APPENDIX D

DISTRICT 110(l) DETERMINATIONS

Implementation of the proposed 2020 Architectural Coatings Suggested Control Measure (2020 SCM) by air districts would result in a small increase in VOC emissions relative to what would be allowed absent the proposed limit. This small increase is not expected to interfere with attainment or reasonable further progress. CARB staff has analyzed the air quality impacts to ensure that the proposed 2020 SCM meets the requirements for section 110(l) of the Clean Air Act (CAA) for each district that may potentially adopt the proposed 2020 SCM. Specifically, section 110(l) states: "Each revision to an implementation plan submitted by a State under this chapter shall be adopted by such State after reasonable notice and public hearing. The Administrator shall not approve a revision of a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 7501 of this title), or any other applicable requirement of this chapter." Staff's analysis of the air quality impacts for the 110(l) demonstration show that the increased VOC emissions do not interfere with reasonable further progress towards attainment of the ambient air quality standards.

Appendix D contains the 110(l) determinations for nine air districts where Photovoltaic Coatings are being considered for application at existing solar projects. The nine air districts are: Antelope Valley AQMD, Eastern Kern APCD, Imperial County APCD, Mojave Desert AQMD, Monterey Bay ARD, Sacramento Metro AQMD, San Joaquin Valley APCD, San Luis Obispo County APCD, and Santa Barbara County APCD. Staff is aware that use of Photovoltaic Coatings is being considered for projects at other districts as well. Any district not named above would need to perform their own technical evaluations of the potential impacts of allowing the use of Photovoltaic Coatings in their districts. These 110(l) determinations have been prepared so that air districts can use them either as is or with minimal modifications when they submit their architectural coatings rules to U.S. EPA as a SIP revision.

Clean Air Act 110(l) Determination for Antelope Valley AQMD Rule 1113: Architectural Coatings

Introduction

The Antelope Valley Air Quality Management District (Antelope Valley AQMD) is submitting a revision to Rule 1113, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 1113 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Antelope Valley AQMD by 0.04 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within Antelope Valley, Photovoltaic Coatings may be used on solar modules which collectively generate 432 megawatts (MW) of electricity. If all 432 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 34 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established daily (27 gallons/day) volume limits for the Antelope Valley AQMD to restrict these emissions. These volume limits restrict the increase of VOC emissions to 0.068 tpd. These emissions are 0.2 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for Antelope Valley AQMD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 1113 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last

for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	63,487	26	1.5	7.2	5.7	4.3	47.6

The previously adopted Rule 1113 was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 1113. Amending Rule 1113 to include the 2019 SCM updates will provide VOC emission reductions of 0.04 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the Antelope Valley AQMD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 1113 includes requirements to comply with the National Rule exceedance fee.

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 1113 aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately 13 MW of conventional power plant electricity generation in California along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds (VOCs). However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Antelope Valley APCD, Photovoltaic Coatings may be applied to solar modules that collectively generate 432 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 1113 limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the Antelope Valley AQMD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 1113 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

The Antelope Valley AQMD includes the northeast portion of Los Angeles County and is adjacent to Kern County to the north and San Bernardino County to the east. The Antelope Valley AQMD is one of two districts responsible for the Western Mojave Desert ozone nonattainment area that also includes the southwestern desert portion of San Bernardino County served by the Mojave Desert AQMD. The Western Mojave Desert has been designated nonattainment for multiple ozone National Ambient Air Quality Standards (NAAQS).

Photochemical modeling in the *Antelope Valley Federal 75 ppb Ozone Nonattainment Plan for the Western Mojave Desert Nonattainment Area* (2017 Ozone SIP) demonstrated that emissions from the South Coast Air Basin and the San Joaquin Valley contribute significantly to ozone levels in the Antelope Valley. The modeling[2] demonstrated attainment of the 75 part per billion (ppb) 8-hour ozone standard by the attainment date of 2026. The 2017 Ozone SIP also included Reasonable Further Progress (RFP) demonstrations showing reduced emissions in the years 2020, 2023, and 2026. The Antelope Valley AQMD has also been designated as nonattainment for the newer 70 ppb 8-hour ozone standard. For this standard, the Antelope Valley AQMD will need to demonstrate RFP in 2023 and 2026.

ROG is a precursor for ozone. Architectural coatings, including Photovoltaic Coatings, are a source of ROG in Antelope Valley AQMD. Table 2 shows the anthropogenic ROG emissions in Antelope Valley AQMD jurisdiction on a summer-averaged basis for 2020-2027, the relevant years to the existing ozone attainment plan for the 75 ppb standard, and the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM.

Table 2
Antelope Valley AQMD ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Antelope Valley AQMD (Summer average)	41.29	41.37	41.41	41.44	41.46	41.51	41.66	41.78
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating as % of Total	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

Ozone nonattainment areas are required to demonstrate RFP until attainment of the standard. The projected reductions in ROG in the Western Mojave Desert are sufficient

[2] *AVAQMD Federal 75 ppb Ozone Attainment Plan (Western Antelope Valley Nonattainment Area)* https://avaqmd.ca.gov/files/de07ac191/AVAQMD+2016+75ppb+Final+Ozone+Attainment+Plan.pdf

to accommodate the small potential increase associated with the Photovoltaic Coatings category. While ROG emissions could, at most, be increased by 0.2 percent from Photovoltaic Coatings, the excess RFP emission reductions in the Western Mojave Desert is between 1.5 and 9.0 percent[3].

Conclusion

While the Antelope Valley AQMD has not yet met the 75 ppb 8-hour ozone standard, the area has made progress toward attaining the 8-hour ozone standard. Over the last decade, exceedance days over the 75 ppb 8-hour ozone standard were reduced by almost 90 percent[4]. While this progress lowering ozone levels in the Antelope Valley is mainly due to NOx and ROG emission reductions in the upwind areas, the Antelope Valley AQMD continues to make progress reducing ROG emissions. Between 2015 and 2026, total ROG emissions are expected to decline in the Western Mojave Desert ozone nonattainment area by 7 percent[5].

The ROG reductions in 2020, 2023, and 2026, as demonstrated in the 2017 Ozone SIP, in addition to the significant NOx reductions in the Antelope Valley, provide a buffer of excess reductions that more than accommodates the potential increase in ROG from the Photovoltaic Coatings to meet RFP.

While ROG reductions benefit ozone air quality, modeling in the South Coast 2016 Air Quality Management Plan that included attainment modeling for the Antelope Valley indicated that while significant NOx reductions are required for attainment of the 8-hour ozone standard, only limited ROG reductions are needed[6]. In areas like the Antelope Valley where ozone formation is shown to be NOx dependent, very small changes in ROG are not likely to affect ozone concentrations. Therefore, a 0.2 percent increase in ROG emissions in the Antelope Valley is unlikely to increase ozone formation.

