California Air Resources Board

Staff Report
Proposed SIP Revision for the 15 µg/m³ Annual PM2.5 Standard for the San Joaquin Valley

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CARB Governing Board Hearing Date: September 24, 2021

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Background

The 2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards (2018 PM2.5 Plan or SIP) was developed jointly by the California Air Resources Board (CARB or Board) and the San Joaquin Valley Air Pollution Control District (District) to address four fine particulate matter (PM2.5) federal ambient air quality standards: 15 microgram per cubic meter (µg/m3) annual, 65 µg/m3 24-hour, 35 µg/m3 24-hour, and 12 µg/m3 annual standards. The U.S. Environmental Protection Agency (U.S. EPA) approved the portions of the 2018 PM2.5 Plan pertaining to the 35 µg/m3 24-hour standard with an attainment date of 2024 last year. U.S. EPA's review of the portions pertaining to the 12 µg/m3 annual standard, which has an attainment date of 2025, is ongoing. For the 65 µg/m3 24-hour and the 15 µg/m3 annual standards, the 2018 PM2.5 Plan established 2020 as the attainment date.

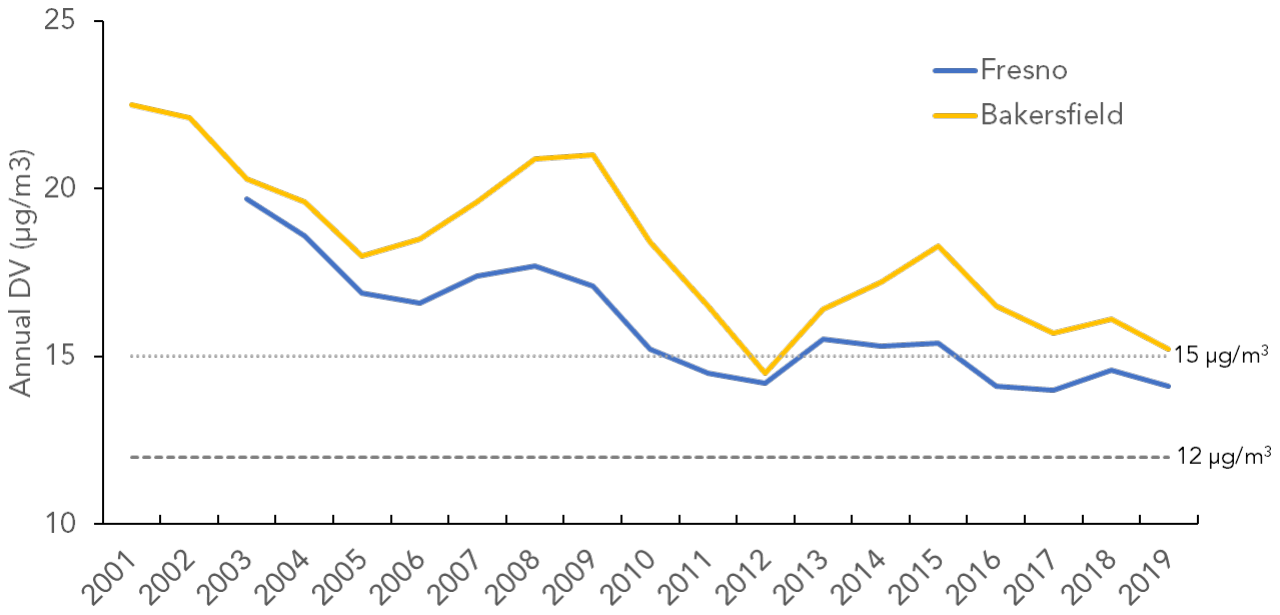
CARB and the District demonstrated that the Valley met the 65 µg/m3 24-hour standard in 2020 when the impacts of wildfires are excluded, as allowed by exceptional events guidance provided under the federal Clean Air Act. However, for the 15 µg/m3 annual standard, one air monitoring site—Bakersfield-Planz—recorded a value over the standard in 2020 despite excluding the impacts of wildfires. Since the 2020 attainment date was no longer approvable, U.S. EPA proposed, on July 22, 2021, to partially approve and partially disapprove the portions of the 2018 PM2.5 Plan pertaining to the 15 µg/m3 annual standard (86 FR 38652). Specifically, U.S. EPA proposed to disapprove the following SIP elements related to the attainment demonstration for the 15 µg/m3 standard: the precursor demonstration, BACM/BACT demonstration, five percent demonstration, attainment demonstration, RFP demonstration, quantitative milestone demonstration, motor vehicle emissions budgets, and contingency measure. U.S. EPA proposed to approve the 2013 base year emissions inventories. The disapproval requires the District and CARB to revise the SIP and submit to U.S. EPA an approvable SIP revision demonstrating attainment of the 15 µg/m3 annual standard as soon as possible.

