State of California
AIR RESOURCES BOARD

PUBLIC HEARING TO CONSIDER THE PROPOSED UPDATES TO THE SUGGESTED CONTROL MEASURE FOR ARCHITECTURAL COATINGS

STAFF REPORT FOR PROPOSED UPDATES TO THE SUGGESTED CONTROL MEASURE FOR ARCHITECTURAL COATINGS

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EXECUTIVE SUMMARY

Introduction

On May 23, 2019, the California Air Resources Board (CARB or Board) approved the 2019 Suggested Control Measure for Architectural Coatings (SCM), updating the 2007 SCM. During the hearing, the Board received comments from stakeholders regarding the need to add a new coating category intended for use on solar modules. Pellucere Technologies, Inc. stated that their new product, MoreSun®, an anti-reflective and anti-soiling optical coating, would provide three to four percent energy efficiency improvement of solar modules. The Board directed CARB staff to work with Pellucere Technologies, Inc., air districts, the United States Environmental Protection Agency (U.S. EPA) and other interested stakeholders to evaluate the feasibility of incorporating a new photovoltaic panel coating category into the SCM.

Staff is proposing to update the 2019 SCM for Architectural Coatings (2020 SCM). The proposed 2020 SCM will add a new coating category for Photovoltaic Coatings and establish a volatile organic compound (VOC) limit for the category of 600 grams per liter (g/l). The proposed 2020 SCM is not a formal regulation. It is a model rule that can be used by the local air pollution control districts and air quality management districts (APCD/AQMD or district) to update their architectural coatings rules. This Staff Report presents the staff's proposed 2020 SCM for Architectural Coatings.

Because the proposed 2020 SCM is a model rule, rather than a formal regulation, CARB staff is not required to prepare an Initial Statement of Reasons or a Final Statement of Reasons to respond to public comments. Instead, staff has prepared this Staff Report, which is similar to an Initial Statement of Reasons and addresses comments that were received during the development process. In this Staff Report, staff presents the rationale for the proposed 2020 SCM.

Background

Architectural coatings are products that are applied to stationary structures and their accessories. They include house paints, stains, industrial maintenance coatings, traffic coatings, and many other products. When these coatings are applied, VOCs are emitted from the coatings and solvents that are used for thinning of the coatings and clean-up of the application equipment.

Under California law, the 35 local air districts have the primary legal authority for adopting control measures for non-vehicular sources such as architectural coatings, as provided in Health and Safety Code Sections 39002, 40000, and 40001. As such, CARB does not directly regulate architectural coatings. However, CARB serves as an oversight agency and provides assistance to the districts. One way that CARB provides assistance is by developing an SCM for architectural coatings. The SCM serves as a model rule that can be used by districts throughout California. CARB approved an SCM for architectural coatings in 1977 and updated it in 1985, 1989, 2000, 2007, and 2019. While CARB provides support to the districts by developing the SCM, the districts are

ultimately responsible for adopting, implementing, and enforcing architectural coating rules in California.

Currently, 22 of the 35 air districts have architectural coating rules; 15 are based on the 2007 SCM and six are based on the 2000 SCM. The South Coast AQMD is covered by Rule 1113, which is more stringent than the 2019 SCM. The remaining 13 districts without their own architectural coatings rules are covered by the U.S. EPA Architectural Coatings: National Volatile Organic Compounds Emission Standards (National Rule). The San Joaquin Valley Air Pollution Control District (San Joaquin Valley APCD) is expected to revise their architectural coatings rule to implement the 2019 SCM in April 2020.

In the presence of sunlight, VOCs and nitrogen oxides (NO_x) undergo a series of chemical reactions to form ozone. VOC emissions from architectural coatings can also lead to the formation of particulate matter (PM). Ozone is a strong oxidizer that irritates the respiratory system, leading to a variety of adverse health effects. It also damages plant life and property. Particulate matter less than 10 microns in diameter can be inhaled deep into the lungs. PM exposure has also been associated with a wide range of adverse health impacts, including hospitalization and premature death. Since the use of architectural coatings generates air pollutants, CARB staff has worked with districts and other stakeholders to reduce emissions from architectural coatings and help districts achieve their air quality goals.

To protect California's population from the harmful effects of exposure to ozone and PM, CARB and the U.S. EPA have established ambient air quality standards for these contaminants. Most of California's 35 local districts are classified as "nonattainment", because they do not meet State or federal ambient air quality standards for ozone and PM. For nonattainment districts, clean air laws require districts to develop plans to describe how they will attain ambient air quality standards. The California Clean Air Act requires nonattainment districts to prepare and submit plans for attaining and maintaining the State standards. The federal Clean Air Act (CAA) requires districts to develop state implementation plans (SIPs) if they have not attained federal air quality standards.

Process for Developing the 2020 SCM

The proposed 2020 SCM was developed in cooperation with air districts and the U.S. EPA and in consultation with industry stakeholders. CARB staff formed a Working Group as part of the 2020 SCM development process, which included air districts and the U.S. EPA. Staff had numerous meetings with air districts, and U.S. EPA in developing the proposal. Staff also met numerous times with stakeholders and held a public workshop to discuss the proposal.

As part of the 2020 SCM development process, staff identified an additional company, DSM, that manufactures Photovoltaic Coatings. DSM is a multinational company headquartered in the Netherlands. It has been applying Photovoltaic Coatings to uncoated solar modules in Europe for the last three years.

Objectives of the Proposed 2020 SCM

The proposed 2020 SCM will update the 2019 SCM to reflect current coatings technology. A key objective of the SCM is to promote consistency and uniformity among district rules. This consistency makes it easier for manufacturers and painting contractors to comply with district rules.

The 2020 SCM sets up a framework for air districts to revise their rules with provisions that would allow the application of Photovoltaic Coatings on uncoated modules at solar facilities in California. CARB staff has conducted a technical evaluation of the coating category, and the emissions and economic impacts of allowing the use of these coatings. The analysis focuses on the nine districts that have been identified as having solar installations with uncoated modules where Photovoltaic Coatings are likely to be used along with districts that expressed interest in possibly modifying their rules to include the new coating category.

Photovoltaic Coatings are applied to installed uncoated solar modules. The coating has anti-reflective properties which allow the module to harness more light and provides an increase in electricity generation. This increase in electricity generation results in avoided emissions from generating electricity by conventional means. Data provided by the coating manufacturers shows that the efficiency improvement of the modules is about three to four percent. However, because of the performance requirements of the coatings, they are formulated with high levels of VOCs.

Overview of the Proposed Update

In general, manufacturers comply with the VOC limits by reformulating their products to replace some of the VOC solvent with water or exempt compounds. Manufacturers also modify their formulations to increase the amount of resin and pigment solids contained in the coatings. However, the Photovoltaic Coating category is different than other architectural coatings. First, the coating is applied in such a way that it achieves a very thin film. Second, the coating must dry quickly. Third, there are only two companies that are currently marketing Photovoltaic Coatings for in-field application to previously installed uncoated solar modules. The coatings formulations for both companies have relatively high VOC compared to other architectural coatings.

Staff is proposing to add a new category for Photovoltaic Coatings with a VOC content limit of 600 g/l. Staff is also proposing a sunset date of January 1, 2028 along with provisions that include notification and reporting requirements to aid in the implementation of the Photovoltaic Coatings requirements (see Appendix A). To minimize emission increases from Photovoltaic Coatings, the 2020 SCM sets a volume limit in gallons per day to prevent emissions from application of Photovoltaic Coatings

from exceeding the California Environmental Quality Act (CEQA) thresholds for each air district.

Unlike other architectural coatings, the Photovoltaic Coatings are a one-time application for installed uncoated modules. Photovoltaic solar modules produced since around 2016 have been precoated at the factory with anti-reflective coatings. Thus, Photovoltaic Coatings will only be applied to modules that were not coated during the manufacturing process. This means that the quantity of Photovoltaic Coatings that will likely be used is limited by the number of existing uncoated solar module installations.

In the 2019 SCM, Photovoltaic Coatings would be considered Low Solids Coatings, which are subject to a VOC limit of 120 g/l. Staff evaluated the feasibility of reformulating these coatings to meet the existing VOC limit and concluded that it was not feasible to reformulate to the lower VOC limit and maintain the performance characteristics of the coatings described previously. Based on a review of available products, staff determined that the Photovoltaic Coatings category can meet a VOC limit of 600 g/l.

The application of Photovoltaic Coatings in a field setting in California is new and will result in additional VOC emissions that are not accounted for in district plans to attain the ozone and PM standards. The addition of this category with the proposed limit is therefore projected to result in VOC emission increases, triggering federal CAA requirements for air districts to show that those increases will not interfere with the attainment or maintenance of the ambient air quality standards. Specifically, the CAA 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” (42 U.S.C. §7401 et seq. (1970)). In order to avoid backsliding, CARB staff, along with U.S. EPA and districts, developed 110(l) Determinations for the nine impacted districts. CARB staff 110(l) Determinations for these nine air districts are found in Appendix D.

The proposed VOC limit for the new coating category is shown in Table ES-1, along with other limits that could apply.

Table ES-1
Proposed VOC Limit

Coating Category	Current Limit (g/l)[1,2]	Proposed Limit (g/l)[2]
Coating Category: Photovoltaic Coatings	120	**600**

1. Photovoltaic Coatings are covered under the Low Solids Category in the current SCM.
2. Limit is VOC Actual, which is also referred to as “Material VOC”.

Air Quality Impacts

As discussed above, if no changes are made, Photovoltaic Coatings could not be used in most areas in California because current formulations do not meet the 120 g/l VOC limit for the Low Solids Coatings category. By establishing a 600 g/l VOC limit, the proposed 2020 SCM would increase VOC emissions by 280 tons if all the identified uncoated solar modules are coated. However, because the coated modules produce more electricity relative to the uncoated modules, if all the identified uncoated modules in California are coated, the equivalent of 113 MW of electricity capacity would be gained. This is equivalent to eliminating the need for one small conventional natural gas fueled power plant. To minimize emission increases from Photovoltaic Coatings, the 2020 SCM will implement a volume limit in gallons per day (gallon/day) to prevent the use of Photovoltaic Coating from exceeding CEQA thresholds for each air district. Table ES-2 shows the proposed volume limits and yearly equivalent MW coated by district. Through discussions with manufacturers, staff assumed 150 days per year are suitable for coating solar panels. Table ES-3 shows the potential power plant emissions avoided from having the more efficient electricity production from coated solar modules over their estimated useful life.

Table ES-2
Proposed Volume Limits

Air District	Daily Volume Limit (Gallons)	Equivalent MW Coated Annually[2]
Antelope Valley AQMD	27	128
Eastern Kern APCD	27	137
Imperial Valley APCD	27	123
Mojave Desert AQMD	27	176
Monterey Bay ARD	27	171
Sacramento Metro AQMD	12.5	58
San Joaquin Valley APCD[1]	100	131
San Luis Obispo County APCD	27	129
Santa Barbara APCD	27	129

1. An additional annual volume limit of 3,900 gallons per year is applicable in the San Joaquin Valley APCD.
2. Staff assumed 150 coating days per year.

Table ES-3
Estimated Power Plant Emissions Avoided

Energy Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM_{10} (Tons)	$PM_{2.5}$ (Tons)	VOC (Tons)	CO (Tons)
CARB Electricity Mix	554,627	227	13	63	50	38	416

- Reflects emissions avoided from greenhouse gas (GHG) and criteria pollutants for power plant over a 10-year period.
- Assumes 3% (~113 MW equivalent) increase Photovoltaic capacity due to the application of the coatings.
- CARB electricity mix is derived from GHG and criteria pollutant inventories, and California Energy Commission electricity generation data.

Staff Recommendation

Staff recommends the Board approve the proposed 2020 SCM and direct staff to transmit the SCM to the air districts for their consideration when updating their architectural coating rules.

CHAPTER I. INTRODUCTION AND BACKGROUND

A. Introduction

Architectural coatings are products that are applied to stationary structures and their accessories. They include house paints, stains, industrial maintenance coatings, traffic coatings, and many other products. When these coatings are applied, volatile organic compounds (VOCs) are emitted from the coatings and from the solvents that are used for thinning and clean-up.

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 district). The California Air Resources Board (CARB or Board) is responsible for serving as an oversight agency and providing assistance to the air districts. One way that CARB provides assistance is by developing an SCM for architectural coatings. The SCM serves as a model rule that can be used by air districts throughout California. CARB approved an SCM for architectural coatings in 1977 and updated it in 1985, 1989, 2000, 2007, and 2019. While CARB provides support to the air districts by developing the SCM, the air districts are ultimately responsible for adopting, implementing, and enforcing architectural coating rules in California. Staff is proposing to update the 2019 SCM to establish a new coating category for Photovoltaic Coatings and establish a VOC limit for the category. This update to the SCM (2020 SCM) would include provisions to allow the use of Photovoltaic Coatings on uncoated solar modules in California for the next seven years.

B. Background

Currently, 15 California air districts have adopted architectural coating rules based on the SCM that the Board approved in 2007. Six additional air districts have architectural coating rules based on the 2000 SCM. South Coast AQMD is covered by Rule 1113, which is more stringent that the 2019 SCM. California's 13 remaining air districts are covered by the National Rule. The National Rule was finalized in September 1998 and became effective throughout the country, including all California air districts, on September 13, 1999. The Ozone Transport Commission (OTC), which represents northeastern states, has developed a model rule for architectural coatings based in part on the 2007 SCM. Environment Canada (EC) has also indirectly relied on the SCM. The EC regulation is based on an earlier version of the OTC model rule which relied on the 2000 SCM.

The proposed 2020 SCM (see Appendix A) will update the 2019 version of the SCM (see Appendix B). The proposed 2020 SCM adds a new coating category for Photovoltaic Coatings and a corresponding VOC limit of 600 grams per liter (g/l). Rationale for the proposed updates to the 2019 SCM is provided in the following chapters.

Photovoltaic coatings are designed with anti-reflective properties to allow solar modules to harness more sunlight and therefore produce more electricity. These coatings are

applied on pre-installed solar modules, which is a recent development in the coating industry. These coatings also tend to be formulated with higher VOCs content. These coatings also have anti-soiling properties which likely contribute to the increase in the electricity produced. The anti-soiling properties keep modules clean longer which reduces the cleaning frequency the solar modules require to maintain peak performance. It is important to note that the anti-soiling properties are difficult to quantify.

While there is limited data on the durability and performance of these coatings, pilot demonstrations in California show that there is an increase in the amount of electricity generated from coated modules in comparison to uncoated modules (Pellucere, 2019a; Pellucere, 2019b). Demonstrations in Europe also show similar improvements in electricity generation (DSM, 2020a).

To date, staff has identified two coating manufacturers that produce and offer such coatings. Staff had numerous discussions with these companies in an effort to understand the technology and the potential to feasibly lower the VOC content of the coatings.

C. Need for an Update to the 2019 SCM

During the development of the 2019 SCM, staff began working with Pellucere Technologies, Inc to determine the feasibility of incorporating Photovoltaic Coatings into the SCM. Currently in most district rules, if a coating does not meet one of the specialty coating category definitions, it falls into either the Flat or Nonflat Coating categories based on the coating gloss level. Due to timing, staff was unable to complete the evaluation prior to the May 2019 Board meeting. At the meeting, the Board directed staff to continue working with industry stakeholders, districts, and U.S. EPA to determine the feasibility of incorporating a Photovoltaic Coating category with an appropriate VOC limit in the SCM.

Staff has continued to work with industry stakeholders, air districts, and U.S. EPA to complete the evaluation. Based on staff's evaluation of the Photovoltaic Coatings, staff concluded that Photovoltaic Coatings would be classified as a Low Solids Coating and be subject to a 120 g/l VOC limit in the 2019 SCM. 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 may apply. Based on this information, staff concluded that establishing a new category for Photovoltaic Coatings in the SCM would be appropriate. The proposed 2020 SCM updates add a new category for Photovoltaic Coatings with a VOC limit of 600 g/l. Staff has evaluated the emission impacts of using Photovoltaic Coatings to coat the existing installed uncoated solar modules in California. Chapter II of this report presents the staff emissions impact analysis.

Photovoltaic Coatings are different from other architectural coatings as their primary function is to increase the efficiency of the solar modules as opposed to protecting the

substrate from environmental conditions. An additional consideration is that there is an air quality tradeoff in that the use of the coating will cause a one-time release in VOC emissions from the currently allowed levels. However, doing so would provide a long-term emissions benefit resulting from the increased electricity generation. The staff's proposal is structured to recognize these considerations as well as other constraints air districts face based on their existing commitments to continue making progress towards attaining the air quality standards under the federal CAA.

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 will only be applied one time to an uncoated solar photovoltaic module. Therefore, the use of a Photovoltaic Coating is limited to those uncoated modules already installed.

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 in rolling back carbon emissions to 1990 levels by 2020. With the passage of additional laws (such as Senate Bill (SB) 32 in 2014 and Assembly Bill (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 goal for California is to reduce greenhouse gases 80 percent below 1990 levels by 2050. The proposed 2020 SCM would contribute to these efforts by allowing the use of a coating that can provide as much as four percent improvement in efficiency of the uncoated solar modules. Staff estimates that if all identified uncoated solar modules were coated with Photovoltaic Coatings, it would provide the equivalent of adding 113 MW of new electricity generating capacity. This would result in avoided emissions from conventional power plant electricity generation of both greenhouse gases and criteria pollutants.

D. Air Quality Standards

To protect California's population from the harmful effects of ozone and PM, CARB and U.S. EPA have established ambient air quality standards for these contaminants. Most of California's 35 air districts are classified as "nonattainment" due to noncompliance with State or federal ambient air quality standards for ozone and PM. For nonattainment air districts, clean air laws require air districts to develop plans to describe how they will attain ambient air quality standards. Appendix C of the 2019 SCM Staff Report provides further information on air quality standards and air districts that have been designated as "nonattainment" (CARB, 2019). The federal CAA requires air districts to demonstrate that no rule relaxation would interfere with reasonable further progress and ultimate attainment, or ongoing maintenance, of the ambient air quality standards (42 U.S.C. §7401 et seq. (1970)). Thus, staff has prepared 110(l) determinations for air districts where potential projects with uncoated solar modules have been identified. Specifically, the CAA 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". CARB staff 110(l) determinations for air districts are in Appendix D. Based on these determinations, staff concludes that the proposed 2020 SCM would not interfere with attainment of or reasonable further progress towards attainment of the air quality standards.

CHAPTER II. EMISSIONS & REDUCTIONS

A. Estimated Emissions from Architectural Coatings

VOC emissions in California from the use of architectural coatings, including colorants, are estimated to be about 32 tons per day (tpd) on an annual average basis in 2013, and 44 tpd if associated solvent thinning and cleanup activities are included. The South Coast AQMD accounts for 11 tpd, excluding colorants and solvent thinning and cleanup. Total emissions from architectural coatings and associated materials represent about five percent of the total VOC emissions from stationary and area sources, and 2.6 percent of all VOC emissions statewide (CARB, 2019).

Emissions from architectural coatings are estimated from surveys of architectural coatings sales in California. CARB has conducted eight surveys over the past 30 years which collected sales and emissions data for coatings sold in California in 1975, 1980, 1984, 1988, 1990, 1996, 2000, 2004, and 2013.

B. Estimated Emission Impacts from the Proposed Changes to the SCM

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 by 2.50 tpd statewide. CARB staff is proposing to update the SCM again in May 2020 (2020 SCM), which would establish a new category for Photovoltaic Coatings with a proposed VOC limit of 600 g/l.

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. Currently, the SCM does not have a defined coating category for photovoltaic solar modules; these coatings would be considered either a Flat Coating or a Low Solids Coating (dependent on the solids content of the coating). Based on staff's understanding of the coating formulations, Photovoltaic Coatings would be a Low Solids Coating. The proposal establishes a VOC limit of 600 g/l, whereas Low Solids Coatings has a VOC limit of 120 g/l, respectively.

Photovoltaic Coatings are intended for solar photovoltaic modules used in utility-scale applications. Photovoltaic Coatings are not intended for use on residential solar photovoltaic modules. The sites where photovoltaic coatings are targeted for use is limited to specific regions of California. Typically, these sites are remotely located and are limited in the number of sites. According to 2018 GIS data from the California Energy Commission (CEC), 27 air districts have solar photovoltaic modules. Table 2-1 shows CEC solar photovoltaic megawatt capacity and number of sites for the 27 air districts. As of 2018, the total California installed solar electricity capacity from 726 photovoltaic sites is 10,471 MW (CEC, 2020).

