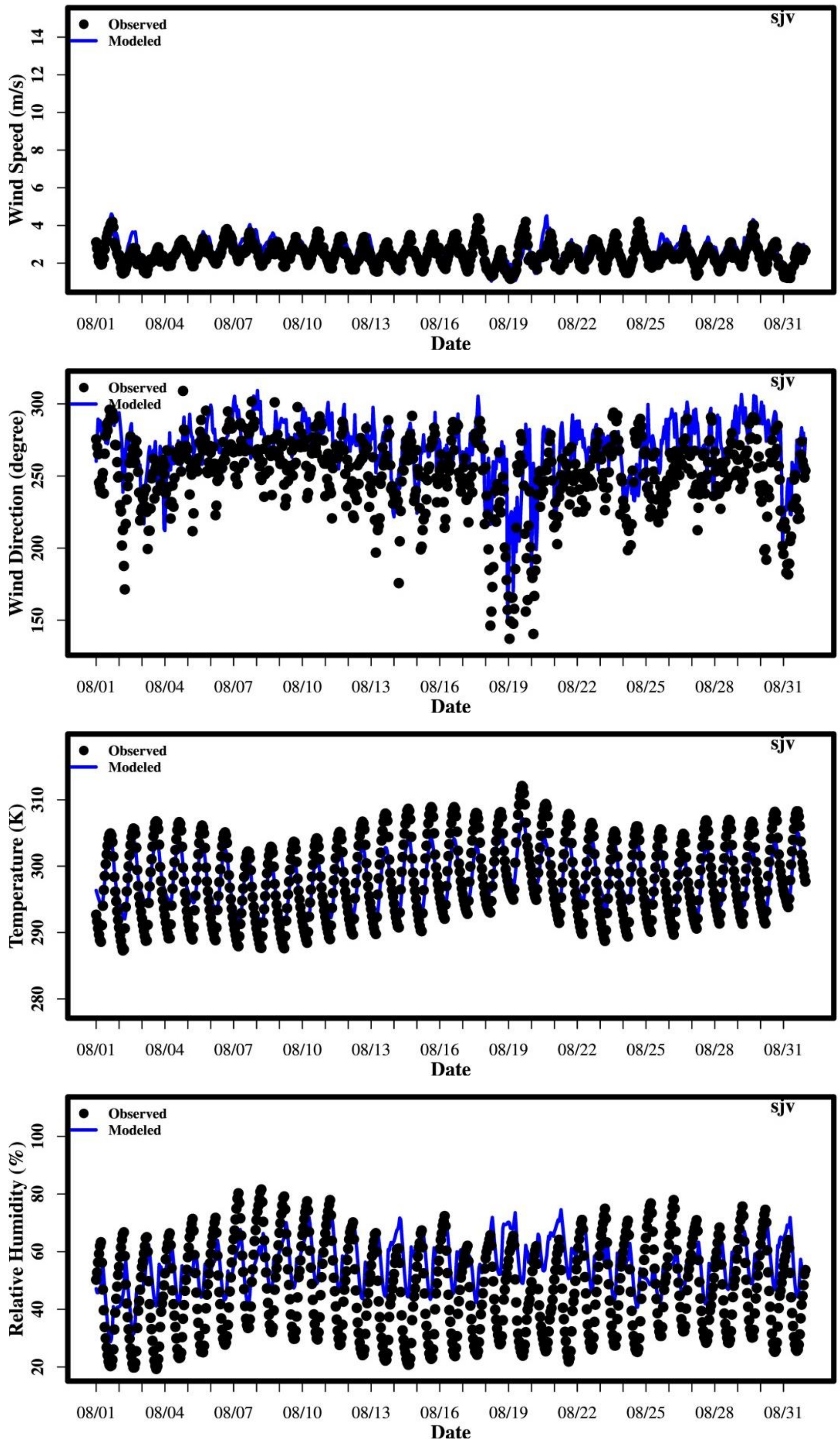


Figure S. 8 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in August 2013.

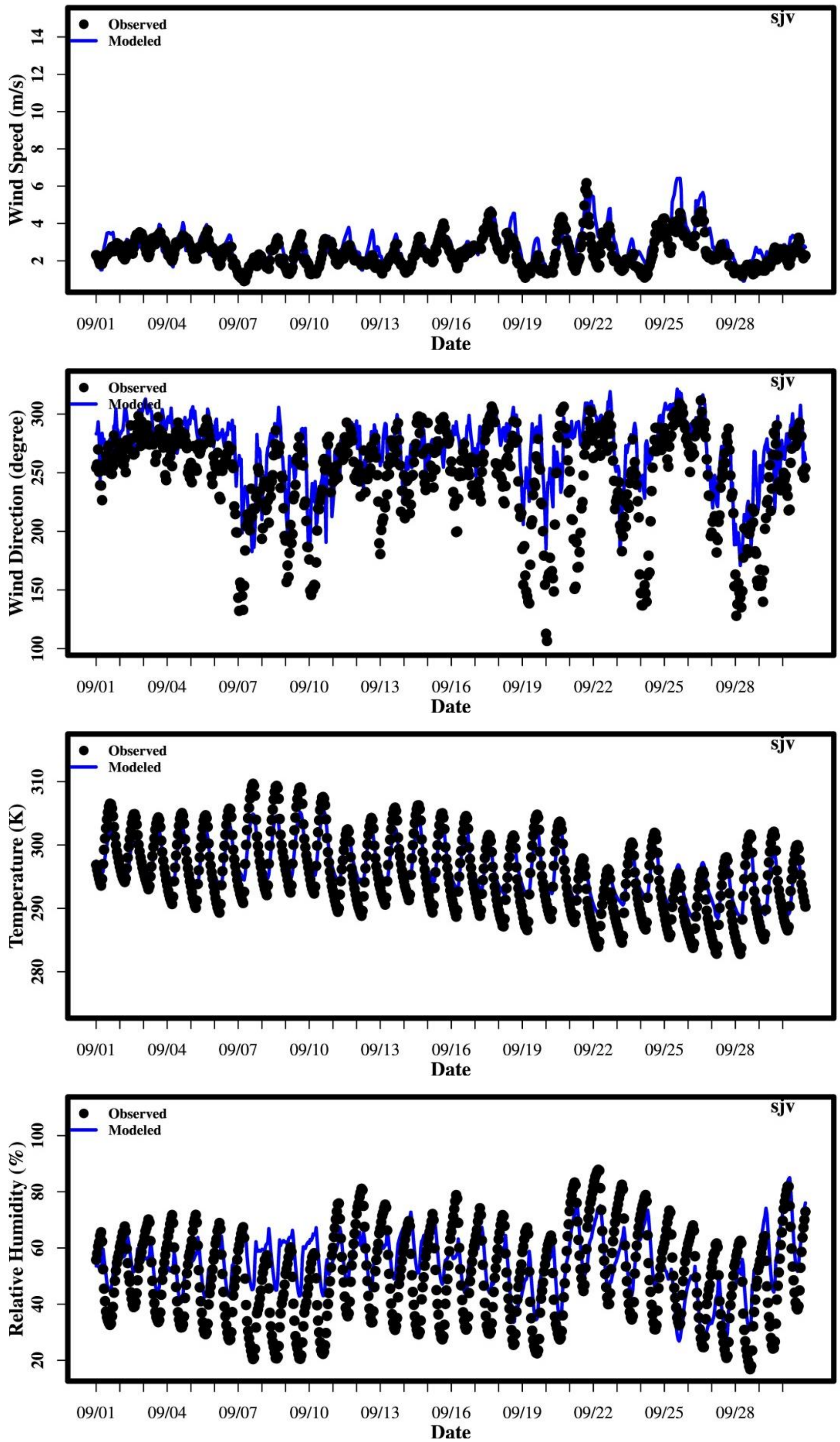


Figure S. 9 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in September 2013.

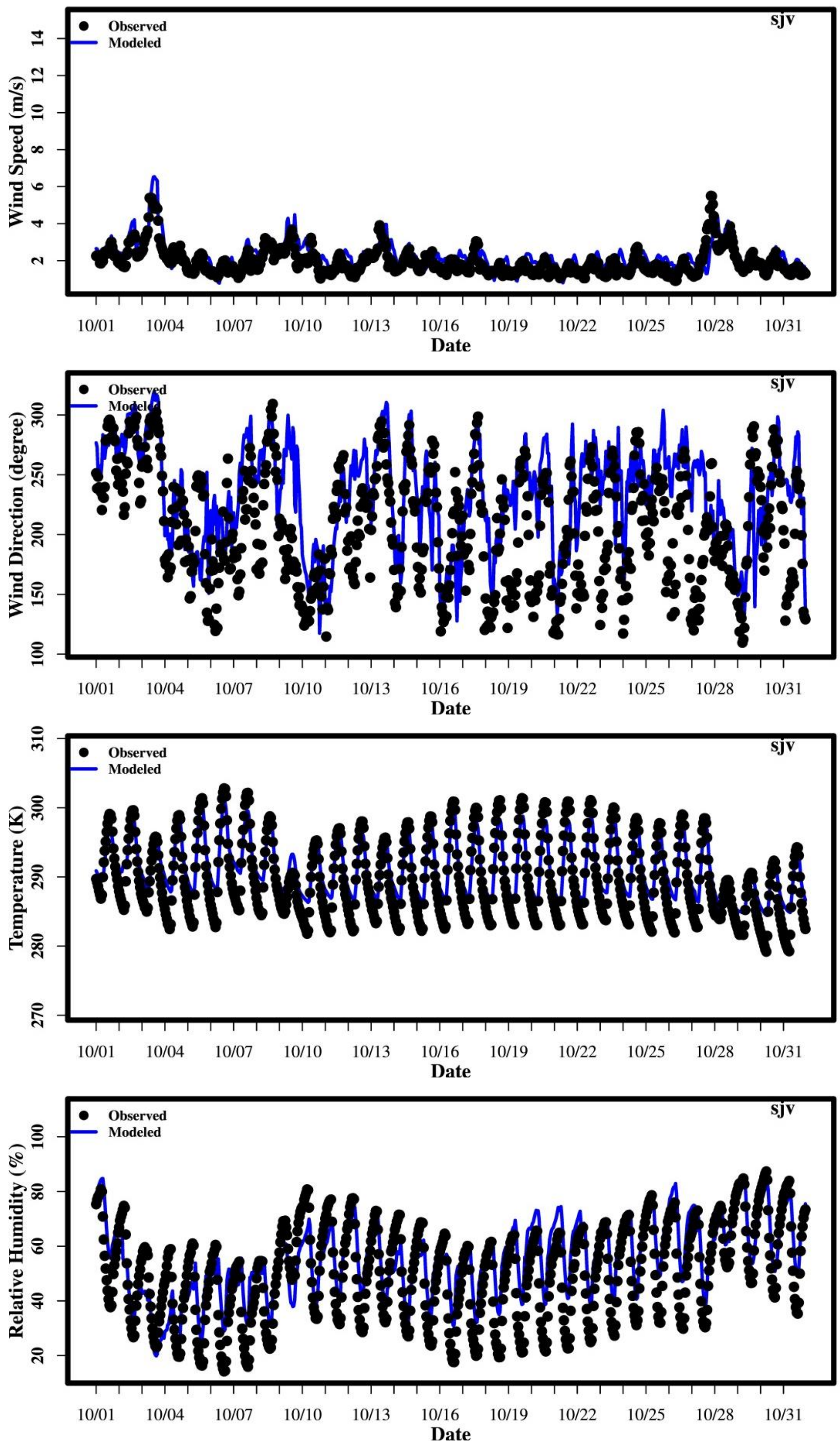


Figure S. 10 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in October 2013.

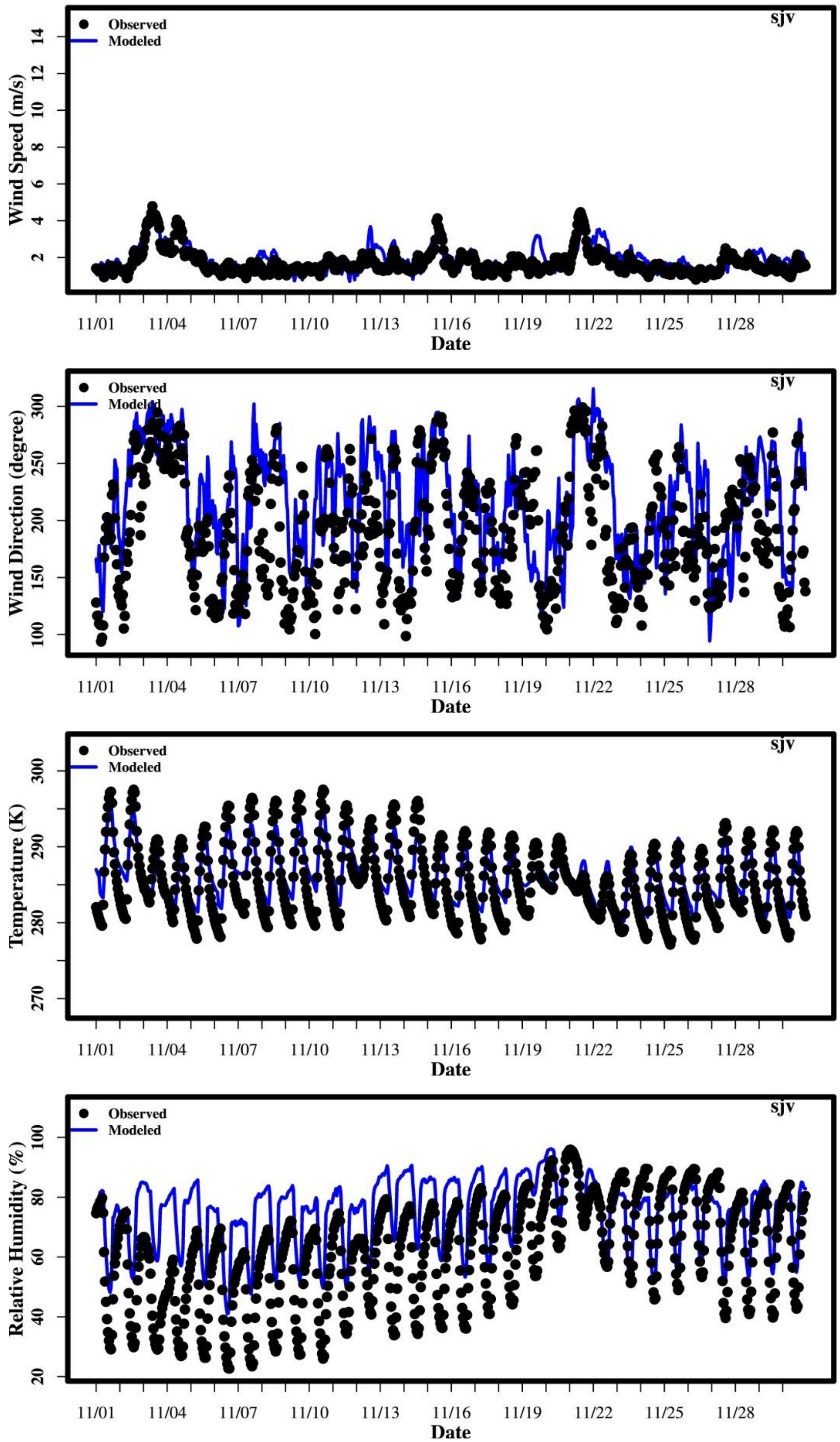


Figure S. 11 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in November 2013.

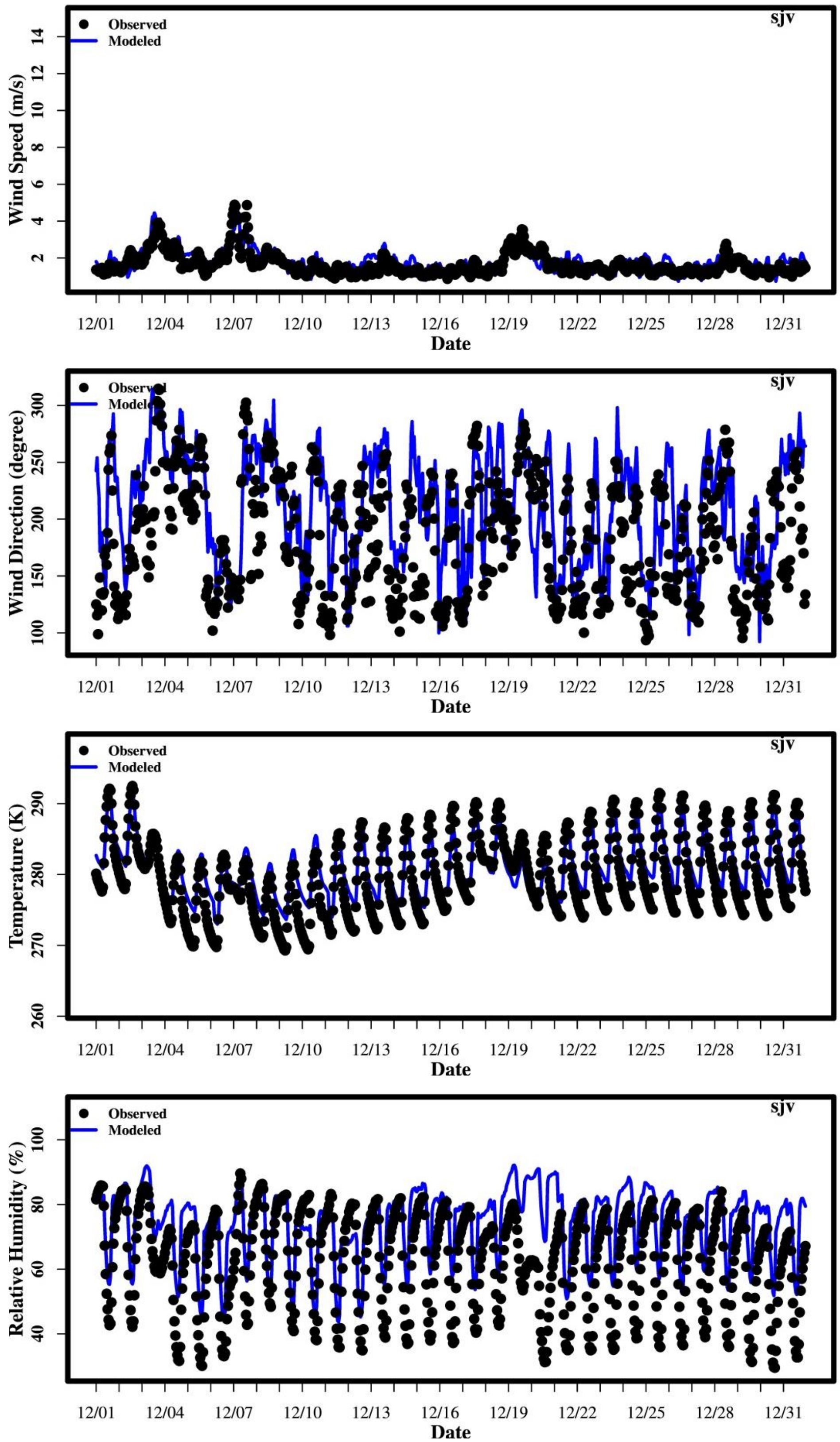


Figure S. 12 Time series of wind speed, direction, temperature and relative humidity for San Joaquin Valley in December 2013.