Even though annual PM2.5 levels have been declining across the Valley, and in 2019 were below the 15 µg/m3 standard at all of the Valley's air monitoring sites, the almost year-round occurrence of wildfires in 2020 contributed to elevated particulate matter levels that impacted calculation of the values used for determining attainment of the annual standard (the average of 2018-2020 monitoring data). After excluding data impacted by wildfire exceptional events, only Bakersfield-Planz, which had a PM2.5 design value (three-year average, 2018-2020) of 15.4 µg/m3, exceeded the 15 µg/m3 annual standard. 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. However, Bakersfield-Planz is expected to attain the standard in coming years as CARB and District regulations and incentive measures are implemented.

It is important to note that annual PM2.5 levels at the high sites in the Valley, including Bakersfield-Planz, have seen a steady decline, as shown in Figure 1 below, with some year-to-year variability associated with drought conditions and meteorology. 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 without the impacts of wildfires excluded. In contrast, ten years ago, 2011, seven of the nine sites now in attainment exceeded the standard.

Figure 1. San Joaquin Valley Pre-2020 Trends in Annual PM2.5 Design Values at Bakersfield & Fresno



SIP Revision

CARB and the District worked together to develop the Proposed Attainment Plan Revision for the 1997 Annual PM2.5 Standard (15 µg/m3 SIP Revision)[1]. The 15 µg/m3 SIP Revision amends the 2018 PM2.5 Plan to update the SIP elements associated with the disapproved attainment demonstration and demonstrates that the Valley will meet the standard in 2023, including at the high site of Bakersfield-Planz with a 2023 design value of 14.7 µg/m3. It addresses the deficiencies identified in U.S. EPA's proposed disapproval with the exception of the precursor demonstration, which is addressed in this Staff Report, and contingency, which the District will act on separately at a later date. Specifically, the document includes a 5 percent plan demonstration, attainment modeling demonstration, motor vehicle emission budgets, reasonable further progress, and quantitative milestones. The 15 µg/m3 SIP Revision satisfies statutory requirements for a Clean Air Act §189(d) plan for a Serious nonattainment area SIP submission.

The Valley is able to demonstrate attainment with reductions in emissions of oxides of nitrogen (NOx) and PM2.5 coming from (1) ongoing implementation of CARB and the

[1] *Attainment-Plan-Revision-for-the-1997-Annual-PM2.5-Standard.pdf (valleyair.org)*

District's existing control strategy, (2) newly adopted CARB and District measures providing near-term reductions, and (3) a new CARB aggregate emission reduction commitment in 2023 made for the 15 µg/m3 SIP Revision for reductions from measures in the 2018 PM2.5 Plan which have not yet been considered by CARB. The near-term reductions from newly adopted measures and the new commitment are described in more detail below. The District Governing Board will consider approval of the 15 µg/m3 SIP Revision at a public hearing on August 19, 2021.

Adopted Measures with Emissions Reductions in 2023

Ongoing implementation of CARB and the District's existing control program will achieve the vast majority of emissions reductions needed for attainment of the PM2.5 standards in the Valley. Several measures which have been recently adopted by CARB and the District, mainly from the 2018 PM2.5 Plan, will provide a substantial portion of the remaining emissions reductions needed for the Valley to reach attainment in 2023.

The attainment demonstration in the 15 µg/m3 SIP Revision includes new emissions reductions in 2023 from two regulations which CARB adopted in 2018: namely, the Amended Warranty Requirements for Heavy-Duty Vehicles (adopted June 2018) and Lower Opacity Limits for Heavy-Duty Vehicles (adopted May 2018). Together, these two measures from the 2018 PM2.5 Plan ensure lower levels of engine deterioration while heavy-duty vehicles are in operation. The lower opacity levels also provide CARB's enforcement team with the tools needed to take corrective action against trucks with high exhaust PM emissions. The attainment demonstration includes new emissions reductions from the District's 2018 PM2.5 Plan Residential Wood Burning Strategy (adopted June 2019) which provides reductions of direct PM2.5 emissions in the near-term: in the 15 µg/m3 SIP Revision, the District quantified 0.2 tons per day (tpd) of direct PM2.5 emissions reductions from this measure in 2023.