Table 2-1
Districts with Solar Facilities

Air District	Capacity (MW)	Number of Sites
Amador County Air Pollution Control District	2	1
Antelope Valley Air Quality Management District	1,088	101
Bay Area Air Quality Management District	127	74
Butte County Air Quality Management District	8	7
Calaveras County Air Pollution Control District	2	1
Feather River Air Quality Management District	5	5
Glenn County Air Pollution Control District	2	1
Great Basin Unified Air Pollution Control District	2	1
Imperial County Air Pollution Control District	1,439	22
Kern Air Pollution Control District	2,098	35
Lake County Air Quality Management District	3	3
Mendocino County Air Quality Management District	7	4
Mojave Desert Air Quality Management District	1,109	60
Monterey Bay Air Resources District	289	17
Northern Sonoma County Air Pollution Control District	8	6
Placer County Air Pollution Control District	6	4
Sacramento Metro Air Quality Management District	140	38
San Diego County Air Pollution Control District	100	21
San Joaquin Valley Air Pollution Control District	2,363	185
San Luis Obispo County Air Pollution Control District	810	12
Santa Barbara County Air Pollution Control District	42	2
Shasta County Air Quality Management District	8	5
South Coast Air Quality Management District	769	92
Tehama County Air Pollution Control District	9	10
Tuolumne County Air Pollution Control District	2	1
Ventura County Air Pollution Control District	4	2
Yolo Solano Air Quality Management District	29	16
Total	**10,471**	**726**

(CEC, 2020)

Because the proposed 2020 SCM is most likely to be implemented in air districts with photovoltaic installations, the staff's analysis focused on the nine districts listed in Table 2-2. Staff estimates there are about 3,774 MW of installed solar electricity generation capacity of uncoated solar modules within those nine districts. This is based on discussions with the manufacturers of photovoltaic coatings and information from the CEC. Table 2-2 shows solar photovoltaic megawatt capacity, number of sites, and the total VOC emissions for the nine air districts staff focused on as having potential for application of photovoltaic coatings. Based on recent discussion with one coating manufacturer, staff became aware of additional potential projects in three other air

districts: Bay Area AQMD, San Diego APCD, and Great Basin Unified APCD. The manufacturer is still evaluating these projects and they are not included in this analysis. In addition, in discussions with photovoltaic coating manufacturers, staff was informed that solar modules post-2016 were manufactured with the coating. Therefore, modules installed prior to 2016 would benefit from in-field application of photovoltaic coatings.

Table 2-2
Districts with Solar Facilities and Photovoltaic Coating Potential

Air District	Capacity (MW)	Number of Sites	VOC (Tons)
Antelope Valley AQMD	432	4	34.3
Eastern Kern APCD	182	2	13.5
Imperial Valley APCD	1,021	7	84.3
Mojave Desert AQMD	744	3	42.9
Monterey Bay ARD	169	1	10.0
Sacramento Metro AQMD	98	9	8.0
San Joaquin Valley APCD	373	7	27.9
San Luis Obispo County APCD	715	1	56.2
Santa Barbara APCD	40	1	3.1
Total	**3,774**	**35**	**280.2**

Staff estimates the total VOC emissions from applying Photovoltaic Coatings to the 3,774 MW of solar modules is 280 tons, as identified in Table 2-2. The total emissions are calculated using the capacity, the VOC content, the coverage rate of the coating, and the estimated surface area of the solar modules. Details of the calculations are presented in Appendix C.

The proposed provisions for Photovoltaic Coatings limit the use of the coatings to quantities that will keep the VOC emissions below CEQA thresholds. This does not prevent air districts from choosing a different volume limit, provided the air district conducts its own CEQA analysis and CEQA mitigation as appropriate. Air districts not included in the proposed 2020 SCM may choose to incorporate the proposed 2020 SCM into its local rule as long as the air district conducts its own economic and environmental analyses. Table 2-3 shows the daily volume limits, equivalent MW coated by air district and the corresponding VOC emissions. Equivalent MW coated is the number of megawatts that can be coated per day based on the daily volume limit of each district. The San Joaquin Valley APCD has an annual volume limit in addition to the daily volume limit to limit the annual VOC emissions. Staff assumes coatings are applied 150 days per year. Details of the emissions calculation methodology are provided in Appendix C.

Table 2-3
Proposed Volume Limits and Resulting Emissions by Air District

Air District	Daily Volume Limit (Gallons)	Equivalent MW Coated	Emissions (TPD)
Antelope Valley AQMD	27	0.85	0.068
Eastern Kern APCD	27	0.91	0.068
Imperial Valley APCD	27	0.82	0.068
Mojave Desert AQMD	27	1.17	0.068
Monterey Bay ARD	27	1.14	0.068
Sacramento Metro AQMD	12.5	0.38	0.031
San Joaquin Valley APCD [1]	100	3.35	0.25
San Luis Obispo County APCD	27	0.86	0.068
Santa Barbara APCD	27	0.86	0.068

1. An additional annual volume limit of 3,900 gallons per year is applicable in the San Joaquin Valley APCD., with 54 equivalent MW coated and 9.8 tpy in VOC emissions. Staff assumed 150 coating days to determine equivalent MW coated.

As discussed above, currently the Photovoltaic Coatings would be considered a Low Solids Coating and subject to a 120 g/l VOC limit. The proposed VOC limit of 600 g/l would be a rule relaxation. Requirements of the federal CAA section 110(l) require each district that may potentially adopt the proposed 2020 SCM to show that higher VOC limit would not interfere with attainment or progress towards attainment of the air quality standards. The 110(l) analyses are provided in Appendix D.

To lessen the adverse impacts from the Photovoltaic Coatings category emissions increase, the proposed 2020 SCM includes additional provisions. CARB restricted the availability of the coating by including a sunset date of January 1, 2028. This limits the use of these coatings to less than seven years. In addition, the proposed 2020 SCM includes daily volume limits to restrict the emissions allowed from the category. To ensure these emissions are not exceeded, the proposed 2020 SCM includes notification requirements prior to use of any Photovoltaic Coatings. The proposed 2020 SCM includes these provisions for the Photovoltaic Coatings category to minimize the emission impacts.

The increased emissions from applying the Photovoltaic Coatings is a one-time event for each solar module. However, the increased electricity production from applying the coating will last several years resulting in avoided power plant emissions of criteria pollutants and greenhouse gases. The coatings that meet the definition of Photovoltaic Coatings improve the energy efficiency of the solar modules by approximately three to four percent[1]. The improved efficiency will continue for the remaining life of the solar module, estimated at over 10 years. CARB staff estimates the increased efficiency will

[1] Based on information provided by Pellucere Technologies, Inc. (Pellucere, 2020).

result in avoided power plant emissions for at least 10 years. The emissions benefits from the Photovoltaic Coatings are shown in Table 2-4.

Table 2-4
10 Year Estimate of Emissions Avoided from Power Plants[1]

Energy Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM_{10} (Tons)	$PM_{2.5}$ (Tons)	VOC (Tons)	CO (Tons)
CARB Electricity Mix	554,627	227	13	63	50	38	416

1. It is uncertain to what extent the additional MW generated by the solar facilities coated with the photovoltaic coatings would displace electricity produced in California. If it displaces electricity outside of the state, the criteria pollutant emissions avoided in California would be less.
   - Assumes 3% increase in energy efficiency (Pellucere, 2020);
   - Uses CARB criteria pollutants inventory data and 2017 overall GHG emission factor of 0.22 ton per CO_2e per MWh;
   - Uses CEC solar photovoltaic data to calculate average solar photovoltaic site operation hours of 2,230 hours per year;

C. Summary

To estimate emission impacts of the proposed 2020 SCM update, CARB staff evaluated the available Photovoltaic Coatings designed for in the field application. Staff determined that the lowest achievable VOC level is 600 g/l. For the purposes of estimating emission impacts, it is assumed that all the potential uncoated solar generating capacity would be coated over several years. If fewer than the existing population of uncoated solar modules are ultimately coated, the VOC emissions and the criteria pollutant and greenhouse gas emissions avoided would be less.

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CHAPTER III. PROPOSED SUGGESTED CONTROL MEASURE

A. Introduction

In this chapter, staff provides a discussion of CARB's proposed 2020 SCM for architectural coatings, which is contained in Appendix A. The proposed 2020 SCM is an update to the SCM the Board approved in 2019. Where applicable, staff discusses how the proposed 2020 SCM's provisions differ from those of the 2019 SCM. For reference purposes, the 2019 SCM is contained in Appendix B.

Control of VOC emissions from architectural coatings is primarily the responsibility of the local air pollution control districts and air quality management districts in California, collectively referred to as air districts. The proposed 2020 SCM is not a CARB regulation. It is a model rule that air districts can follow when adopting and amending their local architectural coatings rules. If air districts adopt the provisions in the proposed 2020 SCM, air district personnel are responsible for enforcing those provisions.

The proposed 2020 SCM adds a new stand-alone section for Photovoltaic Coatings. The Photovoltaics Coatings category is a temporary category, which includes a commencement date of July 1, 2020 and a sunset date effective January 1, 2028. Photovoltaic Coatings are new coatings applied to solar modules already installed and in operation. Photovoltaic Coatings are effective in increasing the efficiency of solar modules if the solar module was manufactured without an anti-reflective coating. Solar modules manufactured around 2016 have anti-reflective coatings. There are no benefits from coating solar modules manufactured with anti-reflective coatings. Therefore, there are limited applications for Photovoltaic Coatings and a limited timeframe for applying the coatings is appropriate.

The proposed 2020 SCM establishes a new VOC limit of 600 grams per liter for Photovoltaic Coatings. This VOC limit is expressed in grams of VOC per liter of coating. To establish the limit in the proposed 2020 SCM, CARB staff conducted a detailed assessment of the Photovoltaic Coatings category to determine a limit that is technically feasible and cost-effective. Currently staff is aware of two manufacturers of Photovoltaic Coatings that apply installed uncoated modules. At least one manufacturer will need to reformulate their existing product to replace some of the VOC solvent with water or exempt compounds. Manufacturers may also modify their formulations by increasing the amount of resin and pigment solids contained in the coatings. One manufacturer already has a product that complies with the proposed 600 g/l VOC limit.

B. Proposed Changes

Provided below is a summary of the proposed 2020 SCM. Details of these changes are discussed in this chapter and in Chapter V.

The proposed 2020 SCM adds a new stand-alone section denoted as Section 9 for a new category, Photovoltaic Coatings. The new section includes several subsections

that provide the requirements for Photovoltaic Coatings. Below, staff summarizes the requirements for Photovoltaic Coatings in the proposed 2020 SCM.

1. Exemptions

Architectural coatings sold in small containers (one liter or less) are exempt from the VOC limits and majority of the provisions of the 2019 SCM. However, coatings in small containers are subject to the reporting requirements in Section 7 of the SCM. Manufacturers are required to provide survey data for small containers. CARB staff is proposing language that would remove the small container exemption for Photovoltaic Coatings.

2. Definitions

Staff is proposing to define Photovoltaic Coatings since this is a new coating category.

3. Standards

The proposed 2020 SCM establishes a VOC content limit for Photovoltaic Coatings at 600 g/l, expressed as VOC Actual. The proposed limit would become effective on June 1, 2020.

a. Volume Limits

In addition to VOC Content Limits, the proposed 2020 SCM (see Appendix A) will establish Volume Limits for Photovoltaic Coatings for each local air district. The proposed limits would become effective on July 1, 2020.

Table 3-1
Proposed Coating Volume Limits for Photovoltaic Coatings by Air District[1]

Air District	Daily Volume Limit (Gallons)	Effective Date
Antelope Valley AQMD	27	7/1/2020 to 12/31/2027
Eastern Kern APCD	27	7/1/2020 to 12/31/2027
Imperial County APCD	27	7/1/2020 to 12/31/2027
Mojave Desert AQMD	27	7/1/2020 to 12/31/2027
Monterey Bay ARD	27	7/1/2020 to 12/31/2027
Sacramento Metropolitan AQMD	12.5	7/1/2020 to 12/31/2027
San Joaquin Valley APCD[2]	100	7/1/2020 to 12/31/2027
San Luis Obispo APCD	27	7/1/2020 to 12/31/2027
Santa Barbara County APCD	27	7/1/2020 to 12/31/2027

1. Staff identified solar facilities in the air districts in Table 3-1. Districts not listed in Table 3-1 may still include the photovoltaic coating provisions in their rules, however, they may need to do their own analysis.
2. An additional annual volume limit of 3,900 gallons per year is applicable in the San Joaquin Valley APCD.

b. Most Restrictive VOC Limit

If a coating meets the definition of Photovoltaic Coatings, then that coating is not required to meet the VOC limits in Table 1.

c. Sell-Through of Coatings

Under the proposed 2020 SCM, sell-through for Photovoltaic Coatings is prohibited.

d. Painting Practices

Photovoltaic Coatings must meet the painting practices in Section 5.4 of the proposed 2020 SCM, which is the same as in the 2019 SCM.

e. Thinning

If a user adds thinners or other additives to a Photovoltaic Coating, the coating must still meet the VOC limits in Section 9.3 of 600 g/l, expressed as VOC Actual.

4. Container Labeling Requirements

The proposed 2020 SCM describes labeling requirements and specifies where information should be placed on coating containers. Staff is proposing to add language specific to Photovoltaic Coatings requiring the label to include “applied as a single layer to solar photovoltaic modules.”

5. Sunset Date

The proposed 2020 SCM includes a provision to sunset the Photovoltaic Coatings category on January 1, 2028.

6. Notification Requirements

This section of the proposed 2020 SCM is new and is applicable to Photovoltaic Coatings only. The proposed 2020 SCM includes notification requirements to local Air Districts and to U.S. EPA.

a. Notify Air District

The proposed 2020 SCM includes requirements for the Photovoltaic Coating manufacturer to notify the local air district prior to applying Photovoltaic Coatings. The manufacturer is required to provide an estimate of the emissions from Photovoltaic Coatings, including the calculations used, and an estimate of the materials used in gallons.

b. Notify U.S. EPA

The proposed 2020 SCM also requires the Photovoltaic Coatings manufacturer to notify the U.S. EPA prior to applying Photovoltaic Coatings. The notification shall comply with

the requirements of 40 CFR Part 59 Subpart D, including, but not limited to, 40 CFR 59.403 exceedance fees, 59.407 recordkeeping requirements, and 59.408 reporting requirements.

7. Reporting Requirements

The proposed 2020 SCM includes additional reporting requirements for the new category, Photovoltaic Coatings. Manufacturers of Photovoltaic Coatings shall submit annual reports to the local air districts. These annual reports shall include the source name, location, contact information, ownership status, and description of the business activity. In addition, these annual reports shall identify the period the coatings were applied (including the start date, completion date, and increments of progress), the actual VOC emissions from Photovoltaic Coatings during the reporting period (including the calculations used), and the actual gallons of Photovoltaic Coatings used during the reporting period.

8. Compliance Provisions and Test Methods

The proposed 2020 SCM does not change compliance provisions or test methods.

CHAPTER IV. PROCESS FOR DEVELOPING PROPOSED 2020 SCM

At the May 2019 Board Hearing, the Board directed staff to continue working with industry stakeholders, air districts, and the U.S. EPA to evaluate the feasibility of adding a new coating category in the SCM for coatings intended for use on installed uncoated solar modules. CARB staff initiated this evaluation immediately following the May 2019 Board Hearing. This evaluation included:

- Meeting with industry trade groups and individual manufacturers;
- Meeting with air district representatives;
- Hosting a public workshop;
- Conducting a technology assessment of the coating category;
- Preparing an environmental impact analysis; and
- Preparing an economic analysis.

A. Gather Information on Photovoltaic Coatings

CARB staff had been working with Pellucere Technologies, Inc prior to the May 2019 Board meeting. CARB staff continued working with manufacturers and industry groups immediately following the May 2019 Board Hearing to evaluate the Photovoltaic Coatings category. In this process, staff identified another manufacturer, DSM, that has developed and applied Photovoltaic Coatings in Europe.

Staff held several meetings with industry representatives to gather information on Photovoltaic Coatings.

B. Informal Meetings with Air Districts and Industry

CARB staff and air district personnel established an Air District Working Group to develop the proposed 2020 SCM. As part of the 2020 SCM development process, staff discussed with the Air District Working Group whether to pursue establishing a new category for Photovoltaic Coatings. CARB staff had eight conference calls with this group to discuss items such as the need for a Photovoltaic Coatings category, air district SIP impacts, possible SCM proposals, and specific SCM language. In November 2019, the Air District Working Group and U.S. EPA met with coating industry representatives to discuss a preliminary proposal and potential revisions to the SCM. The group discussed potential revisions to the SCM including revisions of coating category definitions; proposed VOC limits; potential volume limits; and documentation necessary for Section 110(l) of the Clean Air Act (CAA). In order to expedite the approval of district rule amendments, CARB, the U.S. EPA, and local air districts agreed to work together in developing the 2020 SCM to incorporate a Photovoltaic Coatings category.

CARB staff also had meetings and conference calls with coating industry representatives and individual manufacturers about their concerns.

C. Formal Public Meetings

In developing the proposed 2020 SCM, CARB staff hosted one public workshop in Sacramento on February 26, 2020. Participants included representatives from industry (coatings manufacturers, and trade associations); local air districts; and the U.S. EPA. At the workshop, CARB staff presented the proposed modifications to include the Photovoltaic Coatings category, which included draft regulatory language for Photovoltaic Coatings and draft limits for VOC content and annual coating volumes by local air district. CARB staff also made available draft regulatory language for the proposed 2020 SCM. Comments were submitted to CARB from manufacturers, trade associations, and other stakeholders. CARB's staff responses to those comments are contained in Chapter V.

Staff posted draft SCM materials on CARB's website, sent List Serve notices to over 3,200 subscribers to announce the availability of these materials, and sent email notices to all 2014 Survey respondents. Posted items included the workshop announcement, draft 2020 SCM language, and workshop slide presentation. The workshop announcement is contained in Appendix E.

D. Evaluation of Other Architectural Coating Rules

1. U.S. EPA National Architectural Coating Rule

On August 14, 1998, the U.S. EPA promulgated the final version of their National Volatile Organic Compound Emission Standards for Architectural Coatings (National Rule) (U.S. EPA, 1998a). The National Rule took effect on September 13, 1999 and it was adopted in accordance with section 183(e) of the Federal Clean Air Act, which allows U.S. EPA to regulate manufacturers and importers to obtain VOC emission reductions. Section 183(e) does not give U.S. EPA the authority to regulate end users, so the National Rule only applies to manufacturers and importers of architectural coatings (U.S. EPA, 1998a; U.S. EPA,1998b). CARB's SCM applies to a broader range of entities, including manufacturers, distributors, retailers, and users of architectural coatings.

The National Rule, section 59.410, specifically allows states or local governments to adopt more stringent emission limits for architectural coatings. The VOC limits in the 2019 SCM and the proposed 2020 SCM are equal to or more stringent than those in the National Rule. In California, approximately two percent of the population lives in areas that are governed by the National Rule. About 55 percent of the population is subject to air district rules based on the 2007 SCM or the 2000 SCM, and about 43 percent of the population is covered by South Coast AQMD Rule 1113.

The proposed 2020 SCM establishes a VOC limit of 600 g/l for Photovoltaic Coatings. Photovoltaic Coatings would be considered either Flat or Nonflat coatings in the National Rule, depending on the gloss of the coating. The VOC

limit in the National Rule for Flat Coatings: Exterior is 250 g/l and 380 g/l for Nonflat Coatings: Exterior.

The National Rule contains flexibility provisions that are not in the proposed 2020 SCM: (1) an exceedance fee provision; (2) a tonnage exemption; and (3) a recycled coatings compliance option. For compliance with these provisions, manufacturers and importers must keep specified records and submit annual reports to the appropriate regional U.S. EPA office. Any Photovoltaic Coating exceeding the applicable National Rule VOC limit must comply with the exceedance fee provision of the National Rule.

The exceedance fee provision allows manufacturers and importers to comply with the rule by paying a fee, in lieu of meeting the VOC content limits. The tonnage exemption allows manufacturers and importers to sell or distribute limited quantities of architectural coatings that do not comply with the VOC content limits and for which no exceedance fee is paid.

2. South Coast AQMD Rule 1113

On November 8, 1996 and May 14, 1999, the South Coast AQMD revised Rule 1113, their architectural coating regulation (SCAQMD, 1996; 1999). These revisions of Rule 1113 contained interim VOC limits that were largely adopted in the 2000 SCM. Since that time, the South Coast AQMD has revised Rule 1113 in 2001, 2002, 2003, 2004, 2006, 2007, 2011, 2013, and 2016 (SCAQMD, 2001; 2002a; 2003; 2004; 2006b; 2007; 2011; 2013; 2016). While developing the proposed 2020 SCM, SCAQMD staff indicated the district would not incorporate the changes included in the proposed 2020 SCM. The SCAQMD indicated it does not intend to implement the 2020 SCM to address Photovoltaic Coatings at this time.

E. Technology Assessment

To ensure that the proposed 2020 SCM is technologically and commercially feasible, CARB staff conducted a technology assessment for the Photovoltaic Coatings category. Details of this assessments are provided in Chapter V. Some of the sources of information utilized in the technology assessments included: data provided by manufacturers, manufacturers' product data sheets; Internet websites; books and trade magazines; technical reports; test results and specifications; discussions with manufacturers; and information from trade associations. Based on these technical analyses, staff has concluded that the overall performance of the product meeting the proposed VOC limit is similar to the performance of their higher VOC counterpart.