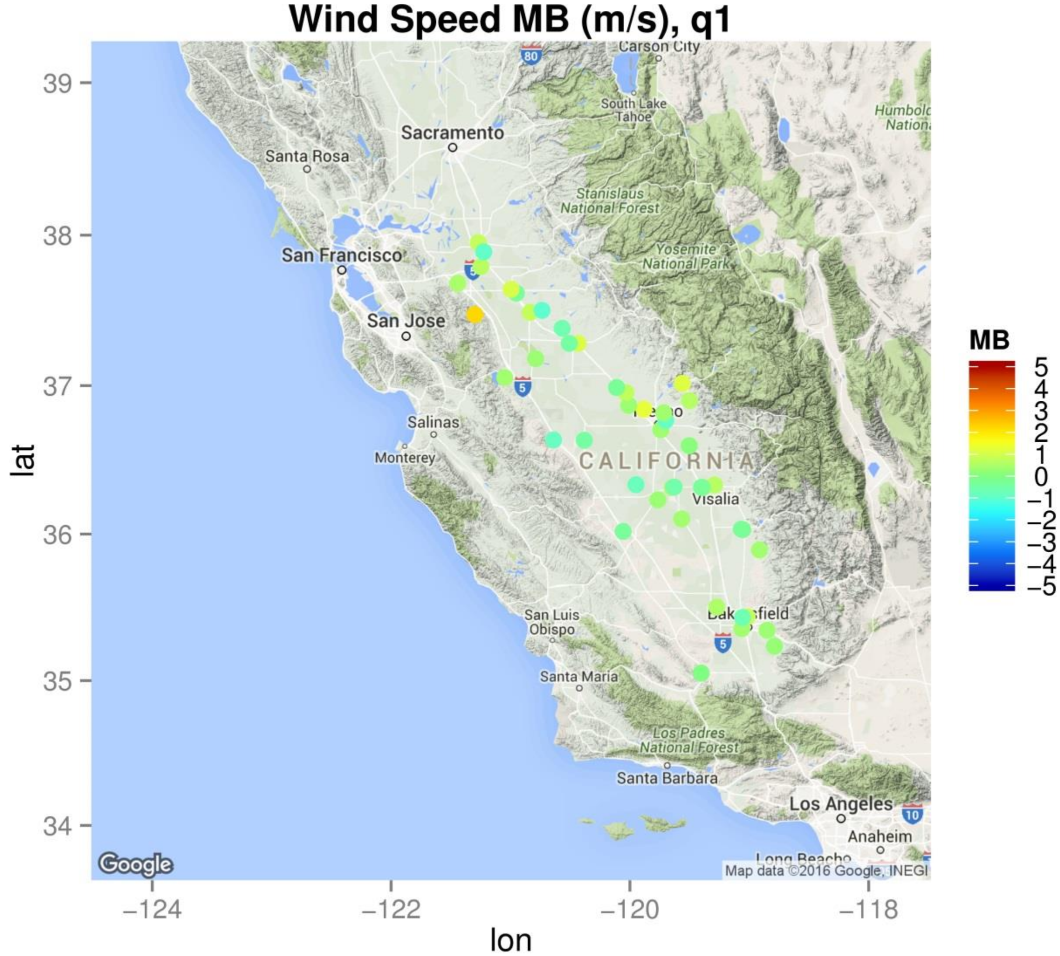


Figure S. 13 Hourly wind speed mean error in the first quarter of 2013

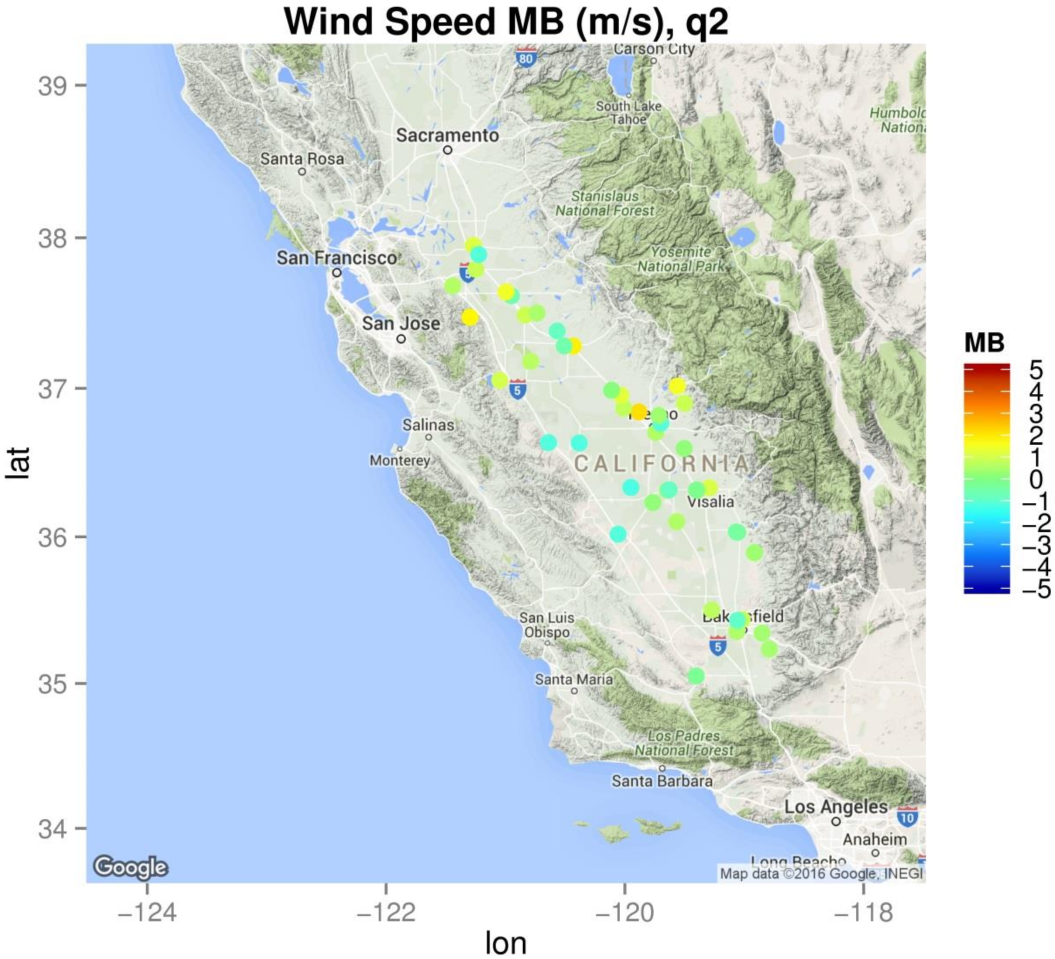


Figure S. 14 Hourly wind speed mean bias in the second quarter of 2013

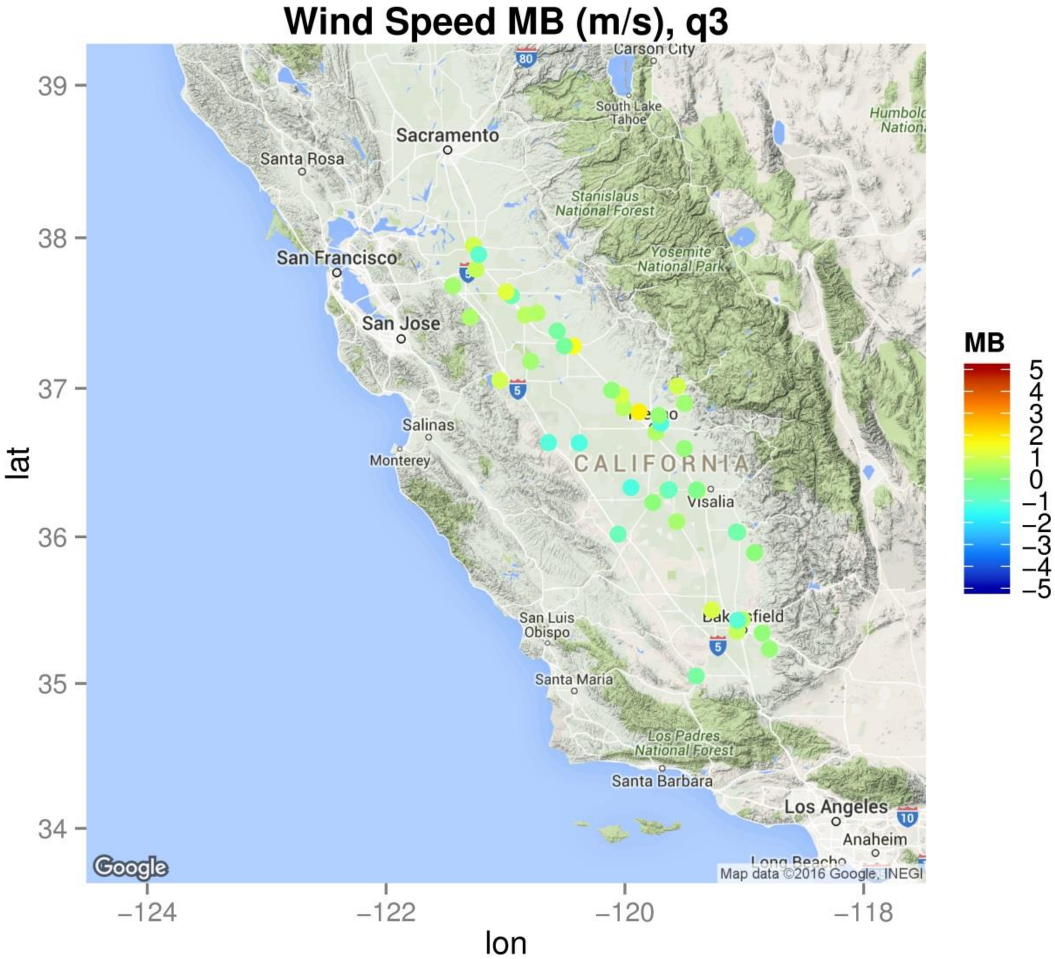


Figure S. 15 Hourly wind speed mean bias in the third quarter of 2013

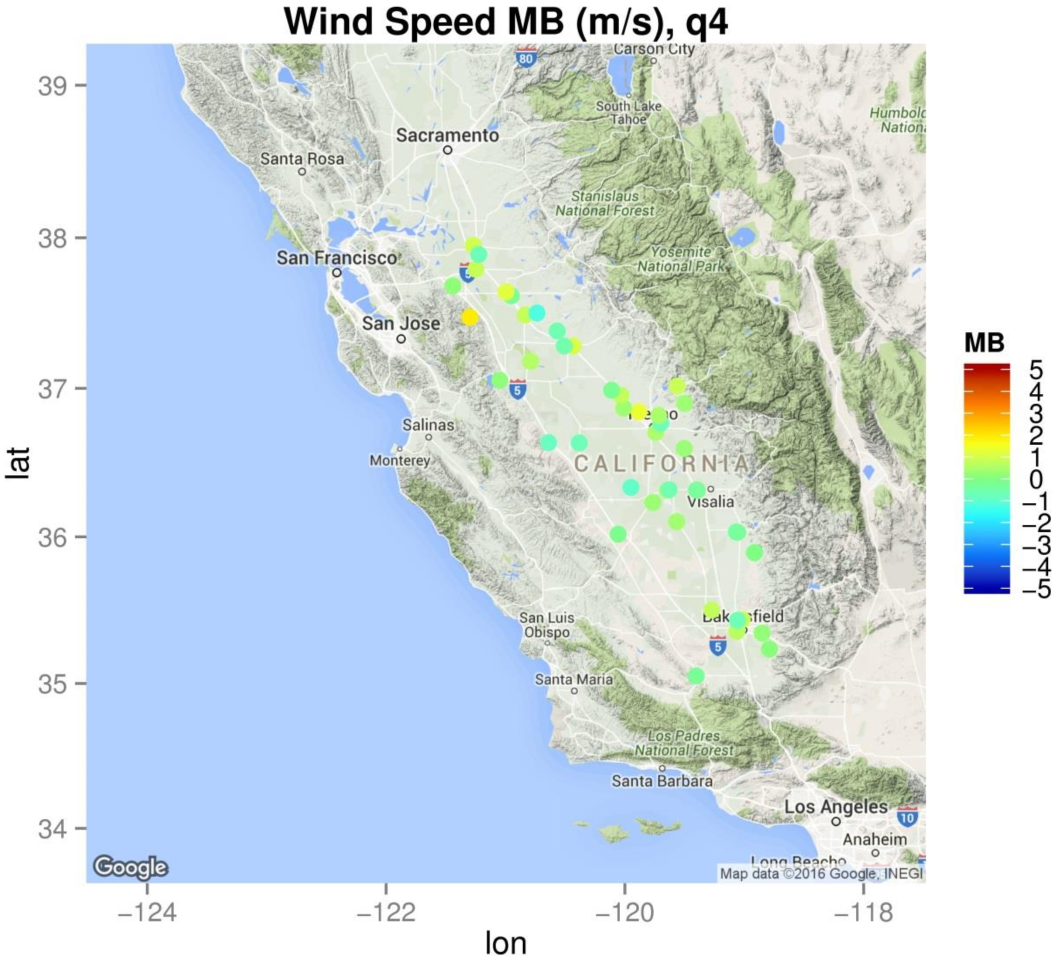


Figure S. 16 Hourly wind speed mean bias in the fourth quarter of 2013

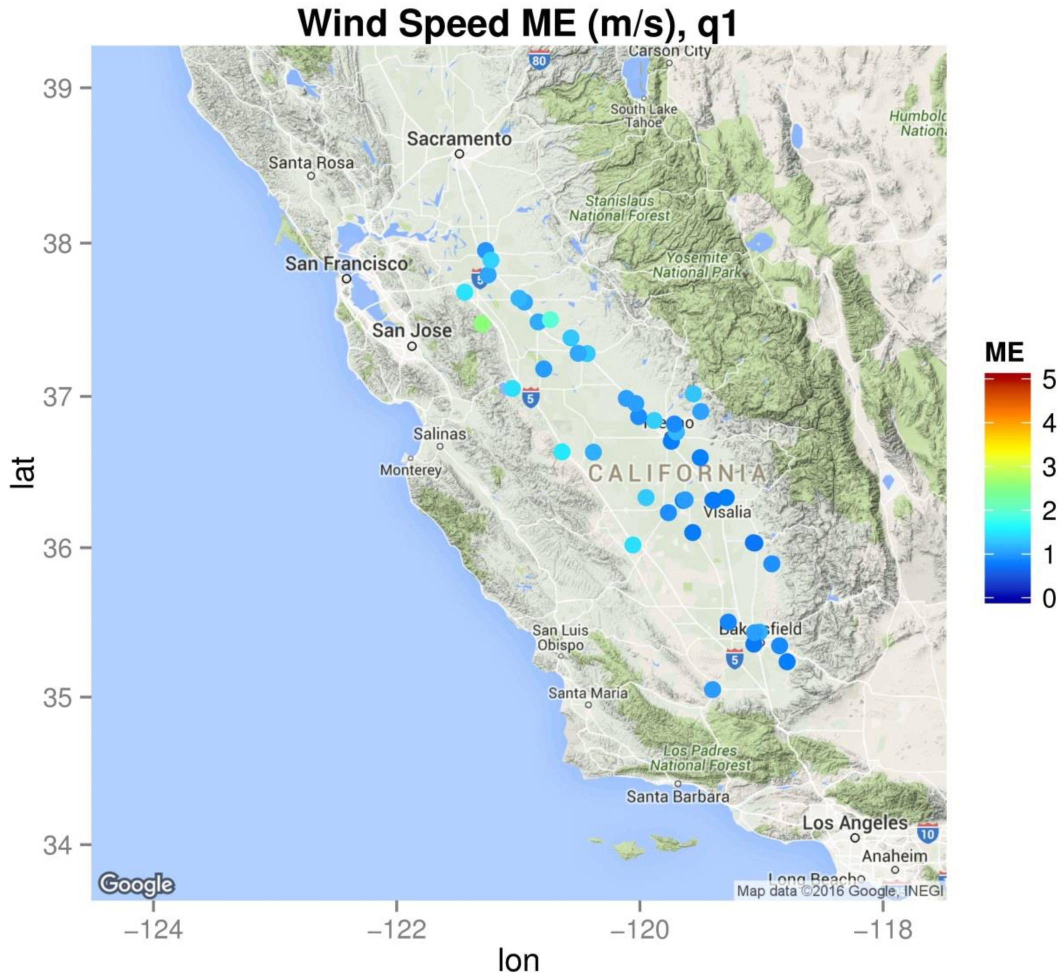


Figure S. 17 Hourly wind speed mean error in the first quarter of 2013

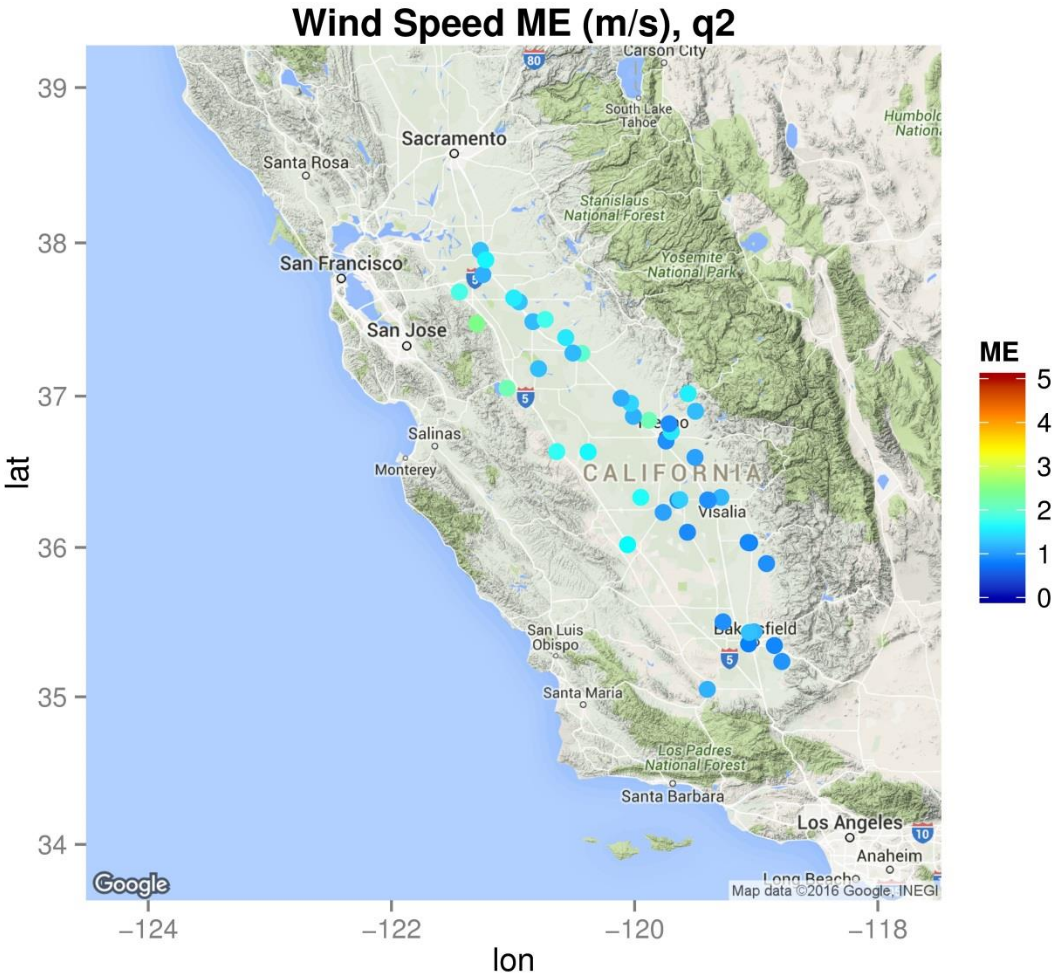


Figure S. 18 Hourly wind speed mean error in the second quarter of 2013

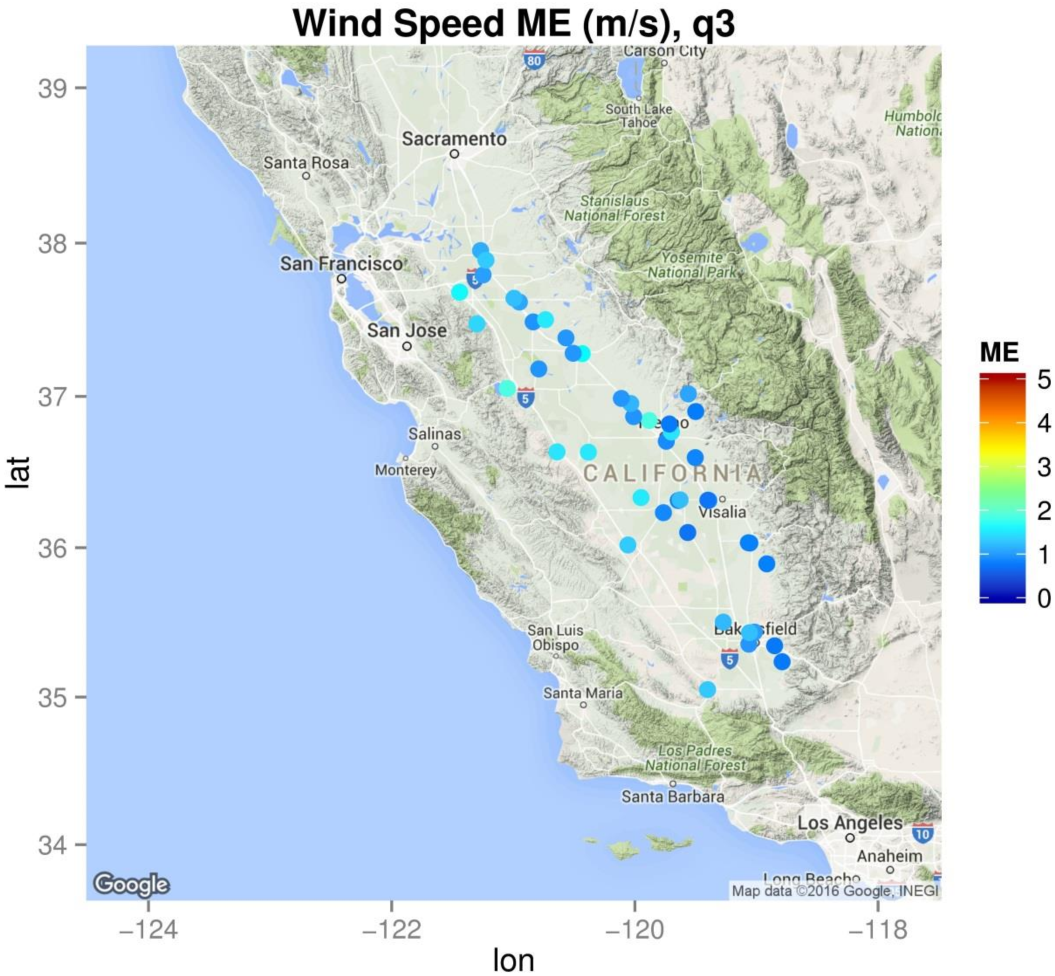


Figure S. 19 Hourly wind speed mean error in the third quarter of 2013

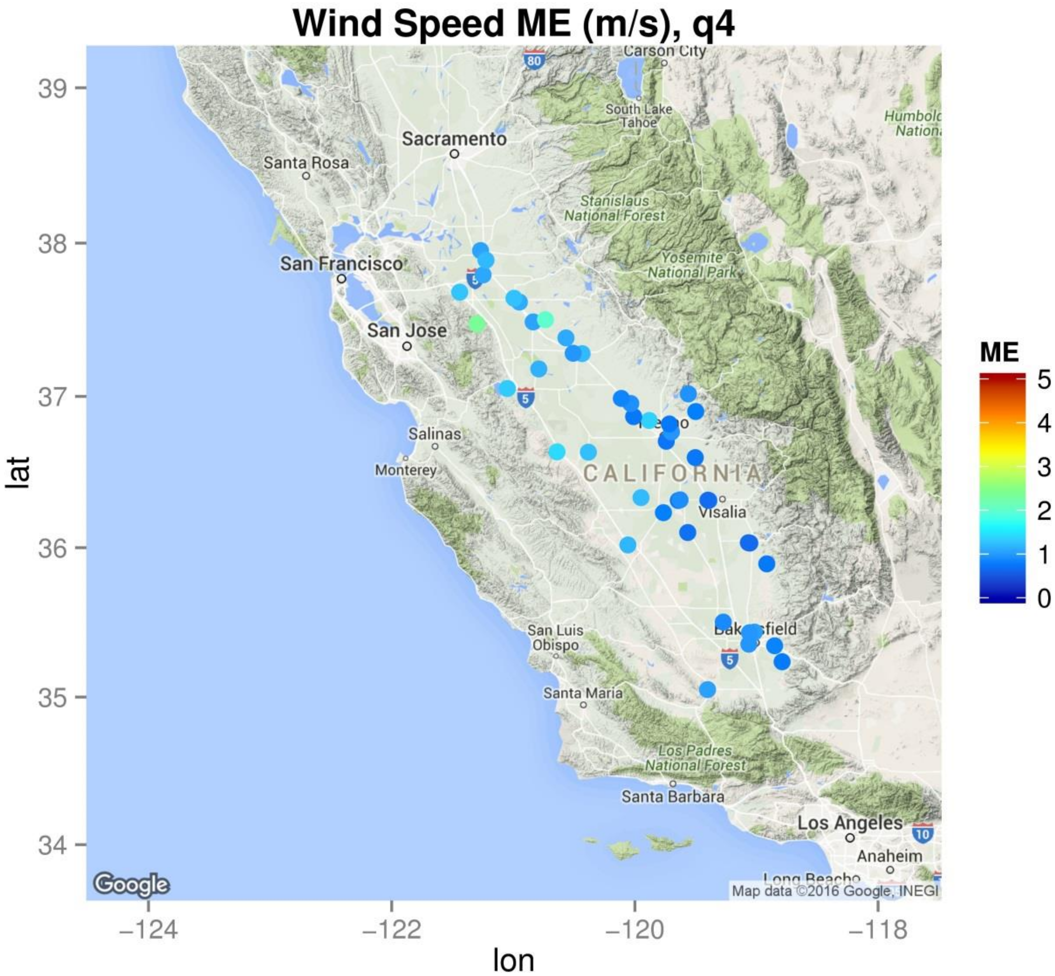


Figure S. 20 Hourly wind speed mean error in the fourth quarter of 2013

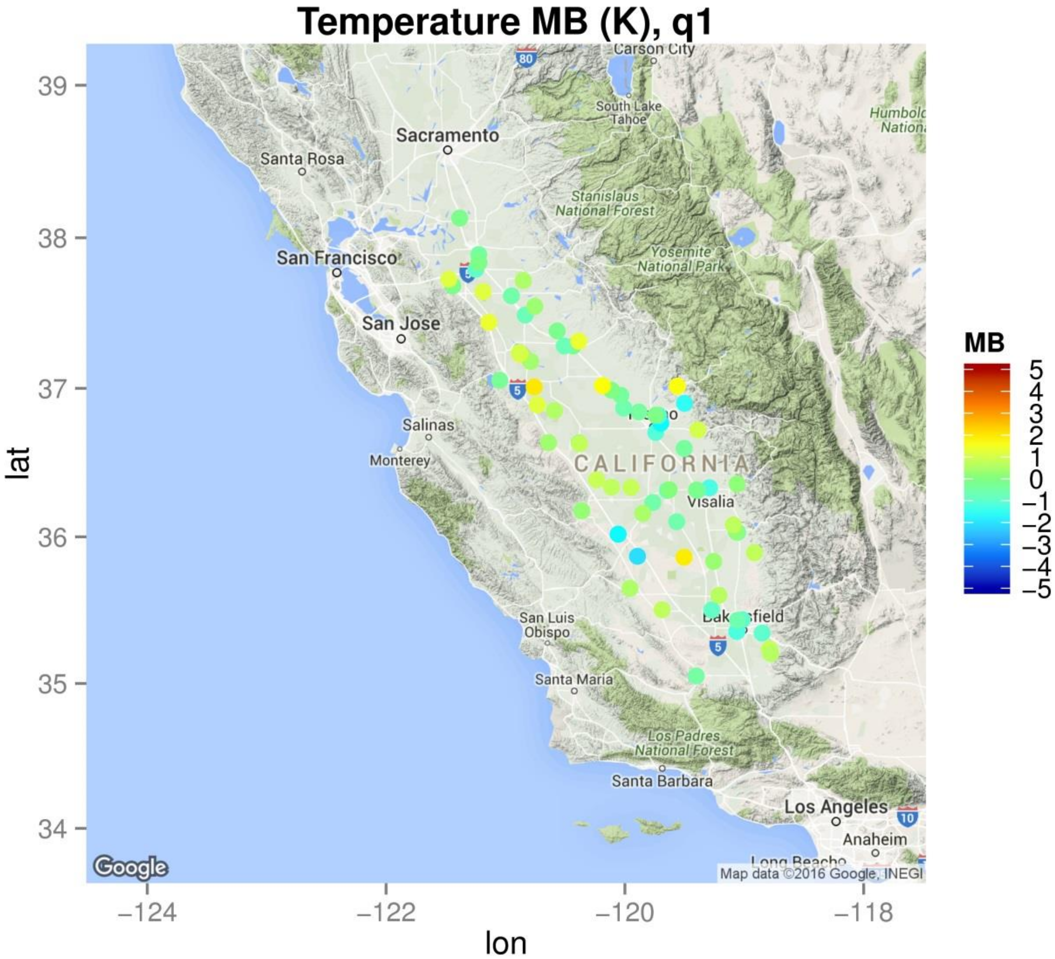