Reductions of NOx and PM2.5 emissions from the Accelerated Turnover of Agricultural Equipment Incentive Measure are not included in the attainment demonstration for the 15 µg/m3 SIP Revision since it did not include a specific commitment for 2023 and was not needed to demonstrate attainment based on the modeling. Nevertheless, the reductions from this measure are essential to improve PM2.5 air quality in the Valley. In 2024, the attainment year for the 35 µg/m3 24-hour standard, this measure achieves 5.9 tpd NOx reduction and 0.3 tpd PM2.5 reduction, and by the preceding year in 2023, a large portion of those emissions reductions will be realized.

The phase-out of the open burning of agricultural material is not a control measure included in the 2018 PM2.5 Plan. Approved by the District Governing Board in June 2021 and concurred upon by CARB, this measure represents CARB and the District's ongoing efforts to identify and develop new measures that will achieve emissions reductions in the Valley. The near-complete phase-out of open agricultural burning by 2025 achieves emissions reductions not accounted for in the 2018 PM2.5 Plan as early as January 1, 2021 and will continue achieving reductions through the 15 µg/m3 standard attainment year of 2023 and beyond. As with reductions from the turnover of agricultural equipment, reductions from the agricultural burning phase-out strategy are not included in the attainment demonstration for

the 15 µg/m3 SIP Revision, but they will further reduce PM2.5 levels and exposure to near-source PM2.5 pollution for communities in the Valley.

CARB Commitment

The measures described above, which have already been adopted by CARB and the District, provide substantial additional emissions reductions for the Valley in 2023 beyond the existing control strategy. However, to attain the 15 µg/m3 annual standard in 2023, additional emission reductions were needed. In addition to the emissions reductions provided from the Amended Warranty Requirements for Heavy-Duty Vehicles regulation, the Lower Opacity Limits for Heavy-Duty Vehicles regulation, and the District's Residential Wood Burning Strategy, the attainment demonstration in the 15 µg/m3 SIP Revision also relies on a new CARB aggregate emission reduction commitment to demonstrate attainment in 2023 of the 15 µg/m3 annual PM2.5 standard.

CARB's Heavy-Duty Inspection and Maintenance Program regulation (Heavy-Duty I/M) will achieve near-term emissions reductions in the Valley in 2023. CARB has previously committed to pursuing this measure, as described in the San Joaquin Valley Supplement to the 2016 State Strategy for the State Implementation Plan (Valley State SIP Strategy) and the 2018 PM2.5 Plan. The Board will consider the proposed Heavy-Duty I/M regulation at its December 2021 Board hearing. The 15 µg/m3 SIP Revision proposes a commitment to achieve the aggregate emission reductions specified below in Table 1 by 2023. CARB staff proposes to commit to achieve, in aggregate, 3.0 tpd of NOx emission reductions and 0.04 tpd of PM2.5 emission reductions in 2023.

Table 1. San Joaquin Valley Expected Emission Reductions from State Measures (2023)

Measure	**2023 NOx (tpd)**	**2023 PM2.5 (tpd)**
Valley State SIP Strategy Measure		
Heavy-Duty Vehicle Inspection and Maintenance Program	3.0	0.04
CARB Aggregate Emission Reduction Commitment	**3.0**	**0.04**

This measure, in conjunction with the existing control program and newly adopted measures described above, identify all of the reductions required from mobile sources for the Valley's PM2.5 attainment needs for the 15 µg/m3 annual standard. While Table 1 includes an estimate of the emission reductions from the individual measure, the final measure 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