Antelope Valley AQMD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: Antelope Valley Federal 75 ppb Ozone Nonattainment Plan for the Western Mojave Desert Nonattainment Area (2017 Ozone SIP)

Appendix B: 2019 Suggested Control Measure for Architectural Coatings

Appendix C: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Suggested Control Measure for Architectural Coatings

[3] https://ww3.arb.ca.gov/planning/sip/2018sipupdate/2018update.pdf, page 37
[4] https://www.arb.ca.gov/aqmis2/ozone_annual_tenyear.php
[5] https://ww3.arb.ca.gov/planning/sip/planarea/wmdaqmp/2016sip_staffreport.pdf
[6] http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/chapter4.pdf?sfvrsn=4

Appendix E: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Clean Air Act 110(l) Determination for Eastern Kern APCD Rule 410.1A: Architectural Coatings

Introduction

The Eastern Kern Air Pollution Control District (Eastern Kern APCD) is submitting a revision to Rule 410.1A, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 410.1A did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Eastern Kern APCD by 0.02 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within the Eastern Kern APCD, Photovoltaic Coatings may be used on solar modules which collectively generate 182 megawatts (MW) of electricity. If all 182 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 14 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (27 gallons/day) volume limit for the Eastern Kern APCD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.068 tpd. These emissions are 0.4 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the Eastern Kern APCD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. In addition, the 2020 SCM includes a daily volume limit to restrict the emissions allowed from the category. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 410.1A include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	26,747	10.9	0.6	3	2.4	1.8	20.1

The previously adopted Rule 410.1A was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 410.1A. Amending Rule 410.1A to include the 2019 SCM updates will provide VOC emission reductions of 0.02 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the Eastern Kern APCD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 410.1A includes requirements to comply with the National Rule exceedance fee.

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap -and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 410.1A aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately six MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Eastern Kern APCD, Photovoltaic Coatings may be applied to solar modules that collectively generate 182 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 410.1A limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the Eastern Kern APCD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 410.1A establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

The Eastern Kern APCD covers the eastern half of Kern County. It is rural, with an estimated 2017 population of 138,699 in 3,792 square miles, bounded by mountains on the north and west that descend to the western edge of the Mojave Desert. These mountains include the southern end of the Sierra Nevada Range where it joins the Tehachapi Mountains to the southwest and the El Paso Mountains running northeast to the Searles Valley. A small portion of the District, corresponding to the Indian Wells hydrologic unit in the northeastern corner of the District, meets the 75 ppb 8-hour ozone standard.

Eastern Kern is sparsely populated with a few small cities around the intersections of state roads and interstate highways. Edwards Air Force Base is in the southeast corner of Eastern Kern. Eastern Kern is separated by several mountain ranges from populated valleys and coastal areas with other nonattainment areas to the west and south. Passes through surrounding mountain ranges serve as “transport corridors” for ozone to Eastern Kern. The Tehachapis' crest line varies in height from approximately 4,000-8,000 feet with a pass through which runs Route 58 and a major freight rail corridor connecting the San Joaquin Valley and the Mojave Desert at a lower 2000-3000 feet in elevation. The Soledad Pass and Cajon Passes, west and east of the San Gabriel Mountains to the south of the District, connect the South Coast Air Basin with the Antelope Valley. Eastern Kern is influenced primarily by transport through the Tehachapi Pass corridor with some potential influence through Soledad Pass. Soledad Pass and Cajon Pass mainly influence air quality in the eastern Mojave Desert due to prevailing wind directions, but can transport pollutants to the District’s southeast corner near the Edwards Air Force Base.

Architectural coatings, including Photovoltaic Coatings, are a source of ROG in Eastern Kern County. Table 2 shows the ROG emissions in the Eastern Kern County ozone and PM10 nonattainment areas (NAA) for 2020-2027, the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB’s architectural coatings SCM.

Table *2*
Eastern Kern County ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Ozone NAA (Summer average)	9.21	9.16	9.11	9.07	9.05	9.04	9.05	9.05
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating as % of Ozone NAA Total	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**
PM10 NAA (Annual average)	9.80	9.76	9.73	9.69	9.68	9.69	9.70	9.72

Table *2*
Eastern Kern County ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Photovoltaic Coating – potential emissions increase	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Photovoltaic Coating as % of PM10 NAA Total	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

The impact of reducing emissions of precursors on air quality may be evaluated using model sensitivity simulations and estimating the change in pollutant concentrations given a change in emissions. While photochemical modeling routinely conducted for SIP development is unavailable to assess the sensitivity of ozone to changes in NO_x and VOC emissions for Eastern Kern, analysis in the 2016 Eastern Kern Ozone SIP (*Eastern Kern Air Pollution Control District 2017 Ozone Attainment Plan For 2008 Federal 75 ppb 8-Hour Ozone Standard*, Figure 2-7, Page H-23) of the weekend ozone effect suggest that ozone formation in the region is NO_x limited and relatively insensitive to changes in VOC emissions (i.e., lower ozone on weekends supports ozone formation being limited by NO_x emissions and not VOCs). With respect to precursor-driven particle formation, the same would be true for PM2.5 and PM10.

Eastern Kern APCD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: Eastern Kern Air Pollution Control District 2017 Ozone Attainment Plan For 2008 Federal 75 ppb 8-Hour Ozone Standard

Appendix B: 2019 Suggested Control Measure for Architectural Coatings

Appendix C: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Suggested Control Measure for Architectural Coatings

Appendix E: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

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Clean Air Act 110(l) Determination for Imperial County APCD Rule 424: Architectural Coatings

Introduction

The Imperial County Air Pollution Control District (Imperial County APCD) is submitting a revision to Rule 424, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 424 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l, respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Imperial County APCD by 0.02 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within Imperial County, Photovoltaic Coatings may be used on solar modules which collectively generate 1,021 megawatts (MW) of electricity. If all 1,021 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 84 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (27 gallons/day) volume limit for the Imperial County APCD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.068 tpd. These emissions are 0.4 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the Imperial County APCD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. In addition, the 2020 SCM includes a daily volume limit to restrict the emissions allowed from the category. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 424 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	150,046	61.4	3.5	17	13.5	10.3	112.5

The previously adopted Rule 424 was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 424. Amending Rule 424 to include the 2019 SCM updates will provide VOC emission reductions of 0.02 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in Imperial County prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 424 includes requirements to comply with the National Rule exceedance fee.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 424 aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately 31 MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Imperial County APCD, Photovoltaic Coatings may be applied to solar modules that collectively generate 1,021 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 424 limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the Imperial County APCD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 424 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

Imperial County is located on the border of the United States and Mexico and is adjacent to Riverside County to the north, San Diego County to the west, and the state of Arizona to the east. The nonattainment area as designated under multiple ozone National Ambient Air Quality Standards (NAAQS) is the full geographical area of the county. The nonattainment area as designated under multiple PM2.5 NAAQS spans approximately one-fourth the width of Imperial County and includes the agricultural region and the three largest cities: Brawley, El Centro, and Calexico. The nonattainment area as designated under the PM10 NAAQS is the entire western portion of the county extending eastward about three-fourths the width of the county toward the Arizona border.