F. Environmental Analysis

Chapter VI discusses the environmental impact analysis CARB staff has prepared for the implementation of the proposed 2020 SCM.

G. Economic Analysis

Chapter VIII discusses the economic impacts CARB staff anticipates from implementation of the proposed 2020 SCM. CARB staff quantified the economic impacts to the extent feasible, but economic impact analyses can be inherently imprecise by nature. Therefore, some projections are necessarily qualitative or semi-quantitative, based on general observations about the architectural coatings industry. The economic impacts analysis for the proposed 2020 SCM provides a general picture of the economic impacts that typical businesses might encounter, but staff recognizes that individual companies may experience impacts different than those projected in this analysis.

The staff evaluation includes a business impacts analysis. The business impacts analysis evaluated the impacts on profitability, employment, and competitiveness to California businesses, consumers, and government agencies.

CHAPTER V. TECHNICAL ASSESSMENT

A. Overview of Technical Assessment

In this chapter, staff provides a discussion of the Photovoltaic Coatings category. This chapter contains a description of Photovoltaic Coatings, and the rationale for establishing a new VOC limit and additional requirements for this category.

For all other coating categories, the VOC limits remain the same as the 2019 SCM and are consistent with the South Coast AQMD's Rule 1113 VOC limits that are currently in effect. To expedite the opportunity to use Photovoltaic Coatings, CARB is proposing an effective date of July 1, 2020 for the proposed 2020 SCM.

The discussions of the proposed new category for Photovoltaic Coatings explain why staff believes that the requirements for Photovoltaic Coatings are technologically and commercially feasible by the proposed effective date. Sources of information for the technology assessments included the following:

- Information from coating manufacturers (brochures, product data sheets, product labels, and safety data sheets);
- Coating formulation and performance data from Internet websites; books and trade magazines; technical reports;
- Industry standards and specifications;
- Meetings with manufacturers;
- Information provided by trade associations;
- Discussions with local air districts;
- Discussions with U.S. EPA; National Rule preamble and Background Information Document (U.S. EPA, 1998a; U.S. EPA, 1998b).

While industry representatives have raised some concerns about the efficacy of the lower VOC product, staff has concluded that the proposed VOC limit is technologically and commercially feasible. Table 5-1 contains the proposed category and applicable VOC limits.

Table 5-1
Proposed VOC Limit

Coating Category	Current VOC Limit (g/l)	Proposed VOC Limit (g/l)
Photovoltaic Coatings*	120	600

* This is a new category. These products are new and did not previously exist. However, due to the structure of the architectural coating rules, it would have fallen under the low solids coating category and been subject to a VOC limit of 120 grams per liter.

The remainder of this chapter provides: a comparison of VOC limits from different architectural coating rules, the proposed category definition, major changes between the 2019 SCM and the proposed 2020 SCM, a description of product uses and formulations, the rationale for the proposed VOC limit, and a discussion of the issues associated with the proposed VOC limit.

B. Photovoltaic Coatings

Under current regulations the applicable VOC limits for Photovoltaic Coatings would be either the limits for the Flat or Nonflat Coatings categories or the Low Solids Coatings category. These limits are shown in Table 5-2.

Table 5-2
VOC Limits for Photovoltaic Coatings (g/l)

U.S. EPA	SCAQMD	SCM[1]
250 (If under Flat: Exterior), 380 (if under Nonflat: Exterior)	50 (Under Nonflat or Flat coatings)	120 (Low Solids)

1. The VOC for Low Solids Coatings is VOC Actual. For Flat or Nonflat the VOC is VOC Regulatory. For a brief discussion of the difference between VOC Actual and VOC Regulatory, please see Appendix C.

1. Category Definition

A coating labeled and formulated for application to solar photovoltaic modules. Photovoltaic Coatings are applied as a single layer to solar photovoltaic modules already installed. Photovoltaic Coatings do not include coatings applied to photovoltaic modules in shop applications

2. Proposed Changes

Photovoltaic Coatings is a new category for coatings that are new to the market and were not available in previous versions of the SCM. In the current SCM and in most district architectural coating rules, these coatings are covered under the Low Solids Coating category. Thus, they would be subject to a VOC limit of 120 g/l. After discussions with the coating manufacturers, staff concluded that Photovoltaic Coatings cannot be formulated at the 120 g/l level. Therefore, the proposed VOC Limit for Photovoltaic Coatings would increase from 120 g/l to 600 g/l.

3. Coating Description

Photovoltaic Coatings are applied to solar modules manufactured without an anti-reflective coating. Photovoltaic Coatings are applied directly to already installed solar modules as a single thin film a couple of hundred nanometers thick-. These coatings have anti-reflective properties which improve the solar modules ability to harness solar energy. This increases the efficiency of solar modules by as much as three to four percent, provided the solar modules were manufactured without an antireflective coating. These coatings are intended for application at utility-scale solar installations. Currently staff does not have indications from manufacturers that these coatings would be applied to residential roof top solar modules.

Photovoltaic Coatings are formulated with relative high levels of VOC in order to achieve the desired film thickness. To achieve the relatively thin film needed for optimal module performance, the coating needs to dry relatively fast. The coating and the application process have been optimized to achieve the desired performance requirements.

Photovoltaic Coatings formulations are alcohol-based silicate that, when dried effectively, creates a thin film of glass on the solar modules.

4. Substrates/Exposures

Photovoltaic Coatings are applied directly to the solar module surface.

5. Market

Photovoltaic Coatings have been applied during the manufacturing process for several years. However, applying Photovoltaic Coatings to solar modules already installed and producing electricity in the field is a new technology. Manufacturers have developed product formulations and application technologies which enable the coatings to be applied to solar modules in the field. These new coatings can be applied in more diverse conditions typical of field conditions than the controlled environmental conditions seen during the manufacturing process in a factory.

There is little experience with Photovoltaic Coatings in California since to date they have been applied in only a few demonstration projects. Less than five megawatts (MW) capacity of uncoated solar modules have been coated with Photovoltaic Coatings in California. Staff analysis indicates there are approximately 3,774 MW of remaining installed solar modules in California that could be coated with Photovoltaic Coatings. These solar modules are not spread across California uniformly. Rather, the solar modules are more concentrated in areas of California with high probability of sunny weather and tend to be located in relatively unpopulated areas.

6. Manufacturer and Industry Issues

Some manufacturers and industry representatives have expressed concerns about establishing a new category for Photovoltaic Coatings as well as concerns about the

proposed 2020 SCM language. Below are key issues that have been brought to staff's attention during interactions with industry representatives.

Roof Coatings Manufacturers Association (RCMA) provided the following comments.

Issue: "We are concerned that the controls put in place are little more than justification to essentially exempt an entire industry in a short term effort."

Response: CARB added additional requirements to minimize the impact from the use of Photovoltaic Coatings. These include daily volume limits, notification requirements, and reporting requirements which are currently not required of the other architectural coatings categories.

Issue: "We are further concerned that in three years when this change is due to sunset that additional extensions will be granted at cost to other industries in an effort to lower total VOC emissions through offset."

Response: CARB does not plan to update the Suggested Control Measure for Architectural Coatings in three years.

Issue: "We find the lack of transparency regarding the solvent identification troubling and request that it be identified."

Response: CARB is unable to provide the formulation data used in the analysis, due to proprietary formulation issues. This is consistent with the treatment of the formulation data provided for all architectural coatings' formulation data.

Issue: "An unintended consequence may be roof warranty concerns where this coating is applied to rooftop mounted solar panels."

Response: Photovoltaic Coatings are intended for commercial solar applications, not residential. Typically, the installations in these settings are ground level and not attached to a roof.

Issue: "We request CARB consider the addition of a thermoplastic product category to mirror OTC."

Response: There are thermoplastic coatings meeting the existing VOC limits. CARB compared the reported performances of the coatings meeting 50 g/l and coatings meeting 550 g/l, the coatings were comparable in all performance metrics.

The American Coatings Association (ACA) provided the following comments.

Issue: "ACA is concerned that the air districts will feel compelled to quickly adopt the new Photovoltaic Coatings category and that the districts will shorten the compliance timeframe that the industry needs to implement all the 2019 SCM changes. The coatings industry needs at least one year from rule adoption to fully implement the 2019 SCM amendments. ACA requests ARB suggest to the districts in a hurry to just adopt the Photovoltaic Coatings category and not the entire 2019 AIM SCM. If these districts do adopt the entire 2019 SCM that ARB suggest they include separate compliance timeframes for the Photovoltaic Coatings category versus other changes, and ensure that the districts provide at least one year implementation from rule adoption for all the additional 2019 SCM changes."

Response: CARB staff recommends the Photovoltaic Coatings SCM have an effective date of July 1, 2020 and the 2019 SCM VOC limits commence on January 1, 2022, as amended on May 23, 2019.

Issue: "There appears to be at least two products currently on the market (600 g/l and 800 g/l). ACA suggests that ARB carefully consider and document the reasons why an 800 g/l limit was not included given technical considerations including coating application; increase in light gathering solar efficiency; self-cleaning, and durability of the products currently on the market."

Response: CARB staff have reviewed the Photovoltaic Coatings and have determined the 600 g/l VOC limit is technologically and commercially feasible.

Issue: "Other than a coating thickness, the Photovoltaic Coatings definition does not include performance standards to the extent found in other specialty coating categories. ACA suggests adding additional performance standards including self-cleaning, increase in light gathering efficiency, or protecting/extending the life of the installation."

Response: There are existing specialty categories that do not include performance standards in the category definition. CARB discussed including performance criteria into the definition with the local air districts and U.S. EPA and determined the performance standards were not necessary for the Photovoltaic Coatings category.

DSM provided the following comments.

Issue: "Amend the VOC content limit from 600 g/l to 800 g/l and reduce the annual volume limit per air district accordingly."

Response: Staff recommends the VOC content limit of 600 g/l. Staff believes the performance of the Photovoltaic Coatings meeting the 600 g/l VOC content limit are comparable to the performance of the Photovoltaic Coatings with a higher VOC content. Additionally, this may result in more solar modules being coated because one potential reformulation option is to increase the solids content which would improve the coverage rate.

Issue: “DSM recommends an extension of the sunset date to January 1, 2029.”

Response: CARB staff recommends a sunset date of January 1, 2028. Staff believes this date provides adequate time to reformulate and apply the Photovoltaic Coatings to the uncoated solar modules.

Pellucere Technologies provided the following comments.

Issue: “In order to accommodate air districts which have eligible solar modules that have not yet been identified, we would propose the following insertion:
If an Air District not identified in the SCM wishes to add this PV Coatings category to its Architectural Coatings rule, it should contact ARB to complete a 110(l) analysis to ensure that the appropriate annual limits are established consistent with the guidance in the SCM.”

Response: Local air districts not identified in the proposed 2020 SCM are able to add the Photovoltaic Coatings category in their local air district rule provided they conduct their own technical analysis, rather than utilizing the technical analysis provided in the proposed 2020 SCM.

Issue: “Ensure PV Coatings Are Applied on the Maximum Number of Solar Panels: First, to ensure the maximum number of qualifying photovoltaic panels actually receive PV Coating application in California, we propose to take steps to minimize the risk that a manufacturer reserves emissions capacity under the proposed rule but then does not apply the coating. A scenario could be seen where one manufacture quickly notifies the relevant parties it plans to apply its product on all qualifying panels in California blocking any competitor. A solution would be to require a company to include in its annual report, under section 9.15.12, the actual solar modules coated as a percentage of modules promised under its Notification Requirements under 9.14. If a company does not complete at least 70% of its modules as promised under section 9.14, it should lose the ability to be the “first in” to apply its product in the specified Air District.

This could be applied in Section 9.15 as follows: ‘9.15.2.7. Description of whether the actual area covered in 9.15.2.6. are at least 70% of what was provided in Notification 9.14.1.6.’ The penalty is simply that an applicant will go to the back of the line in the selected Air District. This could be added as follows: ‘9.14.1.x Suspension of Notification Privileges: If an applicant does not comply with Section 9.15.2.7., the applicant may not submit additional Notifications to the Air District prior to June 1 of the following calendar year.’”

Response: Staff added language in the SCM to address the issue.

7. Conclusion

Staff recommends a 600 g/l VOC limit for Photovoltaic Coatings, effective July 1, 2020. The proposed VOC limit is technologically and commercially feasible by July 1, 2020 based on staff’s review of industry data.

CHAPTER VI. ENVIRONMENTAL ANALYSIS

A. Introduction

The proposed SCM serves as a model rule, and would not be implemented by CARB, nor would it be implemented by any districts unless they choose to do so. As such, the proposed SCM is not a "project" subject to CEQA, as its approval by CARB would not commit any jurisdiction to implementing it. Furthermore, even if the proposed SCM were considered a "project" (which it is not), it would likely qualify for one or more CEQA exemptions, including the Class 8 exemption for actions by regulatory agencies for protection of the environment (See 14 CCR § 15308) and the "general rule" or "common sense" exemption (See 14 CCR 15061(b)(3)). However, as CARB did in the 2000 Program Environmental Impact Report (PEIR) (https://ww2.arb.ca.gov/sites/default/files/2020-04/CARB%202000%20PEIR.pdf), CARB has chosen to analyze the SCM under CEQA in an effort to facilitate use of the SCM by local air districts, essentially providing the districts with a turn-key model rule that has been fully analyzed under CEQA. As stated in the 2000 PEIR, this environmental analysis is "not intended to dictate how a district may use the ARB's SCM Program EIR. It will be up to each district to decide on the best way to comply with CEQA in their particular circumstances. The ARB's SCM Program EIR will simply be available for whatever use the district feels is appropriate." (CARB, 2000).

CARB's regulatory program which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of the California Environmental Quality Act (CEQA) (14 CCR 15251(d)). Public agencies with certified regulatory programs are exempt from certain CEQA requirements, including but not limited to, preparing environmental impact reports, negative declarations, and initial studies. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report to comply with CEQA (17 CCR 60000-60008).

This chapter provides the basis for CARB's determination that, even if the proposed SCM were considered a "project" (which it is not), and even if such a project were not considered exempt from CEQA, no subsequent or supplemental environmental analysis is required for the proposed SCM. A brief explanation of this determination is provided in section D below. This EA serves as a substitute document equivalent to an addendum to the Final Program Environmental Impact Report for the 2000 SCM for Architectural Coatings (2000 PEIR) to explain CARB's determination that no additional environmental analysis is required for the proposed SCM.

B. Prior Environmental Analysis

As noted above, in connection with developing the 2000 SCM for Architectural Coatings, staff prepared the 2000 PEIR, which is incorporated by reference herein (CARB, 2000). The PEIR included an analysis of environmental impacts that could potentially result from the implementation of the 2000 SCM throughout California (excluding the South Coast AQMD). Staff investigated the potential for environmental impacts in six main areas: air quality, water demand and quality, public services, transportation and circulation, solid and hazardous waste, and health hazards. The analysis concluded that implementing the 2000 SCM would have no significant adverse impacts and a net air quality benefit. This section summarizes the analysis from the 2000 PEIR on air quality, wastewater treatment, hazardous waste disposal, and human health.

1. Air Quality Impacts

Adverse air quality impacts are considered significant if the proposed SCM: conflicts with or obstructs implementation of the applicable air quality plan; violates any air quality standard or contributes to an existing or projected air quality violation; exposes sensitive receptors to substantial pollutant concentrations; exposes off-site receptors to significant concentrations of hazardous air pollutants; results in a cumulatively considerable net increase of any criteria pollutant for which the project region is in nonattainment; diminishes an existing air quality rule or future compliance requirement resulting in a significant increase in air pollutants; or creates objectionable odors affecting a substantial number of people.

Staff found in the 2000 PEIR that the adoption and implementation of the SCM on a statewide basis (excluding the South Coast AQMD) would produce long-term VOC emission reductions, and staff concluded that no significant adverse air quality impacts would result from the SCM. During the development of the 2000 SCM, industry had concerns that lowering the VOC content of coatings would result in overall increased VOC emissions due to increased coating thickness, more thinning, topcoats, touch-ups, priming, recoating, substitution with higher VOC coatings, and greater reactivity. Industry claimed that new formulations would result in more coating use, causing an increase in VOC emissions. Industry also claimed that more reactive solvents would be used in the compliant formulations than those used in existing coatings, contributing to increased ozone formation. At the time, staff reviewed their concerns, and found that industry's concerns would not occur and the SCM would achieve significant VOC emission reductions.

Industry also claimed that increased application of acetone-based coatings had the potential to increase objectionable odors. Staff found that this was not accurate, because acetone used as a replacement for other solvents may have fewer odor impacts due to its higher odor threshold in comparison to other solvents used in coatings. The SCM allowed manufacturers sufficient time to reformulate and solve any associated odor problems. It was determined that no significant adverse odor impacts were expected from lowering VOC limits.

No significant adverse air quality impacts were anticipated, therefore, no mitigation measures were necessary.

2. Human Health Hazards

The human health impacts analysis performed in the 2000 PEIR for the 2000 SCM examined the potential increased long-term (carcinogenic and chronic) and short-term (acute) human health impacts associated with the use of various replacement solvents in compliant coating formulations. The analysis concluded that due to the application of compliant coatings, the public and coating applicators would not be exposed to either long-term or short-term health risks due to the application of compliant coatings. Future compliant coatings would contain less hazardous materials, or nonhazardous materials, as compared to solvent-borne coatings, resulting in a net benefit.

Staff also evaluated the use of low- or zero-VOC, two-component, industrial maintenance (IM) systems containing diisocyanate compounds, and the field monitoring data showed that concentrations of diisocyanate compounds emitted during application were below the established health protective thresholds. Furthermore, staff determined the exposure to diisocyanates would be limited since IM systems are typically used for touch-up and exposure and applicators follow sufficient safety equipment and procedures. Thus, no adverse human health impacts were anticipated and no mitigation measures were necessary.

3. Potential Water Resources Impacts

Water resource impacts are divided into two categories: water demand and water quality. In the 2000 PEIR, staff found that the SCM would not have significant impacts on water demand and water quality. The 2000 SCM did not promote the use of coatings formed with hazardous solvents that would create water quality impacts. While some hydrologic regions had insufficient capacity to meet the current and projected water demand, staff determined at the time that the increased water demand associated with implementing the SCM was *de minimis*. Staff also found that the use of exempt solvents that are not considered VOCs and were less toxic than solvents used at that time was expected to result in equivalent or fewer water quality impacts. Manufacturing and cleanup practices associated with waterborne coatings did not change as a result of the 2000 SCM, thus, no additional water quality impacts would result. No significant impacts were expected therefore no mitigation measures were necessary.

4. Hazardous Waste Disposal

The Department of Toxic Substances Control (DTSC) is the lead agency in California for hazardous waste management. DTSC enforces California's Hazardous Waste Control laws, issues permits to hazardous waste facilities, and mitigates contaminated hazardous waste sites. In California, leftover liquid waterborne and solvent-borne coatings are considered a hazardous waste and must be disposed of with a facility that is registered with DTSC. Hazardous materials as defined in 40 CFR 261.20 and

California Title 22 Article 9 (including listed substances, 40 CFR 261.30) are disposed of in Class I landfills.

The solid waste/hazardous waste analysis performed in the PEIR for the 2000 SCM examined increased disposal of compliant coatings due to the possibility of shorter shelf or pot lives or lesser freeze/thaw capabilities. Based on staff's analysis, adverse solid waste/hazardous waste impacts associated with the proposed SCM were determined to be insignificant. Therefore, no mitigation measures were necessary.

5. Other Environmental Impacts

The PEIR for the 2000 SCM determined that there will be no significant adverse impacts to the following environmental resources in California as a result of implementing the SCM:

- Public Services
- Transportation/Circulation
- Land Use and Planning
- Population and Housing
- Geophysical
- Biological Resources
- Energy and Mineral Resources
- Noise
- Aesthetics
- Cultural Resources
- Recreation

C. Proposed Modifications

Please refer to Chapter III for a detailed discussion of the proposed changes to the SCM. The proposed 2020 SCM would establish a new coating category for Photovoltaic Coatings. Currently, the 2019 SCM does not have a defined coating category for Photovoltaic Coatings. The intent of adding Photovoltaic Coatings to the proposed 2020 SCM is to allow the use of this new coating in California. Currently, Photovoltaic Coatings are considered a Low Solids Coating, but the coatings do not meet the Low Solids Coating VOC limit of 120 g/l based on a detailed technical assessment of the coatings' formulations.

The proposed 2020 SCM would add a new stand-alone section for Photovoltaic Coatings. This new category would be temporary, beginning on July 1, 2020, and sunsetting January 1, 2028. The new section establishes a VOC limit of 600 g/l for Photovoltaic Coatings. It also establishes limits on the volume of these coatings that can be used daily. This would help ensure that any applications of Photovoltaic Coatings would not exceed the CEQA thresholds for each air district. The CEQA thresholds and volume limits are shown in Table 6-1. The photovoltaic coating

manufacturer will also be required to notify the local air district prior to applying the Photovoltaic Coating and to provide an annual report of all coatings used.