Figure S. 21 Hourly temperature mean bias in the first quarter of 2013

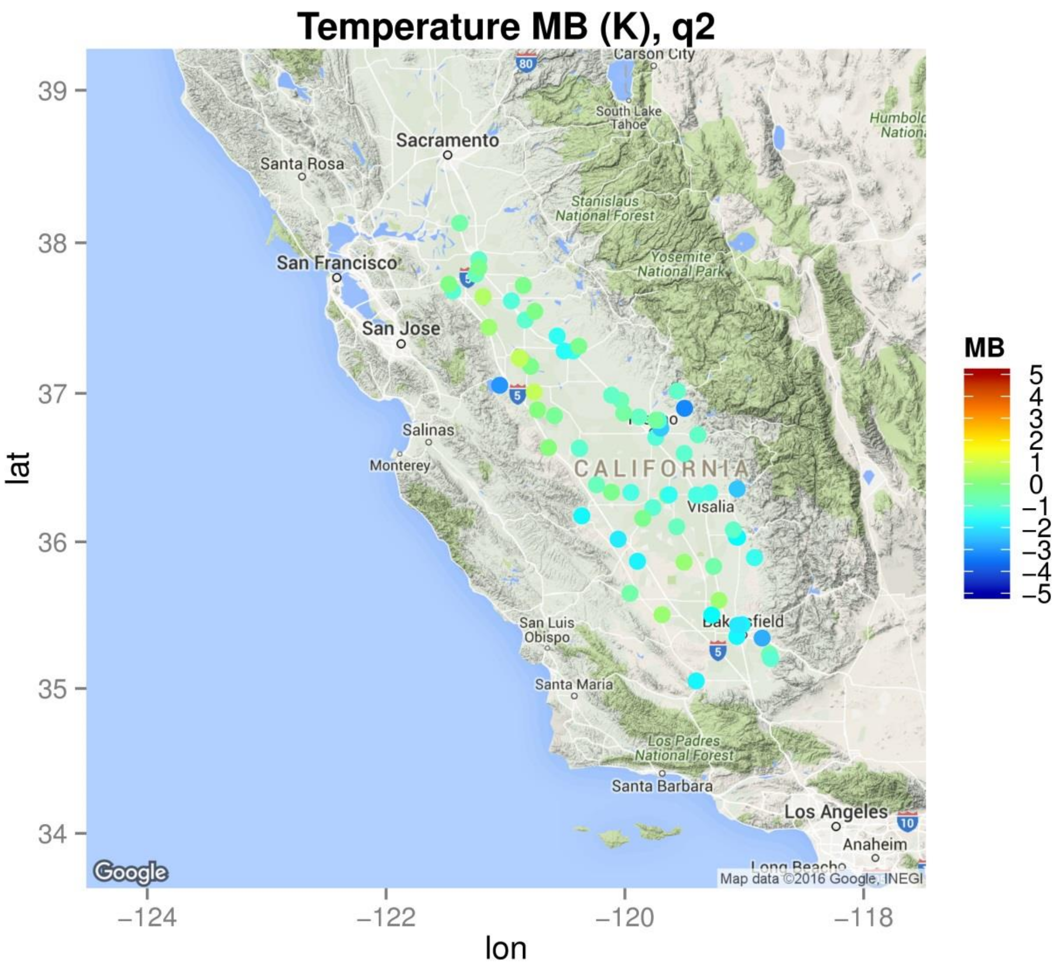


Figure S. 22 Hourly temperature mean bias in the second quarter of 2013

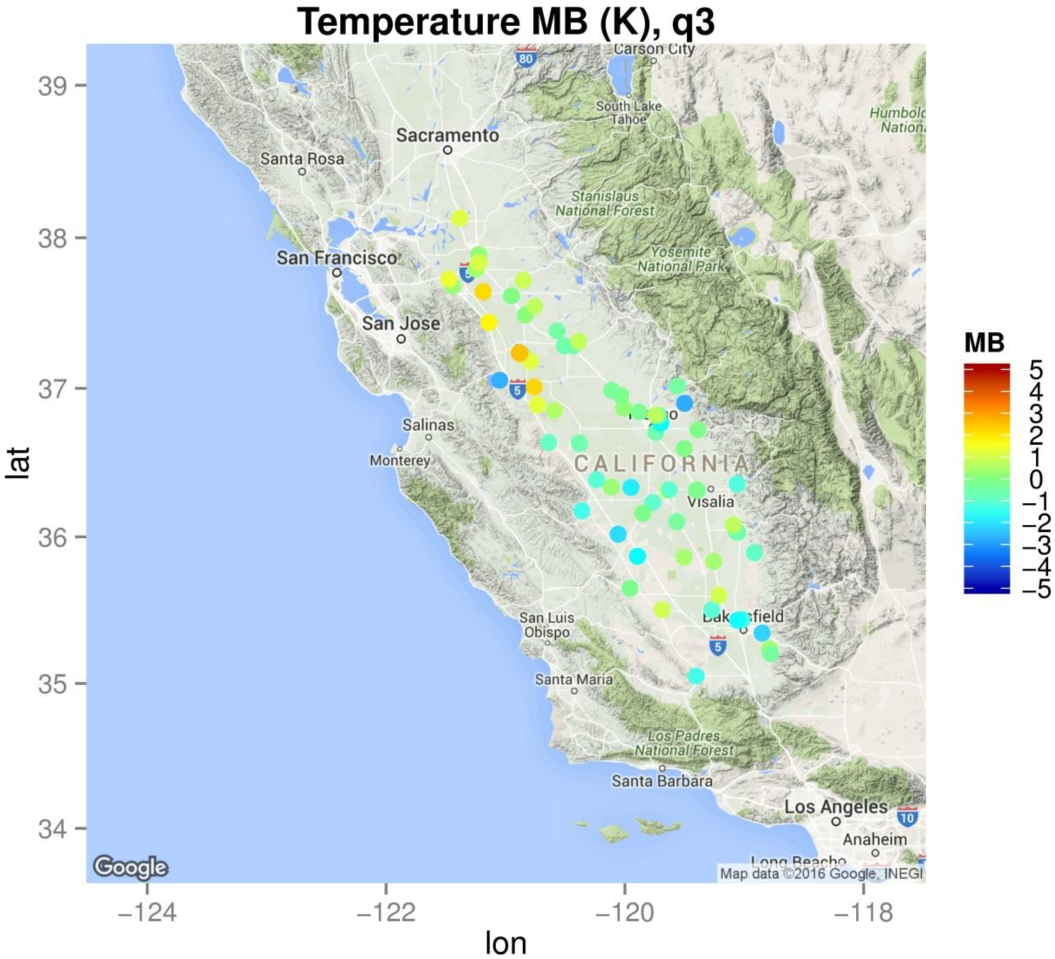


Figure S. 23 Hourly temperature mean bias in the third quarter of 2013

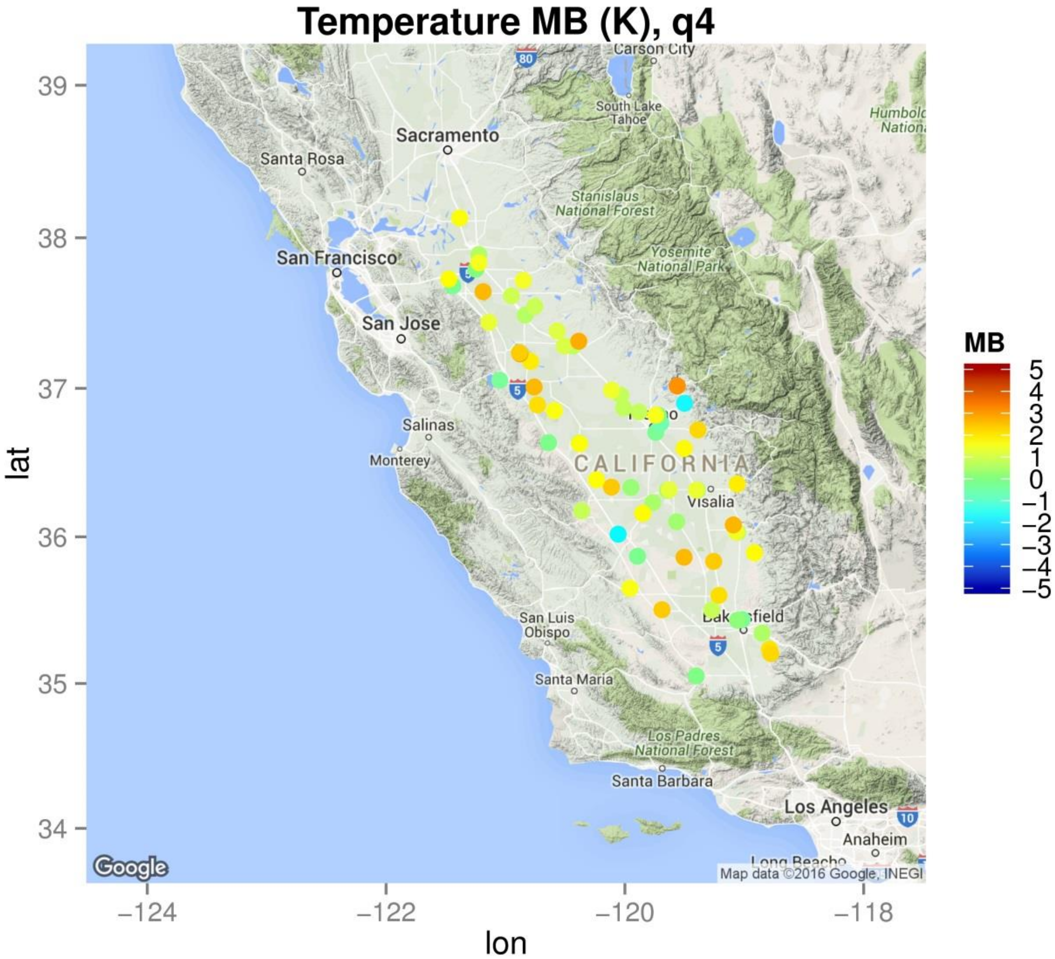


Figure S. 24 Hourly temperature mean bias in the fourth quarter of 2013

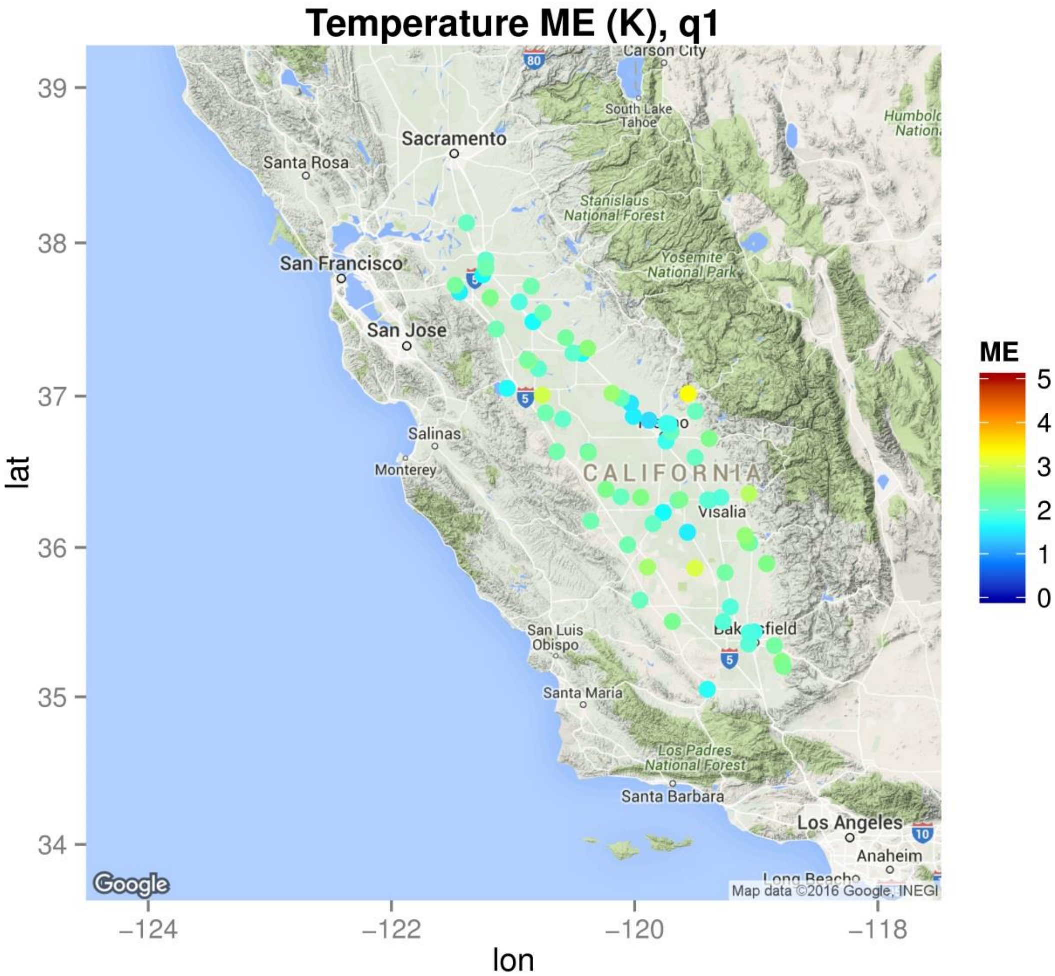


Figure S. 25 Hourly temperature mean error in the first quarter of 2013

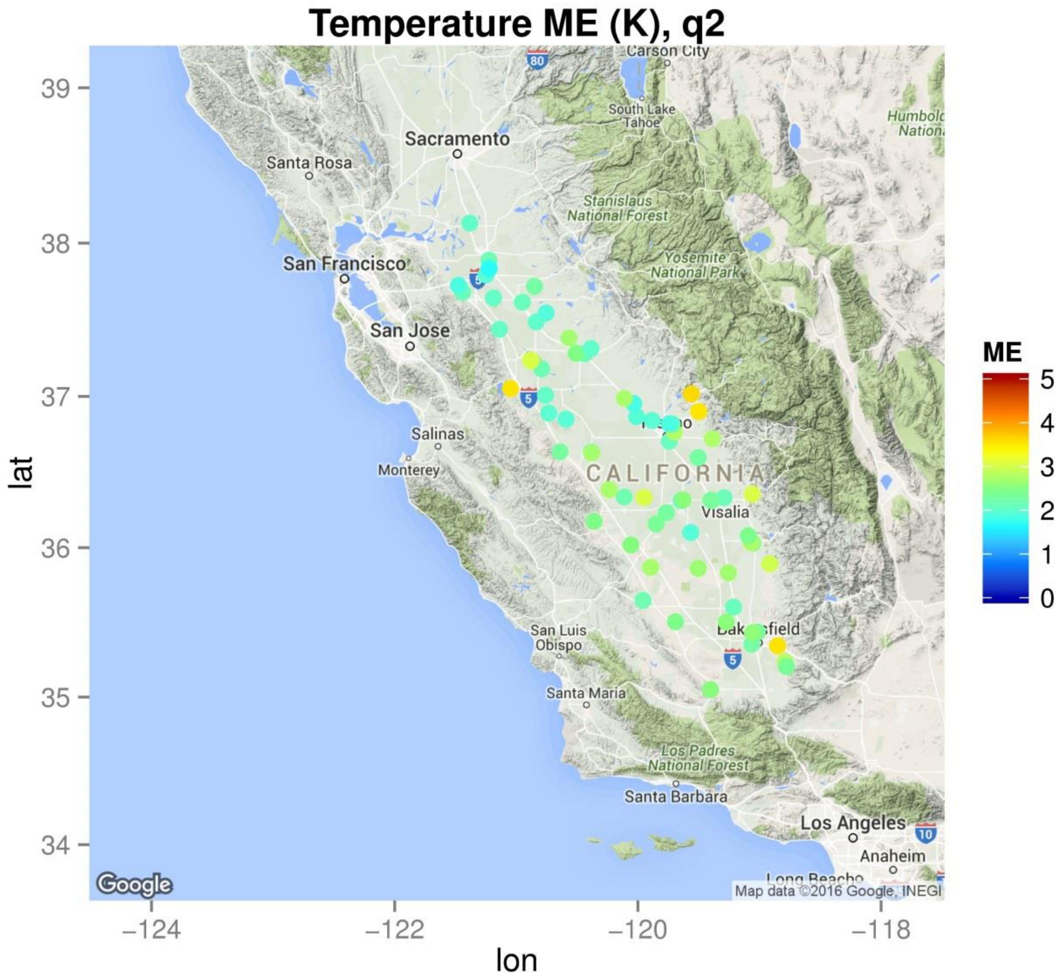


Figure S. 26 Hourly temperature mean error in the second quarter of 2013

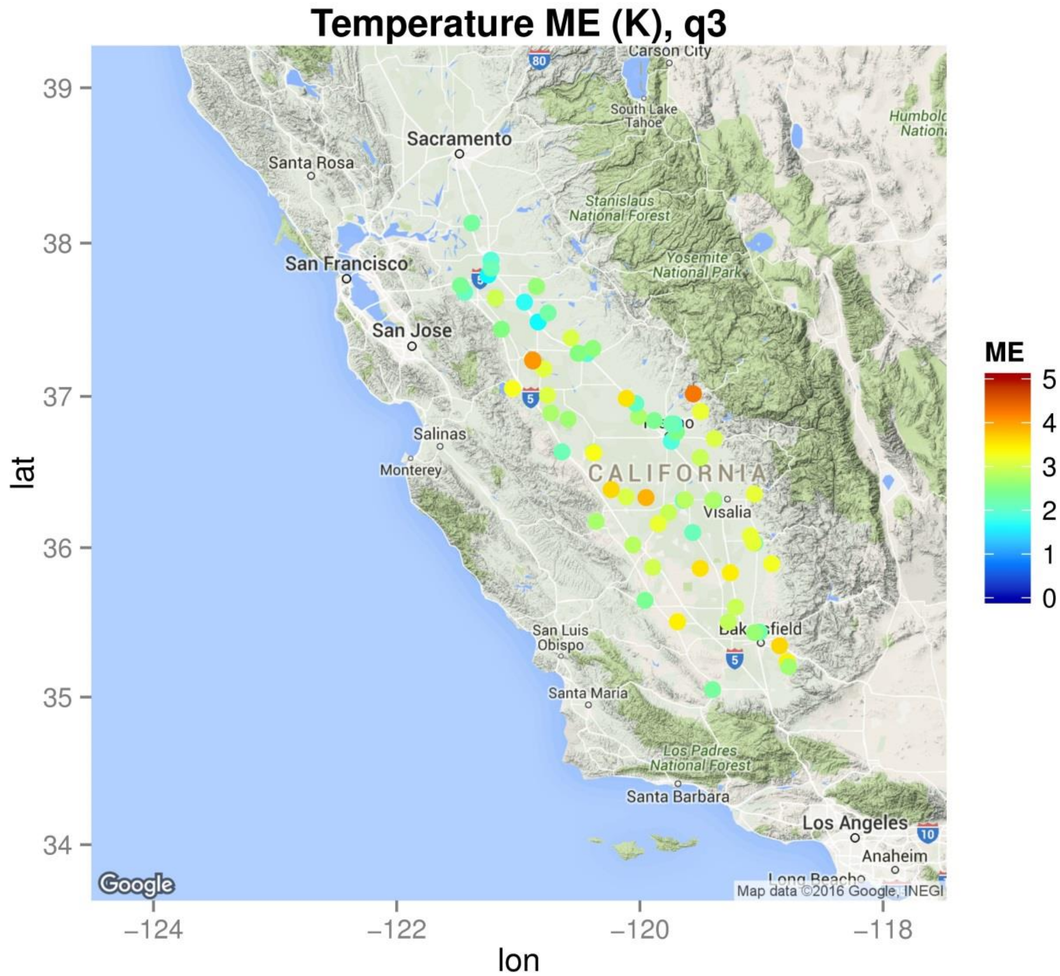


Figure S. 27 Hourly temperature mean error in the third quarter of 2013

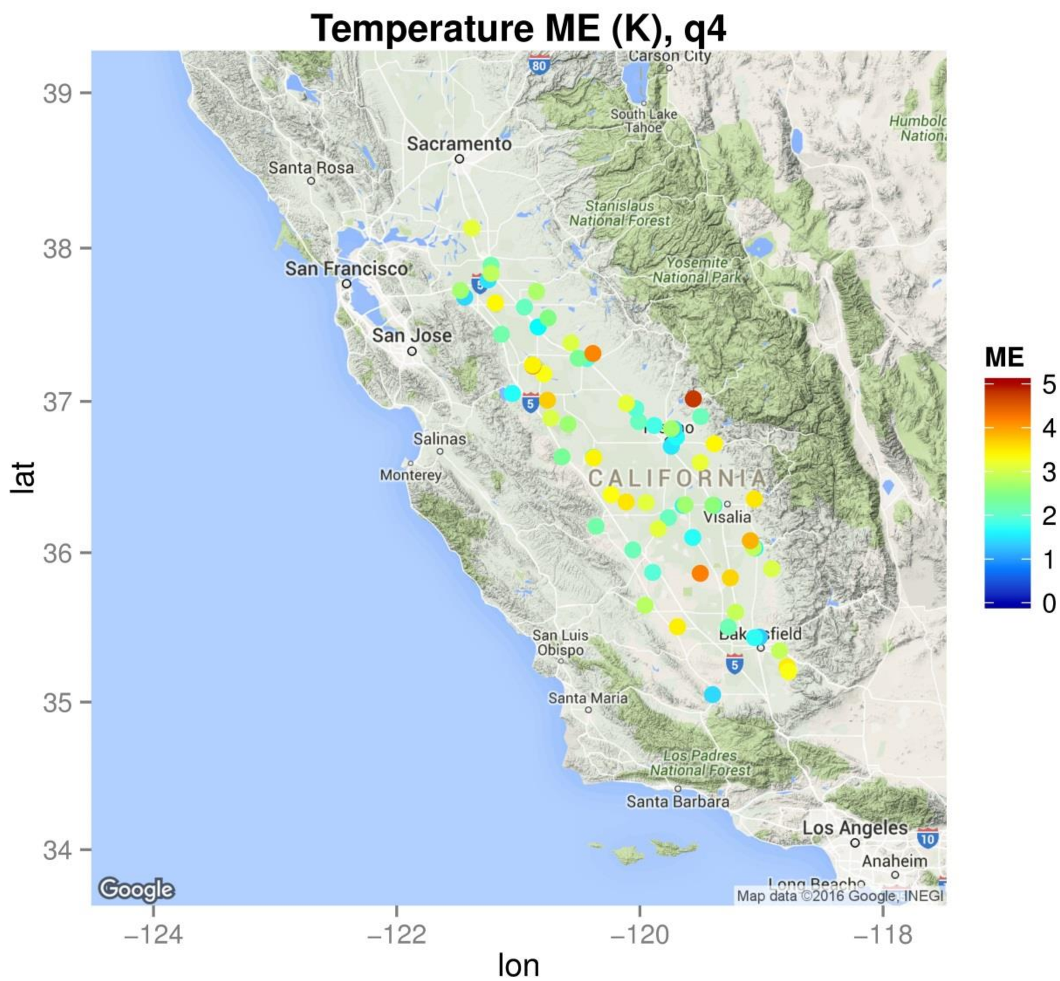


Figure S. 28 Hourly temperature mean error in the fourth quarter of 2013

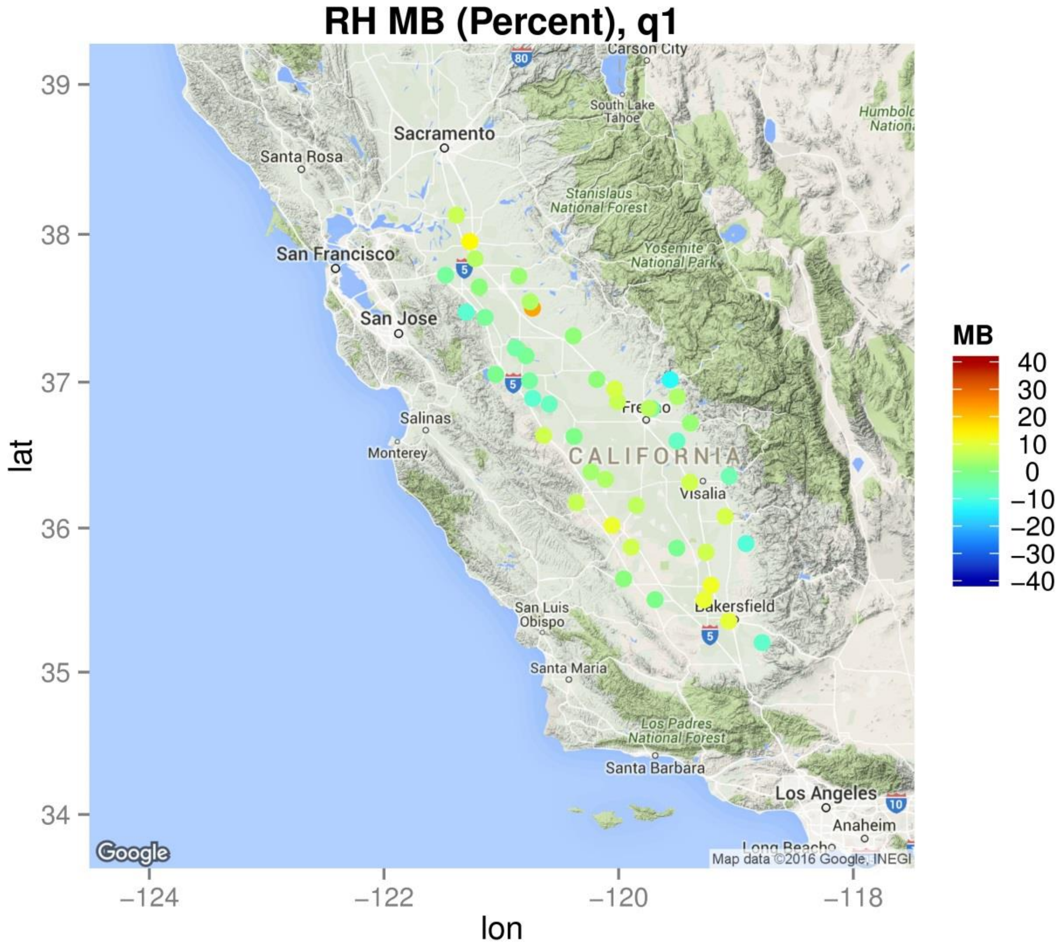