Photochemical modeling for Imperial County's ozone and PM2.5 nonattainment areas has demonstrated that emissions outside of the county, and outside of the United States, play a significant role. Consequently, Imperial County APCD and CARB have prepared plans for all relevant ozone and PM2.5 standards using provisions in CAA section 179B demonstrating that the area would attain the relevant standard by the applicable attainment date but for the impacts of emissions emanating from outside of the country (specifically from Mexicali, Baja California, Mexico).

The attainment year for the *Imperial County 2017 State Implementation Plan for the 2008 8-Hour Ozone Standard* (2017 Ozone SIP) was 2017; the attainment year for the *Imperial County 2018 Redesignation Request and Maintenance Plan for Particulate Matter less than 10 Microns in Diameter* (2018 PM10 Plan) was 2016; and the attainment year for the *Imperial County 2018 Annual Particulate Matter less than 2.5 Microns in Diameter State Implementation Plan* (2018 PM2.5 SIP) is 2021. For all plans except the 2018 PM2.5 SIP, the attainment years are in the past, so the demonstrations included for the 2017 Ozone SIP and the 2018 PM10 Plan would be in no way affected by potential future increases in emissions from Photovoltaic Coatings.

Architectural coatings, including Photovoltaic Coatings, are a source of ROG in Imperial County. Table 2 shows the ROG emissions in the Imperial County ozone, PM2.5, and PM10 nonattainment areas (NAA) for 2020-2027, the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM.

Table 2
Imperial County ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Ozone NAA (Summer average)	16.20	16.04	16.03	16.03	16.00	15.99	15.84	15.82
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating as % of Ozone NAA Total	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**
PM2.5 NAA (Annual average)	10.73	10.66	10.67	10.81	10.82	10.84	10.79	10.80
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating as % of PM2.5 NAA Total	**0.6%**	**0.6%**	**0.6%**	**0.6%**	**0.6%**	**0.6%**	**0.6%**	**0.6%**
PM10 NAA (Annual average)	14.68	14.56	14.57	14.62	14.62	14.62	14.51	14.51
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating as % of PM10 NAA Total	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

To evaluate the impact of reducing emissions of precursors on the base and future year design values, various model sensitivity simulations were conducted. The results from the sensitivity analysis performed for photochemical modeling[2] as a part of the 2017 Ozone SIP provide the potential impact of changes in precursor emissions on the future year ozone design value at the El Centro monitor. As described in the 2017 Ozone SIP, a simplified analysis based on a linear relationship between the Mexican emission inventory and the modeled reduction in the 2017 design value indicated that a 1.0 tpd reduction in NOx emissions or ROG emissions could decrease the design value by up to 0.2 ppb. Given that the potential increase in ROG from Photovoltaic Coatings in Imperial County is 0.07 tpd, the potential impact on the ozone design value in the area would be an insignificant 0.01 ppb.

[2] *Imperial County 2017 State Implementation Plan for the 2008 8-Hour Ozone Standard*, Appendices F, I https://www.arb.ca.gov/planning/sip/planarea/imperial/2017O3sip_final.pdf

For the 2018 PM2.5 SIP, the model sensitivity simulations conducted to evaluate the impact of reducing emissions of different precursors on the base year PM2.5 design values reduced emissions of the precursor species in Imperial County by 70 percent from the base year (2012) emissions. If anthropogenic ROG emissions in Imperial County were reduced by 70 percent in 2012, the PM2.5 design value (14.23 ug/m3) at the Calexico monitor would only decrease by 0.03 ug/m3, or 0.21 percent. Due to ROG's insignificant impact on the PM2.5 design value, the addition of 0.07 tpd of ROG emissions (0.6% increase compared to 10.73 tpd in 2020) in any future years would not affect the PM2.5 design value at Calexico.

Similar to the 2018 PM2.5 SIP, the 2018 PM10 SIP found that reductions in emissions of PM10 precursors (including ROG) would not be effective in reducing PM10 concentrations and would lead to insignificant air quality changes. Furthermore, emissions of PM10 precursors are expected to decrease between the attainment year (2016) and the end of the maintenance period (2030).

Imperial County APCD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: Imperial County 2017 State Implementation Plan for the 2008 8-Hour Ozone Standard, Appendices F, I

Appendix B: 2019 Suggested Control Measure for Architectural Coatings

Appendix C: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Suggested Control Measure for Architectural Coatings

Appendix E: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Clean Air Act 110(l) Determination for Mojave Desert AQMD Rule 1113: Architectural Coatings

Introduction

The Mojave Desert Air Quality Management District (Mojave Desert AQMD) is submitting a revision to Rule 1113, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 1113 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Mojave Desert AQMD by 0.06 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within the Mojave Desert AQMD, Photovoltaic Coatings may be used on solar modules which collectively generate 744 megawatts (MW) of electricity. If all the 744 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 43 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (27 gallons/day) volume limit for the Mojave Desert AQMD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.068 tpd. These emissions are 0.2 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the Mojave Desert AQMD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. In addition, the 2020 SCM includes daily volume limits to restrict the emissions allowed from the category. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 1113 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	109,338	44.8	2.6	12.4	9.9	7.5	82

The previously adopted Rule 1113 was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 1113. Amending Rule 1113 to include the 2019 SCM updates will provide VOC emission reductions of 0.06 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the Mojave Desert AQMD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 1113 includes requirements to comply with the National Rule exceedance fee.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap -and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 1113 aid in these efforts by providing an estimated three percent improvement in the efficiency of the existing solar modules, eliminating approximately 22 MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic gases or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Mojave Desert AQMD, Photovoltaic Coatings may be applied to solar modules that collectively generate 744 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 1113 limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the Mojave Desert AQMD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 1113 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

The Mojave Desert AQMD includes the desert portion of San Bernardino County and the segment of eastern Riverside County commonly known as the Palo Verde Valley. The Western Mojave AQMD is one of two districts responsible for the Western Mojave Desert ozone nonattainment area that consists of the southwestern desert portion of San Bernardino County and the entire area served by the Antelope Valley AQMD. The Western Mojave Desert has been designated nonattainment for multiple ozone National Ambient Air Quality Standards (NAAQS). The Mojave Desert AQMD also includes two areas designated nonattainment under the PM10 NAAQS, Trona and a portion of San Bernardino County.