Table 6-1
Proposed Volume Limits

Air District	CEQA Threshold (tpd)	CEQA Threshold (tpy)	Daily Volume Limit (Gallons)
Antelope Valley AQMD	0.0685	25	27
Eastern Kern APCD	0.0685	25	27
Imperial Valley APCD	0.0685	25	27
Mojave Desert AQMD	0.0685	25	27
Monterey Bay ARD	0.0685	25	27
Sacramento Metro AQMD	0.0325	11.86	12.5
San Joaquin Valley APCD[1]	N/A	10	100
San Luis Obispo County APCD	0.0685	25	27
Santa Barbara APCD	0.0685	25	27

1. An additional annual volume limit of 3,900 gallons per year is applicable in the San Joaquin Valley APCD.

Because implementation of the proposed 2020 SCM by air districts will result in increased VOC emissions relative to what would be allowed absent the proposed limit, CARB staff has analyzed the air quality impacts to show 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 (See Appendix D). Therefore, staff concludes that no changes to compliance response evaluated in the 2000 PEIR would result from these updates.

D. Analysis

1. Legal Standards

When considering modifications to the SCM for which a substitute document equivalent to an PEIR had previously been prepared, CARB looks to Public

Resources Code section 21166 and CEQA Guidelines section 15162 for guidance on the requirements for subsequent or supplemental environmental review.

CEQA Guidelines section 15162 states:

(a) When an PEIR has been certified or a negative declaration adopted for a project, no subsequent PEIR shall be prepared for that project unless the lead agency determines, on the basis of substantial evidence in the light of the whole record, one or more of the following:

(1) Substantial changes are proposed in the project which will require major revisions of the previous PEIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects;

(2) Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous PEIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or

(3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous PEIR was certified as complete or the negative declaration was adopted, shows any of the following:

(A) The project will have one or more significant effects not discussed in the previous PEIR or negative declaration;

(B) Significant effects previously examined will be substantially more severe than shown in the previous PEIR;

(C) Mitigation measures or alternatives previously found not to be feasible would in fact be feasible and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or

(D) Mitigation measures or alternatives which are considerably different from those analyzed in the previous PEIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

If a subsequent or supplemental PEIR or negative declaration is not required, the lead agency may document its decision and supporting evidence in an addendum (14 CCR 15164 (e)). The addendum and lead agency's findings should include a brief explanation, supported by substantial evidence, of the decision not to prepare a subsequent or supplemental PEIR or negative declaration (14 CCR 15164(e)). An

addendum need not be circulated for public review, but must be considered by the lead agency prior to making a decision on the project (14 CCR 15164(c), (d)).

2. Basis for Determination

CARB has determined that the proposed amendments do not involve any changes that result in any new significant adverse environmental impacts or a substantial increase in the severity of the significant adverse impacts previously disclosed in the 2000 PEIR. Furthermore, there are no changes in circumstances or new information that would otherwise warrant any subsequent or supplemental environmental review. The 2000 PEIR adequately addresses the implementation of the SCM as modified by the proposed amendments and no additional environmental analysis is required. The basis for CARB's determination that none of the conditions requiring further environmental review are triggered by the proposed modifications is based on the following analysis.

(1) There are no substantial changes to the SCM previously analyzed in the Environmental Analysis which require major revisions to the Environmental Analysis involving new significant environmental effects or a substantial increase in the severity of previously identified effects.

The proposed 2020 SCM establishes the lowest technically feasible VOC limit for Photovoltaic Coatings. In addition, the proposed 2020 SCM limits the volume of coating used daily to prevent exceedance of CEQA VOC thresholds of each district that may potentially adopt the 2020 SCM. To maintain the volume limits, the proposed 2020 SCM includes requirements for the photovoltaic coating manufacturer to notify the local air district prior to applying Photovoltaic Coatings. The manufacturer will be required to provide an estimate of the emissions from Photovoltaic Coatings, along with the calculations used, and an estimate of the materials used in gallons, to ensure that the daily volume limits are consistent with CEQA VOC thresholds.

CARB staff's 110(l) determinations demonstrate that although each application of Photovoltaic Coating will result in a one-time release of VOC emissions, application of this coating will provide emissions benefits that will last several years. The application of these coatings is a one-time event for each solar module, and the coatings are expected to last 10 to 15 years on the modules, providing a three to four percent increase in the electricity produced relative to the uncoated solar modules. CARB staff determines the increased energy efficiency will result in avoided power plant emissions of criteria pollutants and greenhouse gases for at least 10 years (see Chapter II).

Based on this information, CARB has determined that no significant adverse environmental impacts should occur if air districts adopt the proposed 2020 SCM.

(2) There are no substantial changes with respect to the circumstances under which the SCM is being undertaken which require major revisions to the previous Environmental Analysis involving new significant environmental effects or a substantial increase in the severity of previously identified effects.

There are no substantial changes to the environmental setting or circumstances in which the updates to the SCM are being implemented compared to that analyzed in the 2000 PEIR. As previously stated, the proposed 2020 SCM would add a stand-alone section to the SCM for Photovoltaic Coatings. The provisions are temporary and would be in effect commencing July 1, 2020 and sunsetting January 1, 2028. The proposed 2020 SCM will also limit the volume of coating used to avoid exceeding the CEQA VOC thresholds for each district that may potentially adopt the proposed 2020 SCM. The 110(l) determinations demonstrate that although each application of Photovoltaic Coating will result in a one-time release of VOC emissions, the proposed update to the SCM will provide increased energy efficiency along with avoided power plant emissions of criteria pollutants and greenhouse gases. The solar facilities where these coatings will be used are remotely located, generally away from urban areas and densely populated areas. Therefore, given the daily volume limits and the location where the coatings will be applied, the emissions release from coating applications will not have a significant impact on ozone levels. Based on available information, CARB has determined that no significant adverse environmental impacts should occur if districts adopt the proposed 2020 SCM.

(3) There is no new information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous Environmental Analysis was certified as complete, that changes the conclusions of the Environmental Analysis with regard to impacts, mitigation measures, or alternatives;

The proposed 2020 SCM does not result in any changes to the conclusions found in the 2000 PEIR with regards to impacts, mitigation measures, or alternatives. Although the proposed SCM would result in limited one-time emissions releases, it ensures those increases are small by limiting the volume that can be applied daily. Additionally, as discussed above, application of the coating on solar modules will provide long-term emissions benefits resulting from the increased energy efficiency. The proposed Photovoltaic Coating section is temporary, sunsetting January 1, 2028, and the daily volume limits and notification process ensure CEQA VOC thresholds for each district will not be exceeded. All these components of the proposed 2020 SCM would result in no significant impacts to environmental resources in California, as the 2000 PEIR previously stated. Therefore, the conclusions found in the

2000 PEIR about the compliance responses for the SCM or potential environmental impacts to any resource areas have not changed.

No supplemental or subsequent environmental analysis is required for the proposed updates to the SCM because, as described above, the proposed changes do not result in any new significant environmental impacts or in a substantial increase in the severity of the impacts previously disclosed for the SCM in the 2000 PEIR. Further, there are no changes in circumstances or new information that would otherwise warrant any additional environmental review. For a more detailed discussion regarding these topics, please refer to the PEIR for the 2000 SCM (CARB, 2000). Staff believes that districts can use the information in this chapter and the PEIR from the 2000 SCM to support their environmental impact analyses when they adopt local rules based on the proposed 2020 SCM.

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CHAPTER VII. ENVIRONMENTAL JUSTICE

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Government Code, section 65040.12, subdivision (c)). CARB is committed to making environmental justice an integral part of its activities. The Board approved its Environmental Justice Policies and Actions (Policies) on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of State law (CARB, 2001). These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

The proposed SCM is not expected to result in significant negative impacts in any community. The result of the proposed 2020 SCM would be a one-time increase in VOC emissions, as each solar module will be coated only once. However, because solar facilities are typically in remote locations the potential for significant exposure to the one-time VOC emissions from the application of the Photovoltaic Coatings is relatively low. Furthermore, the emissions exposure potential is limited by the CEQA threshold levels. It is unlikely that increased exposure to VOCs significantly impact California communities, including those with populations of low-income or minority residents

Generally, use of architectural coatings products is fairly uniform across the state, tracking with human population, and their emissions are spread over the course of a day, rather than concentrated at a particular time of day. Photovoltaic Coatings are different in that they would be applied at large solar facilities, which typically are located far from high population centers. The coatings will be applied once to the solar module and are expected to last for 10 to 15 years. The coated solar modules will produce more electricity than if left uncoated. Thus, providing additional electricity that does not have to be produced using conventional fuels, such as natural gas or other hydrocarbon fuels, would result in avoided power plant emissions of greenhouse gases and criteria pollutants. For these reasons, staff believes that the application of Photovoltaic Coatings would benefit all Californians. Staff does not expect any communities, especially those with low-income and minority populations, regardless of location, to be disproportionately impacted by the Board’s approval, and eventual implementation by the air districts, of the proposed 2020 SCM.

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CHAPTER VIII. ECONOMIC IMPACTS

A. Background

This chapter discusses the economic impacts staff anticipates from implementing the proposed 2020 SCM VOC limit for Photovoltaic Coatings. At the time of developing this Staff Report, staff was aware of two Photovoltaic Coatings manufacturers, Pellucere Technologies Inc. and DSM. DSM would have to reformulate their product to meet the proposed 600 g/l limit.

Photovoltaic Coatings are not a typical architectural coating. It will be sold and distributed differently. The manufacturer will sell the coating and the application of the coating as a service to the owners of the uncoated solar modules, rather than manufacture the coating and sell the coating to the consumer through retailers or distributors.

The current limits in architectural coatings regulations that Photovoltaic Coatings could be subject to are unachievable for Photovoltaic Coatings and prevents their use in California. Photovoltaic Coatings were recently developed for application to already installed uncoated solar modules that are just beginning to enter the market. By establishing a new coating category and a higher VOC content limit for Photovoltaic Coatings, the SCM would enable the use of these coatings in California. Therefore, the proposed 2020 SCM does not cause an adverse economic impact. Rather, the proposed 2020 SCM provides an opportunity for manufacturers to sell and use their products in California.

Unfortunately, the VOC limit proposed in the 2020 SCM does not enable one manufacturer to sell and use their existing coating without reformulating to meet the VOC limit. Although these costs are not caused by the 2020 SCM, staff provides an estimate of these costs. These costs are assumed to be similar to the costs incurred by manufacturers of architectural coatings in the 2019 SCM (CARB, 2019).

CARB staff quantified the economic impacts to the extent feasible. However, economic impact analyses can be inherently imprecise by nature. Therefore, some projections are necessarily qualitative or semiquantitative, based on general observations about the architectural coatings industry and Photovoltaic Coatings. The economic impact analysis for the proposed 2020 SCM provides a general picture of the economic impacts that typical businesses and manufacturers of Photovoltaic Coatings might encounter. However, staff recognizes that individual companies may experience impacts differing from those projected in this analysis.

The overall projected impacts are summarized first, followed by a more detailed discussion of specific aspects of the economic impacts in the sections listed below:

- Summary of Economic Impacts
- General Approach
- Annual Cost and Cost Effectiveness
- Impact to Businesses

- Impact to Consumers

It is important to note that staff conducted the economic impacts analysis even though the analysis is not required under the California Administrative Procedure Act (APA) for suggested control measures. The analysis uses methodologies and assumptions like those used to support adoption of the 1998 U.S. EPA National Architectural Coatings Rule (U.S. EPA, 1998a; U.S. EPA, 1998b), the 2011 South Coast AQMD Rule 1113 (SCAQMD, 2011), and CARB's 2019 SCM for Architectural Coatings (CARB, 2019). Moreover, the analysis uses the same methodology adopted by the Board in approving all consumer product rulemakings since 1990 (CARB, 1990; CARB, 1991; CARB, 1997; CARB, 1999; CARB, 2013).

B. Summary of Economic Impacts

Overall, staff believes the one affected business will be able to absorb the costs of meeting the proposed VOC limit and requirements with no significant adverse impacts on their profitability. Profitability impacts were estimated by calculating the decline in the return on owner's equity (ROE). This ROE value encompasses the whole architectural coatings industry. Therefore, staff believes this analysis includes the profitability impact to DSM. Assuming DSM will have to absorb all costs associated with the 2020 SCM, the impact expected to result in an average ROE decline of three percent. This is not considered to be a significant impact on the profitability of affected businesses.

Staff believes the cost to reformulate Photovoltaic Coatings impacted by the SCM is similar to the costs of reformulating other architectural coating categories with similar sales volumes. Staff anticipates the average nonrecurring and raw material costs to reformulate Photovoltaic Coatings will be approximately $16,000 and $74,000, respectively (CARB, 2019). The annual non-raw material cost estimated for other architectural coatings is not applicable to Photovoltaic Coatings because Photovoltaic Coatings are provided as part of a service and do not go to the typical marketing and distribution channels.

Overall, staff expects the proposed 2020 SCM to have no significant impact on employment, business creation, elimination or expansion, or business competitiveness in California. Staff also expects no significant adverse fiscal impacts on any local or State agencies.

In determining the cost-effectiveness to reformulate Photovoltaic Coatings, staff assumed that if DSM decides to reformulate, they would acquire half of the potential market of uncoated solar module capacity. The emissions reduced are assumed to be the difference between the current VOC content of the coating of 800 g/l and the proposed limit of 600 g/l. Staff believes this analysis provides a reasonable representation of the cost-effectiveness to reformulate Photovoltaic Coatings. Staff estimates the proposed 2020 SCM overall cost-effectiveness to be approximately $2 to $3 per pound of VOC reduced. The overall cost-effectiveness for the 2019 SCM was $1.85 per pound of VOC reduced. The 2007 architectural coatings SCM had an

overall cost effectiveness of $1.12 per pound of VOC reduced. In comparison, the cost-effectiveness of CARB consumer product regulations and measures fall within a range of no cost to about $6.90 per pound of VOC reduced (CARB and CAPCOA, 1989; CARB, 1990, 1991, 1997, 1999, 2004, 2007, 2019).

Since Photovoltaic Coatings are provided as part of a service to utility-scale photovoltaic electricity generating facilities, staff believes there will not be any cost passed on to the consumers. Therefore, consumer analysis such as the 2019 SCM does not apply. The Photovoltaic Coatings manufacturer who must reformulate to meet the proposed limit may decide to pass reformulation costs on to the photovoltaic electricity generating facilities.

C. General Approach

1. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall consider the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states. Because the staff's proposal is a SCM rather than an administrative regulation, the business impacts assessment is not required. However, CARB staff conducted the normally required business impacts assessment to provide the Board and air districts a comprehensive evaluation of the potential cost impacts.

Similarly, staff also evaluated the SCM's potential impacts to State and local agencies even though the analysis is not required for a SCM. Normally, State agencies are required to estimate the cost or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance and APA. Staff's estimate shall include any nondiscretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

If the proposal been a regulation, Health and Safety Code section 57005 would have required the CARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year.

2. Methodology

The methodology used in the 2019 SCM Staff Report (CARB, 2019) is applied in the proposed 2020 SCM. The cost-effectiveness is presented to compare the proposal's cost efficiency in reducing a pound of VOC relative to the cost efficiency of other rules and control measures adopted by the air districts and CARB.

In the 2019 SCM Staff Report (CARB, 2019), the business impact analysis employed two scenarios under which all costs incurred to meet the proposal are absorbed by the coating manufacturers, and then by assuming that all costs incurred are passed on to consumers in the form of increased cost of coatings at the retail level. However, since Photovoltaic Coatings are provided/sold as part of a service to apply the coatings to solar modules, staff does not believe there will be an impact to average consumers. A Photovoltaic Coatings manufacturer who must reformulate to meet the proposed VOC limit, may decide to pass reformulation costs on to solar site owners. Staff believes the cost of the coatings is a minor part of the overall cost of having the solar modules coated. Therefore, the cost of reformulation would have a minimal impact on the overall cost of the service provided.

Staff does not expect the proposed VOC limit for Photovoltaic Coatings to impact contractors, raw material suppliers, distributors, and retailers of other architectural coatings. The purpose of the proposed 2020 SCM is to add a new coating category and VOC limit for Photovoltaic Coatings.

D. Annual Costs and Cost-Effectiveness of the Proposed Limit

For a discussion of the methodology for determining annual cost and cost effectiveness refer to Chapter VIII of the 2019 SCM Staff Report. The methodology is explained in detail in Appendix G of the 2019 SCM Staff Report (CARB, 2019).

Table 8-1 shows the estimated range and average annual cost Photovoltaic Coatings manufacturer would incur to reformulate. The table uses analysis in Appendix G of the 2019 SCM Staff Report (CARB, 2019). This includes recurring costs from raw material and non-raw material and annualized nonrecurring costs. Recurring raw material costs is the total category non-compliant gallons multiplied by the cost difference between a compliant and non-compliant product per gallon. It excludes costs from Nonflat Coatings, Nonflat-High Gloss Coatings and Stains. As mentioned above, staff believes these three coating categories do not effectively represent the cost to reformulate Photovoltaic Coatings.

Table 8-1
Total Annual Cost to Reformulate

Range	Annual Recurring Costs (Raw Material) Dollars per Year	Annual Recurring Costs (Non-raw Material) Dollars per Year	Annualized Nonrecurring Cost Dollars per Year	Total Annual Cost per Year
Min	-$315,543	$5,828	$2,744	$235,541
Max	$769,809	$439,030	$419,857	$838,382
Average	$15,737	$89,083	$73,540	$178,359

(CARB, 2019)

The total emissions from the noncompliant product would be 392 tons of VOCs. This assumes the product would be used on half the uncoated solar modules, has a VOC content of 800 g/l, and a coverage rate of 29 milliliters per square meter (DSM, 2020b). The total VOC emissions from a compliant coating for the same amount of solar modules is 140.1 tons, or half the emissions in Table 2-2. Therefore, the emission reductions from reformulating the noncompliant product is 251.9 tons of VOC. To be conservative, staff assumed these reductions would occur over seven years which results in an annual cost effectiveness of $2.48.

E. Economic Impacts on Businesses

1. Potential Impact on California Businesses

Staff's analysis shows that the affected business would be able to absorb the costs of the proposed 2020 SCM with no significant adverse impacts on their profitability. However, the proposed 2020 SCM may impose economic hardship on some businesses with small or no margin of profitability. These businesses, if hard pressed, can seek relief under the variance provision of the local air districts for extensions to their compliance dates. Such extensions may provide sufficient time to minimize the cost impacts to these businesses. Because the proposed updates would not alter significantly the profitability of most businesses, staff does not expect a noticeable change in employment, business creation, elimination or expansion, and business competitiveness in California.

2. Affected Businesses

This portion of the economic impact analysis is based on a comparison of the return on owners' equity (ROE) for affected businesses before and after inclusion of the cost to comply with the proposed requirements utilizing financial data from the industry representative of various company sizes. The data used in this analysis are obtained from Bizminer 2018 and the CARB 2014 Architectural Coatings Survey.

Any business that manufactures or markets Photovoltaic Coatings would potentially be affected by the proposed 2020 SCM. Others that are potentially affected include businesses that supply resins, solvents, other ingredients and equipment to these manufacturers or marketers, or distribute, sell or use Photovoltaic Coatings. However, the focus of this analysis is manufacturers because these businesses would be directly affected by the proposed 2020 SCM. The North American Industry Classification System (NAICS) code 325110 was utilized in this analysis to identify relevant industry data. Architectural Coatings constitute approximately 30-35 percent of the Paints and Coatings Industry represented by NAICS code 325110. All affected categories of coatings are classified under the North American Industry Classification System (NAICS) 325510.

According to the 2014 Survey, 161 companies nationwide manufacture or market architectural coatings in California. For a discussion of the architectural coatings industry please see the staff report for the 2019 SCM (CARB, 2019).

Paints and coatings manufacturers generated about $27.5 billion in national sales in 2016, of which an estimated $1.3 billion was in California (ACA, 2018; U.S. Census, 2018). The majority of the revenue was generated by a few companies; ten of the 161 manufacturers account for 85 percent of the volume, with the remaining 151 companies accounting for the remaining 15 percent (CARB, 2019).

Staff has identified only two manufacturers of Photovoltaic Coatings. One manufacturer would have to reformulate their coating if they choose to offer it in California because it does not meet the proposed 600 g/l limit.

Staff estimated profitability impacts by calculating the decline in the return on owner's equity (ROE). Assuming that coating manufacturers will have to absorb all of the costs associated with the SCM, the proposed 2020 SCM is expected to result in an average ROE decline of three percent is not considered to be a significant impact on the profitability of affected businesses.

F. Potential Impacts on California Consumers

Photovoltaic Coatings are sold to facilities as part of a service to coat the solar modules and not sold by manufacturers for public consumption. Manufacturers have developed product formulations and application technologies which enable the coatings to be applied to preinstalled solar modules in the field. Therefore, staff does not anticipate there being potential impacts to California consumers from the proposed 2020 SCM.

CHAPTER IX. EVALUATION OF REGULATORY ALTERNATIVES

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. While the SCM is not a CARB regulation, staff considered alternatives to the proposed 2020 SCM. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the proposed 2020 SCM.