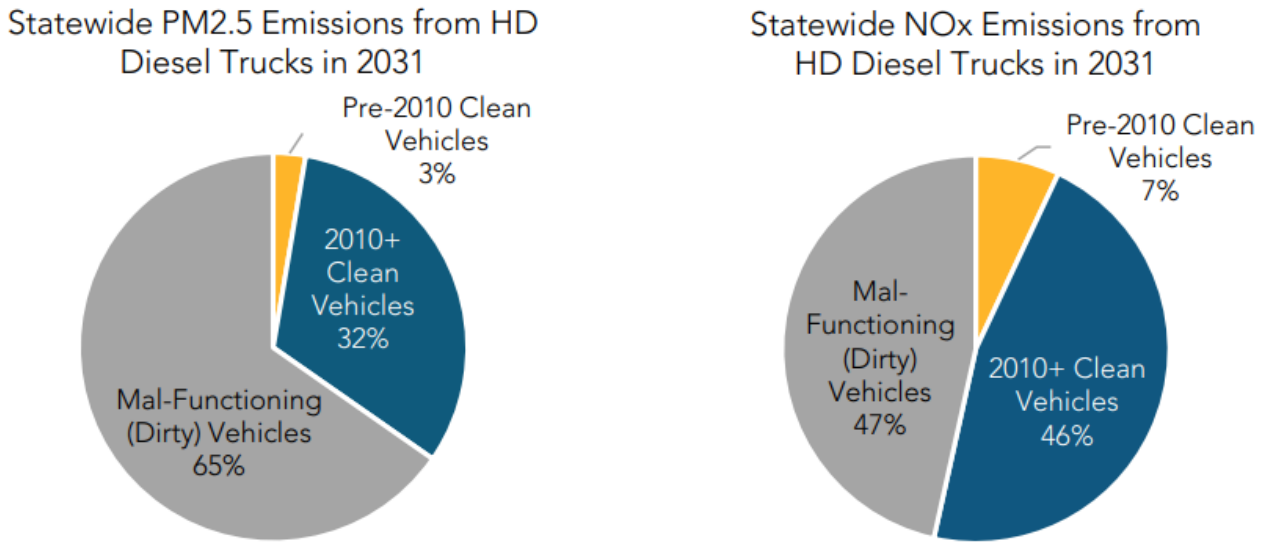
to achieving the total aggregate emission reductions. If actual emission decreases occur that exceed the projections reflected in the current emissions inventory and the Valley State SIP Strategy, CARB will submit an updated emissions inventory to U.S. EPA as part of a SIP revision. The SIP revision 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.

Heavy-Duty Inspection and Maintenance Program

The Heavy-Duty I/M Program will ensure that in-use emission control components and systems on heavy-duty trucks (those above 14,000 pounds gross vehicle weight rating) are properly functioning, so that these vehicles continue to operate at their cleanest possible levels for the duration of their on-road operation. In the past two years, CARB staff has held a series of public workshops and workgroup meetings, and expects to bring a regulation to the Board in 2021. To expand on the emission reduction opportunities, California Senate Bill (SB) 210 (Leyva; Statutes of 2019) was passed by the Legislature and signed into law by Governor Newsom on September 20, 2019. SB 210 enhanced the relevant regulatory authority by requiring that on-road heavy-duty diesel vehicles comply with the forthcoming Heavy-Duty I/M program in order to register annually with the California Department of Motor Vehicles (DMV). This direct tie-in to vehicle registration ensures that the program will achieve maximum emissions reductions.

Over the years, CARB has adopted regulations designed to reduce emissions from heavy-duty truck fleets by mandating vehicles meet stricter emissions standards, and requiring replacement of older engines with cleaner engine technology that includes diesel particulate filters, NOx controls, and on-board diagnostics (OBD). As a result of these collective efforts, emissions from heavy-duty vehicles are lower than in previous years and are continuing to decline. While emissions from heavy-duty trucks are declining, they are still significant; and the majority of heavy-duty truck emissions are now coming from a small percentage of vehicles whose engines and emissions control systems are malfunctioning or are poorly maintained. As shown in Figure 2, CARB staff estimate that by 2031, 65 percent of PM emissions and 47 percent of NOx emissions from heavy-duty diesel trucks will be due to emissions control systems that are malfunctioning or poorly maintained.