As it pertains to ozone standards in the Mojave Desert, photochemical modeling in the *Mojave Desert Federal 75 ppb Ozone Nonattainment Plan for the Western Mojave Desert Nonattainment Area* (2017 Ozone SIP) demonstrated that emissions from the South Coast Air Basin and the San Joaquin Valley contribute significantly to ozone levels in the Western Mojave Desert. The modeling[2] demonstrated attainment of the 75 part per billion (ppb) 8-hour ozone standard by the attainment date of 2026. The 2017 Ozone SIP also included Reasonable Further Progress (RFP) demonstrations showing reduced emissions in the years 2020, 2023, and 2026. The Mojave Desert AQMD has also been designated as nonattainment for the more recent 70 ppb 8-hour ozone standard. For this standard, the Mojave Desert AQMD will need to demonstrate RFP in 2023 and 2026.

In addition to Mojave Desert being nonattainment for ozone standards, portions of the Western Mojave AQMD were previously designated nonattainment for the PM10 standard. However, in 1994, U.S. EPA determined that Trona and San Bernardino County PM10 nonattainment areas met the 24-hour PM10 standard.

ROG is a precursor for both ozone and PM10. Architectural coatings, including Photovoltaic Coatings, are a source of ROG in the Mojave Desert AQMD. Table 2 shows the anthropogenic ROG emissions in the Mojave Desert AQMD jurisdiction on a summer-averaged basis for 2020-2027, the relevant years to the existing ozone attainment plan for the 75 ppb standard, and the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM.

[2] *Mojave Desert Federal 75 ppb Ozone Nonattainment Plan for the Western Mojave Desert Nonattainment Area,* Appendix D
https://ww3.arb.ca.gov/planning/sip/planarea/wmdaqmp/2016sip_mdplan.pdf

Table 2
Mojave Desert AQMD ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Mojave Desert AQMD (Summer average)	32.46	32.25	32.24	31.86	31.75	31.67	31.55	31.57
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating as % of Total	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

Ozone nonattainment areas are required to demonstrate RFP until attainment of the standard. The projected reductions in ROG in the Mojave Desert are sufficient to accommodate the small potential increase associated with the Photovoltaic Coatings category. While ROG emissions could, at most, be increased by 0.2 percent from Photovoltaic Coatings, the excess RFP emission reductions in the Western Mojave Desert in 2020, 2023, and 2026 is between 1.5 and 9.0 percent[3].

Conclusion

While the Mojave Desert AQMD has not yet met the 75 ppb ozone standard, the area has made progress toward attaining the ozone standard. Over the last decade, exceedance days over the 75 ppb 8-hour ozone standard were reduced by approximately one-half.[4] While this progress lowering ozone levels in the Mojave Desert is mainly due to NOx and ROG emission reductions in the upwind areas, the Mojave Desert AQMD continues to make progress reducing ROG emissions. Between 2015 and 2026, total ROG emissions are expected to decline in the Western Mojave ozone nonattainment area by seven percent[5].

The ROG reductions in 2020, 2023 and 2026, in addition to the significant NOx reductions in the Mojave Desert, provide a buffer of excess reductions that more than accommodates the potential increase in ROG from the Photovoltaic Coatings to meet RFP.

While ROG reductions benefit ozone air quality, modeling in the South Coast 2016 Air Quality Management Plan that included attainment modeling for the Mojave Desert indicated that while significant NOx reductions are required for attainment of the ozone standard, only limited ROG reductions are needed[6]. In areas like the Mojave Desert where ozone formation is shown to be NOx dependent, very small changes in ROG are

[3] https://ww3.arb.ca.gov/planning/sip/2018sipupdate/2018update.pdf, page 37
[4] https://www.arb.ca.gov/aqmis2/ozone_annual_tenyear.php
[5] https://ww3.arb.ca.gov/planning/sip/planarea/wmdaqmp/2016sip_staffreport.pdf
[6] http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/chapter4.pdf?sfvrsn=4

not likely to affect ozone concentrations. Therefore, a 0.2 percent increase in ROG emissions in the Mojave Desert is unlikely to increase ozone formation.

Mojave Desert AQMD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: Mojave Desert Federal 75 ppb Ozone Nonattainment Plan for the Western Mojave Desert Nonattainment Area (2017 Ozone SIP)

Appendix B: 2019 Suggested Control Measure for Architectural Coatings

Appendix C: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Suggested Control Measure for Architectural Coatings

Appendix E: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Clean Air Act 110(l) Determination for Monterey Bay Air Resources District Rule 426: Architectural Coatings

Introduction

The Monterey Bay Air Resources District (Monterey Bay ARD) is submitting a revision to Rule 426, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 426 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Monterey Bay ARD by 0.09 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within Monterey Bay region,[1] Photovoltaic Coatings may be used on solar modules which collectively generate 169 megawatts (MW) of electricity. If all 169 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 10 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (27 gallons/day) volume limit for Monterey Bay ARD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.068 tpd. These emissions are 0.13 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the Monterey Bay ARD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 426 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

[1] MBARD is the agency responsible for air quality within the Monterey, Santa Cruz, and San Benito Counties. Together, the three counties form the North Central Coast Air Basin.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coatings. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent.[2] The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	24,836	10.2	0.6	2.8	2.2	1.7	18.6

The previously adopted Rule 426 was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 426. Amending Rule 426 to include the 2019 SCM updates will provide VOC emission reductions of 0.09 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the Monterey Bay ARD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 426 includes requirements to comply with the National Rule exceedance fee.

[2] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of a Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 426 aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately five MW of existing conventional power plant electricity generation in California along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Monterey Bay region, Photovoltaic Coatings may be applied to solar modules that collectively generate 169 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 426 limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the Monterey Bay ARD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 426 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

Monterey Bay ARD is the local air quality agency responsible for regulating emissions from stationary sources and implementing other air quality related activities throughout Monterey, Santa Cruz, and San Benito Counties, which together form the North Central Coast Air Basin. Geographically, the District is located on the California coast, and includes major portions of the Salinas Valley and the Santa Lucia and Coastal Mountain Ranges. The annual average temperature in the area is approximately 58°F and varies from a high in the summer of approximately 71°F to a low in the winter of about 42°F.[3] In general, ozone production is more limited in cooler climates, typically found along California's central coast.

Currently, the Monterey Bay ARD attains the federal National Ambient Air Quality Standards (NAAQS) for ozone, as well as PM2.5 and PM10. An increase in VOC emissions from Photovoltaic Coatings in the Basin would therefore not impact the approvability of any existing State Implementation Plan (SIP) for the area.

Architectural coatings, including Photovoltaic Coatings, are a source of VOCs in the Monterey Bay region. Table 2 shows District emissions of ROG for 2020 - 2027, the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM.