Alternative One – No Action

A "No Action" alternative would be to forgo approving the proposed updates, making no changes to the SCM, thereby leaving photovoltaic coatings regulated under the Low Solids coatings category. Without establishing a new category with a higher VOC limit, Photovoltaic Coatings could not be used. The "No Action" alternative would require Photovoltaic Coating manufacturers to file a variance with the air districts that contain projects of interest. The no action alternative was rejected because it would be a less efficient approach to achieving emission reductions and it would potentially not achieve emission reductions necessary to attain the State and federal ambient air quality standards. Furthermore, some districts do not have a variance process for area source emissions.

Alternative Two – Propose Higher VOC Limit

A second alternative to the proposed 2020 SCM would be for CARB to propose a higher VOC limit of 800 g/l. CARB staff determined that this alternative would not be as effective based on technical evaluation. Staff concluded that the lower VOC limit of 600 g/l for photovoltaic coatings is achievable and provides comparable performance benefits as the higher VOC Photovoltaic Coating while minimizing the emissions increase.

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CHAPTER X. REFERENCES

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APPENDIX A

PROPOSED 2020 SUGGESTED CONTROL MEASURE FOR ARCHITECTURAL COATINGS

Note: Additions are shown as underline and deletions are shown as strikeout

California Air Resources Board (CARB)
Suggested Control Measure for Architectural Coatings

Sections 1 through 8 have no changes

9. PHOTOVOLTAIC COATINGS

9.1 **Exemptions:** There are no exemptions for Photovoltaic Coatings. The requirements of Section 9 are applicable to all Photovoltaic Coatings regardless of container size.

9.2 **Definition:** A coating labeled and formulated for application to solar photovoltaic modules. Photovoltaic Coatings are applied as a single layer to solar photovoltaic modules already installed. Photovoltaic Coatings do not include coatings applied to photovoltaic modules in shop applications.

9.3 **VOC Content Limits**: Commencing July 1, 2020, no person shall:

9.3.1 manufacture, blend, or repackage for use within the district; or
9.3.2 supply, sell, market, or offer for sale for use within the district; or
9.3.3 solicit for application or apply within the district, any Photovoltaic Coating with a VOC content in excess of 600 g/l. VOC limit expressed as VOC Actual, thinned to the manufacturer's maximum thinning recommendation.

9.4 **Volume Limits**: The volume of gallons of Photovoltaic Coatings are limited by the air district where the coatings will be applied. Table 3 includes the volume limits for Photovoltaic Coatings.

9.5 **Most Restrictive VOC Limit**: If a coating meets the definition in Section 9.2, then that coating is not required to meet the VOC limits in Table 1.

9.6 **Sell-Through Provisions**: Sell-through for Photovoltaic Coatings is prohibited.

9.7 **Painting Practices**: Photovoltaic Coatings must meet the painting practices in Section 5.4.

9.8 **Thinning**: No person who applies or solicits the application of any Photovoltaic Coating shall apply a coating that is thinned to exceed the applicable VOC limit specified in 9.3.

9.9 **Container Labeling Requirements:** Each manufacturer of any Photovoltaic Coating subject to this rule shall display the information listed in subsections 6.1.1 through 6.1.3 on the coating container (or label) in which the coating is sold or distributed. In addition, the label must include "applied as a single layer to solar photovoltaic modules."

9.10 **Sunset Date:** Effective January 1, 2028, the Photovoltaic Coatings category sunsets and the coatings are required to meet the applicable limits in Table 1.

9.11 **Calculation of VOC Content:** For the purpose of determining compliance with the VOC content limits in Section 9.3, the VOC content of a coating shall be determined as defined in subsection 4.67.

9.12 **VOC Content of Coatings:** The VOC content of Photovoltaic Coatings shall be determined as provided in subsection 8.2.

9.13 **Compliance Provisions and Test Methods**: The test methods identified in Section 8.5 shall be used to test coatings subject to the provisions of this rule.

9.14 **Notification Requirements**:

9.14.1 **Notify Air District:** Prior to use of any Photovoltaic Coatings, the Coating Manufacturer shall complete and submit a notification to the local air district. The notification shall include, but not be limited to the following information:

9.14.1.1. Source name, owner name, location, contact and telephone,
9.14.1.2. Agreement with business owner to apply Photovoltaic Coatings.,
9.14.1.3. Description of business activity,
9.14.1.4. Identification of the period the Photovoltaic Coatings will be applied, including an estimate of start date, completion date and increments of progress,
9.14.1.5. An estimate of emissions from Photovoltaic Coatings during the period, including the calculations used, and
9.14.1.6. An estimate of materials used in gallons of Photovoltaic Coatings during the period.

9.14.2 **Notify U.S. EPA:** Any manufacturer or importer of a Photovoltaic Coating used in California shall notify U.S. EPA Region IX of any coating use that exceeded the applicable VOC limit identified in 40 CFR Part 59 Subpart D and shall comply with the requirements of 40 CFR Part 59 Subpart D, including, but not limited to, 40 CFR 59.403 exceedance fees, 59.407 recordkeeping requirements, and 59.408 reporting requirements.

9.15 **Reporting Requirements**:

9.15.1 **Sales Data:** Photovoltaic Coatings are subject to the reporting requirements provided in subsection 7.1 and 7.2.

9.15.2 **Annual Reports:** Anywhere Photovoltaic Coatings are applied to solar photovoltaic modules, the Coating Manufacturer must submit an annual report no later than March 31st to the local air district that includes, at the least:

9.15.2.1. Source name, location, contact and telephone,
9.15.2.2. Ownership status,
9.15.2.3. Description of business activity,

9.15.2.4. Identify the period the coatings were applied, including the start date, completion date and increments of progress,
9.15.2.5. The actual VOC emissions from Photovoltaic Coatings during the reporting period, including the calculations used, and
9.15.2.6. The actual gallons of Photovoltaic Coatings used during the reporting period.

Table 3
COATING VOLUME LIMITS FOR PHOTOVOLTAIC COATINGS

Air District*	Daily Volume Limit (Gallons)	Effective Date
Antelope Valley AQMD	27	7/1/2020 to 12/31/2027
Eastern Kern APCD	27	7/1/2020 to 12/31/2027
Imperial County APCD	27	7/1/2020 to 12/31/2027
Mojave Desert AQMD	27	7/1/2020 to 12/31/2027
Monterey Bay ARD	27	7/1/2020 to 12/31/2027
Sacramento Metropolitan AQMD	12.5	7/1/2020 to 12/31/2027
San Joaquin Valley APCD**	100**	7/1/2020 to 12/31/2027
San Luis Obispo County APCD	27	7/1/2020 to 12/31/2027
Santa Barbara County APCD	27	7/1/2020 to 12/31/2027

*Any air district not listed may incorporate the limits for Photovoltaic Coatings, provided the air district completes its own economic and environmental analyses.
** An additional annual volume limit of 3,900 gallons per year is applicable in the San Joaquin Valley APCD.

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APPENDIX B

2019 SUGGESTED CONTROL MEASURE FOR ARCHITECTURAL COATINGS

California Air Resources Board (CARB)
2019 Suggested Control Measure for Architectural Coatings

1. APPLICABILITY

1.1 Except as provided in subsection 3, this rule is applicable to any person who:

1.1.1 Supplies, sells, markets, or offers for sale any architectural coating for use within the District; or
1.1.2 Manufactures, blends, or repackages any architectural coating for use within the District; or
1.1.3 Applies or solicits the application of any architectural coating within the District.

2. SEVERABILITY

2.1 Each provision of this rule shall be deemed severable, and in the event that any provision of this rule is held to be invalid, the remainder of this rule shall continue in full force and effect.

3. EXEMPTIONS

3.1 This rule does not apply to:

3.1.1 Any architectural coating that is supplied, sold, offered for sale, or manufactured for use outside of the District or for shipment to other manufacturers for reformulation or repackaging.
3.1.2 Any aerosol coating product.

3.2 With the exception of section 7, this rule does not apply to any architectural coating that is sold in a container with a volume of one liter (1.057 quart) or less provided the following requirements are met:

3.2.1 The coating container is not bundled together with other containers of the same specific coating category (listed in Table 1) to be sold as a unit that exceeds one liter (1.057 quart), excluding containers packed together for shipping to a retail outlet, and
3.2.2 The label or any other product literature does not suggest combining multiple containers of the same specific category (listed in Table 1) so that the combination exceeds one liter (1.057 quart).

3.3 Colorant added at the factory or at the worksite is not subject to the VOC limit in Table 2. In addition, containers of colorant sold at the point of sale for use in the field or on a job site are also not subject to the VOC limit in Table 2.

4. DEFINITIONS

4.1 Adhesive: Any chemical substance that is applied for the purpose of bonding two surfaces together other than by mechanical means.

4.2 Aerosol Coating Product: A pressurized coating product containing pigments or resins that dispenses product ingredients by means of a propellant, and is packaged in a disposable container for hand-held application, or for use in specialized equipment for ground traffic/marking applications.

4.3 Aluminum Roof Coating: A coating labeled and formulated exclusively for application to roofs and containing at least 84 grams of elemental aluminum pigment per liter of coating (at least 0.7 pounds per gallon). Pigment content shall be determined in accordance with SCAQMD Method 318-95, incorporated by reference in subsection 8.5.4.

4.4 Appurtenance: Any accessory to a stationary structure coated at the site of installation, whether installed or detached, including, but not limited to: bathroom and kitchen fixtures; cabinets; concrete forms; doors; elevators; fences; hand railings; heating equipment, air conditioning equipment, and other fixed mechanical equipment or stationary tools; lampposts; partitions; pipes and piping systems; rain gutters and downspouts; stairways, fixed ladders, catwalks, and fire escapes; and window screens.

4.5 Architectural Coating: A coating to be applied to stationary structures or their appurtenances at the site of installation, to portable buildings at the site of installation, to pavements, or to curbs. Coatings applied in shop applications or to non-stationary structures such as airplanes, ships, boats, railcars, and automobiles, and adhesives are not considered architectural coatings for the purposes of this rule.

4.6 Basement Specialty Coating: A clear or opaque coating that is labeled and formulated for application to concrete and masonry surfaces to provide a hydrostatic seal for basements and other below-grade surfaces. Basement Specialty Coatings must meet the following criteria:

4.6.1 Coating must be capable of withstanding at least 10 psi of hydrostatic pressure, as determined in accordance with ASTM D7088-17, which is incorporated by reference in subsection 8.5.12; and

4.6.2 Coating must be resistant to mold and mildew growth and must achieve a microbial growth rating of 8 or more, as determined in accordance with ASTM D3273-16 and ASTM D3274-09 (2017), incorporated by reference in subsection 8.5.19.

4.7 Bitumens: Black or brown materials, including, but not limited to, asphalt, tar, pitch, and asphaltite that are soluble in carbon disulfide, consist mainly

of hydrocarbons, and are obtained from natural deposits or as residues from the distillation of crude petroleum or coal.

4.8 Bituminous Roof Coating: A coating which incorporates bitumens that is labeled and formulated exclusively for roofing.

4.9 Bituminous Roof Primer: A primer which incorporates bitumens that is labeled and formulated exclusively for roofing and intended for the purpose of preparing a weathered or aged surface or improving the adhesion of subsequent surfacing components.

4.10 Bond Breaker: A coating labeled and formulated for application between layers of concrete to prevent a freshly poured top layer of concrete from bonding to the layer over which it is poured.

4.11 Building Envelope: The ensemble of exterior and demising partitions of a building that enclose conditioned space.

4.12 Building Envelope Coating: The fluid applied coating applied to the building envelope to provide a continuous barrier to air or vapor leakage through the building envelope that separates conditioned from unconditioned spaces. Building Envelope Coatings are applied to diverse materials including, but not limited to, concrete masonry units (CMU), oriented strand board (OSB), gypsum board, and wood substrates and must meet the following performance criteria:

4.12.1 Air Barriers formulated to have an air permeance not exceeding 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm/ft^2 @ 1.57 psf), [0.02 liters per square meter per second under a pressure differential of 75 Pa (0.02 L/(s m^2) @ 75 Pa)] when tested in accordance with ASTM E2178-13, incorporated by reference in subsection 8.5.23; and/or

4.12.2 Water Resistive Barriers formulated to resist liquid water that has penetrated a cladding system from further intruding into the exterior wall assembly and is classified as follows:

4.12.2.1 Passes water resistance testing accordance to ASTM E331-00 (2016), incorporated by reference in subsection 8.5.24 and

4.12.2.2 Water vapor permeance is classified in accordance with ASTM E96/96M-16, incorporated by reference in subsection 8.5.25.

4.13 Coating: A material applied onto or impregnated into a substrate for protective, decorative, or functional purposes. Such materials include, but are not limited to, paints, varnishes, sealers, and stains.

4.14 Colorant: A concentrated pigment dispersion in water, solvent, and/or binder that is added to an architectural coating after packaging in sale units to produce the desired color.

4.15 Concrete Curing Compound: A coating labeled and formulated for application to freshly poured concrete to perform one or more of the following functions:

4.15.1 Retard the evaporation of water; or
4.15.2 Harden or dustproof the surface of freshly poured concrete.

4.16 Concrete/Masonry Sealer: A clear or opaque coating that is labeled and formulated primarily for application to concrete and masonry surfaces to perform one or more of the following functions:

4.16.1 Prevent penetration of water; or
4.16.2 Provide resistance against abrasion, alkalis, acids, mildew, staining, or ultraviolet light; or
4.16.3 Harden or dustproof the surface of aged or cured concrete.

4.17 Driveway Sealer: A coating labeled and formulated for application to worn asphalt driveway surfaces to perform one or more of the following functions:

4.17.1 Fill cracks; or
4.17.2 Seal the surface to provide protection; or
4.17.3 Restore or preserve the appearance.

4.18 Dry Fog Coating: A coating labeled and formulated only for spray application such that overspray droplets dry before subsequent contact with incidental surfaces in the vicinity of the surface coating activity.

4.19 Exempt Compound: A compound identified as exempt under the definition of Volatile Organic Compound (VOC), subsection 4.64. Exempt compounds content of a coating shall be determined by U.S. EPA Method 24 or South Coast Air Quality Management District (SCAQMD) Method 303-91 (Revised 1996), incorporated by reference in subsection 8.5.8.

4.20 Faux Finishing Coating: A coating labeled and formulated to meet one or more of the following criteria:

4.20.1 A glaze or textured coating used to create artistic effects, including, but not limited to: dirt, suede, old age, smoke damage, and simulated marble and wood grain; or
4.20.2 A decorative coating used to create a metallic, iridescent, or pearlescent appearance that contains at least 48 grams of pearlescent mica pigment or other iridescent pigment per liter of coating as applied (at least 0.4 pounds per gallon); or

4.20.3 A decorative coating used to create a metallic appearance that contains less than 48 grams of elemental metallic pigment per liter of coating as applied (less than 0.4 pounds per gallon), when tested in accordance with SCAQMD Method 318-95, incorporated by reference in subsection 8.5.4; or

4.20.4 A decorative coating used to create a metallic appearance that contains greater than 48 grams of elemental metallic pigment per liter of coating as applied (greater than 0.4 pounds per gallon) and which requires a clear topcoat to prevent the degradation of the finish under normal use conditions. The metallic pigment content shall be determined in accordance with SCAQMD Method 318-95, incorporated by reference in subsection 8.5.4; or

4.20.5 A clear topcoat to seal and protect a Faux Finishing coating that meets the requirements of subsection 4.20.1, 4.20.2, 4.20.3, or 4.20.4. These clear topcoats must be sold and used solely as part of a Faux Finishing coating system, and must be labeled in accordance with subsection 6.1.4.

4.21 Fire-Resistive Coating: A coating labeled and formulated to protect structural integrity by increasing the fire endurance of interior or exterior steel and other structural materials. The Fire Resistive category includes sprayed fire resistive materials and intumescent fire resistive coatings that are used to bring structural materials into compliance with federal, state, and local building code requirements. Fire Resistive coatings shall be tested in accordance with ASTM Designation E119-18ce1, incorporated by reference in subsection 8.5.2. Fire Resistive coatings and testing agencies must be approved by building code officials.

4.22 Fire-Retardant Coating: A coating labeled and formulated to retard ignition and flame spread, that has been fire tested and rated by a testing agency approved by building code officials for use in bringing building and construction materials into compliance with federal, state and local building code requirements. The fire-retardant coating and the testing agency must be approved by building code officials. The fire-retardant coating shall be tested in accordance with ASTM Designation E84-18b, incorporated by reference in subsection 8.5.1.

Effective January 1, 2010, the Fire Retardant coating category is eliminated and coatings with fire retardant properties will be subject to the VOC limit of their primary category (e.g., Flat, Nonflat, etc.).

4.23 Flat Coating: A coating that is not defined under any other definition in this rule and that registers gloss less than 15 on an 85-degree meter or less than 5 on a 60-degree meter according to ASTM Designation D523-14 (2018), incorporated by reference in subsection 8.5.3.

4.24 Floor Coating: An opaque coating that is labeled and formulated for application to flooring, including, but not limited to, decks, porches, steps, garage floors, and other horizontal surfaces which may be subject to foot traffic.

4.25 Form-Release Compound: A coating labeled and formulated for application to a concrete form to prevent the freshly poured concrete from bonding to the form. The form may consist of wood, metal, or some material other than concrete.

4.26 Graphic Arts Coating or Sign Paint: A coating labeled and formulated for hand-application by artists using brush, airbrush, or roller techniques to indoor and outdoor signs (excluding structural components) and murals, including lettering enamels, poster colors, copy blockers, and bulletin enamels.

4.27 High-Temperature Coating: A high performance coating labeled and formulated for application to substrates exposed continuously or intermittently to temperatures above 204˚C (400˚F).

4.28 Industrial Maintenance Coating: A high performance architectural coating, including primers, sealers, undercoaters, intermediate coats, and topcoats formulated for application to substrates, including floors, exposed to one or more of the following extreme environmental conditions listed in subsections 4.28.1 through 4.28.5, and labeled as specified in subsection 6.1.5:

4.28.1 Immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposure of interior surfaces to moisture condensation; or
4.28.2 Acute or chronic exposure to corrosive, caustic or acidic agents, or to chemicals, chemical fumes, or chemical mixtures or solutions; or
4.28.3 Frequent exposure to temperatures above 121˚C (250˚F); or
4.28.4 Frequent heavy abrasion, including mechanical wear and frequent scrubbing with industrial solvents, cleansers, or scouring agents; or
4.28.5 Exterior exposure of metal structures and structural components.

4.29 Interior Stain: A stain labeled and formulated exclusively for use on interior surfaces.

4.30 Intumescent: A material that swells as a result of heat exposure, thus increasing in volume and decreasing in density.

4.31 Low Solids Coating: A coating containing 0.12 kilogram or less of solids per liter (1 pound or less of solids per gallon) of coating material as recommended for application by the manufacturer. The VOC content for

Low Solids Coatings shall be calculated in accordance with subsection 4.65.

4.32 Magnesite Cement Coating: A coating labeled and formulated for application to magnesite cement decking to protect the magnesite cement substrate from erosion by water.

4.33 Manufacturer's Maximum Thinning Recommendation: The maximum recommendation for thinning that is indicated on the label or lid of the coating container.

4.34 Market: To facilitate sales through third party vendors including, but not limited to, catalog or ecommerce sales that bring together buyers and sellers. For the purposes of this rule, market does not mean to generally promote or advertise coatings.

4.35 Mastic Texture Coating: A coating labeled and formulated to cover holes and minor cracks and to conceal surface irregularities, and is applied in a single coat of at least 10 mils (at least 0.010 inch) dry film thickness.

4.36 Medium Density Fiberboard (MDF): A composite wood product, panel, molding, or other building material composed of cellulosic fibers (usually wood) made by dry forming and pressing of a resinated fiber mat.

4.37 Metallic Pigmented Coating: A coating that is labeled and formulated to provide a metallic appearance. Metallic Pigmented coatings must contain at least 48 grams of elemental metallic pigment (excluding zinc) per liter of coating as applied (at least 0.4 pounds per gallon), when tested in accordance with SCAQMD Method 318-95, incorporated by reference in subsection 8.5.4. The Metallic Pigmented Coating category does not include coatings applied to roofs or Zinc-Rich Primers.

4.38 Multi-Color Coating: A coating that is packaged in a single container and that is labeled and formulated to exhibit more than one color when applied in a single coat.

4.39 Nonflat Coating: A coating that is not defined under any other definition in this rule and that registers a gloss of 15 or greater on an 85-degree meter and 5 or greater on a 60-degree meter according to ASTM Designation D523-14 (2018), incorporated by reference in subsection 8.5.3.

4.40 Particleboard: A composite wood product panel, molding, or other building material composed of cellulosic material (usually wood) in the form of discrete particles, as distinguished from fibers, flakes, or strands, which are pressed together with resin.

4.41 Pearlescent: Exhibiting various colors depending on the angles of illumination and viewing, as observed in mother-of-pearl.