Figure 2. NOx and PM2.5 Emission Contributions from Malfunctioning Heavy-Duty Diesel Trucks in California



The proposed program would apply to all on-road non-gasoline heavy-duty vehicles with a gross vehicle weight rating over 14,000 pounds that operate in California, including vehicles registered out of state and out of country. This robust program would be the first of its kind to rely on remote telematics to periodically download and transmit engines' OBD data to CARB for use in identifying malfunctioning emissions-related components and requiring timely repairs. The periodic testing component would be complemented by roadside emissions monitoring (remote sensing devices and/or CARB's Portable Emissions AcQuisition System, known as PEAQS) to detect high emitting vehicles between periodic test cycles and require additional testing and repair to ensure emissions control components are operating properly. Vehicle owners would be required to demonstrate that their vehicles' emissions control systems are properly functioning, thereby reducing excess NOx and PM emissions resulting from mal-maintenance and tampering. Key program elements include:
1) streamlined testing processes that nearly eliminate vehicle downtime for inspections;
2) requirements for all heavy-duty vehicles to possess a valid compliance certificate accessible upon request by CARB or California Highway Patrol (CHP) inspectors; and 3) the ability for the DMV to withhold vehicle registration on non-compliant California vehicles. The regulation is projected to begin implementation starting January 1, 2023.

To ensure that the benefits of the Heavy-Duty I/M program will be maximized in the near-term, CARB is planning to deploy a network of PEAQS sensors in the South Coast and San Joaquin Valley regions. PEAQS captures a portion of the emissions from the exhaust plumes of passing heavy-duty vehicles and, within seconds, reports the concentration of pollutants, including carbon dioxide (CO2), black carbon particulate matter (BC), and nitrogen oxide (NO), in the vehicle exhaust.

Since early 2019, CARB has been working to adapt PEAQS into a rugged, autonomous, remote sensing device that can be deployed at locations throughout the state and transmit data back to CARB data servers. These autonomous units also capture identifying characteristics of the vehicle associated with a particular emissions plume.

In August of 2019, CARB staff installed the first autonomous, roadside plume capture, remote sensing device in San Bernardino County. Following that successful rollout, CARB installed the second autonomous PEAQS unit in Riverside County in August of 2020. These systems have monitored thousands of vehicles and are used to enforce opacity emissions standards established by current CARB regulations.

Moving forward, CARB plans to retrofit these two systems with NOx sensors and will install all future systems with NOx sensors to support enforcement of the forthcoming Heavy-Duty I/M Program, which regulates both particulate matter and NOx emissions. Under this regulation, enforcement action will be initiated on high emitting trucks screened by PEAQS and repairs will be required if follow up tests indicate the need for maintenance.

Because of the immediate need for PM and NOx emissions reductions to achieve air quality targets, in advance of the Heavy-Duty I/M regulation, CARB plans to install eight more units within the San Joaquin Valley and South Coast Air Basins by January 1, 2023, bringing the network to a total of 10 systems. Two to three of these systems will be installed over the course of 2021 in Madera, Kern, and Los Angeles Counties.

In 2022, CARB will install the remaining five to six systems in Los Angeles, Merced, and Riverside Counties. CARB staff has conducted a series of public workshops and workgroup meetings for Heavy-Duty I/M to engage stakeholders and invite their input throughout CARB's public process for program development and will continue to do so throughout 2021, through the Board's December 2021 hearing to consider the proposed regulation.

Emissions Inventories

An emissions inventory is a comprehensive estimate of air pollutant emissions, by source, for a specific geographic area during a given time period. Emissions inventories are used in the SIP to identify pollutants of concern and their sources; to determine the amount, distribution, and trends of pollutants; as an input to air quality modeling; to identify and track control strategies; and as input to health risk assessment. Although CARB has updated emissions inventories since the 2018 PM2.5 Plan, the 15 µg/m3 SIP Revision uses the same inventory as the one in the 2018 PM2.5 Plan, which it amends, for consistency.

The differences between the emissions inventory used in the 2018 PM2.5 Plan and the updated emissions inventory recently developed by CARB are not substantial in the SIP baseline year of 2013. Emissions of PM2.5 are approximately 6 percent higher in the new inventory while emissions of NOx are approximately 7 percent lower, as shown in Table 2. The inventory for emissions from on-road vehicles is derived from EMFAC, CARB's emissions model developed and used to assess emissions from on-road vehicles including cars, trucks, and buses in California. The 2018 PM2.5 Plan inventory relied on the most up-to-date version of EMFAC at the time, EMFAC 2014, which used baseline emissions in 2013 grown from

2012 actual data from the DMV. The most recent U.S. EPA-approved version of EMFAC, EMFAC 2017, uses actual DMV data through 2016 including the 2013 baseline emissions. The 2013 emission levels are lower in EMFAC 2017, meaning that growth was less than we anticipated using EMFAC 2014. These differences are not substantial enough to affect the attainment demonstration showing the Valley will attain the 15 µg/m3 annual standard in 2023.