Table 2
Monterey Bay Air Resources District Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
ROG (Summer average)	53.41	53.37	53.34	53.35	53.44	53.57	53.73	53.93
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating (as % of ROG total)	**0.13%**	**0.13%**	**0.13%**	**0.13%**	**0.13%**	**0.13%**	**0.13%**	**0.13%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

The impact of reducing emissions of precursors on air quality may be evaluated using model sensitivity simulations and estimating the change in pollutant concentrations given a change in emissions. While photochemical modeling routinely conducted for SIP development is unavailable given the current attainment status for Monterey Bay, the literature suggests that much of California is NOx sensitive and therefore small

[3] Based on Salinas Airport weather data: https://www.ncdc.noaa.gov/cdo-web/datatools/normals

changes in VOCs would not result in significant changes in ozone concentrations.[4] With respect to precursor-driven particle formation, the same would be true for PM2.5 and PM10.

Table 2 indicates that modest increases in emissions of ROG from Photovoltaic Coatings is insignificant when compared with emissions of ROG from 2020 through 2027, accounting for both the emissions growth and anticipated control over time.

Monterey Bay ARD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: 2019 Suggested Control Measure for Architectural Coatings

Appendix B: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix C: 2020 Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

[4] See https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017JD026720 and https://www.sciencedirect.com/science/article/abs/pii/S1352231010002050

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Clean Air Act 110(l) Determination for Sacramento Metropolitan AQMD Rule 442: Architectural Coatings

Introduction

The Sacramento Metropolitan Air Quality Management District (Sacramento Metropolitan AQMD) is submitting a revision to Rule 442, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 442 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Sacramento Metropolitan AQMD by 0.17 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within the Sacramento Metropolitan AQMD, Photovoltaic Coatings may be used on solar modules which collectively generate 98 megawatts (MW) of electricity. If all 98 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be eight tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (12.5 gallons/day) limit for the Sacramento Metropolitan AQMD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.031 tpd. These emissions are 0.04 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the Sacramento Metropolitan AQMD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 442 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	14,402	5.9	0.3	1.6	1.3	1	10.8

The previously adopted Rule 442 was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 442. Amending Rule 442 to include the 2019 SCM updates will provide VOC emission reductions of 0.17 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the Sacramento Metropolitan AQMD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 442 includes requirements to comply with the National Rule exceedance fee.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 442 aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately three MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been show to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Sacramento Metropolitan AQMD, Photovoltaic Coatings may be applied to solar modules that collectively generate 98 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 12.5 gallons per day. Rule 442 limits the application of Photovoltaic Coatings with a daily volume limit of 12.5 gallons per day which will result in an emissions increase of 0.031 tpd for the Sacramento Metropolitan AQMD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 442 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

The Sacramento Metropolitan AQMD is located at the southern edge of the Sacramento Valley Air Basin and is comprised of the entirety of Sacramento County. It is bordered on the east by the Mountain Counties Air Basin, on the west and north by the Sacramento Valley Air Basin, and on the south by the San Joaquin Valley Air Basin. The nonattainment area as designated under the 8-hour ozone National Ambient Air Quality Standards (NAAQS) is comprised of all of Sacramento and Yolo counties, as well as portions of Placer, El Dorado, Solano, and Sutter counties. The 24-hour $PM_{2.5}$ NAAQS nonattainment area is similar, but not identical, being comprised of all of only Sacramento County, with portions of Yolo, Placer, El Dorado, and Solano counties. For PM_{10}, the Sacramento Metropolitan AQMD, comprised only of Sacramento County, was designated as attainment of the PM_{10} NAAQS in September 2013. The district is considered unclassified/attainment for all other NAAQS.

The attainment year for the *Sacramento Regional 2008 NAAQS 8-Hour Ozone Attainment and Reasonable Further Progress Plan* (2017 Ozone SIP) is 2024; the 2015 8-hour ozone NAAQS attainment year will be 2023, with the plan due to U.S. EPA in 2024. For the $PM_{2.5}$ 24-hour NAAQS, in May 2017, the U.S. EPA made a determination of attainment, also known as a Clean Data Determination, based on 2013-2015 data. The attainment year for the *PM_{10} Implementation/Maintenance Plan and Redesignation Request for Sacramento County* (2010 PM_{10} Plan) was 2009. The attainment years for $PM_{2.5}$ and PM_{10} are in the past, so the demonstrations would be in no way affected by potential future increases in emissions from Photovoltaic Coatings; the attainment years for ozone, however, occur after 2023, so the district may incur some impacts from Photovoltaic Coating emissions.

Architectural coatings, including Photovoltaic Coatings, are a source of ROG in Sacramento County. Table 2 shows the ROG emissions in the ozone, PM2.5, and PM10 nonattainment areas (NAA) that include the Sacramento Metropolitan AQMD for 2020-2027, the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM. Emissions increases from Photovoltaic Coatings do not compromise Reasonable Further Progress or attainment demonstrations for any air quality standards for which Sacramento is nonattainment.

Table 2
Sacramento ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Ozone NAA (Summer average)	86.33	85.29	84.33	83.46	82.86	82.38	82.04	81.80
Photovoltaic Coating – potential emissions increase	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
Photovoltaic Coating as % of Ozone NAA Total	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**
PM2.5 NAA (Winter average)	87.75	87.23	86.79	86.43	86.30	86.24	86.29	86.42
Photovoltaic Coating – potential emissions increase	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
Photovoltaic Coating as % of PM2.5 NAA Total	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**
PM2.5 NAA (Annual average)	82.34	81.69	81.12	80.62	80.35	80.14	80.06	80.06
Photovoltaic Coating – potential emissions increase	0.031	0.031	0.031	0.02	0.031	0.031	0.031	0.031
Photovoltaic Coating as % of PM2.5 NAA Total	**0.42%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**
PM10 NAA (Annual average)	45.61	45.25	44.90	44.60	44.42	44.29	44.23	44.21
Photovoltaic Coating – potential emissions increase	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2
Sacramento ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Photovoltaic Coating as % of PM10 NAA Total	**0.07%**	**0.07%**	**0.07%**	**0.07%**	**0.07%**	**0.07%**	**0.07%**	**0.07%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

CARB analysis of the ozone weekend effect and precursor sensitivity analysis in the Sacramento regional ozone nonattainment area has shown that ROG is not a significant precursor for either ozone or PM formation. The change in ozone weekend effect in the region suggests that ozone formation is NOx-limited and that this will continue into the future; ozone isopleths developed for the attainment demonstration for the 2008 8-hour ozone standard indicate that the region will remain in a NOx-limited regime, meaning the sensitivity of ozone formation to ROG emissions controls will be much lower when compared to NOx.[2]

The Sacramento Metropolitan AQMD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: Sacramento Regional 2008 NAAQS 8-Hour Ozone Attainment and Reasonable Further Progress Plan

Appendix B: 2019 Suggested Control Measure for Architectural Coatings

Appendix C: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Suggested Control Measure for Architectural Coatings