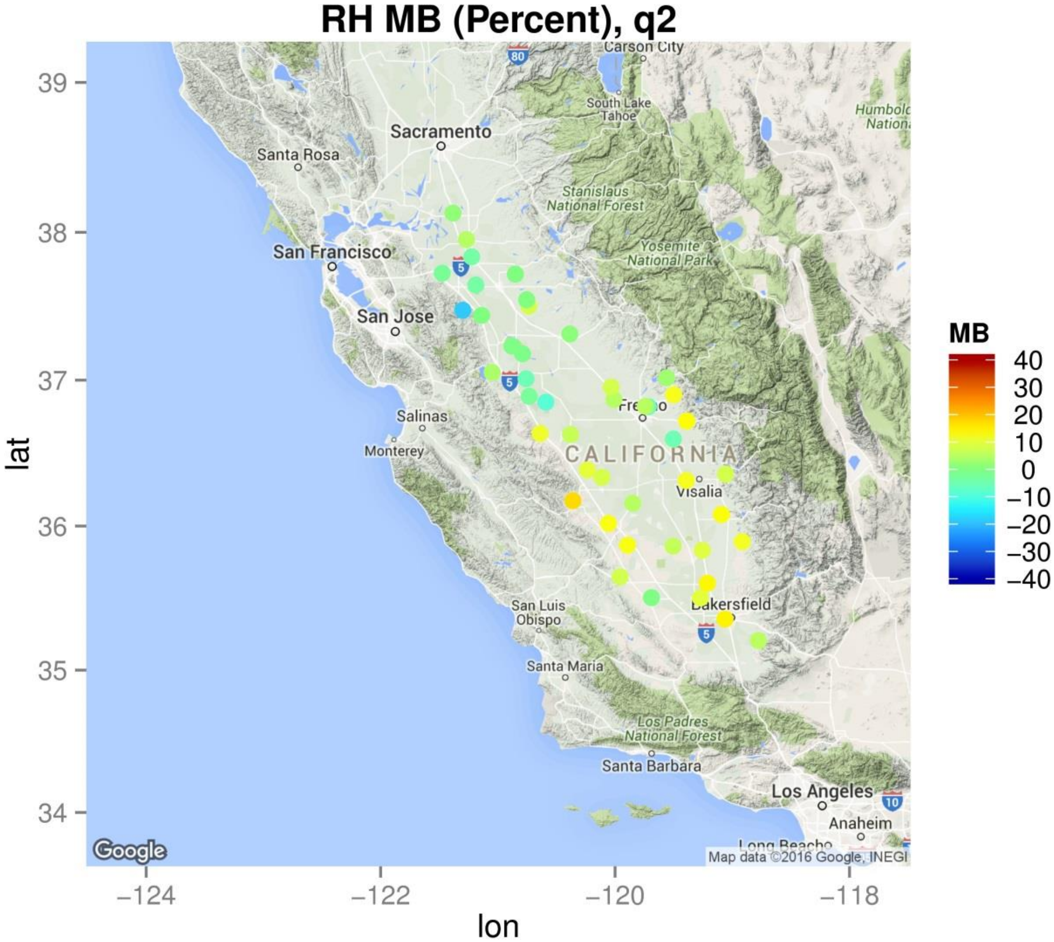


Figure S. 29 Hourly relative humidity mean bias in the first quarter of 2013



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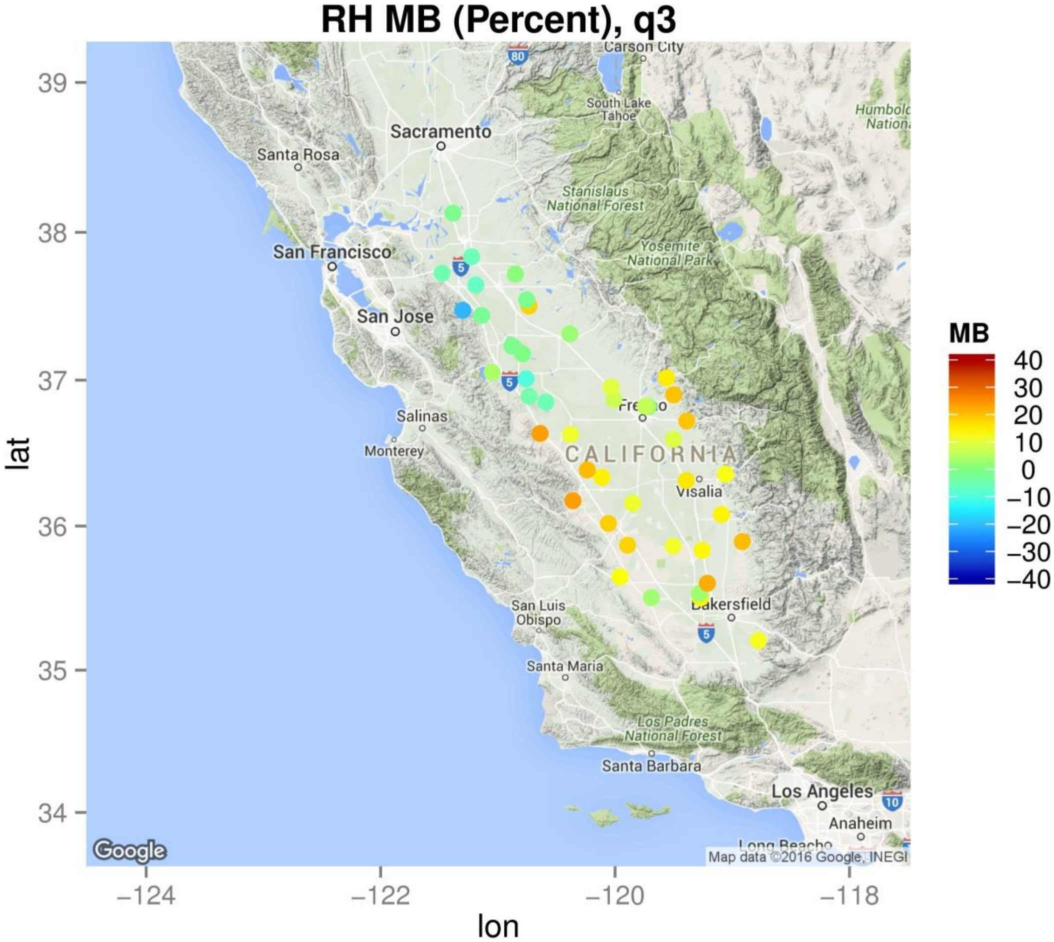

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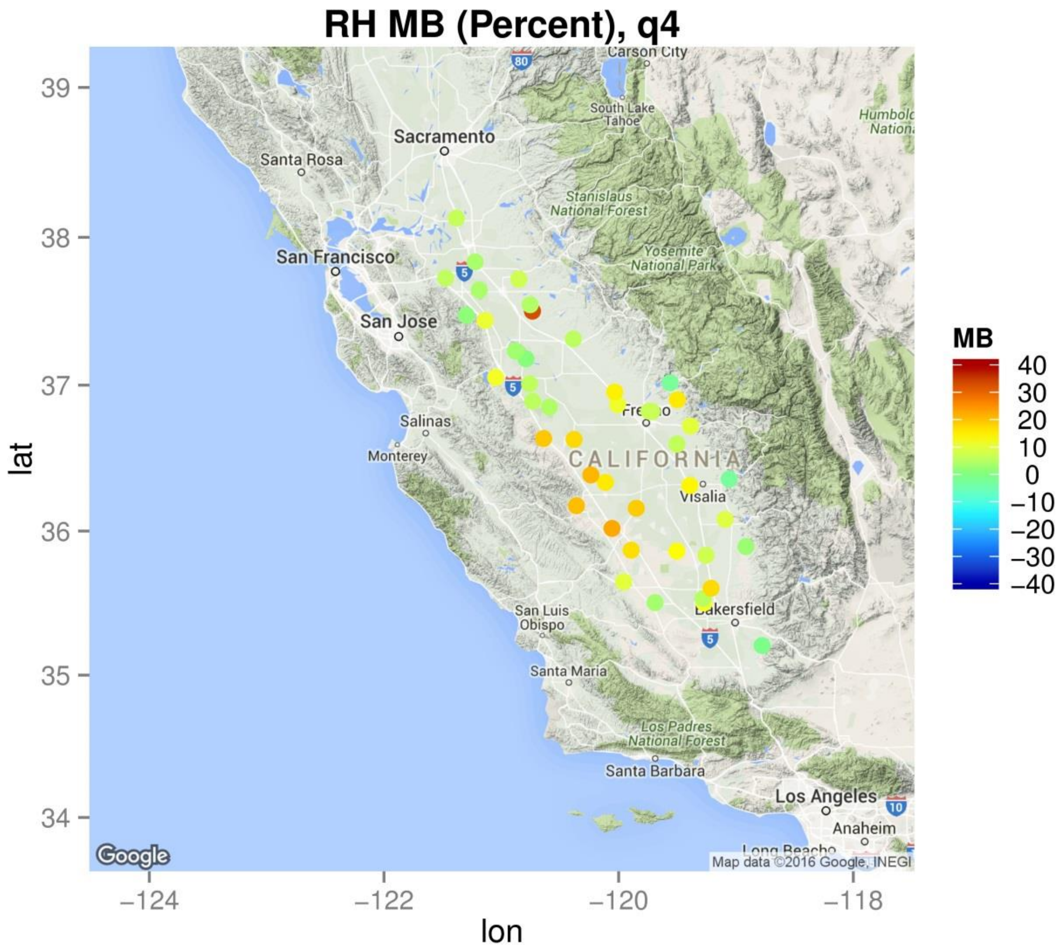

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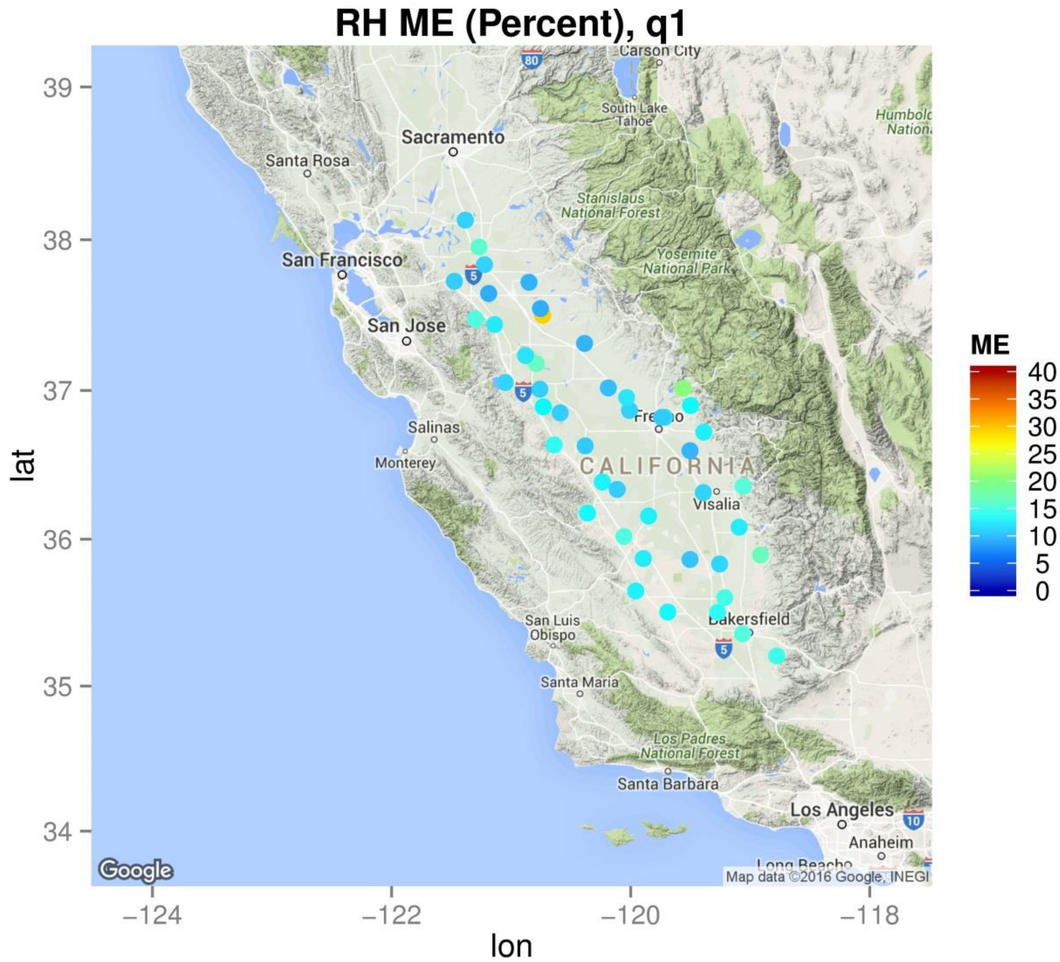

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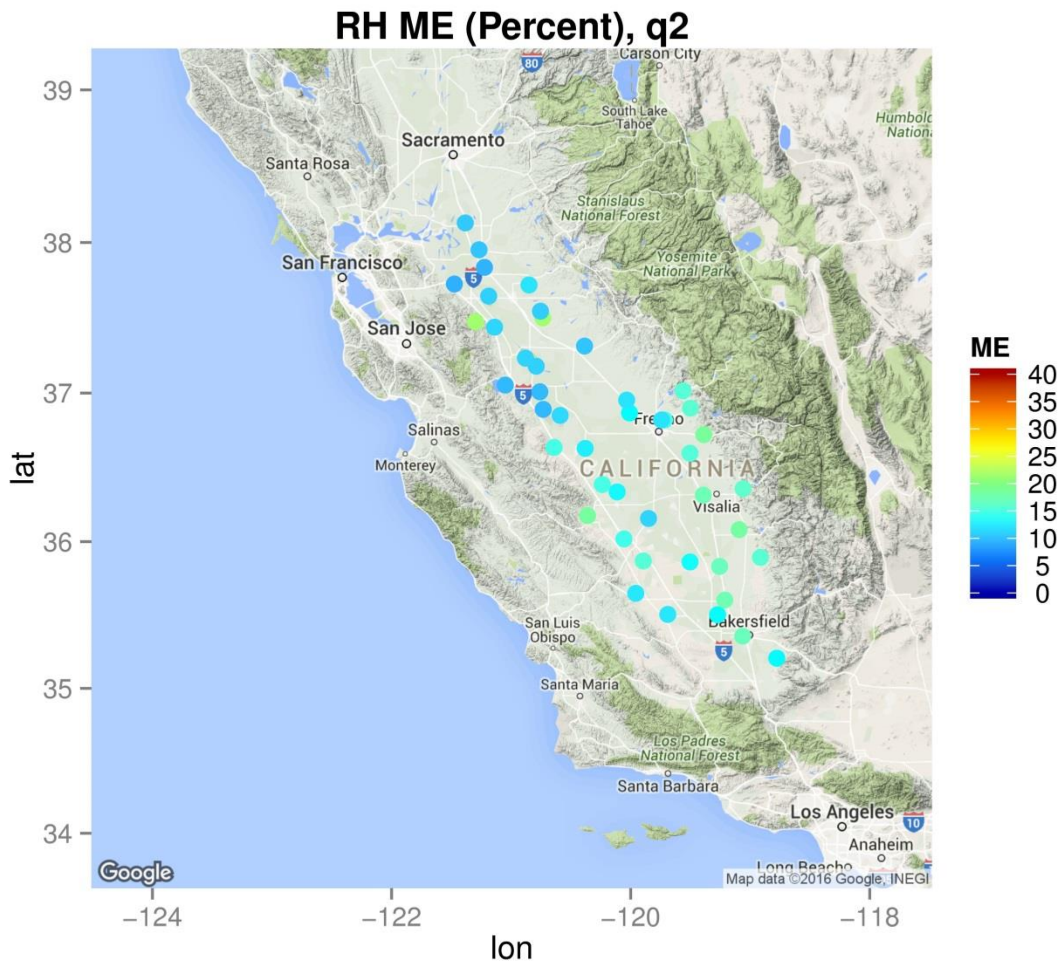

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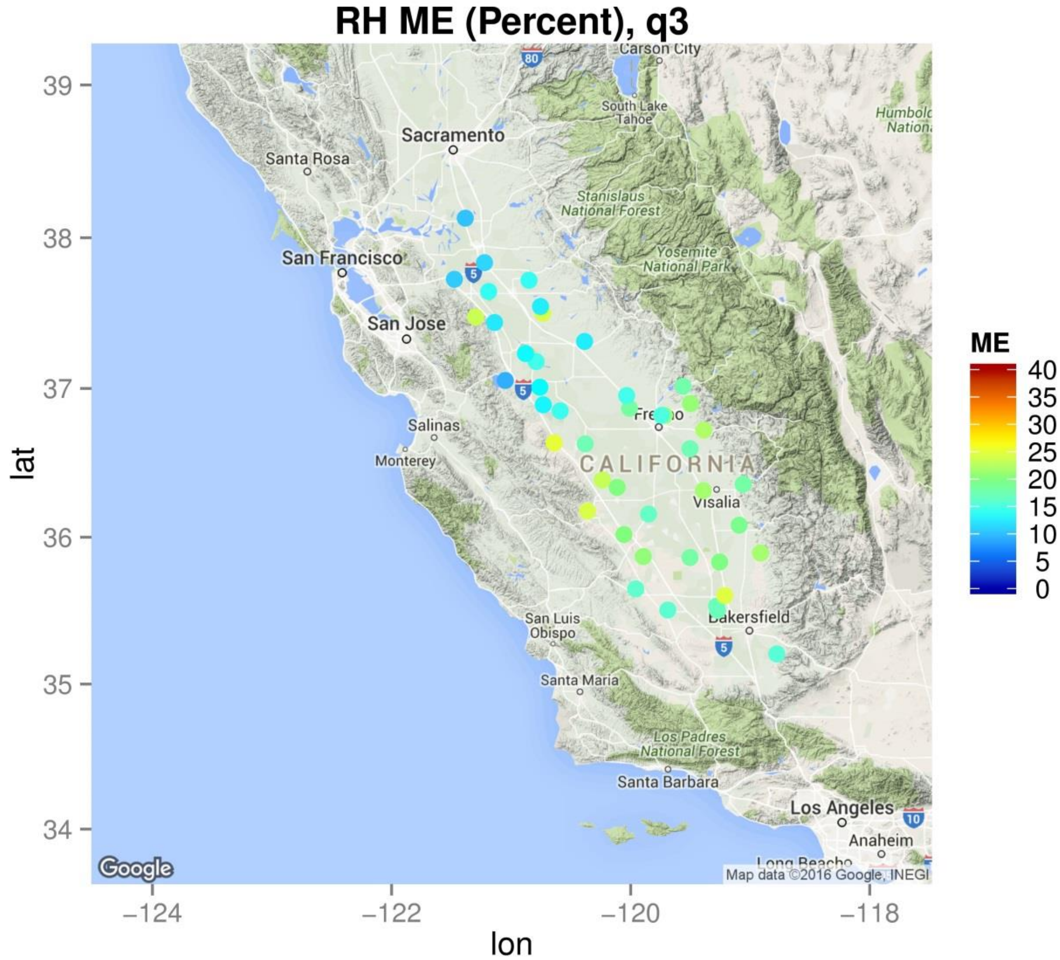

Figure S. 35 Hourly relative humidity mean error in the third quarter of 2013

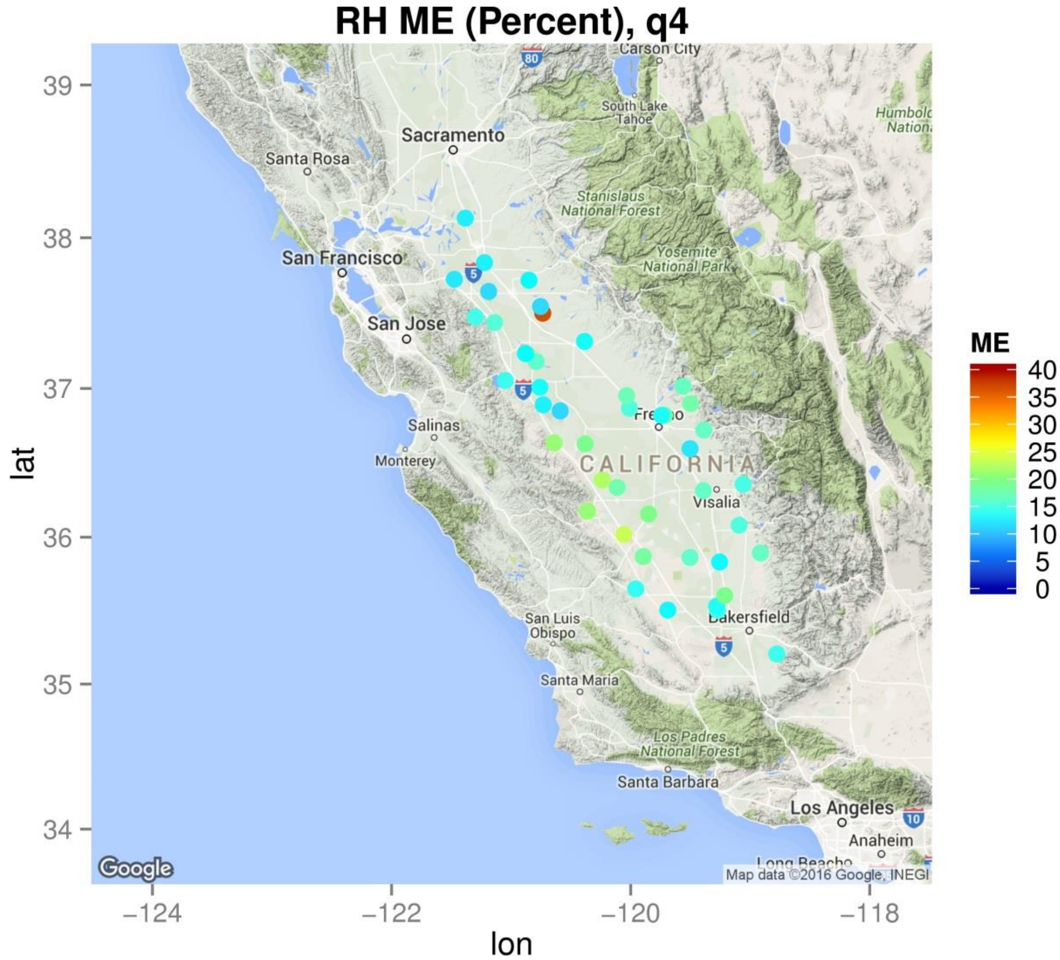

Figure S. 36 Hourly relative humidity mean error in the fourth quarter of 2013

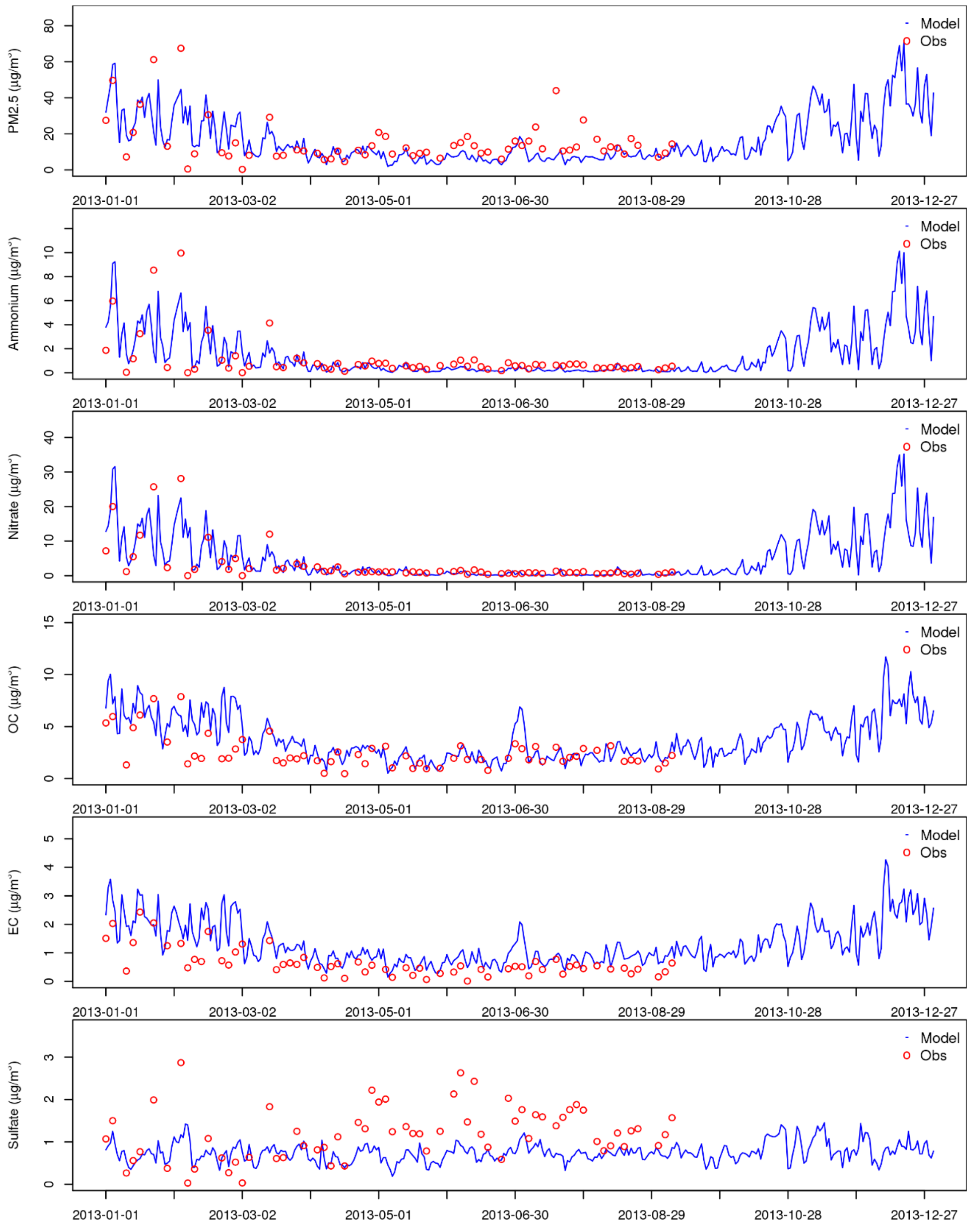

Figure S. 37 Comparison of time series of observed (from CSN measurement) and modeled $PM_{2.5}$ species at Bakersfield