Table 2. Comparison of Annual Emissions under EMFAC2014 and EMFAC2017 in 2013

EMFAC Version	**NOx (tpd)**	**PM2.5 (tpd)**
EMFAC 2017	170.04	6.83
EMFAC 2014	183.09	6.45
Ratio EMFAC2017/EMFAC2014	92.9%	105.9%

Precursor Analysis

In the 2018 PM2.5 Plan (Appendix G: Precursor Demonstration), CARB noted that a precursor sensitivity analysis was conducted for the 2024 attainment year of the 35 µg/m3 24-hour PM2.5 standard but not for the 2025 attainment year of the 12 µg/m3 annual PM2.5 standard because, due to the close proximity of the attainment years for the two standards, precursor sensitivities in 2025 are assumed to be very similar to those modeled in 2024. Precursor sensitivities in the new 2023 attainment year of the 15 µg/m3 annual standard are also assumed to be very similar to those modeled in 2024. This is the case for all precursors examined in the sensitivity analysis: ammonia, oxides of sulfur (SOx), and reactive organic gases (ROG). Thus, CARB's determination in the 2018 PM2.5 Plan—that emissions of ammonia, SOx, and ROG do not contribute significantly to PM2.5 levels that exceed the standards in the area—remains the same in the 15 µg/m3 SIP Revision, and CARB has continued to exclude ammonia, SOx, and ROG from control requirements in the SIP.

For ammonia, CARB has provided U.S. EPA with several additional pieces of documentation to support and clarify CARB's assessment that ammonia is not a significant attainment precursor for secondary PM2.5 formation (i.e. ammonium nitrate) in the Valley. The most recent of these is provided as Attachment 1 to this Staff Report. Multiple field studies in the Valley have confirmed that NOx is the limiting precursor to ammonium nitrate formation and that there is a far greater amount of ammonia in the Valley air than is necessary to participate in the chemistry that leads to ammonium nitrate. Thus, NOx reductions are key for reducing ammonium nitrate and PM2.5 levels in the Valley. The 2018 PM2.5 Plan attainment strategy recognizes this scientific finding and calls for significant NOx reductions, primarily achieved through CARB's mobile source control measures. Air quality modeling also shows that the effectiveness of ammonia controls will rapidly decrease through the 2024/2025 timeframe as the Valley's air becomes even more NOx-limited due to dramatic and ongoing reductions in

NOx from these mobile source control measures. CARB staff's conclusion, based on the scientific analysis available, continues to be that focusing on NOx emission reductions is key to improving the health of Valley residents and actions to reduce ammonia will not provide significant PM2.5 air quality improvements, including in 2023.

Environmental Analysis

CARB has determined that the proposed 15 µg/m3 SIP Revision is not a project subject to, or is otherwise exempt from, the requirements of the California Environmental Quality Act (CEQA). CARB's certified regulatory program, which applies to the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality, has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (14 California Code of Regulations (CCR) 15251(d)). Public agencies with certified regulatory programs are exempt from certain CEQA requirements, including but not limited to, preparing environmental impact reports, negative declarations, and initial studies. For activities that constitute project approvals, as those terms are used in CEQA, CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report prepared for a proposed action to comply with CEQA (17 CCR 60000-60008).

The 15 µg/m3 SIP Revision includes an updated attainment demonstration to show that, given existing commitments and controls, the District will attain the 15 µg/m3 annual PM2.5 standard by 2023 (after narrowly missing the previous 2020 attainment date). In this proposed 15 µg/m3 SIP Revision, CARB is committing to aggregate emission reductions of 3 tpd of NOx and 0.04 tpd of PM2.5 in 2023, anticipated to come from Heavy Duty I/M. CARB has already committed to pursue the Heavy Duty I/M measure and has already engaged in several workshops, with a proposed regulation expected to go before the Board later this year; here, CARB has merely quantified the tonnage of emission reductions anticipated from a Heavy Duty I/M program in the Valley in 2023 and is committing to achieving those reductions for attainment purposes in an aggregate emissions reductions commitment. The 15 µg/m3 SIP Revision therefore does not create new measures or establish an obligation for CARB to create new measures, and thus would not cause a substantial change to the environment requiring additional environmental review (see *Sherwin-Williams Co. v SCAQMD* (2001) 86 Cal.App.4th 1258, 1286).