Appendix E: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

[2] Sacramento Metropolitan AQMD, *Sacramento Regional 2008 NAAQS 8-Hour Ozone Attainment and Reasonable Further Progress Plan*, July 24, 2017. http://www.airquality.org/ProgramCoordination/Documents/Sac%20Regional%202008%20NAAQS%20Attainment%20and%20RFP%20Plan.pdf

Clean Air Act 110(l) Determination for San Joaquin Valley APCD Rule 4601: Architectural Coatings

Introduction

The San Joaquin Valley Air Pollution Control District (San Joaquin Valley APCD) is submitting a revision to Rule 4601, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 4601 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the San Joaquin Valley APCD by 0.45 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within the San Joaquin Valley APCD, Photovoltaic Coatings may be used on solar modules which collectively generate 373 megawatts (MW) of electricity. If all 373 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 28 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established daily (100 gallons/day) and annual (3,900 gallons/year) volume limits for the San Joaquin Valley APCD to restrict these emissions. These volume limits restrict the increase of VOC emissions to 0.25 tpd and 9.8 tons per year (tpy) respectively. These emissions are 0.08 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the San Joaquin Valley APCD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 4601 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	54,816	22.4	1.3	6.2	4.9	3.8	41.1

The previously adopted Rule 4601 was based on the SCM updated by CARB in 2019. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 4601. Amending Rule 4601 to include the 2019 SCM updates will provide VOC emission reductions of 0.45 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the San Joaquin Valley APCD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 4601 includes requirements to comply with the National Rule exceedance fee.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 4601 aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately 11 MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the San Joaquin Valley APCD, Photovoltaic Coatings may be applied to solar modules that collectively generate 373 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 100 gallons per day and an annual volume limit of 3,900 gallons per year. Rule 4601 limits the application of Photovoltaic Coatings with a daily volume limit of 100 gallons per day which will result in an emissions increase of 0.25 tpd for the San Joaquin Valley APCD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 4601 establishes daily and annual volume limits to restrict the VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

Geography and large-scale regional and local weather patterns influence the accumulation, formation, and dispersion of air pollutants in the San Joaquin Valley. Covering nearly 25,000 square miles, the San Joaquin Valley is a lowland area bordered by the Sierra Nevada Mountains to the east, the Pacific Coast range to the west, and the Tehachapi Mountains to the south. The mountains act as air flow barriers, with the resulting stagnant conditions favoring the accumulation of pollutants. To the north, the San Joaquin Valley borders the Sacramento Valley and Delta lowland, which allows for some level of pollutant dispersion. The San Joaquin Valley is nonattainment for multiple ozone and fine particulate matter (PM2.5) standards.

The San Joaquin Valley must attain the 80 parts per billion (ppb) 8-hour ozone standard by 2023 and the 75 ppb 8-hour ozone standard by 2031. In addition, the area must attain four PM2.5 standards in the next six years: the 65 microgram per cubic meter ($\mu g/m^3$) 24-hour and 15 $\mu g/m^3$ annual standards by 2020, the 35 $\mu g/m^3$ 24-hour standard by 2024, and the 12 $\mu g/m^3$ annual standard by 2025. The San Joaquin Valley APCD has developed attainment demonstrations for each of these standards.

Architectural coatings, including Photovoltaic Coatings, are a source of ROG in the San Joaquin Valley. Table 2 shows the ROG emissions in the San Joaquin Valley nonattainment area on a summer average basis for ozone, a winter average basis for PM2.5, and an annual average basis for PM2.5 and PM10 for 2020-2027, the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM. Emissions increases from Photovoltaic Coatings do not compromise Reasonable Further Progress or attainment demonstrations for any air quality standards for which the Valley is nonattainment.

Table 2
San Joaquin Valley ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Ozone NAA (Summer average)	303.77	302.41	301.42	300.23	300.04	300.04	300.3	300.7
Photovoltaic Coating – potential emissions increase	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Photovoltaic Coating as % of Ozone NAA Total	**0.08%**	**0.08%**	**0.08%**	**0.08%**	**0.08%**	**0.08%**	**0.08%**	**0.08%**
PM2.5 NAA (Winter average)	294.11	293.27	292.79	292.08	292.33	292.73	293.35	294.09
Photovoltaic Coating – potential emissions increase	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Photovoltaic Coating as % of PM2.5 NAA Total	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**
PM2.5 and PM10 NAA (Annual average)	296.19	295.22	294.61	293.74	293.84	294.10	294.58	295.19
Photovoltaic Coating – potential emissions increase	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Photovoltaic Coating as % of PM2.5 and PM10 NAA Total	**0.08%**	**0.08%**	**0.08%**	**0.09%**	**0.09%**	**0.09%**	**0.08%**	**0.08%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

CARB analysis of the ozone weekend effect and precursor sensitivity analysis in the San Joaquin Valley has shown that ROG is not a significant precursor in the San

Joaquin Valley for either ozone or PM formation. The change in ozone weekend effect in the San Joaquin Valley suggests that ozone formation is now NOx-limited and that this will continue into the future, as ozone isopleths developed for the attainment demonstration for the 2008 8-hour ozone standard indicate that the San Joaquin Valley will remain in a NOx-limited regime, meaning the sensitivity of ozone formation to ROG emissions controls will be much lower when compared to NOx.[1] Likewise, precursor sensitivity modeling conducted for San Joaquin Valley PM2.5 planning efforts showed that ROG emissions do not contribute significantly to PM2.5 levels.[2]

The air quality analysis above assumes the allowed daily volume of Photovoltaic Coatings is applied resulting in an emissions increase of 0.25 tpd. The emissions increase is 0.08 percent of the total ROG emissions inventory in the San Joaquin Valley from 2020-2027. Therefore, the potential ROG emissions increase of 0.25 tpd is unlikely to increase ozone formation.

The San Joaquin Valley APCD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: 2019 Suggested Control Measure for Architectural Coatings

Appendix B: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix C: 2020 Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

[1] San Joaquin Valley APCD. 2016 Plan for the 2008 8-Hour Ozone Standard, Appendix H. http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2016/June/final/13.pdf

[2] San Joaquin Valley APCD. 2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards, Appendix G. http://www.valleyair.org/pmplans/documents/2018/pm-plan-adopted/G.pdf

Clean Air Act 110(l) Determination for San Luis Obispo County APCD Rule 433: Architectural Coatings

Introduction

The San Luis Obispo County Air Pollution Control District (San Luis Obispo County APCD) is submitting a revision to Rule 433, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 433 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the San Luis Obispo County APCD by 0.03 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within the San Luis Obispo County APCD, Photovoltaic Coatings may be used on solar modules which collectively generate 715 megawatts (MW) of electricity. If all 715 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be 56 tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (27 gallons/day) volume limit for the San Luis Obispo County APCD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.068 tpd. These emissions are 0.4 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the San Luis Obispo County APCD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 433 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	105,076	43	2.5	11.9	9.5	7.2	78.8