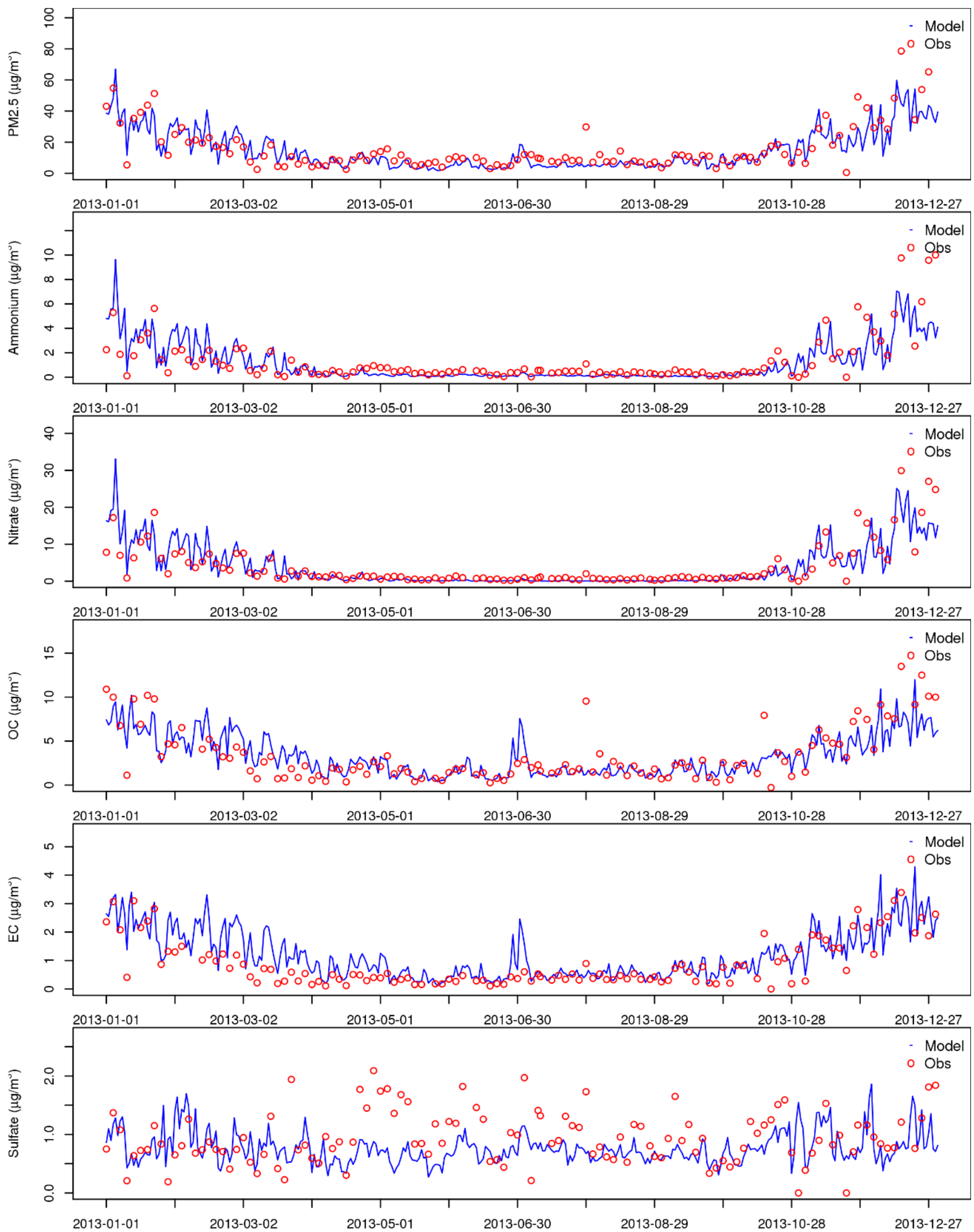

Figure S. 38 Comparison of time series of observed (from CSN measurement) and modeled $PM_{2.5}$ species at Fresno

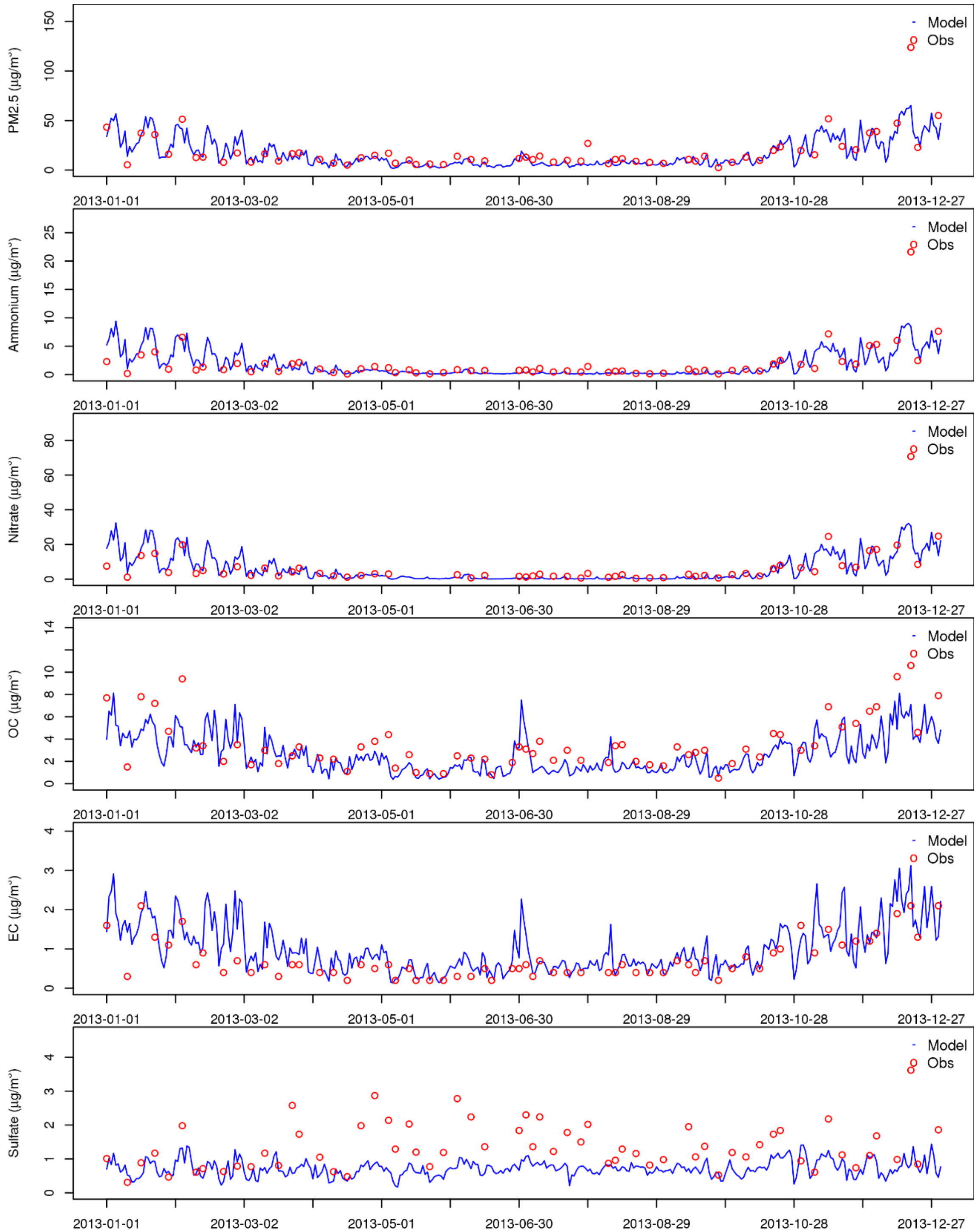

Figure S. 39 Comparison of time series of observed (from CSN measurement) and modeled $PM_{2.5}$ species at Visalia

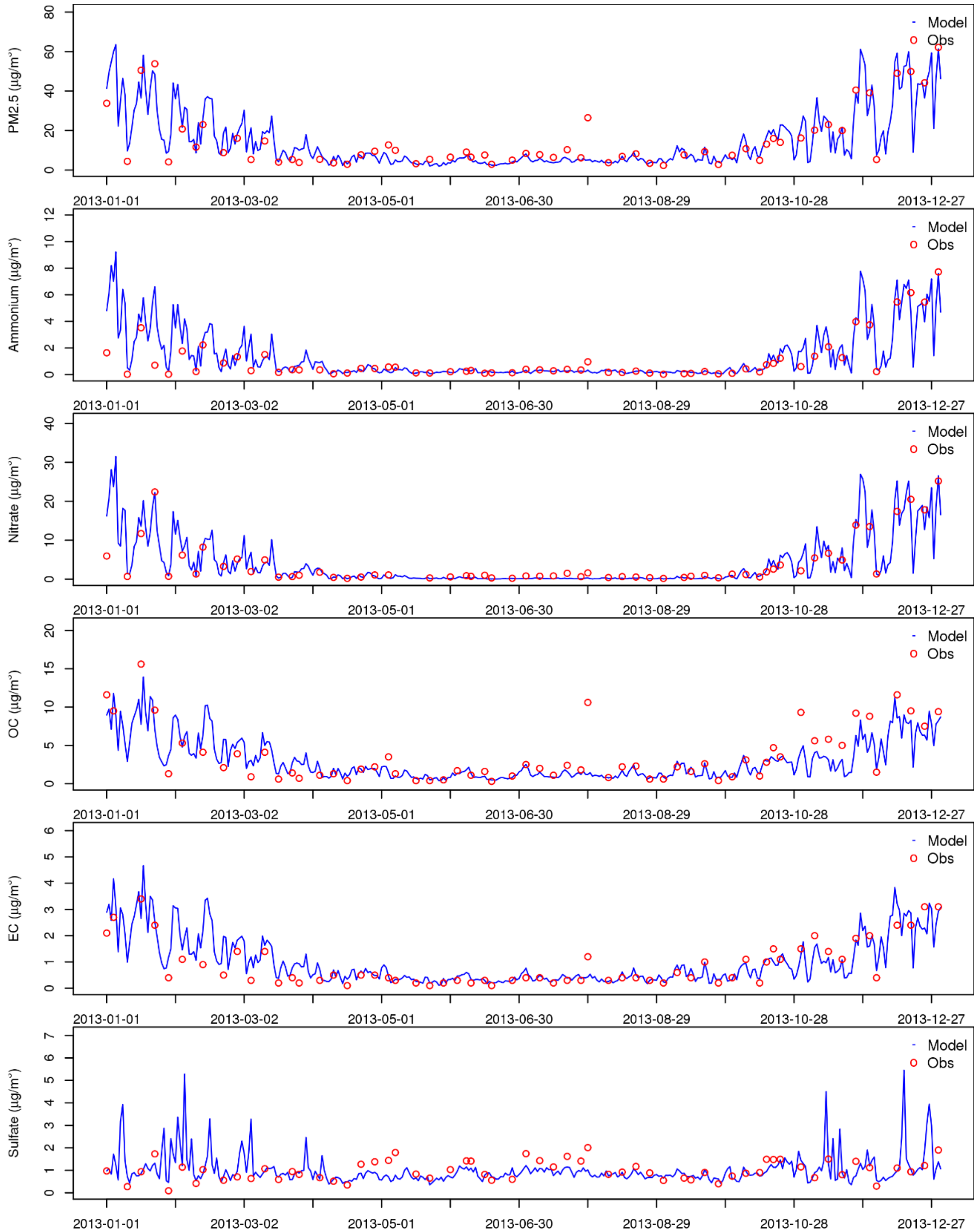

Figure S. 40 Comparison of time series of observed (from CSN measurement) and modeled $PM_{2.5}$ species at Modesto

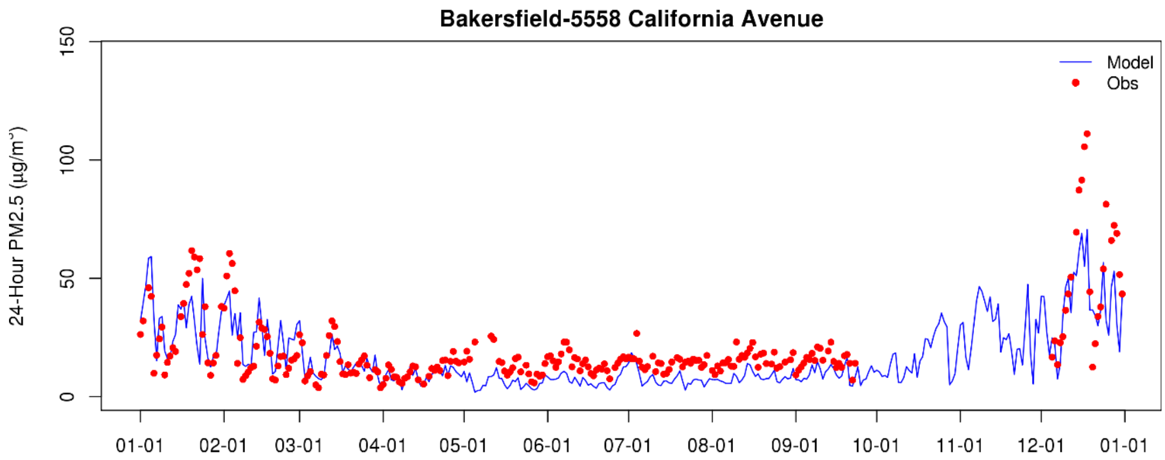

Figure S. 41 Observed and modeled 24-hour average $PM_{2.5}$ at Bakersfield – California Avenue.

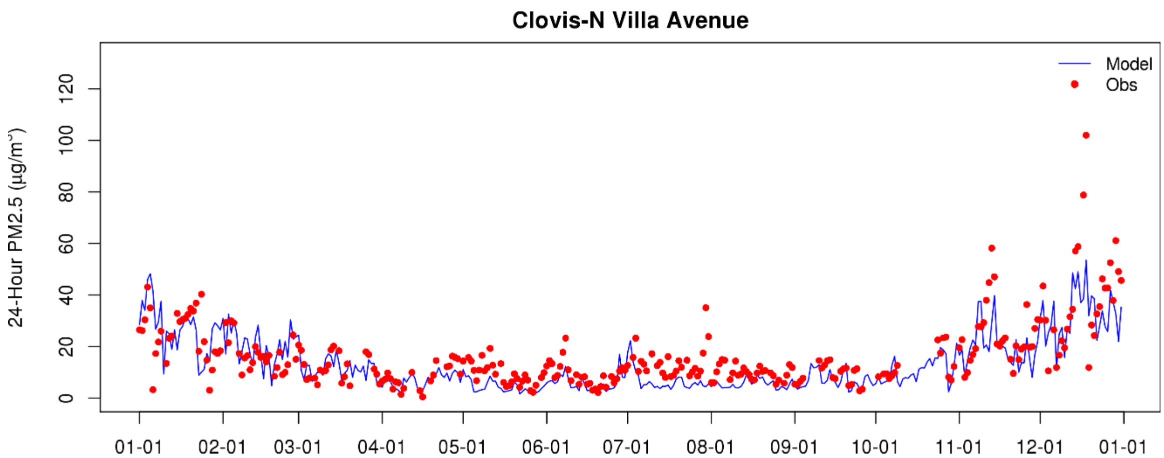

Figure S. 42 Observed and modeled 24-hour average $PM_{2.5}$ at Clovis – Villa Avenue

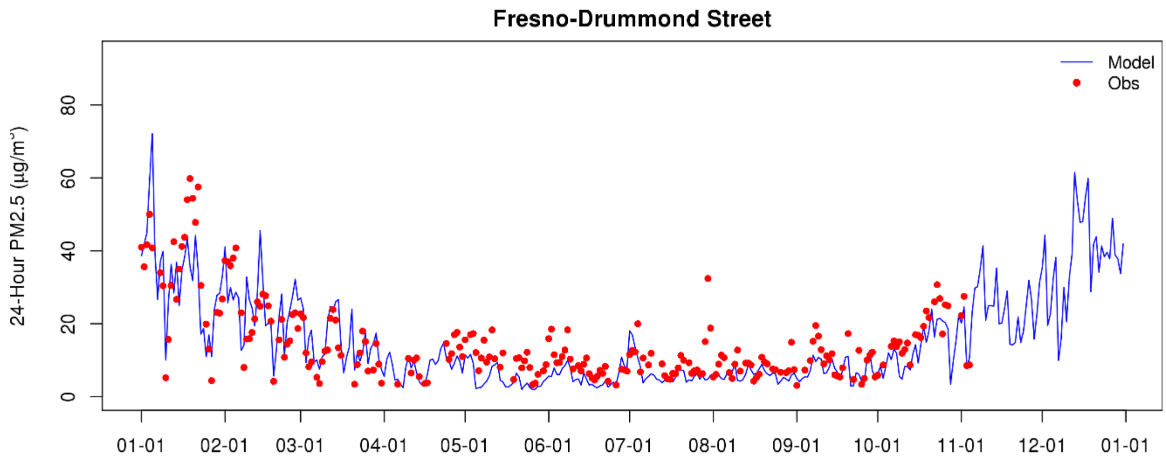

Figure S. 43 Observed and modeled 24-hour average $PM_{2.5}$ at Fresno – Drummond Street

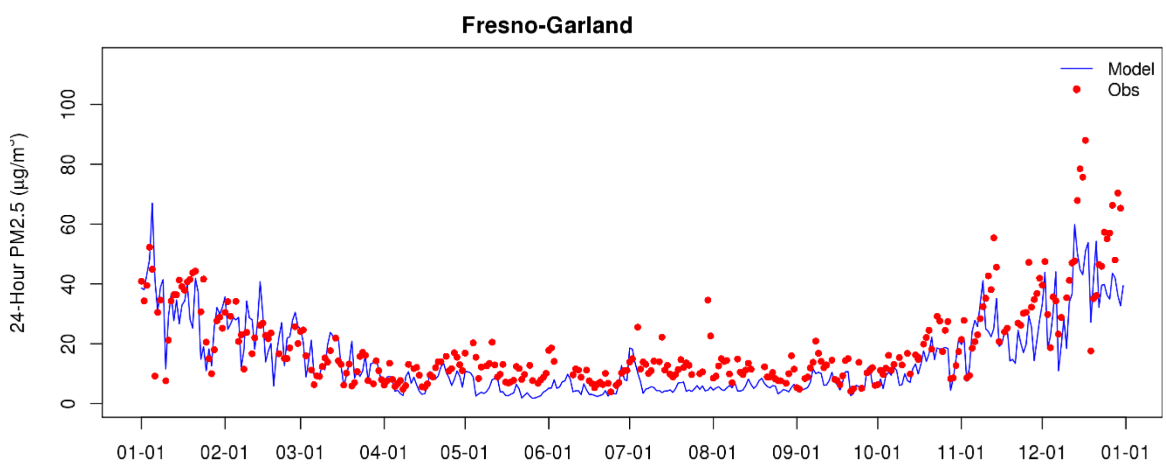

Figure S. 44 Observed and modeled 24-hour average $PM_{2.5}$ at Fresno – Garland

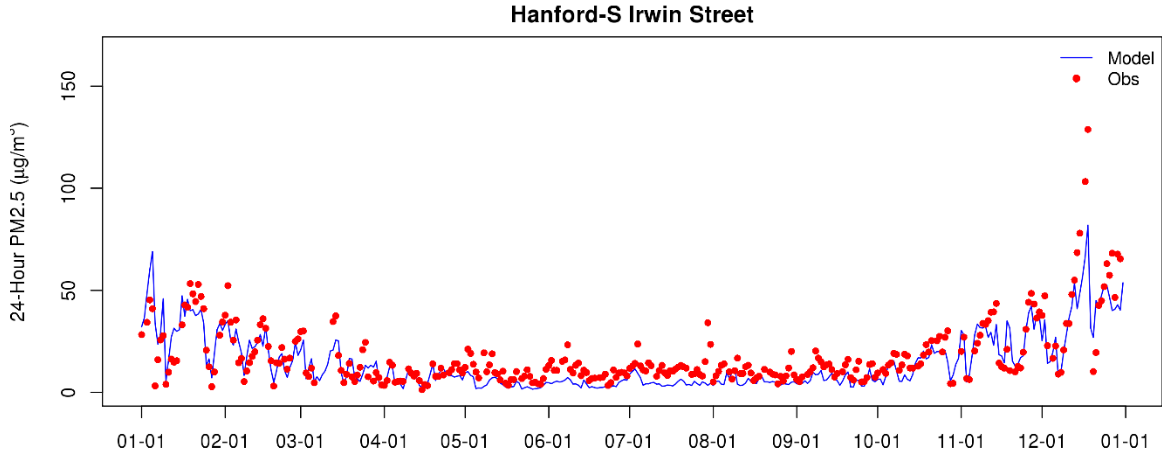

Figure S. 45 Observed and modeled 24-hour average $PM_{2.5}$ at Hanford – Irwin Street