Even if the proposed 15 µg/m3 SIP Revision were considered a project under CEQA, it would be exempt from CEQA under the "common sense" exemption (14 CCR § 15061(b)(3)) and the "Class 8" exemption (14 CCR § 15308). The CEQA Guidelines state "[t]he activity is covered by the common sense exemption that CEQA applies only to projects, which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA." The proposed 15 µg/m3 SIP Revision is also categorically exempt from CEQA under the "Class 8" exemption because it is an action taken by a regulatory agency for the protection of the environment. CARB has

quantified and committed to achieving reductions of NOx and PM2.5 from heavy-duty mobile sources in the Valley from a measure it already analyzed and approved in the State SIP Strategy, and which CARB is in the process of proposing through regulatory processes that involve all required environmental review. CARB's commitment here essentially involves quantifying emissions reductions for a specific year that would result from a measure it has already committed to pursuing. There is no possibility that CARB's quantification of and commitment to these emissions reductions may result in a significant adverse impact on the environment, nor any substantial evidence indicating the proposal could adversely affect air quality or any other environmental resource area. CARB's commitment here would not create or alter its existing commitment to pursue Heavy Duty I/M, and thus would have no possibility of causing any new or substantially increased significant impacts. Therefore, it can be seen with certainty that there is no possibility that the proposed Plan may result in significant adverse impact on the environment. Further, the proposed action is designed to protect the environment (reducing harmful air pollutants to attain federal ambient air quality standards), and CARB found no substantial evidence indicating the proposal could adversely affect air quality or any other environmental resource area, or that any of the exceptions to the exemption applies (14 CCR 15300.2). Therefore, this activity is exempt from CEQA.

Staff Recommendation

CARB staff have reviewed the 15 µg/m3 SIP Revision. The 15 µg/m3 SIP Revision satisfies statutory requirements for a Clean Air Act §189(d) plan for a Serious nonattainment area SIP submission, except for contingency measures, and reflects the portion of emissions reductions needed in the SIP. The District will update the contingency measure element at a later date. Staff recommends that the Board adopt the 15 µg/m3 SIP Revision, including the CARB aggregate emissions reduction commitment for the Valley in 2023 and the precursor demonstration, and direct staff to submit the 15 µg/m3 SIP Revision to U.S. EPA as a revision to the California SIP.

Attachment 1

Update on Ammonia in the San Joaquin Valley

The California Air Resources Board (CARB) is providing this information at the request of United States Environmental Protection Agency (U.S. EPA) staff to further clarify our assessment of ammonia as a precursor to fine particulate matter (PM2.5) in the San Joaquin Valley (Valley). This document reinforces the information CARB previously provided to U.S. EPA in the *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (2018 PM2.5 Plan or Plan), in Attachment A to the May 9, 2019, letter submitting the Plan to U.S. EPA (Attachment A), and in the October 18, 2019, document "Clarifying Information on Ammonia" (Clarifying Information). In addition to summarizing the findings presented in those documents, this update provides new supporting information from a 2017 study.

CARB does not believe ammonia is a significant attainment precursor for PM2.5 in the Valley, as documented in the 2018 PM2.5 Plan, Attachment A, and Clarifying Information documents. PM2.5 is a complex mixture of many chemical species. Roughly 40 percent of PM2.5 is made up of ammonium nitrate which is itself a combination of two precursors, ammonia and oxides of nitrogen (NOx). NOx emissions in the Valley come primarily from mobile sources. Ammonium nitrate reductions are critical for the Valley to attain the federal PM2.5 air quality standards and provide cleaner air to residents. Ammonium nitrate formation is limited by whichever precursor, either ammonia or NOx, is in least supply.