The previously adopted Rule 433 was based on the SCM updated by CARB in 2000. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 433. Amending Rule 433 to include the 2019 SCM updates will provide VOC emission reductions of 0.03 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in the San Luis Obispo County APCD prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 433 includes requirements to comply with the National Rule exceedance fee.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 433 aid in these efforts by providing an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately 21 MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the San Luis Obispo County APCD, Photovoltaic Coatings may be applied to solar modules which collectively generate 715 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 433 limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the San Luis Obispo County APCD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 433 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

San Luis Obispo County is located on the coast of California and is adjacent to Monterey County to the north, Santa Barbara County to the south, and Kern County to the east. On July 20, 2012, U.S. EPA classified the eastern portion of San Luis Obispo County (eastern SLO) as a Marginal nonattainment area for the 75 part per billion (ppb) 8-hour ozone National Ambient Air Quality Standard (ozone standard). In 2018, the eastern SLO nonattainment area was also classified as a Marginal nonattainment area for the latest, 70 ppb, 8-hour ozone standard.

On January 20, 2017, U.S. EPA determined that the eastern SLO nonattainment area met the 2008 ozone standard by the applicable attainment date of July 20, 2016 based on monitored air quality data for years 2013, 2014 and 2015.

Ozone levels in the San Luis Obispo County have continued to decrease in San Luis Obispo County and the three year average of the annual fourth highest 8-hour ozone value[2] is now within 1 ppb to meeting the 70 ppb 8-hour ozone standard, Table 2. As a marginal nonattainment area for the 70 ppb 8-hour ozone standard, eastern SLO must attain this standard in 2020.

Table 2
San Luis Obispo County 8-hour Ozone Averages (ppb)

San Luis Obispo County	2013	2014	2015	2016	2017	2018	2019
8-hour Ozone Averages (ppb)	77	76	73	73	72	72	71

Architectural coatings, including Photovoltaic Coatings, are a source of reactive organic gases (ROG) in San Luis Obispo County. ROG is one of the two precursors to ozone formation. Table 3 shows the ROG emissions in the San Luis Obispo County from 2020 to 2027. In 2020 to 2027, the application of Photovoltaic Coatings has the potential to increase ROG emission under the 2020 amendments to CARB's architectural coatings SCM, Table 3.

[2] The three-year average of the annual fourth highest daily 8-hour ozone level is the metric U.S. EPA applies in measuring ozone levels for the 8-hour ozone standard.

Table 3
San Luis Obispo County ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
San Luis Obispo County Emissions (Summer average)	18.90	18.81	18.74	18.67	18.63	18.61	18.60	18.62
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating (% of San Luis Obispo ROG)	**0.4%**	**0.4%**	**04%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

Analysis of ozone formation in Santa Barbara County, San Luis Obispo County's neighboring coastal county, has shown that ozone formation in Santa Barbara County is NOx-limited, indicating that very small changes in ROG are not likely to significantly affect ozone concentrations[3]. While this analysis was not focused on San Luis Obispo County, the similarities between these coastal counties is significant. Therefore, the small potential increase in ROG levels of 0.4 percent in San Luis Obispo County is unlikely to affect ozone levels or interfere with attainment of the 70 ppb 8-hour ozone standard in 2020.

San Luis Obispo County APCD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: 2019 Suggested Control Measure for Architectural Coatings

Appendix B: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix C: 2020 Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

[3] *Nonattainment-Transitional Designation: Changes to the 2016 Ozone Plan Control Measure Implementation*, SBCAPCD, August 2017

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Clean Air Act 110(l) Determination for Santa Barbara County APCD Rule 323.1: Architectural Coatings

Introduction

The Santa Barbara County Air Pollution Control District (Santa Barbara County APCD) is submitting a revision to Rule 323.1, Architectural Coatings. The revision establishes Photovoltaic Coatings as a new coating category. A Photovoltaic Coating is applied to solar photovoltaic modules already installed and manufactured without an anti-reflective coating. Application of Photovoltaic Coatings to installed solar modules is a new process. Prior to the rule revision, Rule 323.1 did not have a defined coating category for photovoltaic solar modules; these coatings could be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). The revision establishes a volatile organic compound (VOC) limit of 600 grams/liter (g/l), whereas Flat Coatings and Low Solids Coatings have VOC limits of 50 g/l and 120 g/l respectively.

On May 23, 2019, the California Air Resources Board (CARB) updated the Suggested Control Measure for Architectural Coatings (SCM). The SCM is not a formal regulation. It is a model rule that can be adopted by the local air pollution control and air quality management districts (APCD/AQMD or district) to reduce VOC emissions to improve air quality. CARB estimated the impacts from the May 2019 SCM (2019 SCM) updates would reduce VOC emissions in the Santa Barbara County APCD by 0.05 tons per day (tpd).

CARB updated the SCM again in May 2020 (2020 SCM), which established a new category, Photovoltaic Coatings, with a VOC limit of 600 g/l. CARB estimated that within Santa Barbara County, Photovoltaic Coatings may be used on solar modules which collectively generate 40 megawatts (MW) of electricity. If all 40 MW of solar modules are coated with Photovoltaic Coatings, a total increase of VOC emissions would be three tons over the life of the entire project.

To lessen the adverse effects from the Photovoltaic Coatings category emissions increase, the 2020 SCM included additional provisions. The 2020 SCM established a daily (27 gallons/day) volume limit for the Santa Barbara County APCD to restrict these emissions. This volume limit restricts the increase of VOC emissions to 0.068 tpd. These emissions are 0.3 percent of the total reactive organic gases (ROG) emissions inventory in 2020 for the Santa Barbara County APCD.

In addition, CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to approximately seven years. To ensure these allowable emissions are not exceeded, the 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The revisions to Rule 323.1 include these provisions for the Photovoltaic Coatings category to minimize the impacts.

The increased emissions from applying the Photovoltaic Coatings is a single incident for each solar module. However, the emission benefits from applying the coating will last for the lifetime of the coating. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. Consequently, CARB staff estimates the increased solar module efficiency will result in avoided power plant emissions for at least 10 years. The estimated emissions benefits from application of the Photovoltaic Coating are shown in Table 1 below.

Table 1
Estimated Power Plant Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM10 (Tons)	PM2.5 (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	5,878	2.4	0.1	0.7	0.5	0.4	4.4

The previously adopted Rule 323.1 was based on the SCM updated by CARB in 2007. Updates from the 2019 SCM or 2020 SCM are being incorporated jointly in these amendments to Rule 323.1. Amending Rule 323.1 to include the 2019 SCM updates will provide VOC emission reductions of 0.05 tpd. The 2020 SCM updates will result in small and insignificant emission increases in VOC emissions in Santa Barbara County prior to sunset of applicable provisions in the 2020 SCM on January 1, 2028.