4.42 Plywood: A panel product consisting of layers of wood veneers or composite core pressed together with resin. Plywood includes panel products made by either hot or cold pressing (with resin) veneers to a platform.

4.43 Post-Consumer Coating: Finished coatings generated by a business or consumer that have served their intended end uses, and are recovered from or otherwise diverted from the waste stream for the purpose of recycling.

4.44 Pre-Treatment Wash Primer: A primer that contains a minimum of 0.5 percent acid, by weight, when tested in accordance with ASTM Designation D1613-17, incorporated by reference in subsection 8.5.5, that is labeled and formulated for application directly to bare metal surfaces to provide corrosion resistance and to promote adhesion of subsequent topcoats.

4.45 Primer, Sealer, and Undercoater: A coating labeled and formulated for one or more of the following purposes:

- 4.45.1 To provide a firm bond between the substrate and the subsequent coatings; or
- 4.45.2 To prevent subsequent coatings from being absorbed by the substrate; or
- 4.45.3 To prevent harm to subsequent coatings by materials in the substrate; or
- 4.45.4 To provide a smooth surface for the subsequent application of coatings; or
- 4.45.5 To provide a clear finish coat to seal the substrate; or
- 4.45.6 To block materials from penetrating into or leaching out of a substrate.

4.46 Reactive Penetrating Sealer: A clear or pigmented coating that is labeled and formulated for application to above-grade concrete and masonry substrates to provide protection from water and waterborne contaminants, including, but not limited to, alkalis, acids, and salts. Reactive Penetrating Sealers must penetrate into concrete and masonry substrates and chemically react to form covalent bonds with naturally occurring minerals in the substrate. Reactive Penetrating Sealers line the pores of concrete and masonry substrates with a hydrophobic coating, but do not form a surface film. Reactive Penetrating Sealers must meet all of the following criteria:

4.46.1 The Reactive Penetrating Sealer must improve water repellency at least 80 percent after application on a concrete or masonry substrate. This performance must be verified on standardized test specimens, in accordance with one or more of the following standards, incorporated by reference in subsection 8.5.19: ASTM C67/C67M-18, or ASTM C97/97M-18, or ASTM C140/C140M-18a; and

4.46.2 The Reactive Penetrating Sealer must provide a breathable waterproof barrier for concrete or masonry surfaces that does not prevent or substantially retard water vapor transmission. This performance must be verified on standardized test specimens, in accordance with ASTM E96/96M-16 or ASTM D6490-99 (2014), incorporated by reference in subsection 8.5.20; and

4.46.3 Products labeled and formulated for vehicular traffic surface chloride screening applications must meet the performance criteria listed in the National Cooperative Highway Research Report 244 (1981), incorporated by reference in subsection 8.5.21.

Reactive Penetrating Sealers must be labeled in accordance with subsection 6.1.8.

4.47 Recycled Coating: An architectural coating formulated such that it contains a minimum of 50% by volume post-consumer coating, with a maximum of 50% by volume secondary industrial materials or virgin materials.

4.48 Residential: Areas where people reside or lodge, including, but not limited to, single and multiple family dwellings, condominiums, mobile homes, apartment complexes, motels, and hotels.

4.49 Roof Coating: A non-bituminous coating labeled and formulated for application to roofs for the primary purpose of preventing water penetration, reflecting ultraviolet light, or reflecting solar radiation.

4.50 Rust Preventative Coating: A coating formulated to prevent the corrosion of metal surfaces for one or more of the following applications:

4.50.1 Direct-to-metal coating; or

4.50.2 Coating intended for application over rusty, previously coated surfaces.

The Rust Preventative category does not include the following:

4.50.3 Coatings that are required to be applied as a topcoat over a primer; or

4.50.4 Coatings that are intended for use on wood or any other non-metallic surface.

Rust Preventative coatings are for metal substrates only and must be labeled as such, in accordance with the labeling requirements in subsection 6.1.6.

4.51 Secondary Industrial Materials: Products or by-products of the paint manufacturing process that are of known composition and have economic value but can no longer be used for their intended purpose.

4.52 Semitransparent Coating: A coating that contains binders and colored pigments and is formulated to change the color of the surface, but not conceal the grain pattern or texture.

4.53 Shellac: A clear or opaque coating formulated solely with the resinous secretions of the lac beetle (*Laciffer lacca*), and formulated to dry by evaporation without a chemical reaction.

4.54 Shop Application: Application of a coating to a product or a component of a product in or on the premises of a factory or a shop as part of a manufacturing, production, or repairing process (e.g., original equipment manufacturing coatings).

4.55 Solicit: To require for use or to specify, by written or oral contract.

4.56 Specialty Primer, Sealer, and Undercoater: A coating that is formulated for application to a substrate to block water-soluble stains resulting from: fire damage; smoke damage; or water damage.

Specialty Primers, Sealers, and Undercoaters must be labeled in accordance with subsection 6.1.7.

4.57 Stain: A semitransparent or opaque coating labeled and formulated to change the color of a surface but not conceal the grain pattern or texture.

4.58 Stone Consolidant: A coating that is labeled and formulated for application to stone substrates to repair historical structures that have been damaged by weathering or other decay mechanisms. Stone Consolidants must penetrate into stone substrates to create bonds between particles and consolidate deteriorated material. Stone Consolidants must be specified and used in accordance with ASTM E2167-01 (2008), incorporated by reference in subsection 8.5.22.

Stone Consolidants are for professional use only and must be labeled as such, in accordance with the labeling requirements in subsection 6.1.9.

4.59 Swimming Pool Coating: A coating labeled and formulated to coat the interior of swimming pools and to resist swimming pool chemicals. Swimming pool coatings include coatings used for swimming pool repair and maintenance.

4.60 Tile and Stone Sealers: A clear or pigmented sealer that is used for sealing tile, stone or grout to provide resistance against water, alkalis, acids, ultraviolet light or straining and which meet one of the following subcategories:

4.60.1 Penetrating sealers are polymer solutions that cross-link in the substrate and must meet the following criteria:

4.60.1.1 A fine particle structure to penetrate dense tile such as porcelain with absorption as low as 0.10 percent per ASTM C373-18, ASTM C97/97M-18, or ASTM C642-13, incorporated by reference in subsection 8.5.26,

4.60.1.2 Retain or increase static coefficient of friction per ANSI A137.1 (2012), incorporated by reference in subsection 8.5.27,

4.60.1.3 Not create a topical surface film on the tile or stone, and

4.60.1.4 Allow vapor transmission per ASTM E96/96M-16, incorporated by subsection 8.5.28.

4.60.2 Film forming sealers which leave a protective film on the surface.

4.61 Tint Base: An architectural coating to which colorant is added after packaging in sale units to produce a desired color.

4.62 Traffic Marking Coating: A coating labeled and formulated for marking and striping streets, highways, or other traffic surfaces, including, but not limited to, curbs, berms, driveways, parking lots, sidewalks, and airport runways. This coating category also includes Methacrylate Multicomponent Coatings used as traffic marking coatings. The VOC content of Methacrylate Multicomponent Coatings used as traffic marking coatings shall be analyzed by the procedures in 40 CFR Part 59, Subpart D, Appendix A, incorporated by reference in subsection 8.5.11.

4.63 Tub and Tile Refinish Coating: A clear or opaque coating that is labeled and formulated exclusively for refinishing the surface of a bathtub, shower, sink, or countertop. Tub and Tile Refinish coatings must meet all of the following criteria:

4.63.1 The coating must have a scratch hardness of 3H or harder and a gouge hardness of 4H or harder. This must be determined on bonderite 1000, in accordance with ASTM D3363-05 (2011)e2, incorporated by reference in subsection 8.5.14.; and

4.63.2 The coating must have a weight loss of 20 milligrams or less after 1000 cycles. This must be determined with CS-17 wheels on bonderite 1000, in accordance with ASTM D4060-14, incorporated by reference in subsection 8.5.15; and

4.63.3 The coating must withstand 1000 hours or more of exposure with few or no #8 blisters. This must be determined on unscribed bonderite, in accordance with ASTM D4585-99, and

ASTM D714-02 (2017), incorporated by reference in subsection 8.5.16; and

4.63.4 The coating must have an adhesion rating of 4B or better after 24 hours of recovery. This must be determined on unscribed bonderite, in accordance with ASTM D4585-/D4585M-18 and ASTM D3359-17, incorporated by reference in subsection 8.5.13.

4.64 Veneer: Thin sheets of wood peeled or sliced from logs for use in the manufacture of wood products such as plywood, laminated veneer lumber, or other products.

4.65 Virgin Materials: Materials that contain no post-consumer coatings or secondary industrial materials.

4.66 Volatile Organic Compound (VOC): Any volatile compound containing at least one atom of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, and excluding the following:

4.66.1 methane;
methylene chloride (dichloromethane);
1,1,1-trichloroethane (methyl chloroform);
trichlorofluoromethane (CFC-11);
dichlorodifluoromethane (CFC-12);
1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113);
1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC-114);
chloropentafluoroethane (CFC-115);
chlorodifluoromethane (HCFC-22);
1,1,1-trifluoro-2,2-dichloroethane (HCFC-123);
2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124);
1,1-dichloro-1-fluoroethane (HCFC-141b);
1-chloro-1,1-difluoroethane (HCFC-142b);
trifluoromethane (HFC-23);
pentafluoroethane (HFC-125);
1,1,2,2-tetrafluoroethane (HFC-134);
1,1,1,2-tetrafluoroethane (HFC-134a);
1,1,1-trifluoroethane (HFC-143a);
1,1-difluoroethane (HFC-152a);
cyclic, branched, or linear completely methylated siloxanes;
the following classes of perfluorocarbons:
4.66.1.1 cyclic, branched, or linear, completely fluorinated alkanes;
4.66.1.2 cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;
4.66.1.3 cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and
4.66.1.4 sulfur-containing perfluorocarbons with no unsaturations and with the sulfur bonds only to carbon and fluorine; and

4.66.2 the following low-reactive organic compounds which have been exempted by the U.S. EPA:
acetone;
ethane;
parachlorobenzotrifluoride (1-chloro-4-trifluoromethyl benzene);
perchloroethylene; and
methyl acetate.

4.67 VOC Actual: VOC Actual is the weight of VOC per volume of coating or colorant and it is calculated with the following equation:

$$\text{VOC Actual} = \frac{(Ws - Ww - Wec)}{(Vm)}$$

Where:

VOC Actual = the grams of VOC per liter of coating or colorant (also known as "Material VOC")
W_s = weight of volatiles, in grams
W_w = weight of water, in grams
W_{ec} = weight of exempt compounds, in grams
V_m = volume of coating or colorant, in liters

4.68 VOC Content: The weight of VOC per volume of coating or colorant. VOC Content is VOC Regulatory, as defined in subsection 4.69, for all coatings or colorants except those in the Low Solids category. For coatings or colorants in the Low Solids category, the VOC Content is VOC Actual, as defined in subsection 4.67. If the coating is a multi-component product, the VOC content is VOC Regulatory as mixed or catalyzed. If the coating contains silanes, siloxanes, or other ingredients that generate ethanol or other VOCs during the curing process, the VOC content must include the VOCs emitted during curing.

4.69 VOC Regulatory: VOC Regulatory is the weight of VOC per volume of coating or colorant, less the volume of water and exempt compounds. It is calculated with the following equation:

$$\text{VOC Regulatory} = \frac{(Ws - Ww - Wec)}{(Vm - Vw - Vec)}$$

Where:

VOC Regulatory = grams of VOC per liter of coating or colorant, less water and exempt compounds (also known as "Coating VOC")
W_s = weight of volatiles, in grams
W_w = weight of water, in grams
W_{ec} = weight of exempt compounds, in grams

V_m = volume of coating or colorant, in liters
V_w = volume of water, in liters
V_{ec} = volume of exempt compounds, in liters

4.70 Waterproofing Membrane: A clear or opaque coating that is labeled and formulated for application to concrete and masonry surfaces to provide a seamless waterproofing membrane that prevents any penetration of liquid water into the substrate. Waterproofing Membranes are intended for the following waterproofing applications: below-grade surfaces, between concrete slabs, inside tunnels, inside concrete planters, and under flooring materials. Waterproofing Membranes must meet the following criteria:

4.70.1 Coating must be applied in a single coat of at least 25 mils (at least 0.025 inch) dry film thickness; and
4.70.2 Coatings must meet or exceed the requirements contained in ASTM C836/C836M-18, incorporated by reference in subsection 8.5.17.

The Waterproofing Membrane category does not include topcoats that are included in the Concrete/Masonry Sealer category (e.g., parking deck topcoats, pedestrian deck topcoats, etc.).

4.71 Wood Coatings: Coatings labeled and formulated for application to wood substrates only. The Wood Coatings category includes the following clear and semitransparent coatings: lacquers; varnishes; sanding sealers; penetrating oils; clear stains; wood conditioners used as undercoats; and wood sealers used as topcoats. The Wood Coatings category also includes the following opaque wood coatings: opaque lacquers; opaque sanding sealers; and opaque lacquer undercoaters. The Wood Coatings category does not include the following: clear sealers that are labeled and formulated for use on concrete/masonry surfaces; or coatings intended for substrates other than wood.

Wood Coatings must be labeled “For Wood Substrates Only”, in accordance with subsection 6.1.10.

4.72 Wood Preservative: A coating labeled and formulated to protect exposed wood from decay or insect attack, that is registered with both the U.S. EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (7 United States Code (U.S.C.) Section 136, *et seq.*) and with the California Department of Pesticide Regulation.

4.73 Wood Substrate: A substrate made of wood, particleboard, plywood, medium density fiberboard, rattan, wicker, bamboo, or composite products with exposed wood grain. Wood Products do not include items comprised of simulated wood.

4.74 Zinc-Rich Primer: A coating that meets all of the following specifications:

4.74.1 Coating contains at least 65 percent metallic zinc powder or zinc dust by weight of total solids; and
4.74.2 Coating is formulated for application to metal substrates to provide a firm bond between the substrate and subsequent applications of coatings; and
4.74.3 Coating is intended for professional use only and is labeled as such, in accordance with the labeling requirements in subsection 6.1.11.

5. STANDARDS

5.1 **VOC Content Limits:** Except as provided in subsections 5.2 or 5.3, no person shall:

5.1.1 manufacture, blend, or repackage for use within the district; or
5.1.2 supply, sell, market, or offer for sale for use within the district; or
5.1.3 solicit for application or apply within the district, any architectural coating with a VOC content in excess of the corresponding limit specified in Table 1, after the specified effective date in Table 1. Limits are expressed as VOC Regulatory, thinned to the manufacturer's maximum thinning recommendation, excluding any colorant added to tint bases.

5.2 **Most Restrictive VOC Limit:** If a coating meets the definition in Section 4 for one or more specialty coating categories that are listed in Table 1, then that coating is not required to meet the VOC limits for Flat or Nonflat, but is required to meet the VOC limit for the applicable specialty coating listed in Table 1.

With the exception of the specialty coating categories specified in subsections 5.2.1 through 5.2.12, if a coating is recommended for use in more than one of the specialty coating categories listed in Table 1, the most restrictive (or lowest) VOC content limit shall apply. This requirement applies to: usage recommendations that appear anywhere on the coating container, anywhere on any label or sticker affixed to the container, or in any sales, advertising, or technical literature supplied by a manufacturer or anyone acting on their behalf.

5.2.1 Metallic pigmented coatings.
5.2.2 Shellacs.
5.2.3 Pretreatment wash primers.
5.2.4 Industrial maintenance coatings.
5.2.5 Low-solids coatings.
5.2.6 Wood preservatives.
5.2.7 High temperature coatings.

5.2.8 Bituminous roof primers.
5.2.9 Specialty primers, sealers, and undercoaters.
5.2.10 Aluminum roof coatings.
5.2.11 Zinc-rich primers.
5.2.12 Wood Coatings.

5.3 **Sell-Through Provisions:** Coatings or colorants manufactured prior to the applicable effective date specified in Table 1 or Table 2 must meet the following:

5.3.1 A coating manufactured prior to the effective date specified for that coating in Table 1 may be sold, supplied, or offered for sale for up to three years after the specified effective date. In addition, a coating manufactured before the effective date specified for that coating in Table 1 may be applied at any time, both before and after the specified effective date, so long as the coating complied with the standards in effect at the time the coating was manufactured. This subsection 5.3.1 does not apply to any coating that does not display the date or date-code required by subsection 6.1.1.

5.3.2 A colorant manufactured prior to the effective date specified for that colorant in Table 2 may be sold, supplied, or offered for sale for up to three years after the specified effective date. In addition, a colorant manufactured before the effective date specified for that colorant in Table 2 may be applied at any time, both before and after the specified effective date, so long as the colorant complied with the standards in effect at the time the colorant was manufactured. This subsection 5.3.2 does not apply to any colorant that does not display the date or date-code required by subsection 6.2.1.

5.4 **Painting Practices:** All architectural coating containers used to apply the contents therein to a surface directly from the container by pouring, siphoning, brushing, rolling, padding, ragging or other means, shall be closed when not in use. These architectural coating containers include, but are not limited to, drums, buckets, cans, pails, trays or other application containers. Containers of any VOC-containing materials used for thinning and cleanup shall also be closed when not in use.

5.5 **Thinning:** No person who applies or solicits the application of any architectural coating shall apply a coating that is thinned to exceed the applicable VOC limit specified in Table 1.

5.6 **Coatings Not Listed in Table 1:** For any coating that does not meet any of the definitions for the specialty coating categories listed in Table 1, the VOC content limit shall be determined by classifying the coating as a Flat or Nonflat coating, based on its gloss, as defined in subsections 4.23 and

4.39 and the corresponding Flat or Nonflat VOC limit in Table 1 shall apply.

5.7 **Colorants:** No person within the District shall, at the point of sale of any architectural coating subject to subsection 5.1, add to such coating any colorant that contains VOC in excess of the corresponding applicable VOC limit specified in Table 2. The point of sale includes retail outlets that add colorant to a coating container to obtain a specific color.

6. CONTAINER LABELING REQUIREMENTS

6.1 Each manufacturer of any architectural coating subject to this rule shall display the information listed in subsections 6.1.1 through 6.1.11 on the coating container (or label) in which the coating is sold or distributed.

6.1.1 **Date Code:** The date the coating was manufactured, or a date code representing the date, shall be indicated on the label, lid, or bottom of the container. If the manufacturer uses a date code for any coating, the manufacturer shall file an explanation of each code with the Executive Officer.

6.1.2 **Thinning Recommendations:** A statement of the manufacturer's recommendation regarding thinning of the coating shall be indicated on the label or lid of the container. This requirement does not apply to the thinning of architectural coatings with water. If thinning of the coating prior to use is not necessary, the recommendation must specify that the coating is to be applied without thinning.

6.1.3 **VOC Content:** Each container of any coating subject to this rule shall display one of the following values in grams of VOC per liter of coating:

6.1.3.1 Maximum VOC Content as determined from all potential product formulations; or
6.1.3.2 VOC Content as determined from actual formulation data; or
6.1.3.3 VOC Content as determined using the test methods in subsection 8.2.

If the manufacturer does not recommend thinning, the container must display the VOC Content, as supplied. If the manufacturer recommends thinning, the container must display the VOC Content, including the maximum amount of thinning solvent recommended by the manufacturer. If the coating is a multi-component product, the container must display the VOC content as mixed or catalyzed. If the coating contains silanes, siloxanes, or other ingredients that generate ethanol or other VOCs during the curing process, the

VOC content must include the VOCs emitted during curing. VOC Content shall be determined as defined in subsections 4.67, 4.68, and 4.69.

6.1.4 **Faux Finishing Coatings:** The labels of all Faux Finishing coatings shall prominently display the statement “This product can only be sold or used as part of a Faux Finishing coating system”.

6.1.5 **Industrial Maintenance Coatings:** The labels of all Industrial Maintenance coatings shall prominently display the statement “For industrial use only” or “For professional use only”.

6.1.6 **Rust Preventative Coatings:** The labels of all rust preventative coatings shall prominently display the statement “For Metal Substrates Only.”

6.1.7 **Specialty Primers, Sealers, and Undercoaters:** The labels of all specialty primers, sealers, and undercoaters shall prominently display the statement “Specialty Primer, Sealer, Undercoater.”

6.1.8 **Reactive Penetrating Sealers:** The labels of all Reactive Penetrating Sealers shall prominently display the statement “Reactive Penetrating Sealer”.

6.1.9 **Stone Consolidants:** The labels of all Stone Consolidants shall prominently display the statement “Stone Consolidant - For Professional Use Only”.

6.1.10 **Wood Coatings:** The labels of all Wood Coatings shall prominently display the statement “For Wood Substrates Only”.

6.1.11 **Zinc Rich Primers**: The labels of all Zinc Rich Primers shall prominently display the statement “For Professional Use Only”.

6.2 Effective January 1, 2022, each manufacturer of any colorant subject to this rule shall display the information listed in subsections 6.2.1 and 6.2.2 on the container (or label) in which the colorant is sold or distributed.