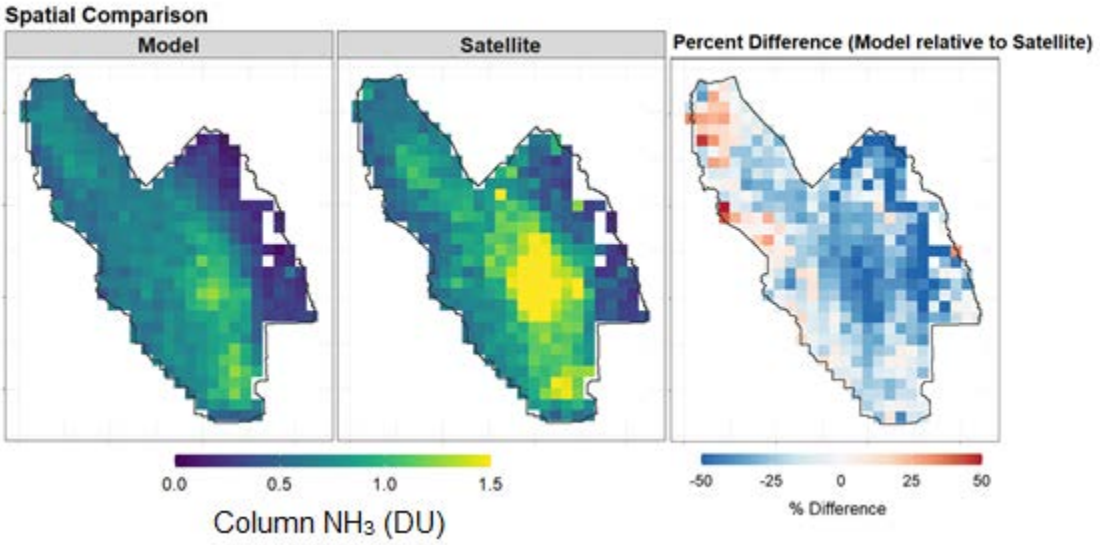
Multiple field studies in the Valley have confirmed that NOx is the limiting precursor to ammonium nitrate formation and that there is a far greater amount of ammonia in the Valley's air than is necessary to participate in the chemistry that leads to ammonium nitrate. Thus, NOx reductions are key for reducing ammonium nitrate and PM2.5 levels in the Valley. The 2018 PM2.5 Plan attainment strategy recognizes this scientific finding and calls for significant NOx reductions, primarily achieved through CARB's mobile source control measures. Air quality modeling also shows that the effectiveness of ammonia controls will rapidly decrease through the 2024/2025 timeframe as the Valley's air becomes even more NOx-limited due to dramatic and ongoing reductions in NOx from these mobile source control measures.

As described in Attachment A to the 2018 PM2.5 Plan submittal letter, as early as the 1995 Integrated Modeling Study (IMS95), in situ measurements in the Valley indicated the region was ammonia saturated, which supports NOx being the controlling precursor to ammonium nitrate formation. Wintertime measurements five years later during the California Regional Particulate Air Quality Study (CRPAQS) field study (December 1999 through February 2001) were consistent with the IMS95 findings, where nearly all of the measurements were ammonia saturated. Measurements during the Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ) field campaign in January and February 2013 support previous findings of an ammonia-saturated environment, where a small to moderate reduction in ammonia emissions is likely to have little to no effect on ammonium nitrate concentrations.

Further, a 2017 study using satellite data also aligns with this previous research. Measurements of column-integrated ammonia taken from the Infrared Atmospheric Sounding Interferometer (IASI), an instrument housed aboard the European Space Agency's MetOP-A satellite which passes over California daily, suggest that CARB's emissions inventory currently underestimates ammonia emissions in the Valley. These results suggest the 2018 PM2.5 Plan modeled sensitivity to ammonia reductions is overstated and further reinforces the efforts to develop and deploy ammonia controls would not move the Valley forward on the path to reducing PM2.5 concentrations, and that NOx emissions reductions are the most effective strategy to reduce ammonium nitrate.

Figure 1 shows the annual average of column ammonia in 2017 from IASI (Satellite) and Community Multiscale Air Quality (CMAQ) (Model). The model is biased low for column ammonia in the Valley. This bias is most noticeable in Tulare County, where both the model and satellite show an ammonia hotspot, but the model shows about half as much ammonia as the satellite.

Figure 1. Maps of annual average ammonia from CMAQ (Model; left) IASI (Satellite; middle) and the percentage difference (DU, 1 DU = 2.69e16 molecules/cm2).



With these new findings from the 2017 study aligning with previous findings from IMS95, CRPAQS, and DISCOVER-AQ, CARB staff's conclusion based on the scientific analysis available continues to be that focusing on NOx emission reductions is key to improving the health of Valley residents and actions to reduce ammonia will not provide significant PM2.5 air quality improvements.