General Discussion

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control and air quality management districts (APCD/AQMD or air district). CARB is responsible for serving as an oversight agency and providing assistance to the air districts by developing the SCM. CARB first approved an SCM for architectural coatings in 1977, revising it several times since, most recently in 2019 and 2020.

The U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule) was finalized in 1998 and went into effect in 1999. In general, the VOC limits in the 2019 SCM are more restrictive than the National Rule.

The 2020 SCM updates by CARB added a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. The National Rule does not include a category for Photovoltaic Coatings. Under the National Rule, a Photovoltaic Coating is likely considered an Exterior Flat Coating, with a VOC limit of 250 g/l. The National Rule allows the use of a coating that exceeds the applicable VOC limit; in such cases, exceedance fees apply. Rule 323.1 includes requirements to comply with the National Rule exceedance fee.

[1] Based on information provided by Pellucere Technologies, Inc. Email from Bob Lukefahr to Jose Gomez and Glen Villa. March 13, 2020.

The use of a Photovoltaic Coating is limited to solar photovoltaic modules manufactured without an anti-reflective coating. Newly manufactured solar photovoltaic modules are coated with an anti-reflective coating during the manufacturing process. A Photovoltaic Coating need only be applied one time to a solar photovoltaic module. Therefore, the anticipated use of Photovoltaic Coating is limited to the legacy population of existing solar modules and therefore has a limited market.

The Global Warming Solutions Act of 2006 (Nunez) expanded CARB's role to development and oversight of greenhouse gas reduction programs. These include Cap-and-Trade, the Low Carbon Fuel Standard and the Zero-Emission Vehicle (ZEV) programs. As a result of these efforts, the State has met its goal of reducing carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as SB 32 in 2014 and AB 398 in 2017), CARB is now mapping out how these programs and others can help California reach its next target: reducing greenhouse gas emissions an additional 40 percent below 1990 levels by 2030. The ultimate goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The revisions to Rule 323.1 aid in these efforts by an estimated three percent improvement in the efficiency of existing solar modules, eliminating approximately one MW of existing conventional power plant electricity generation in California, along with its associated emissions of greenhouse gases and criteria pollutants.

Emissions Impacts

The application of Photovoltaic Coatings will result in increased emissions of volatile organic compounds or VOCs. However, for each solar module where coatings are applied, the emission of VOCs occurs as a single pulse which is offset by the reduced power plant emissions that can be attributed over the lifetime of the solar module coating. A coating that meets the definition of Photovoltaic Coating has been shown to improve the efficiency of the solar modules by approximately three percent. This benefit will last the remaining lifespan of the solar modules which is estimated to be at least ten years.

It is estimated that within the Santa Barbara County APCD, Photovoltaic Coatings may be applied to solar modules that collectively generate 40 MW of electricity. CARB staff analyzed the emission impacts from Photovoltaic Coatings based on a 600 g/l VOC limit. Further assumptions include using an average coating coverage value, solar module dimensions and an application waste factor. Based on these values and the VOC limit, CARB staff has determined a daily volume limit of 27 gallons per day. Rule 323.1 limits the application of Photovoltaic Coatings with a daily volume limit of 27 gallons per day which will result in an emissions increase of 0.068 tpd for the Santa Barbara County APCD.

Effective January 1, 2028, the Photovoltaic Coating category sunsets. Rule 323.1 establishes daily volume limits to restrict the daily VOC emissions from the Photovoltaic Coating category.

Ambient Air Quality Impacts

Santa Barbara County is located on the coast of California and is adjacent to San Luis Obispo County to the north and the Ventura County to the east. In 1991, the Santa Barbara County was designated nonattainment for the 1-hour ozone National Ambient Air Quality Standard (standard). Santa Barbara attained the 1-hour ozone standard in 1999.

In 2001, the Santa Barbara County APCD adopted the 2001 1-Hour Ozone Attainment Demonstration and Maintenance Plan. The Maintenance Plan demonstrated that emissions of ROG and NOx were projected to remain below the 1999 emission levels out to 2015. The ROG emissions in 1999 were 43.7 tpd.

Architectural coatings, including Photovoltaic Coatings, are a source of ROG in Santa Barbara County. Table 2 shows the ROG emissions in the Santa Barbara County for 2020-2027, the years with potential emission increases from Photovoltaic Coatings as applicable under the 2020 amendments to CARB's architectural coatings SCM. This potential increase in ROG from the Photovoltaic Coatings will be 0.3 percent of the total ROG emissions in Santa Barbara in 2020 through 2027.

Table 2
Santa Barbara County ROG Emissions in Tons per Day (tpd)

ROG	2020	2021	2022	2023	2024	2025	2026	2027
Santa Barbara County Emissions (Summer average)	25.40	25.29	25.19	25.11	25.07	25.06	25.06	25.09
Photovoltaic Coating – potential emissions increase	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Photovoltaic Coating (% of Santa Barbara ROG)	**0.3%**	**0.3%**	**0.3%**	**0.3%**	**0.3%**	**0.3%**	**0.3%**	**0.3%**

Source: CARB California Emissions Projection Analysis Model (CEPAM 2016 SIP v1.05)

Current ozone levels in Santa Barbara County are well below NAAQS. In 2018, the Santa Barbara County monitored 1-hour ozone levels were 78 parts per billion (ppb), well below the 120 ppb 1-hour ozone standard. In addition, monitored levels of the more stringent 8-hour ozone concentrations are well below the latest 8-hour ozone standard of 70 parts per billion (ppb), Table 3.

Table 3
Santa Barbara County Annual 8-hour Ozone Levels in Parts per Billion (ppb)

Santa Barbara County	1999	2004	2009	2014	2019
8-hour ozone levels	82	82	77	68	65

Additionally, ozone formation within Santa Barbara County tends to be NOx-limited, indicating that very small changes in ROG are not likely to significantly affect ozone concentrations in the Santa Barbara County areas with the highest recorded ozone concentrations[2]. Therefore, a 0.3 percent increase in ROG emissions in Santa Barbara will not significantly increase ozone formation.

Therefore, the small potential increase in ROG levels is unlikely to affect ozone levels in Santa Barbara County or to affect the area's attainment status of the ozone standard.

Santa Barbara County APCD has prepared this proposal following the guidelines provided by the U.S. Environmental Protection Agency (U.S. EPA).

Appendix A: 2019 Suggested Control Measure for Architectural Coatings

Appendix B: 2019 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

Appendix C: 2020 Suggested Control Measure for Architectural Coatings

Appendix D: 2020 Staff Report for Proposed Updates to the Suggested Control Measure for Architectural Coatings

[2] Nonattainment-Transitional Designation: Changes to the 2016 Ozone Plan Control Measure Implementation, SBCAPCD, August 2017

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