6.2.1 **Date Code**: The date the colorant was manufactured, or a date code representing the date, shall be indicated on the label, lid, or bottom of the container. If the manufacturer uses a date code for any colorant, the manufacturer shall file an explanation of each code with the Executive Officer.

6.2.2 **VOC Content:** Each container of any colorant subject to this rule shall display one of the following values in grams of VOC per liter of colorant:

6.2.2.1 Maximum VOC Content as determined from all potential product formulations; or
6.2.2.2 VOC Content as determined from actual formulation data; or
6.2.2.3 VOC Content as determined using the test methods in subsection 8.2.

If the colorant contains silanes, siloxanes, or other ingredients that generate ethanol or other VOCs during the curing process, the VOC content must include the VOCs emitted during curing. VOC Content shall be determined as defined in subsections 4.67, 4.68, and 4.69.

7. REPORTING REQUIREMENTS

7.1 **Sales Data:** A responsible official from each manufacturer shall upon request of the Executive Officer of the ARB, or his or her delegate, provide data concerning the distribution and sales of architectural coatings. The responsible official shall within 180 days provide information, including, but not limited to:

7.1.1 the name and mailing address of the manufacturer;
7.1.2 the name, address and telephone number of a contact person;
7.1.3 the name of the coating product as it appears on the label and the applicable coating category;
7.1.4 whether the product is marketed for interior or exterior use or both;
7.1.5 the number of gallons sold in California in containers greater than one liter (1.057 quart) and equal to or less than one liter (1.057 quart);
7.1.6 the VOC Actual content and VOC Regulatory content in grams per liter. If thinning is recommended, list the VOC Actual content and VOC Regulatory content after maximum recommended thinning. If containers less than one liter have a different VOC content than containers greater than one liter, list separately. If the coating is a multi-component product, provide the VOC content as mixed or catalyzed;
7.1.7 the names and CAS numbers of the VOC constituents in the product;
7.1.8 the names and CAS numbers of any compounds in the product specifically exempted from the VOC definition, as listed in subsection 4.66.1 or 4.66.2;
7.1.9 whether the product is marketed as solventborne, waterborne, or 100% solids;
7.1.10 description of resin or binder in the product;
7.1.11 whether the coating is a single-component or multi-component product;
7.1.12 the density of the product in pounds per gallon;

7.1.13 the percent by weight of: solids, all volatile materials, water, and any compounds in the product specifically exempted from the VOC definition, as listed in subsection 4.66.1 or 4.66.2; and

7.1.14 the percent by volume of: solids, water, and any compounds in the product specifically exempted from the VOC definition, as listed in subsection 4.66.1 or 4.66.2.

7.2 All sales data listed in subsections 7.1.1 to 7.1.14 shall be maintained by the responsible official for a minimum of three years. Sales data submitted by the responsible official to the Executive Officer of the ARB may be claimed as confidential, and such information shall be handled in accordance with the procedures specified in Title 17, California Code of Regulations Sections 91000-91022.

8. COMPLIANCE PROVISIONS AND TEST METHODS

8.1 **Calculation of VOC Content:** For the purpose of determining compliance with the VOC content limits in Table 1 or Table 2, the VOC content of a coating or colorant shall be determined as defined in subsection 4.67, 4.68, or 4.69. The VOC content of a tint base shall be determined without colorant that is added after the tint base is manufactured. If the manufacturer does not recommend thinning, the VOC Content must be calculated for the product as supplied. If the manufacturer recommends thinning, the VOC Content must be calculated including the maximum amount of thinning solvent recommended by the manufacturer. If the coating is a multi-component product, the VOC content must be calculated as mixed or catalyzed. If the coating contains silanes, siloxanes, or other ingredients that generate ethanol or other VOCs during the curing process, the VOC content must include the VOCs emitted during curing.

8.2 **VOC Content of Coatings:** The VOC content of coatings or colorants shall be determined by the following:

8.2.1 To determine the physical properties of a coating or colorant in order to perform the calculations in subsection 4.67 or 4.69, the reference method for VOC content is U.S. EPA Method 24, incorporated by reference in subsection 8.5.9, except as provided in subsections 8.3 and 8.4.

8.2.2 An alternative method to determine the VOC content of coatings or colorants is SCAQMD Method 304-91 (Revised 1996), incorporated by reference in subsection 8.5.10.

8.2.3 The exempt compounds content shall be determined by SCAQMD Method 303-91 (Revised 1996), BAAQMD Method 43 (Revised 2005), or BAAQMD Method 41 (Revised 2005), as

applicable, incorporated by reference in subsections 8.5.8, 8.5.6, and 8.5.7, respectively.

8.2.4 To determine the VOC content of a coating or colorant, the manufacturer may use U.S. EPA Method 24, or an alternative method as provided in subsection 8.3, formulation data, or any other reasonable means for predicting that the coating or colorant has been formulated as intended (e.g., quality assurance checks, record keeping). However, if there are any inconsistencies between the results of a Method 24 test and any other means for determining VOC content, the Method 24 test results will govern, except when an alternative method is approved as specified in subsection 8.3.

8.2.5 To determine the VOC content of a coating or colorant with a VOC content of 150 g/l or less, the manufacturer may use SCAQMD Method 313, incorporated by reference in subsection 8.5.29, ASTM D6886-18, incorporated by reference in subsection 8.5.30, or any other reasonable means for predicting that the coating or colorant has been formulated as intended (e.g., quality assurance checks, record keeping).

8.2.6 The District Air Pollution Control Officer (APCO) may require the manufacturer to conduct a Method 24 analysis.

8.3 **Alternative Test Methods:** Other test methods demonstrated to provide results that are acceptable for purposes of determining compliance with subsection 8.2, after review and approved in writing by the staffs of the District, the ARB, and the U.S. EPA, may also be used.

8.4 **Methacrylate Traffic Marking Coatings:** Analysis of methacrylate multicomponent coatings used as traffic marking coatings shall be conducted according to a modification of U.S. EPA Method 24 (40 CFR 59, subpart D, Appendix A), incorporated by reference in subsection 8.5.11. This method has not been approved for methacrylate multicomponent coatings used for other purposes than as traffic marking coatings or for other classes of multicomponent coatings.

8.5 **Test Methods:** The following test methods are incorporated by reference herein, and shall be used to test coatings subject to the provisions of this rule:

8.5.1 **Flame Spread Index:** The flame spread index of a fire-retardant coating shall be determined by ASTM E84-18b, “Standard Test Method for Surface Burning Characteristics of Building Materials” (see section 4, Fire-Retardant Coating).

8.5.2 **Fire Resistance Rating:** The fire resistance rating of a fire-resistive coating shall be determined by ASTM E119-18ce1, "Standard Test Methods for Fire Tests of Building Construction and Materials" (see section 4, Fire-Resistive Coating).

8.5.3 **Gloss Determination:** The gloss of a coating shall be determined by ASTM D523-14 (2018), "Standard Test Method for Specular Gloss" (see section 4, Flat Coating and Nonflat Coating).

8.5.4 **Metal Content of Coatings:** The metallic content of a coating shall be determined by SCAQMD Method 318-95, "Determination of Weight Percent Elemental Metal in Coatings by X-Ray Diffraction," *SCAQMD Laboratory Methods of Analysis for Enforcement Samples* (see section 4, Aluminum Roof, Faux Finishing, and Metallic Pigmented Coating).

8.5.5 **Acid Content of Coatings:** The acid content of a coating shall be determined by ASTM D-1613-17, "Standard Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products" (see section 4, Pre-treatment Wash Primer).

8.5.6 **Exempt Compounds--Siloxanes:** Exempt compounds that are cyclic, branched, or linear completely methylated siloxanes, shall be analyzed as exempt compounds for compliance with section 8 by BAAQMD Method 43, "Determination of Volatile Methylsiloxanes in Solvent-Based Coatings, Inks, and Related Materials," *BAAQMD Manual of Procedures*, Volume III, adopted 11/6/96 (see section 4, Volatile Organic Compound, and subsection 8.2).

8.5.7 **Exempt Compounds--Parachlorobenzotrifluoride (PCBTF)**: The exempt compound parachlorobenzotrifluoride, shall be analyzed as an exempt compound for compliance with section 8 by BAAQMD Method 41, "Determination of Volatile Organic Compounds in Solvent Based Coatings and Related Materials Containing Parachlorobenzotrifluoride," *BAAQMD Manual of Procedures*, Volume III, adopted 12/20/95 (see section 4, Volatile Organic Compound, and subsection 8.2).

8.5.8 **Exempt Compounds:** The content of compounds exempt under U.S. EPA Method 24 shall be analyzed by SCAQMD Method 303-91 (Revised 1996), "Determination of Exempt Compounds," *SCAQMD Laboratory Methods of Analysis for Enforcement Samples* (see section 4, Volatile Organic Compound, and subsection 8.2).

8.5.9 **VOC Content of Coatings:** The VOC content of a coating shall be determined by U.S. EPA Method 24 as it exists in appendix A of 40 *Code of Federal Regulations* (CFR) part 60, "Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings" (see subsection 8.2).

8.5.10 **Alternative VOC Content of Coatings:** The VOC content of coatings may be analyzed either by U.S. EPA Method 24 or SCAQMD Method 304-91 (Revised 1996), "Determination of Volatile Organic Compounds (VOC) in Various Materials," *SCAQMD Laboratory Methods of Analysis for Enforcement Samples* (see subsection 8.2).

8.5.11 **Methacrylate Traffic Marking Coatings:** The VOC content of methacrylate multicomponent coatings used as traffic marking coatings shall be analyzed by the procedures in 40 CFR part 59, subpart D, appendix A, "Determination of Volatile Matter Content of Methacrylate Multicomponent Coatings Used as Traffic Marking Coatings" (see subsection 8.4).

8.5.12 **Hydrostatic Pressure for Basement Specialty Coatings**: ASTM D7088-17, "Standard Practice for Resistance to Hydrostatic Pressure for Coatings Used in Below Grade Applications Applied to Masonry" (see section 4, Basement Specialty Coating).

8.5.13 **Tub and Tile Refinish Coating Adhesion:** ASTM D4585/4585M-18, "Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation" and ASTM D3359-17, "Standard Test Methods for Measuring Adhesion by Tape Test" (see section 4, Tub and Tile Refinish Coating).

8.5.14 **Tub and Tile Refinish Coating Hardness**: ASTM D3363-05 (2011)e2, "Standard Test Method for Film Hardness by Pencil Test" (see section 4, Tub and Tile Refinish Coating).

8.5.15 **Tub and Tile Refinish Coating Abrasion Resistance**: ASTM D4060-14, "Standard Test Methods for Abrasion Resistance of Organic Coatings by the Taber Abraser" (see section 4, Tub and Tile Refinish Coating).

8.5.16 **Tub and Tile Refinish Coating Water Resistance**: ASTM D4585/4585M-18, "Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation" and ASTM D714-02 (2017), "Standard Test Method for Evaluating Degree of Blistering of Paints" (see section 4, Tub and Tile Refinish Coating).

8.5.17 **Waterproofing Membrane**: ASTM C836/836M-18, “Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course” (see section 4, Waterproofing Membrane).

8.5.18 **Mold and Mildew Growth for Basement Specialty Coatings**: ASTM D3273-16, “Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber” and ASTM D3274-09 (2017), “Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth or Soil and Dirt Accumulation” (see section 4, Basement Specialty Coating).

8.5.19 **Reactive Penetrating Sealer Water Repellency:** ASTM C67/C67M-18, “Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile”; or ASTM C97/97M-18, “Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone”; or ASTM C140/140M-18a, “Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units” (see section 4, Reactive Penetrating Sealer).

8.5.20 **Reactive Penetrating Sealer Water Vapor Transmission:** ASTM E96/E96M-16, “Standard Test Method for Water Vapor Transmission of Materials”; or ASTM D6490-99 (2014), “Standard Test Method for Water Vapor Transmission of Nonfilm Forming Treatments Used on Cementitious Panels” (see section 4, Reactive Penetrating Sealer).

8.5.21 **Reactive Penetrating Sealer - Chloride Screening Applications:** National Cooperative Highway Research Report 244 (1981), “Concrete Sealers for the Protection of Bridge Structures” (see section 4, Reactive Penetrating Sealer).

8.5.22 **Stone Consolidants:** ASTM E2167-01 (2008), “Standard Guide for Selection and Use of Stone Consolidants” (see section 4, Stone Consolidant).

8.5.23 **Building Envelope Coating Air Permeance of Building Materials:** ASTM E2178-13, “Standard Test Method for Air Permeance of Building Materials” (see section 4, Building Envelope Coating).

8.5.24 **Building Envelope Coating Water Penetration Testing:** ASTM E331-00 (2016), “Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference” (see section 4, Building Envelope Coating).

8.5.25 **Building Envelope Coating Water Vapor Transmission:** ASTM E96/96M-16, “Standard Test Methods for Water Vapor Transmission of Materials” (see section 4, Building Envelope Coating).

8.5.26 **Tile and Stone Sealers Absorption:** ASTM C373-18, “Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tile and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products”; or ASTM C97/97M-18, “Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone”; or ASTM C642-13, “Standard Test Method for Density, Absorption, and Voids in Hardened Concrete” (see section 4, Tile and Stone Sealers).

8.5.27 **Tile and Stone Sealers – Static Coefficient of Friction:** ANSI A137.1 (2012), “American National Standard of Specifications for Ceramic Tile” (see section 4, Tile and Stone Sealers).

8.5.28 **Tile and Stone Sealers Water Vapor Transmissions:** ASTM E96/96M-16, “Standard Test Methods for Water Vapor Transmission of Materials” (see section 4, Tile and Stone Sealers).

8.5.29 **VOC Content of Coatings:** South Coast AQMD Method 313, “Determination of Volatile Organic Compounds (VOC) by Gas Chromatography/Mass Spectrometry/Flame Ionization Detection (GS/MS/FID)” (see section 8.2, VOC Content of Coatings).

8.5.30 **VOC Content of Coatings:** ASTM D6886-18, “Standard Test Method for Determination of the Weight Percent Individual Volatile Organic Compounds in Waterborne Air-Dry Coatings by Gas Chromatography” (see section 8.2, VOC Content of Coatings).

Table 1
VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS

Limits are expressed as VOC Regulatory, thinned to the manufacturer's maximum thinning recommendation, excluding any colorant added to tint bases.

Coating Category	Current Limit	Effective 1/1/2022
Flat Coatings	50	
Nonflat Coatings	100	50
Specialty Coatings		
Aluminum Roof Coatings	400	100
Basement Specialty Coatings	400	
Bituminous Roof Coatings	50	
Bituminous Roof Primers	350	
Bond Breakers	350	
Building Envelope Coatings		50
Concrete Curing Compounds	350	
Concrete/Masonry Sealers	100	
Driveway Sealers	50	
Dry Fog Coatings	150	50
Faux Finishing Coatings	350	
Fire Resistive Coatings	350	150
Floor Coatings	100	50
Form-Release Compounds	250	100
Graphic Arts Coatings (Sign Paints)	500	
High Temperature Coatings	420	
Industrial Maintenance Coatings	250	
Low Solids Coatings[a]	120	
Magnesite Cement Coatings	450	
Mastic Texture Coatings	100	
Metallic Pigmented Coatings	500	
Multi-Color Coatings	250	
Pre-Treatment Wash Primers	420	
Primers, Sealers, and Undercoaters	100	
Reactive Penetrating Sealers	350	

Table 1
VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS

Limits are expressed as VOC Regulatory, thinned to the manufacturer's maximum thinning recommendation, excluding any colorant added to tint bases.

Coating Category	Current Limit	Effective 1/1/2022
Recycled Coatings	250	
Roof Coatings	50	
Rust Preventative Coatings	250	
Shellacs: • Clear • Opaque	 730 550	
Specialty Primers, Sealers, and Undercoaters	100	
Stains: • Exterior/Dual • Interior	 250 250	 100
Stone Consolidants	450	
Swimming Pool Coatings	340	
Tile and Stone Sealers	100	
Traffic Marking Coatings	100	
Tub and Tile Refinish Coatings	420	
Waterproofing Membranes	250	100
Wood Coatings	275	
Wood Preservatives	350	
Zinc-Rich Primers	340	

a. Limit is expressed as VOC Actual.

Table 2
VOC CONTENT LIMITS FOR COLORANTS

Limits are expressed as VOC Regulatory.

Colorant Added To	Effective 1/1/2022
Architectural Coatings, excluding Industrial Maintenance Coatings	50
Solvent-Based Industrial Maintenance Coatings	600
Waterborne Industrial Maintenance Coatings	50
Wood Coatings	600

APPENDIX C

VOC EMISSIONS, GALLON LIMITS AND EMISSIONS AVOIDED METHODOLOGY

A. Summary

The proposed volatile organic compound (VOC) limit for the Photovoltaic Coatings category is 600 grams per liter (g/l). The use of Photovoltaic Coatings is projected to cause a one-time release of VOC emissions in air districts where the coating would potentially be applied to uncoated solar modules. This appendix describes the assumptions and methodology used in the proposed 2020 SCM emissions analysis, which includes estimates of the VOC emissions from using Photovoltaic Coatings; the proposed volume limits; and the estimated greenhouse gas and criteria pollutant emissions avoided from the increased electricity generated by coated solar modules.

B. Calculating VOC Content of Coatings

The terms VOC Regulatory and VOC Actual are used in architectural coatings rules. The VOC Regulatory of a coating/colorant is equivalent to the term "VOC, less water and exempts." The VOC Actual is equivalent to the term "VOC, including water and exempts."

The VOC Regulatory calculates the VOC less exempts and water. It subtracts the volume of water and the volume of exempt compounds from the volume of material in the denominator. The calculation was derived to express the VOC emitted per volume of coating solids to eliminate the effect of dilution. Dilution with water or exempt solvents would reduce the VOC-to-paint-volume ratio while maintaining a constant VOC-to-paint/adhesive-solids ratio. This is important because those materials are applied at a certain film thickness so dilution would result in a larger volume of the material being applied to achieve the same film thickness. For conventional solvent based products with no exempt compounds, the two values are the same.

For waterborne coatings and coatings containing exempt compounds, the VOC Regulatory is always higher than the VOC Actual. For all coating categories except the Low Solids coatings category and the proposed Photovoltaic Coating category, the limits are VOC Regulatory. Low Solids coatings are regulated based on VOC Actual, as well as the proposed Photovoltaic Coatings. VOC emissions are always calculated based on the VOC Actual.

The following equations are used to determine VOC Actual and VOC Regulatory content of an architectural coating.

$$VOC_{Actual} = \frac{W_{vm} - W_w - W_e}{V_c}$$

(Also known as Material VOC)

$$VOC_{Regulatory} = \frac{W_{vm} - W_w - W_e}{V_c - V_w - V_e}$$

(Also known as Coating VOC)

$$VOC_{Regulatory\ \ (Low\ Solids)} = \frac{W_{vm} - W_w - W_e}{V_c}$$

Where:

W_{vm} = Total weight of volatile materials (VOC+water+exempt compounds) in the coating, in grams
W_w = Weight of water in the coating, in grams
W_e = Weight of exempt compounds in the coating, in grams
V_c = Total volume of the coating, in liters
V_w = Volume of water in the coating, in liters
V_e = Volume of exempt compounds in the coating, in liters

For coatings with low solids content (like Photovoltaic Coatings) the VOC Actual and the VOC Regulatory Low Solids are the same.

C. Methodology for VOC Emissions

Assumptions

CARB staff used the following assumptions to calculate VOC emissions, gallon limits, and emissions avoided:

- For eight of the nine districts, the district's CEQA threshold is in tons per day (TPD). This threshold cannot be exceeded by emission increases from Photovoltaic Coatings. San Joaquin Valley APCD is the only district where a CEQA threshold is in tons per year (TPY). This is reflected in the "VOC Emissions" and "Gallon Limits" calculations.
- When determining "VOC Emissions" and "Gallon Limits", staff assumed a coverage rate of 0.014 liters/meter squared.
- When determining "VOC Emissions" and "Gallon Limits", staff used the proposed Photovoltaic Coatings VOC limit of 600 g/l
- When determining "Emissions Avoided", staff assumed solar sites operate on average 2,231 hours per year. This assumption was determined through 2018 GIS data from the California Energy Commission (CEC).
- When determining "Emissions Avoided", staff assumed a 2017 California overall GHG emission factor of 0.22 metric tons carbon dioxide equivalent per megawatt hour.

CARB staff used the following data provided by one of the major solar coating manufacturers to estimate district VOC emissions, gallon Limits and statewide emissions avoided from GHG and criteria pollutants.

Table C-1 shows data for solar sites within the nine impacted districts where staff believes there is potential for Photovoltaic Coatings to be applied.