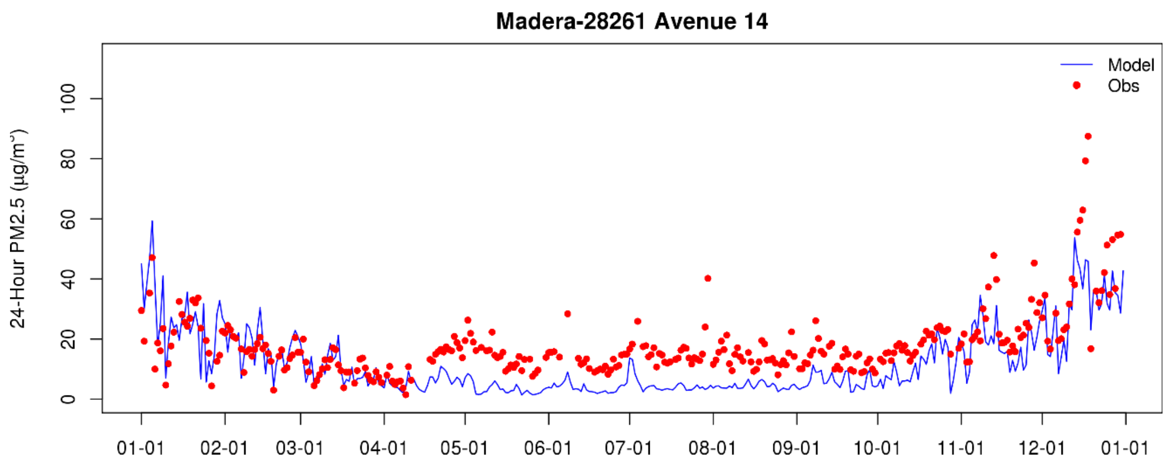

Figure S. 46 Observed and modeled 24-hour average $PM_{2.5}$ at Madera – Avenue 14

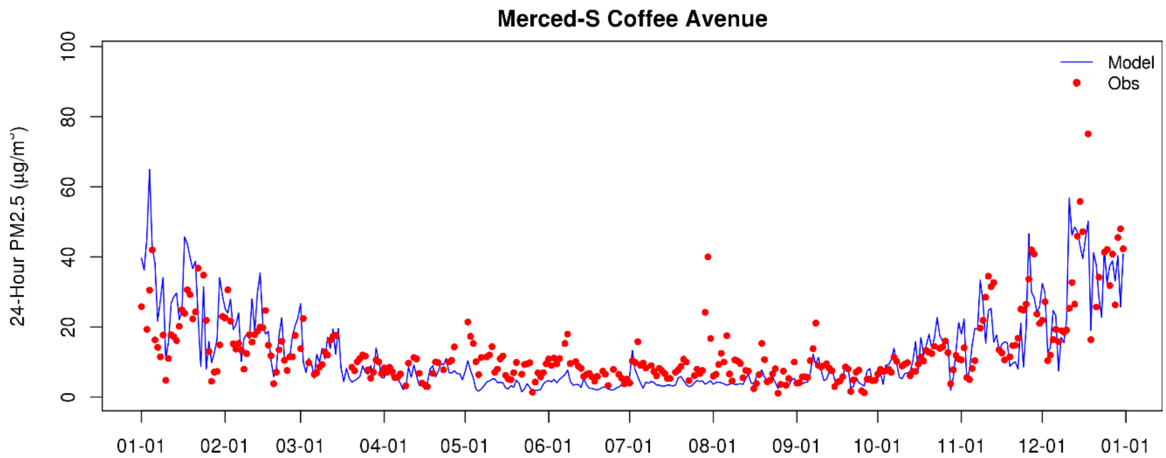

Figure S. 47 Observed and modeled 24-hour average $PM_{2.5}$ at Merced – S Coffee Avenue

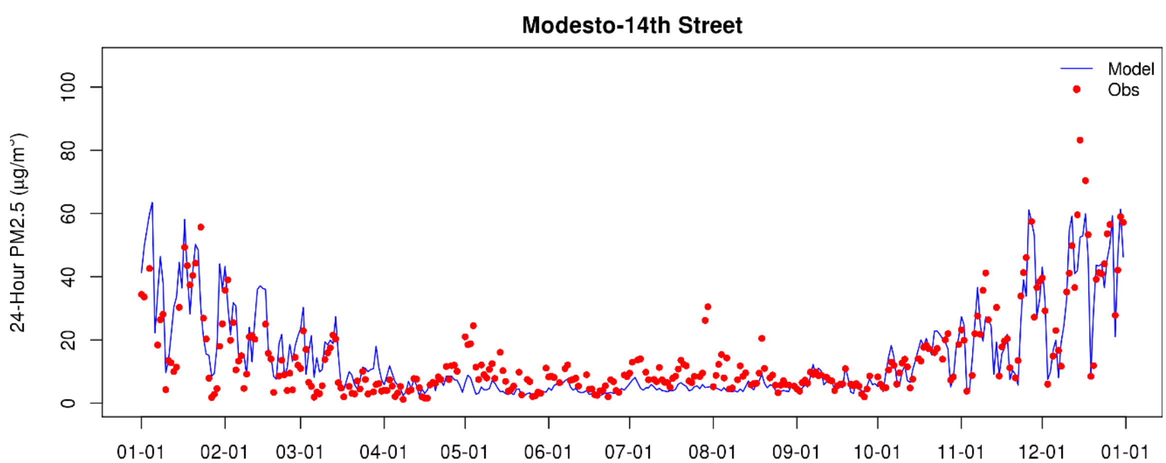

Figure S. 48 Observed and modeled 24-hour average $PM_{2.5}$ at Modesto – 14^{th} Street

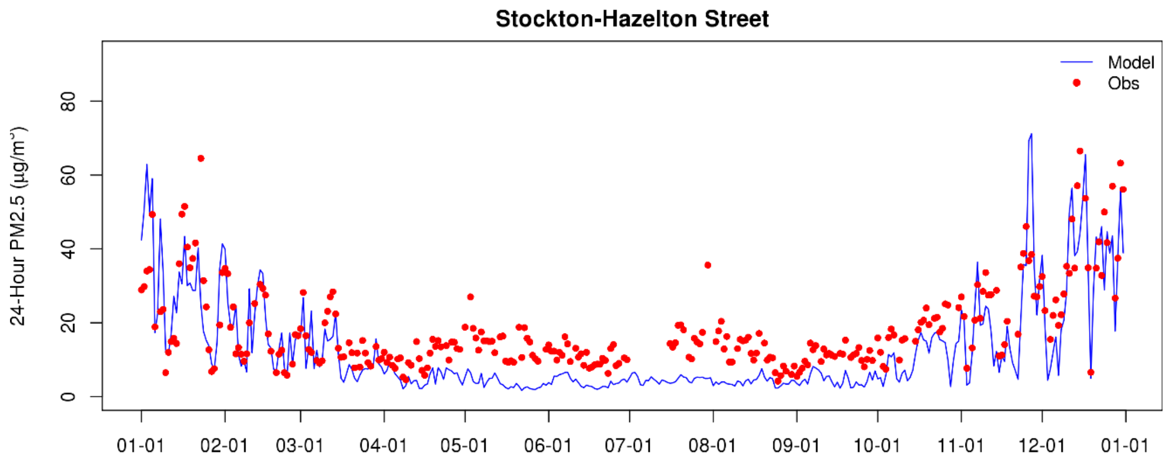

Figure S. 49 Observed and modeled 24-hour average $PM_{2.5}$ at Stockton – Hazelton Street

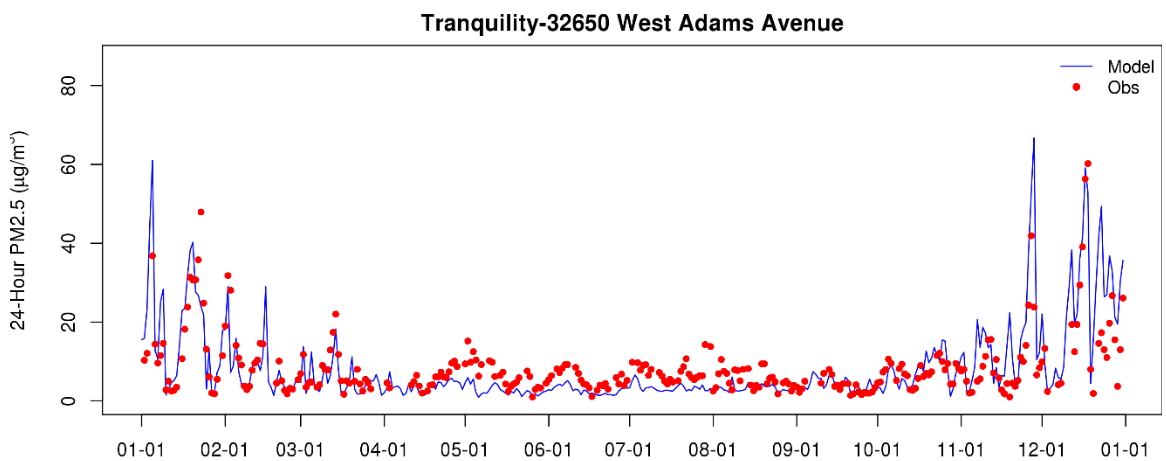

Figure S. 50 Observed and modeled 24-hour average $PM_{2.5}$ at Tranquility – West Adams Avenue

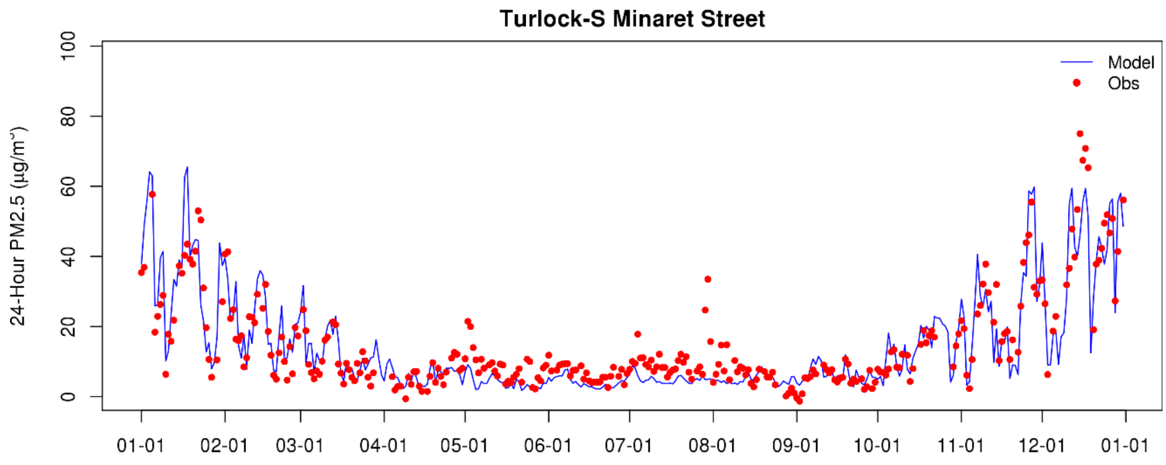

Figure S. 51 Observed and modeled 24-hour average $PM_{2.5}$ at Turlock – Minaret Street

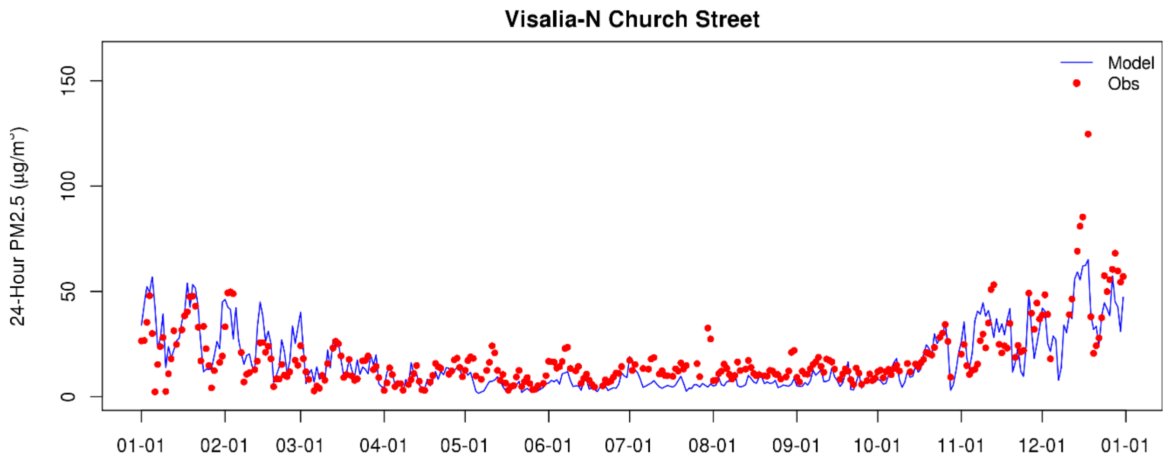

Figure S. 52 Observed and modeled 24-hour average $PM_{2.5}$ at Visalia – Church Street

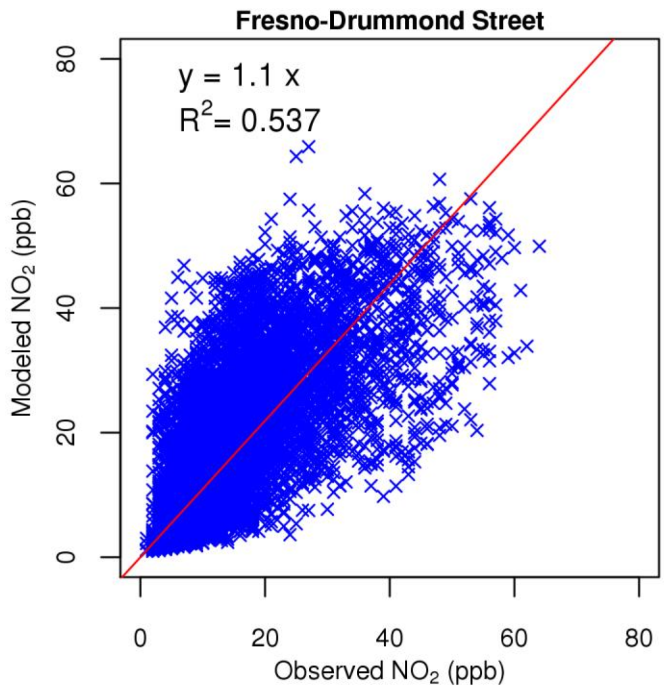

Figure S. 53 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Fresno – Drummond Street

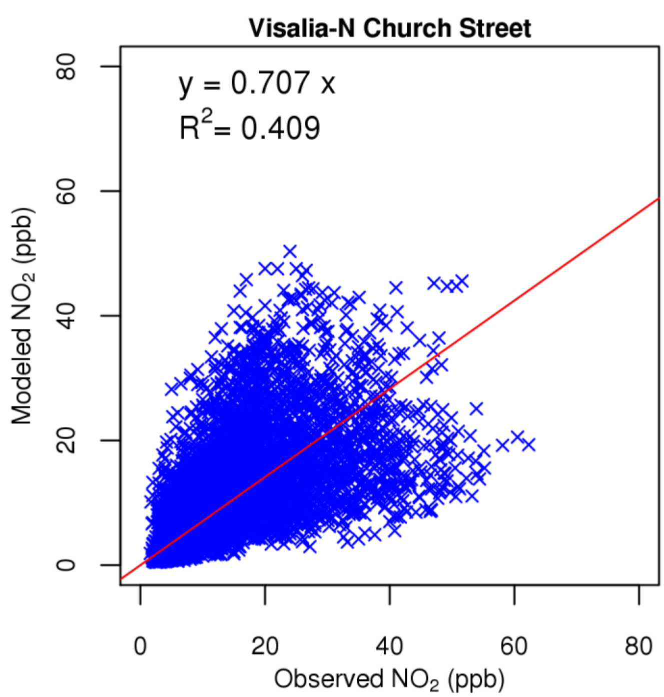

Figure S. 54 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Visalia

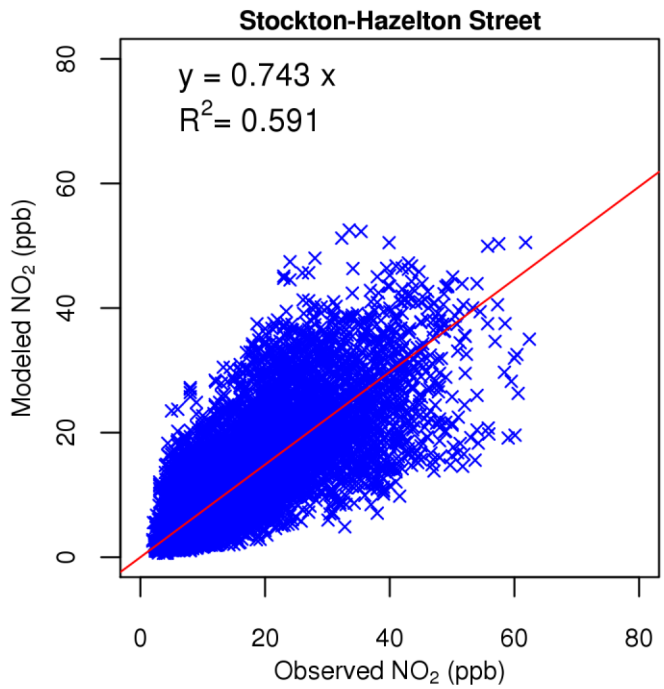

Figure S. 55 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Stockton

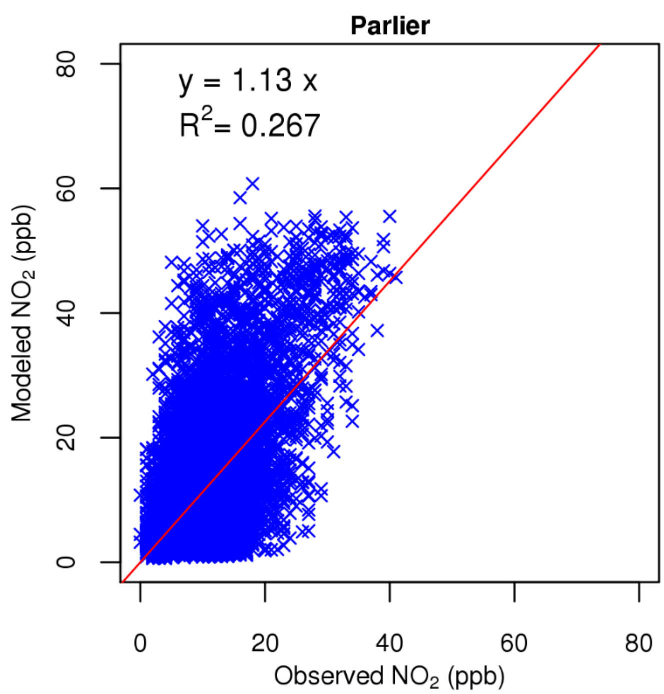

Figure S. 56 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Parlier

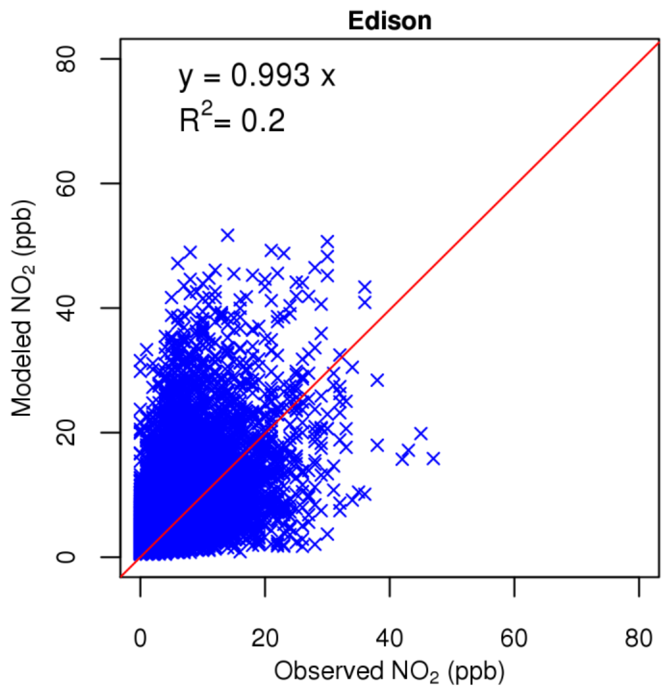

Figure S. 57 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Edison

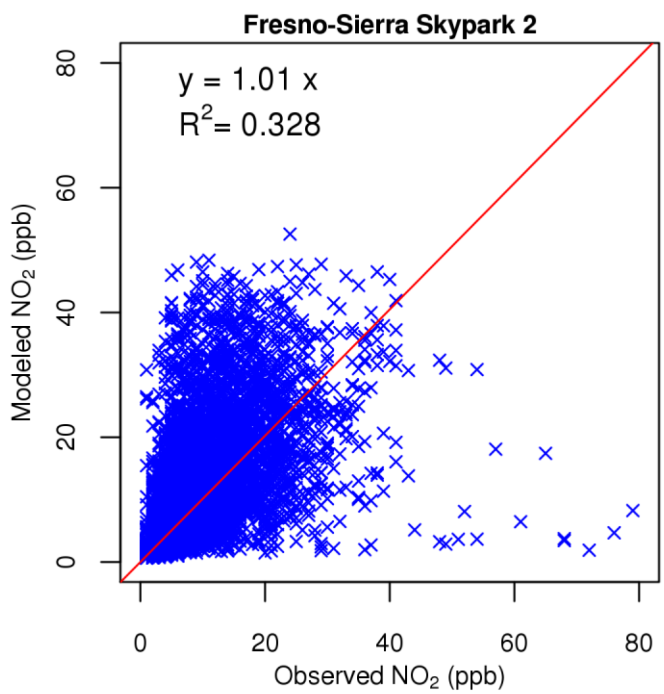

Figure S. 58 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Fresno – Sierra Sky Park

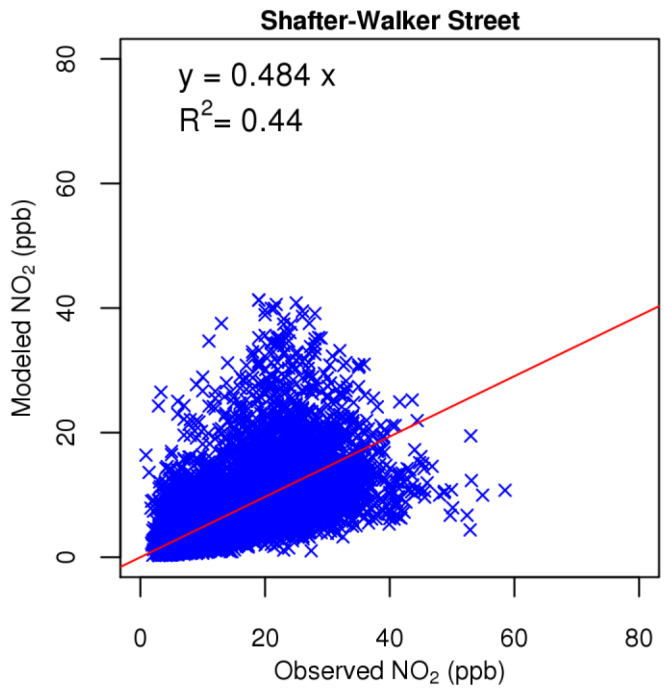

Figure S. 59 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Shafter

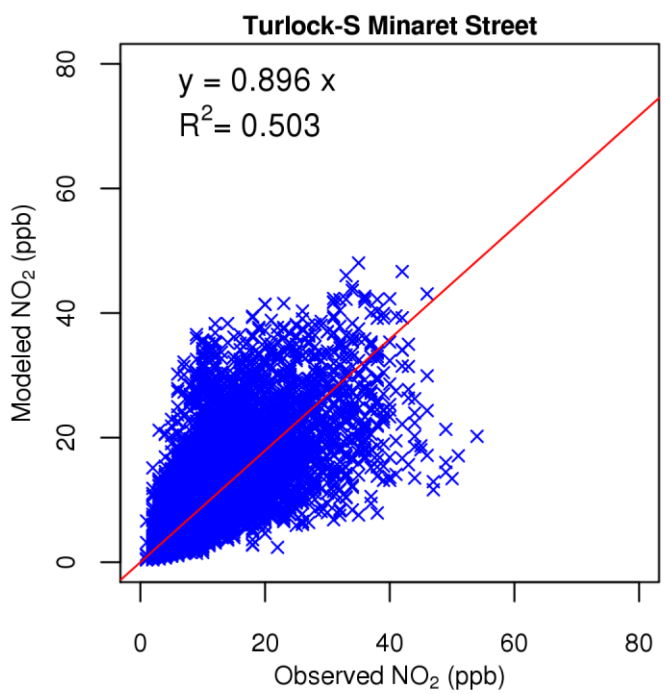

Figure S. 60 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Turlock

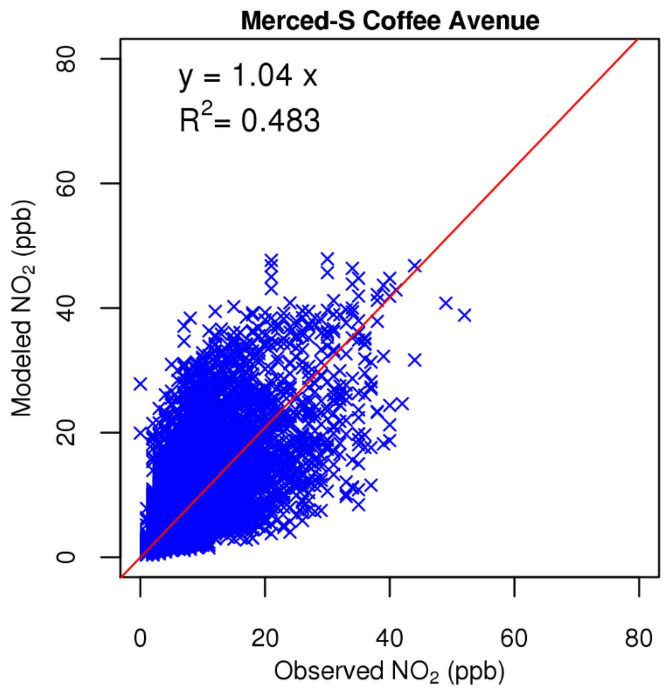

Figure S. 61 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Merced

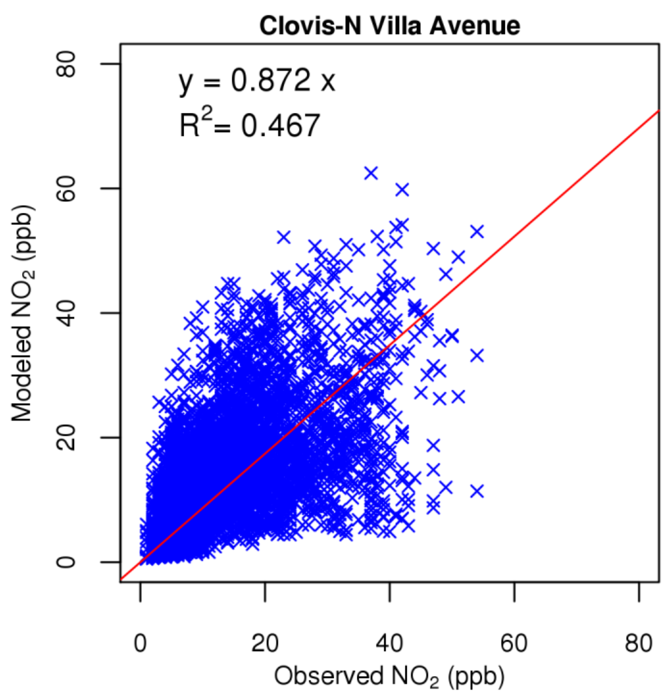

Figure S. 62 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Clovis

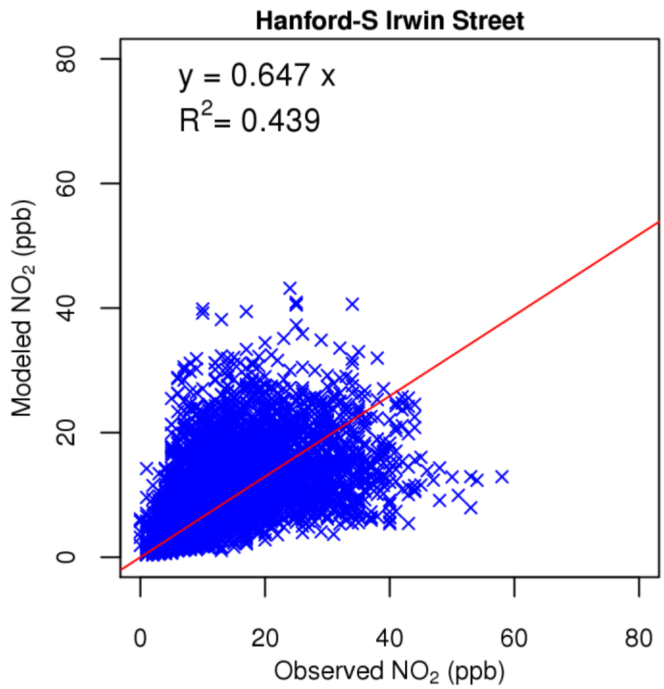

Figure S. 63 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Hanford

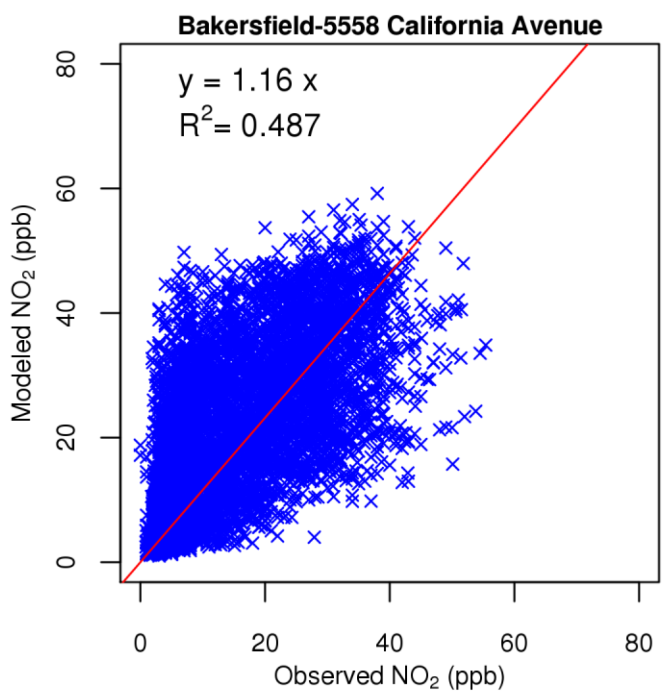

Figure S. 64 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Bakersfield – California Avenue

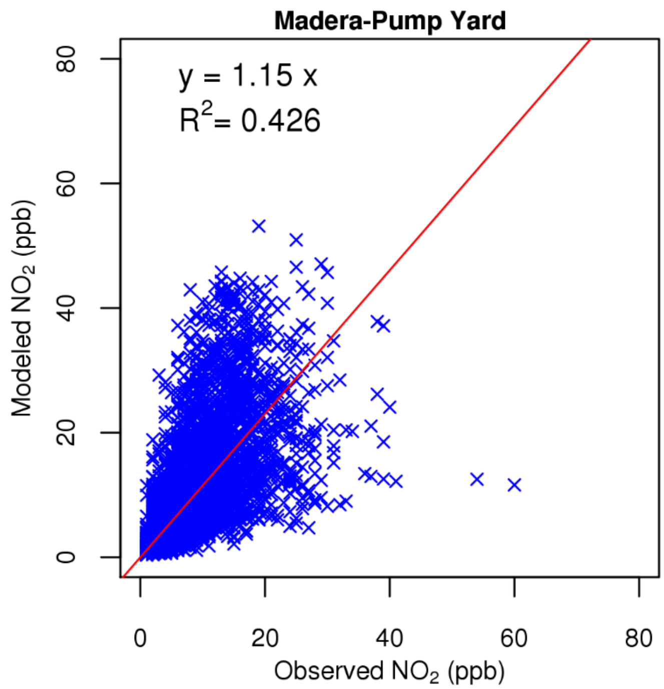

Figure S. 65 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Madera

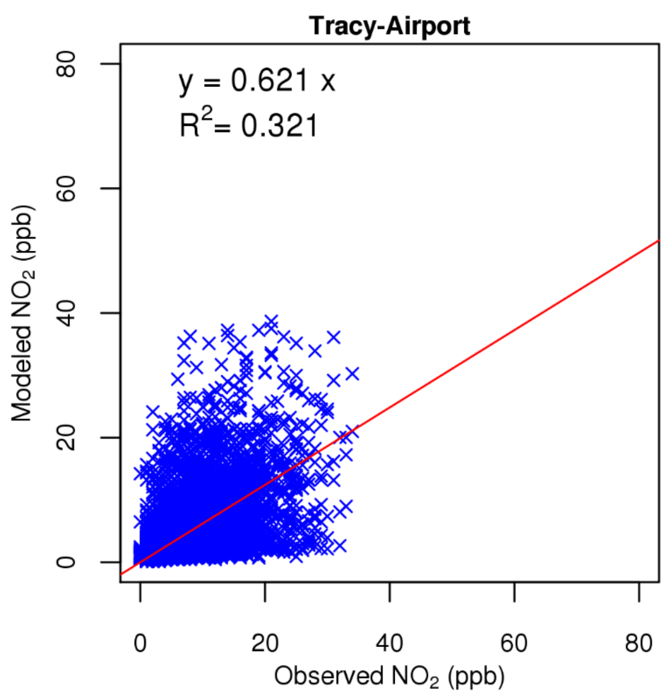

Figure S. 66 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Tracy

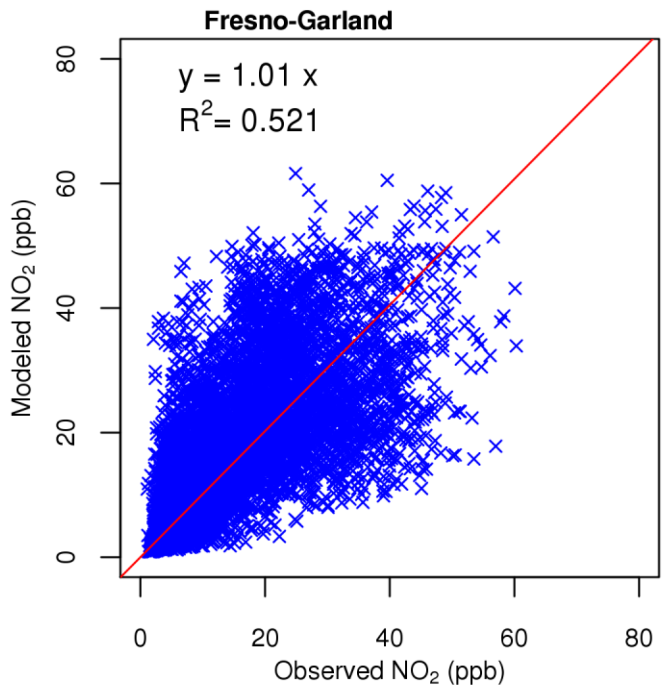

Figure S. 67 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Fresno – Garland

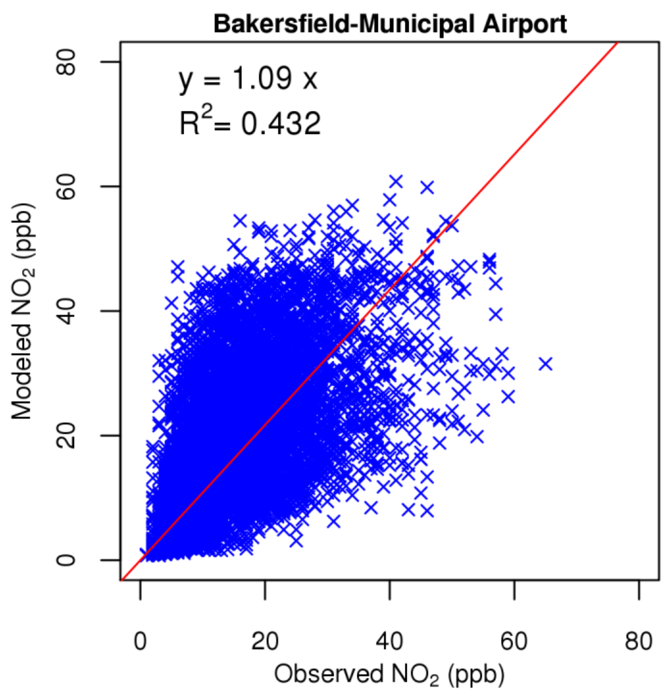

Figure S. 68 Scattering plot of observed and modeled 1-hour NO_2 mixing ratio at Bakersfield – Municipal Airport

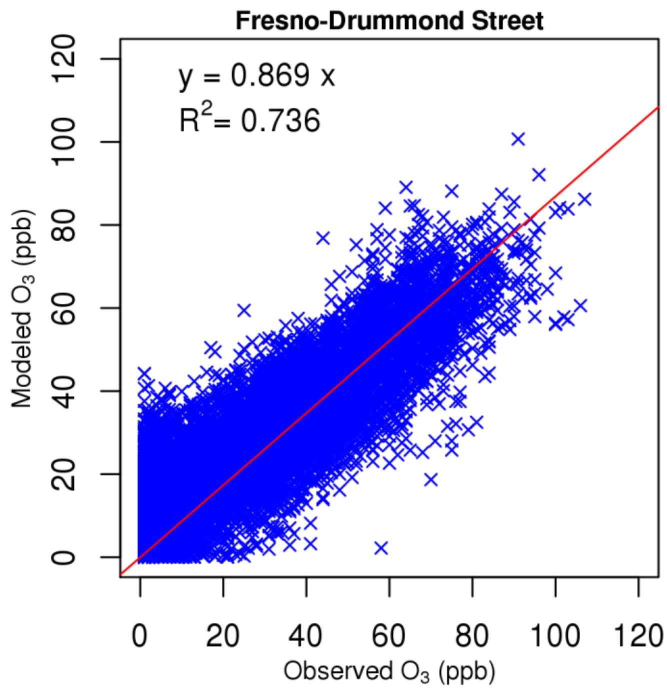

Figure S. 69 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Fresno – Drummond Street

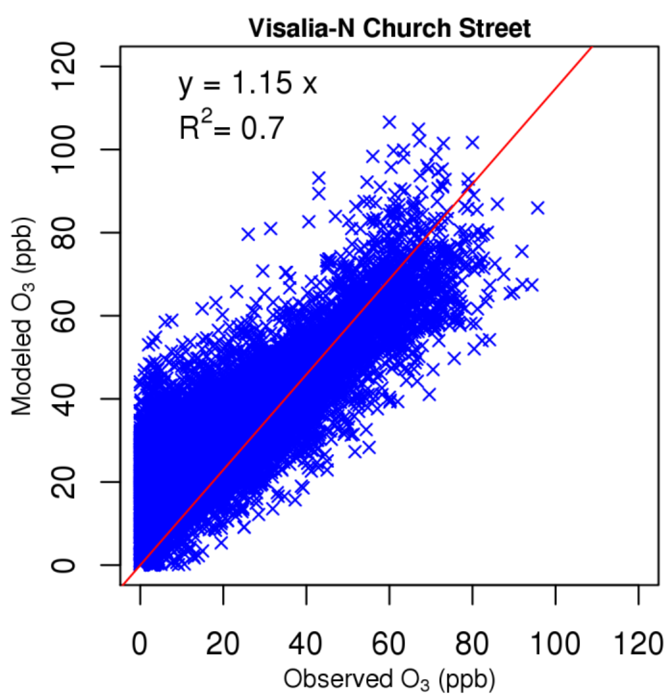

Figure S.70 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Visalia

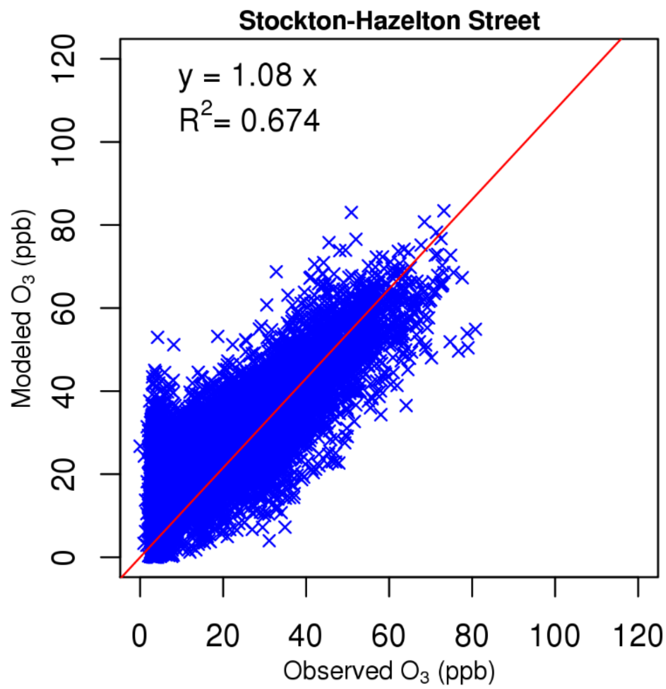

Figure S. 71 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Stockton

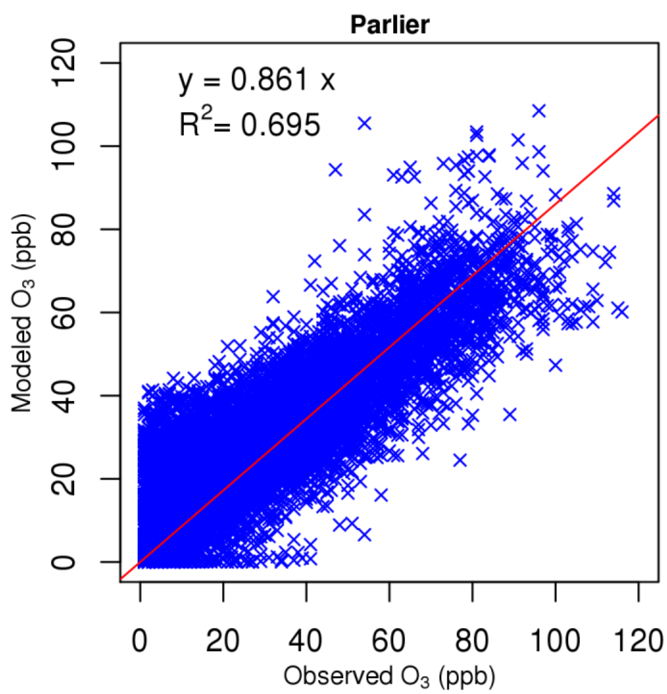

Figure S. 72 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Parlier

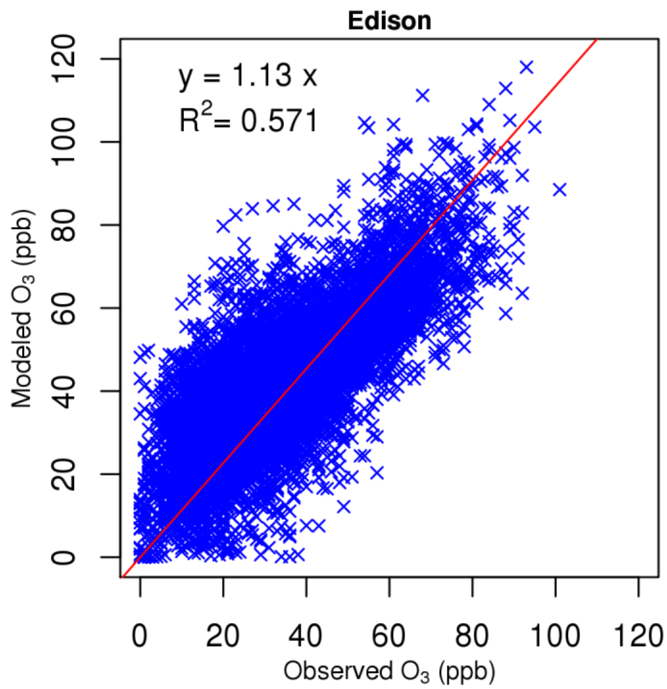

Figure S. 73 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Edison

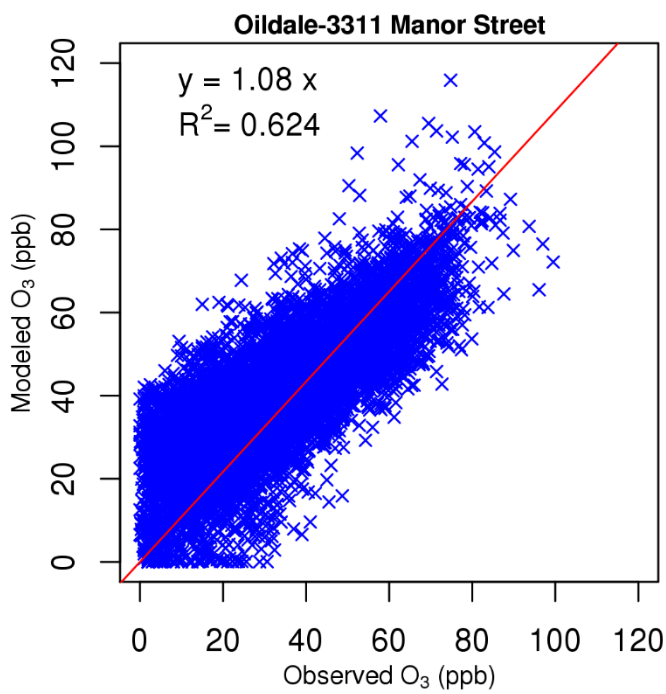

Figure S. 74 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Oildale

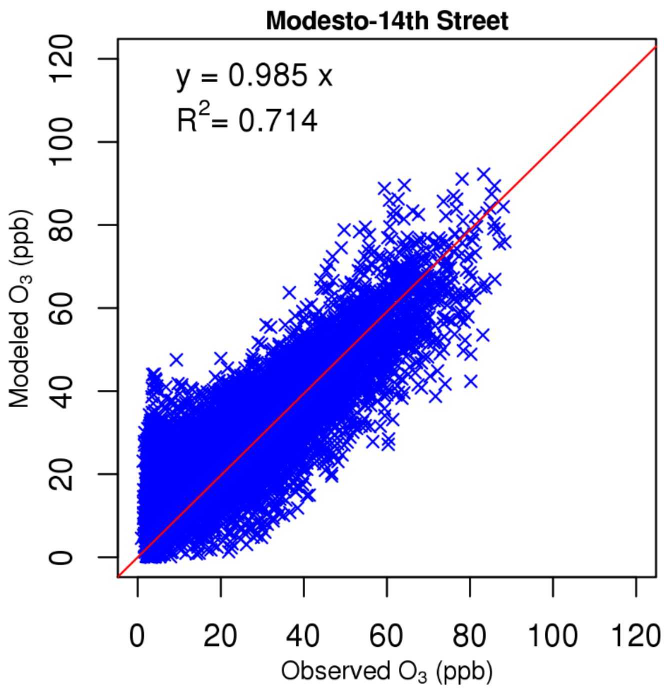

Figure S. 75 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Modesto -14th Street

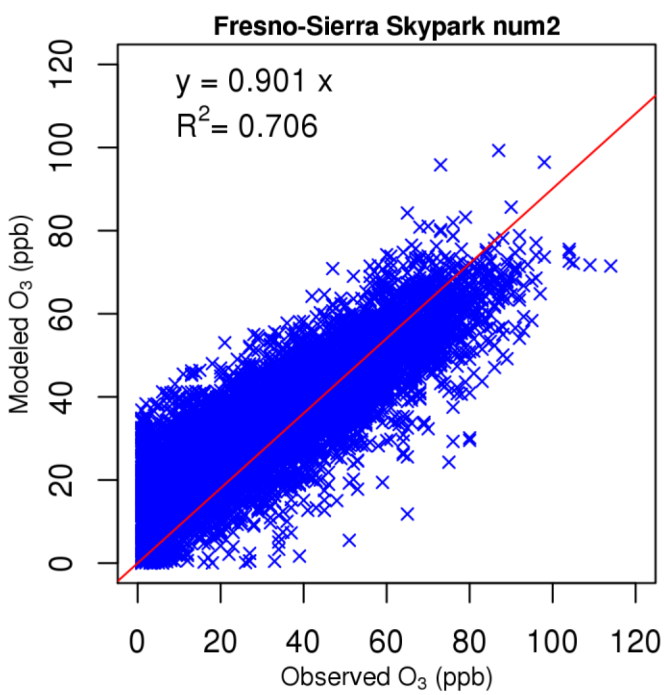

Figure S.76 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Fresno – Sierra Sky Park #2

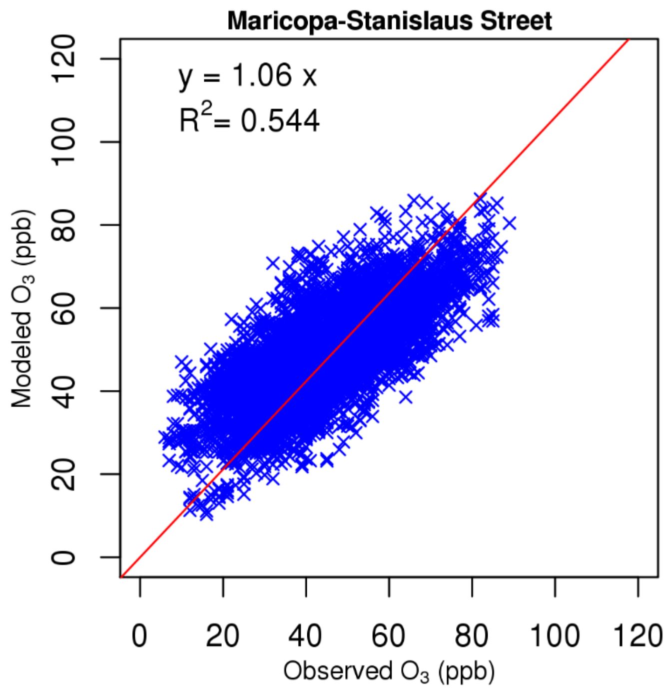

Figure S. 77 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Maricopa

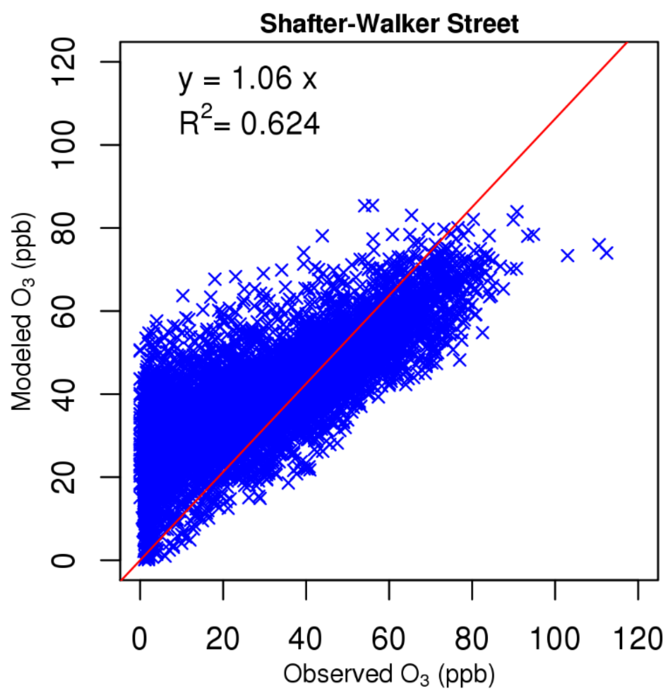

Figure S. 78 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Shafter

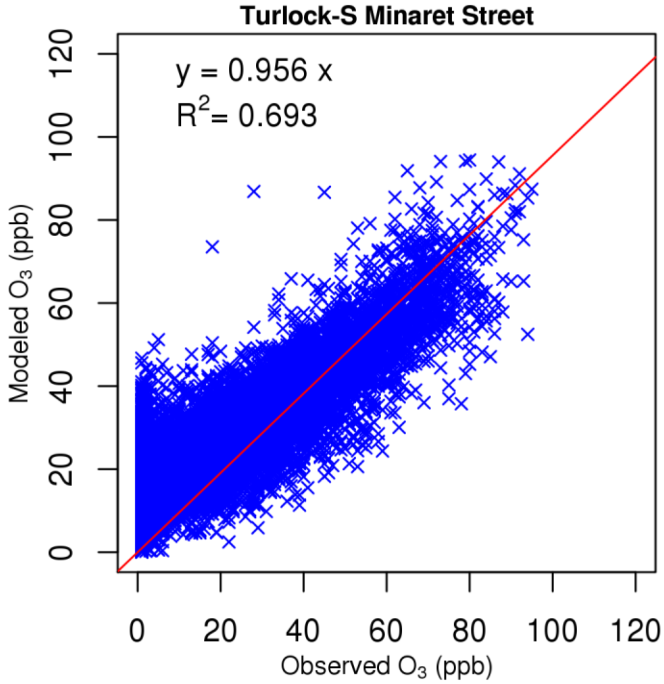

Figure S. 79 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Turlock

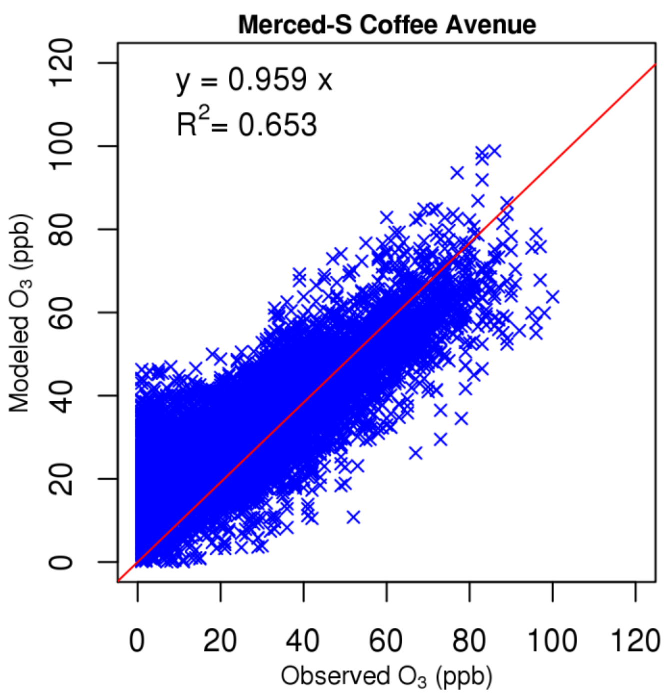

Figure S. 80 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Merced – S Coffee Avenue

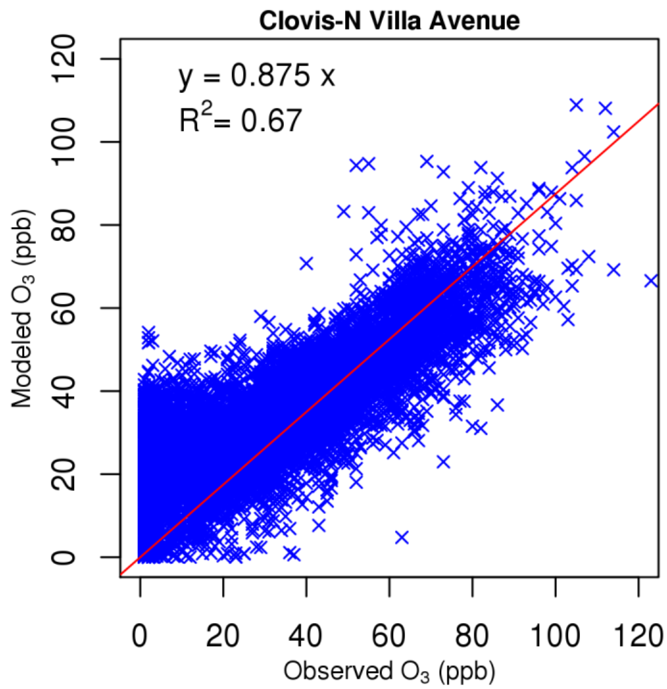

Figure S. 81 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Clovis

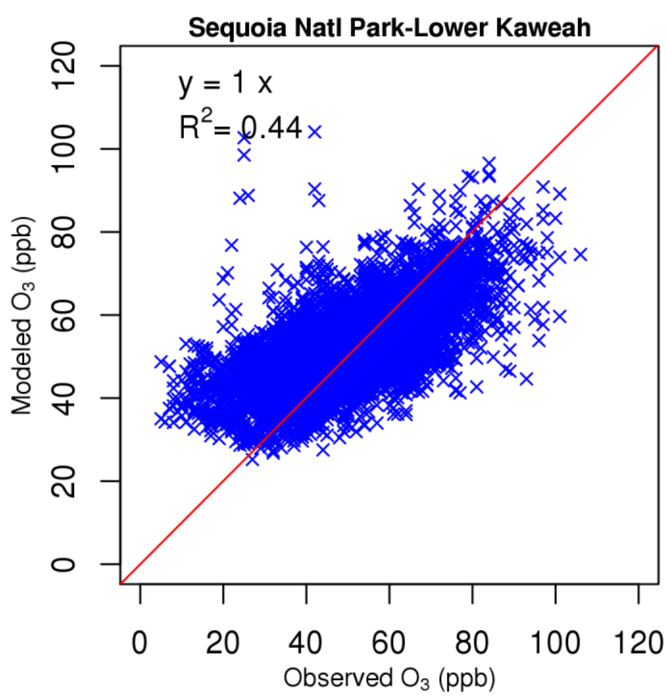

Figure S. 82 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Sequoia National Park

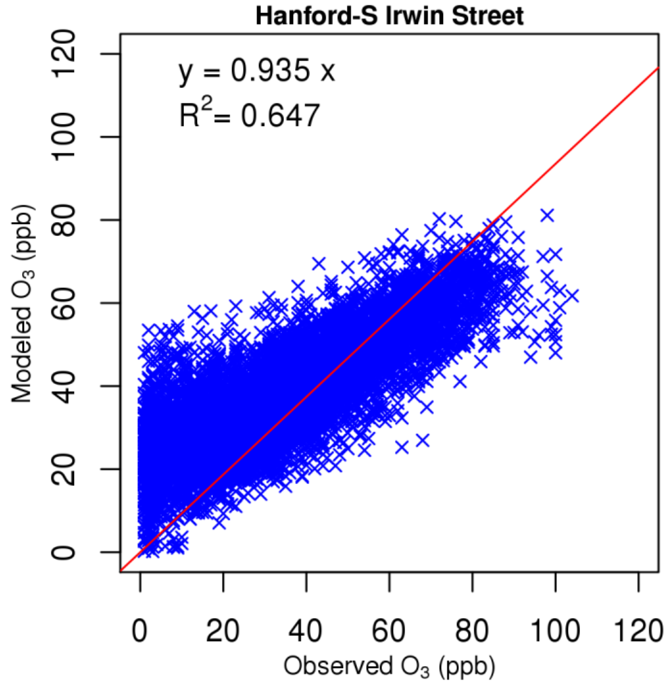

Figure S. 83 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Hanford

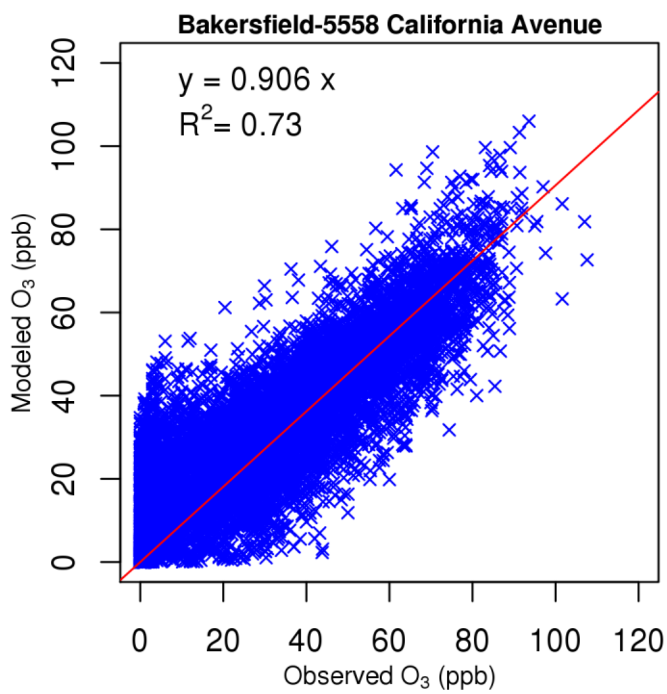

Figure S. 84 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Bakersfield – California Avenue

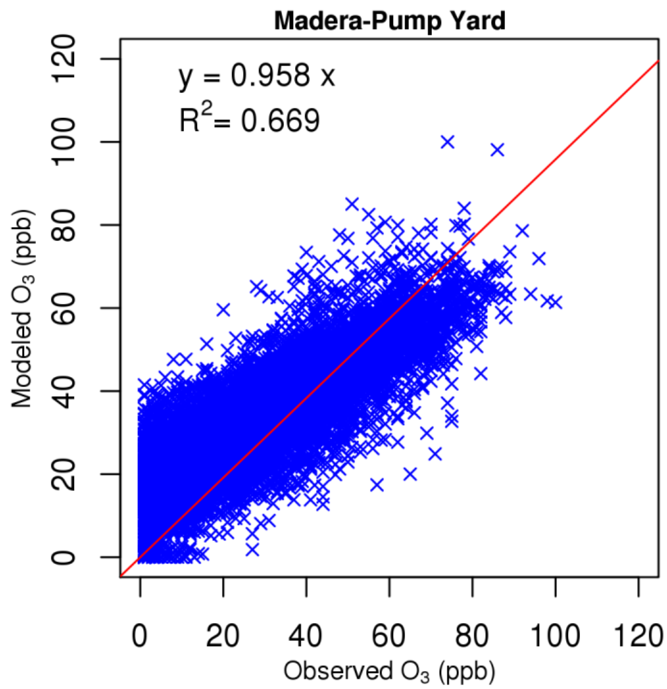

Figure S. 85 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Madera – Pump Yard

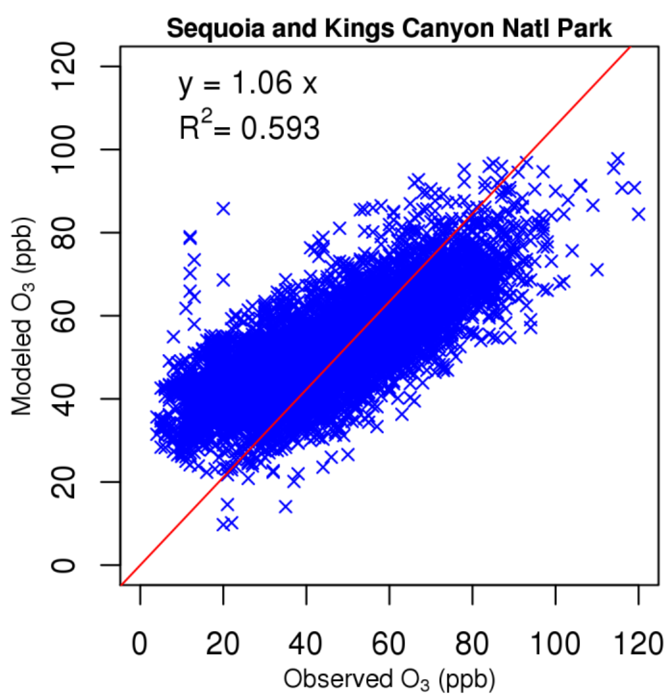

Figure S. 86 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Sequoia and Kings Canyon National Park

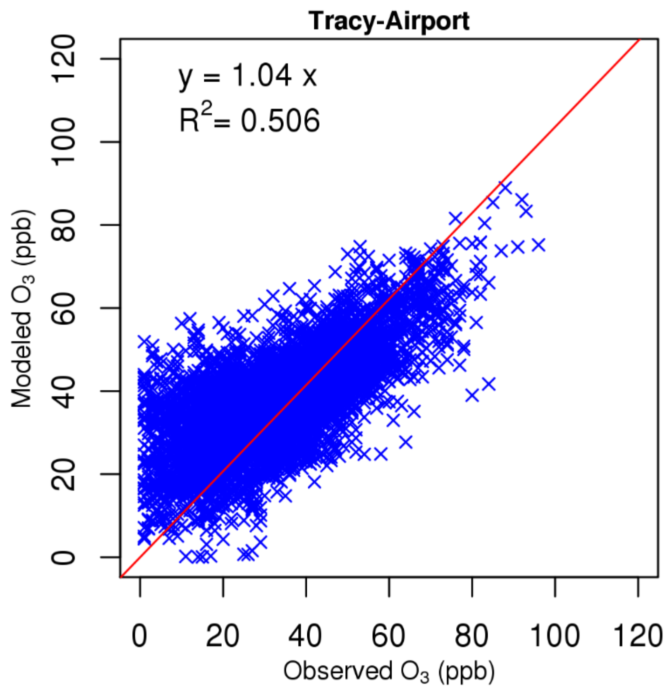

Figure S. 87 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Tracy

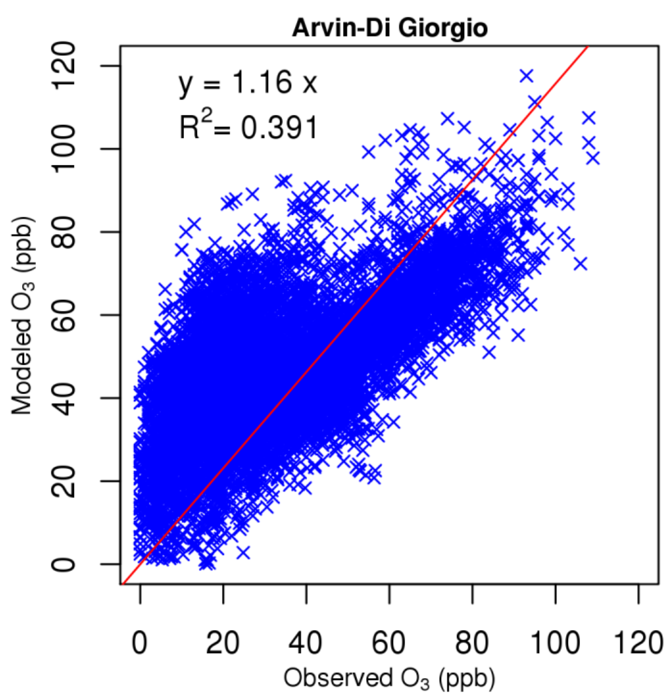

Figure S. 88 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Arvin

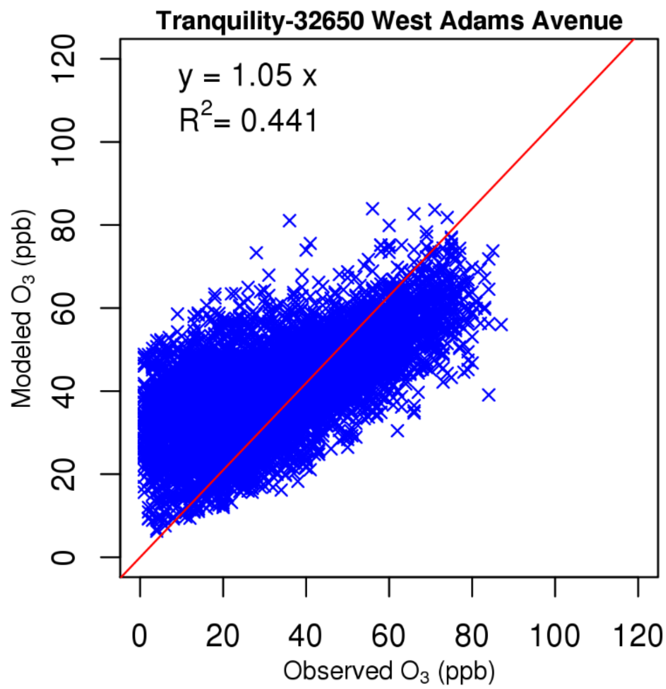

Figure S. 89 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Tranquility

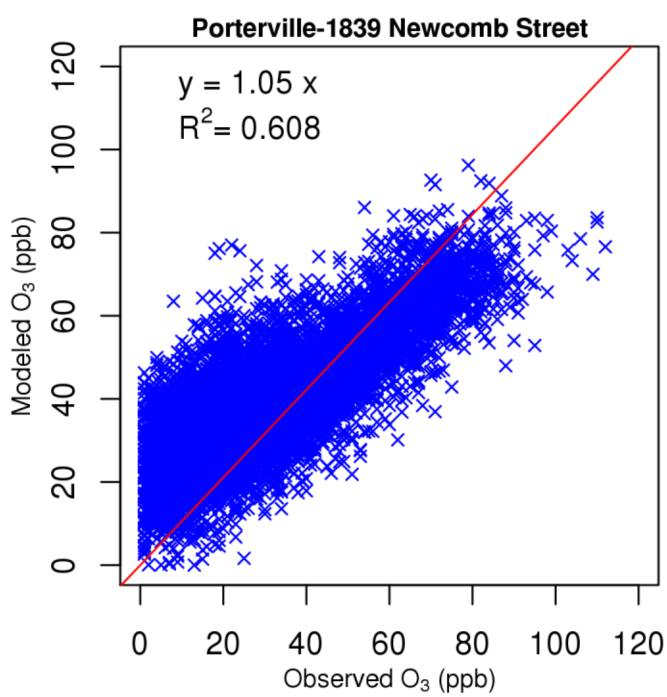

Figure S. 90 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Porterville

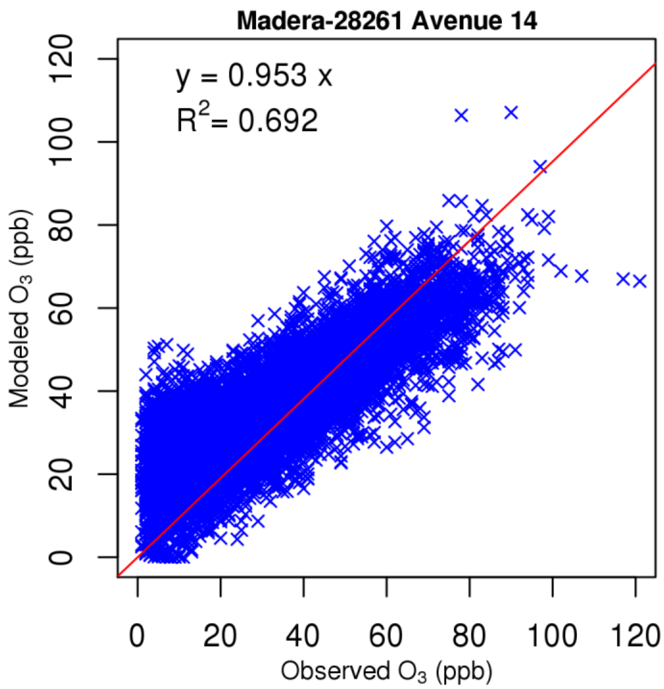

Figure S. 91 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Madera – 28261 Avenue 14

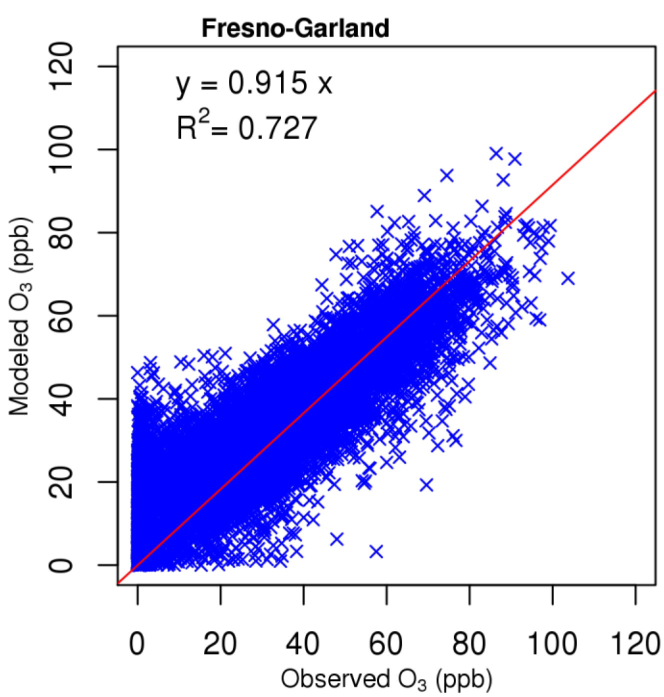

Figure S. 92 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Fresno-Garland

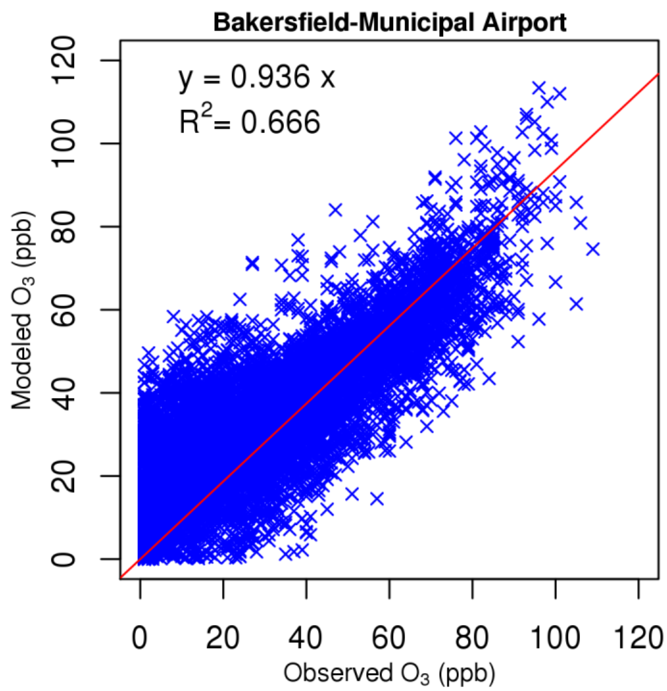

Figure S. 93 Scattering plot of observed and modeled 1-hour O_3 mixing ratio at Bakersfield – Municipal airport