Table C-1
Potential Solar Sites for Photovoltaic Coatings

Air District	Solar Project Name[1]	MW (DC)[1]	Module Surface Area (meters squared)[1]	Number of Modules[1]
Antelope Valley AQMD	Sierra	22.5	0.72	256,800
Antelope Valley AQMD	Antelope Valley Phase 1	255.4	0.72	3,114,560
Antelope Valley AQMD	Antelope Valley Phase 2	61.7	0.72	685,440
Antelope Valley AQMD	Alpine Solar	92.4	0.72	1,087,000
Eastern Kern APCD	Rosamond	38.8	0.72	430,556
Eastern Kern APCD	Catalina	143.2	0.72	1,591,111
Imperial Valley APCD	ISEC South Phase 1	26.5	0.72	353,440
Imperial Valley APCD	ISEC South Phase 2	145.8	0.72	1,943,893
Imperial Valley APCD	Mount Signal Solar	265.8	0.72	3,120,000
Imperial Valley APCD	ISEC West Solar	182.3	0.72	2,278,750
Imperial Valley APCD	Calipatria	22.1	1.23	130,000
Imperial Valley APCD	Solar Gen 2	194	0.72	2,425,000
Imperial Valley APCD	Campo Verde	184	0.72	2,300,000
Mojave Desert AQMD	Blythe Solar	27.3	0.72	341,250
Mojave Desert AQMD	McCoy	325	0.72	2,888,904
Mojave Desert AQMD	Desert Stateline	392	0.72	3,200,000
Monterey Bay ARD	California Flats	169	0.72	1,502,230
Sacramento Metro AQMD	Bruceville Phase 1	1.2	0.72	15,195
Sacramento Metro AQMD	Bruceville Phase 2	20.7	0.72	258,323

Air District	Solar Project Name[1]	MW (DC)[1]	Module Surface Area (meters squared)[1]	Number of Modules[1]
Sacramento Metro AQMD	Boessow	3.7	0.72	45,630
Sacramento Metro AQMD	Point Pleasant	1.2	0.72	15,210
Sacramento Metro AQMD	Kost	3.7	0.72	45,630
Sacramento Metro AQMD	Dillar	11.3	1.94	39,600
Sacramento Metro AQMD	Bruceville	18.8	1.94	66,000
Sacramento Metro AQMD	Kammerer	18.8	1.94	66,000
Sacramento Metro AQMD	McKenzie	18.8	1.94	132,000
San Joaquin Valley APCD	Avenal Solar Phase 1	7.7	1.42	60,000
San Joaquin Valley APCD	Avenal Solar Phase 2	49.9	1.42	390,000
San Joaquin Valley APCD	Kansas South Solar	27.1	1.63	113,280
San Joaquin Valley APCD	Regulus	81.6	1.95	247,273
San Joaquin Valley APCD	Redwood	100	0.72	1,111,000
San Joaquin Valley APCD	Lost Hills - Blackwell	45.5	0.72	505,555
San Joaquin Valley APCD	North Star	61.5	0.72	750,000
San Luis Obispo County APCD	Topaz	715	0.72	8,437,200
Santa Barbara APCD	Cuyama	40	0.72	472,011

1. This data is provided by Pellucere Technologies Inc.

Table C-2 shows the district totals for the facilities listed in Table C-1.

Table C-2
District Totals for Potential Photovoltaic Coatings Sites

Air District	MW[1]	Weighted Average Module Surface Area (meters squared)[1]	Number of Modules[1]
Antelope Valley AQMD	432	0.72	5,143,800
Eastern Kern APCD	182	0.72	2,021,667
Imperial Valley APCD	1,021	0.73	12,551,083
Mojave Desert AQMD	744	0.72	6,430,154
Monterey Bay ARD	169	0.72	1,502,230
Sacramento Metro AQMD	98	1.26	683,588
San Joaquin Valley APCD	373	0.95	3,177,108
San Luis Obispo County APCD	715	0.72	8,437,200
Santa Barbara APCD	40	0.72	472,011

1. This data is provided by Pellucere Technologies Inc. The total megawatts per district may not equal the sum of megawatts in a district from Table C-1 due to rounding.

The following equations were used to determine the district weighted average module surface area in meters squared.

Equation 1:

$$\textbf{Project Weighted Average Module Surface Area } (m^2) = \text{Module Surface Area at Project} * \frac{\text{Number of Modules at Project Site}}{\text{Number of Modules in Air District}}$$

(Note: All these variables are from Table C-1)

Equation 2:

$$\textbf{District Weighted Average Module Surface Area } (m^2) = \Sigma \text{ Project Weighted Average Module Surface Area}$$

(Note: Values are from results of Equation 1)

Example Eastern Kern Weighted Average Module Surface Area Calculation

Table C-3
Eastern Kern APCD Module Surface Area and Number of Modules

Air District	Solar Project Name	Module Surface Area[1] (m^2)	Number of Modules[1]
Eastern Kern APCD	Rosamond	0.72	430,556
Eastern Kern APCD	Catalina	0.72	1,591,111

1. The values for module surface area and number of modules are from table C-1.

$$Rosamond\ Weighted\ Average\ Surface\ Area\ (m^2) = (0.72) * \frac{430{,}556}{2{,}021{,}667} = \mathbf{0.15}$$

$$Catalina\ Weighted\ Average\ Surface\ Area\ (m^2) = (0.72) * \frac{1{,}591{,}111}{2{,}021{,}667} = \mathbf{0.57}$$

$$Eastern\ Kern\ APCD\ Weighted\ Average\ Surface\ Area\ (m^2) = 0.15 + 0.57 = \mathbf{0.72}$$

Table C-4 shows the total potential VOC emissions if all projects identified to date are completed in each air district and the corresponding CEQA Threshold.

Table C-4
Potential Project VOC Emissions and CEQA Thresholds by Air District

Air District	Potential Project VOC Emissions (tons)	CEQA Threshold (TPD)
Antelope Valley AQMD	34	0.0685
Eastern Kern APCD	13	0.0685
Imperial Valley APCD	84	0.0685
Mojave Desert AQMD	43	0.0685
Monterey Bay ARD	10	0.0685
Sacramento Metro AQMD	8	0.0325
San Joaquin Valley APCD[1]	28	N/A
San Luis Obispo County APCD	56	0.0685
Santa Barbara APCD	3	0.0685

1. The San Joaquin Valley APCD does not have an applicable daily CEQA limit, its applicable limit is an annual CEQA threshold of 10 TPY.

The following equations were used to determine the total VOC emissions in a district.

Equation 3:

$$\textbf{Total Surface Area } (m^2) = \text{Total Number of Modules} * \text{Weighted Average Module Surface Area } (m^2)$$

(Note: All these variables are from Table C-2)

Equation 4:

$$\textbf{Total Volume } (l) = \text{Total Surface Area } (m^2) * \text{coverage rate } \left(\frac{l}{m^2}\right)$$

(Note: Total Surface Area (m^2) is from Equation 3. The coverage rate is from CARB staff's assumptions)

Equation 5:

$$\textbf{Total Emissions } (\textbf{tons}) = \frac{\text{Total Volume } (l) * \text{VOC Limit } \left(\frac{g}{l}\right)}{\text{Conversion Factor } \left(\frac{g}{ton}\right)}$$

(Note: Total Volume is from Equation 4. The VOC limit is from CARB staff's assumptions. Conversion Factor is 907,185)

Example Eastern Kern VOC Emission Calculation

$$\textbf{Total Surface Area } (m^2) = 2{,}021{,}667 * 0.72\ (m^2) = \mathbf{1{,}455{,}600}$$

$$\textbf{Total Volume } (l) = 1{,}455{,}600\ (m^2) * 0.014\ \left(\frac{l}{m^2}\right) = \mathbf{20{,}378}$$

$$\textbf{Total Emissions } (\textbf{tons}) = \frac{20{,}378\ (l) * 600\ \left(\frac{g}{l}\right)}{907{,}185\ \left(\frac{g}{ton}\right)} = \mathbf{13}$$

D. Methodology for Gallon Limits and Equivalent Megawatts

CARB staff used an approach similar to the one used to calculate VOC emissions to calculate equivalent megawatts and volume limits.

Table C-5 shows equivalent megawatts and the number of modules that can be coated and volume in gallons per district based on corresponding CEQA Threshold from table C-4.

Table C-5
Equivalent Daily Megawatts, Number of Modules and Volumes per District

Air District	Daily MW	Daily Number of Modules	Daily Volume (Gallons)
Antelope Valley AQMD	0.9	10,274	27.4
Eastern Kern APCD	0.9	10,275	27.4
Imperial Valley APCD	0.8	10,200	27.4
Mojave Desert AQMD	1.2	10,274	27.4
Monterey Bay ARD	1.2	10,275	27.4
Sacramento Metro AQMD	0.4	2,777	13
San Joaquin Valley APCD[1]	3.4	27,399	101.3
San Luis Obispo County APCD	0.9	10,275	27.4
Santa Barbara APCD	0.9	10,274	27.4

1. San Joaquin Valley APCD has a daily and annual gallon limit. The annual values are 1,139,621 modules coated per year and volume of 3,994 gallons/year based on CEQA Threshold of 10 TPY.

The differences in daily megawatts for districts with the same daily volume limit found in Table C-5 is due to variations in solar module technologies. For instance, the capacity and surface area of a module used in one district is different than what is used in another. Therefore, this will result in different daily megawatts even though the daily volume limit is the same.

The following equations were used to calculate equivalent megawatts and number of modules that can be coated per district based on corresponding CEQA Threshold in TPD.

Equation 6:

$$\boldsymbol{Volume\ (l)} = \frac{CEQA\ Threshold\ (TPD) * Conversion\ Factor\ \left(\frac{g}{ton}\right)}{VOC\ Limit}$$

(Note: CEQA Threshold is from Table C-4. The VOC limit is from CARB staff's assumptions. Conversion factor is 907,185)

(Multiply the volume by 0.26417 gallons per liter to convert liters to gallons if desired)

Equation 7:

$$\textbf{Total Surface Area } (\boldsymbol{m^2}) = \frac{Volume\ (l)}{Coverage\ Rate\ \left(\frac{l}{m^2}\right)}$$

(Note: Volume is from Equation 6. The coverage rate is from CARB staff's assumptions)

Equation 8:

$$\textbf{Number of Modules} = \frac{Total\ Surface\ Area\ (m^2)}{Weighted\ Average\ Module\ Surface\ Area\ (m^2)}$$

(Note: Total Surface Area (m^2) is from Equation 7. Weighted Average Module Surface Area (m^2) is from Table C-2)

Equation 9:

$$\textbf{Daily Equivalent Megawatts } (\boldsymbol{MW_e}) = \frac{CEQA\ Number\ of\ Modules}{Number\ of\ Modules} * Megawatts$$

(Note: CEQA Number of Modules is from Table C-5. Number of Modules and Megawatts are from Table C-1)

Example Eastern Kern Daily Number of Modules Calculation

$$\textbf{Volume } (\boldsymbol{l}) = \frac{0.0685\ TPD * 907{,}185\ \left(\frac{g}{ton}\right)}{600\ \left(\frac{g}{l}\right)} = \mathbf{103.57}$$

$$\textbf{Total Surface Area } (\boldsymbol{m^2}) = \frac{103.57\ \frac{l}{day}}{0.014\ \frac{l}{m^2}} = \mathbf{7{,}397.88}$$

$$\textbf{Number of Modules} = \frac{7397.88\ m^2}{0.72\ m^2} = \mathbf{10{,}275}$$

$$\textbf{Daily Equivalent Megawatts } (\boldsymbol{MW_e}) = \frac{10{,}275}{2{,}021{,}667} * 182 = \mathbf{0.9}$$

Table C-6 shows the gallon limits and equivalent yearly megawatts. Through discussions with manufacturers, staff assumed 150 coating days per year. These values are rounded down from the values in Table C-5. The objective of rounding down is to make sure that the proposed gallon limits do not exceed a district's CEQA Threshold.

Table C-6
Proposed Daily Gallon Limits and Equivalent Megawatts

Air District	Daily Volume Limit (Gal)	Equivalent MW Coated Annually[2]
Antelope Valley AQMD	27.0	128
Eastern Kern APCD	27.0	137
Imperial Valley APCD	27.0	123
Mojave Desert AQMD	27.0	176
Monterey Bay ARD	27.0	171
Sacramento Metro AQMD	12.5	58
San Joaquin Valley APCD[1]	100.0	131
San Luis Obispo County APCD	27.0	129
Santa Barbara APCD	27.0	129

1. An annual volume limit of 3,900 gallons per year is applicable in the San Joaquin Valley APCD. The annual equivalent megawatts are shown in Table C-6.
2. Data from a major Photovoltaic Coating manufacturer shows 170 to 210 viable coating days, staff assumed 150 coating days per year.

E. Methodology for Emissions Avoided

Staff took the following steps to determine the emissions avoided over 10 years from power plants through a three percent energy gain from Photovoltaic Coatings:

1. Retrieve data from the California Energy Commission (CEC). Data included California energy generation and capacity from all sources excluding renewable energy sources such as wind, hydro, solar, geothermal and nuclear. Separate data was taken only for solar photovoltaic (PV). The data year used is 2017 (CEC, 2019).

2. Retrieve data from CARB criteria pollutants inventories. Criteria Pollutants analyzed include carbon dioxide (CO_2), nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter with particle size of 10 microns or less (PM_{10}), particulate matter with particle size of 2.5 microns or less ($PM_{2.5}$), volatile organic compounds (VOC) and carbon monoxide (CO). The data year used is 2017 (CARB, 2020).

3. Retrieve the California greenhouse gas (GHG) emission factor. The emission factor used is 0.22 metric ton carbon dioxide equivalent per

megawatt hour . This is for the overall GHG intensities. Total electricity emissions (sum of in-state generation and imports) divided by the sum of tc($\frac{MT\ CO_2e}{MWh}$)Wh consumed in California and MWh exported out of California. Transmission and distribution losses are not represented in the consumption number (CARB, 2018b; CARB, 2019b).

4. Calculate a CARB emission factor for the criteria pollutants and GHG in pounds per megawatt hour using the collected data in steps 1-3.

5. Calculate the tons for GHG and criteria pollutants over a 10-year period.

Step 1: Data Collected from CEC

Table C-7 shows the total energy generated and capacity from CEC collected data. The first three columns (from left to right) show the total generated energy and capacity from all California electricity sources. The remaining three columns are total generated energy and capacity from all California solar photovoltaic sites. As mentioned previously, these values exclude renewable energy sources such as wind, hydro, solar, geothermal and nuclear.

Table C-7
Generated Energy and Capacity from California Energy Source

Generated GWh Overall	Capacity MW Overall	Hours Operated Overall	Solar PV Generated GWh	Solar PV Capacity MW	Solar PV Operated (Hours)
96,187	44,036	2,184	21,895	9,812	2,231

(CEC, 2019)

The following equation was used to calculate average hours operated.

Equation 10:

$$\boldsymbol{Hours\ Operated} = \frac{Energy\ Generated}{Capacity} * \frac{1{,}000\ MW}{GW}$$

(Note: All variables are from Table C-7)

Step 2: Data Collected from CARB Criteria Pollutants Inventory

Table C-8 shows the total criteria pollutants from CARB's California Emissions Inventory Development and Reporting System (CEIDAR). Staff believes there are potential 3,774 MW in California from solar photovoltaic (PV) modules that can be coated with Photovoltaic Coatings. Based on data provided by the coating manufacturers, modules coated with a Photovoltaic Coating can achieve three to four percent in energy gains. Staff used three percent energy gain to estimate the potential emissions avoided. Three percent of 3,774 MW is 113 MW.

Table C-8
CARB Total Criteria Pollutant Emissions

Criteria Pollutant	NO_x (Tons)	SO_x (Tons)	PM_{10} (Tons)	$PM_{2.5}$ (Tons)	VOC (Tons)	CO (Tons)
CEIDARS	8,703.6	695.7	2,197.7	2,075.4	1,454.3	15,701.5
3% PV Adjusted (Equation 11)	22.8	1.8	5.8	5.4	3.8	41.2

(CARB, 2020)

- Through discussions with coating manufacturers, staff assumed 3,774 MW from solar PV modules are eligible for Photovoltaic Coatings. An energy gain of three percent is used. Three percent of 3,774 MW is 113 MW.
- The top row shows the totals for criteria pollutants from California Emissions Inventory Development and Reporting System (CEIDAR). The top row is not emissions avoided from the 3,774 MW. The bottom row are values calculated using equation 11. They will be used to determine an emission factor for calculating emissions avoided.

The remaining example calculations will use a 3% energy gain of 113 MW in the equations.

Equation 11:

$$\boldsymbol{Criteria\ Pollutant\ 3\%\ PV\ Adjusted\ (Tons)} =$$

$$Total\ Criteria\ Pollutant\ Tons * \frac{3\%\ of\ Total\ PV\ Potential\ MWh}{Total\ MWh\ From\ Energy\ Sources}$$

(Note: Total Criteria Pollutant Tons is from Table C-8. 3% of Total PV Potential MWh is calculated from Tables C-7 and C-8. Total MWh from Energy Sources is calculated by values from Table C-7.)

Example NO_x Adjusted Tons Calculation

$$\boldsymbol{NO_x\ 3\%\ PV\ Adjusted\ (Tons)} = 8703.6\ Tons * \frac{113\ MW * 2231\ Hrs}{44{,}036\ MW * 2{,}184\ Hrs} = \mathbf{22.8}$$

Step 3: Data Collected from CARB GHG Inventory

Table C-9 shows the 2014 - 2017 CARB GHG in-state, imports and overall emissions factors in metric tons carbon dioxide per megawatt hour. For this analysis, staff used the most recent data year of 2017 overall emission factor of 0.22 $\left(\frac{MT\ CO_2e}{MWh}\right)$

Table C-9
2014-2017 CARB GHG Emission Factors

Parameter	2014 (MT CO_2e/ MWh)	2015 (MT CO_2e/ MWh)	2016 (MT CO_2e/ MWh)	2017 (MT CO_2e/ MWh)
In-State[1]	0.25	0.25	0.20	0.18
Imports	0.35	0.33	0.26	0.25
Overall[2]	0.31	0.29	0.24	0.22

(CARB, 2018b; CARB, 2019b)

1. In-state electricity emissions and MWh generation include commercial-scale power plants, on-site generation for on-site use, cogeneration emissions attributed to electricity generation, in-state generated electricity exported out of state, and rooftop solar.
2. Total electricity emissions (sum of in-state generation and imports) divided by the sum of total MWh consumed in California and MWh exported out of California. Transmission and distribution losses are not represented in the consumption number.

Step 4: Calculate CARB Emission Factors for Criteria Pollutants in Pounds per Megawatt Hour

Table C-10 shows the calculated CARB emission factors in pounds per megawatt hour for the criteria pollutants and GHG.

Table C-10
CARB Criteria Pollutant and GHG Emission Factors

NO_x (lb/MWh)	SO_x (lb/MWh)	PM_{10} (lb/MWh)	$PM_{2.5}$ (lb/MWh)	VOC (lb/MWh)	CO (lb/MWh)	CO_2 (lb/MWh)
0.18	0.01	0.05	0.04	0.03	0.33	484

The following equations were used to calculate emission factors in pounds per megawatt hour for criteria pollutants and GHG.

Equation 12 (used for criteria pollutants):

$$\textbf{Emission Factor}\left(\frac{\boldsymbol{lb}}{\boldsymbol{MWh}}\right) = \frac{3\%\ PV\ Adjusted\ (tons)}{3\%\ of\ Total\ PV\ Potential\ MWh} * \frac{Pounds}{Ton}$$

(Note: 3% PV Adjusted (tons) is from Table C-8. 3% of Total PV Potential MWh is calculated from Tables C-7 and C-8. Multiply 2000 pounds to convert to US tons)

Equation 13 (used for GHG):

$$\textbf{Emission Factor}\left(\frac{\boldsymbol{lb}}{\boldsymbol{MWh}}\right) = 0.22\ \frac{MT\ CO_2e}{MWh} * \frac{Pounds}{Metric\ Ton}$$

For both Equation 12 and 13, multiply 2200 pounds to convert to metric tons.

Example NO_x Emission Factor Calculation

$$\textbf{Emission Factor}\left(\frac{\boldsymbol{lb}}{\boldsymbol{MWh}}\right) = \frac{22.8\ tons}{113\ MW\ *\ 2231\ Hrs} * \frac{2000\ lb}{Ton} = \mathbf{0.18}$$

Step 5: 10 Year Emissions Avoided from GHG and Criteria Pollutants

Table C-11 shows the calculated CARB emissions avoided for criteria pollutants and GHG. GHG is in metric tons whereas criteria pollutants are in US tons.

Table C-11
Emissions Avoided

Fuel Type	CO_2 (Metric Tons)	NO_x (Tons)	SO_x (Tons)	PM_{10} (Tons)	$PM_{2.5}$ (Tons)	VOC (Tons)	CO (Tons)
California Electricity Mix	554,627	227	13	63	50	38	416

- Reflects emissions avoided from GHG and criteria pollutants for power plant over a 10-year period.
- Assumes 3% (~113 MW equivalent) increase Photovoltaic capacity due to the application of the coatings.
- California electricity mix is derived from GHG and criteria pollutant inventories, and California Energy Commission electricity generation data. (CARB, 2018b; CARB, 2019b; CARB, 2020; CEC, 2019; CEC, 2020)

The following equations were used to calculate the emissions avoided from GHG and criteria pollutants.

Equation 14:

$$\boldsymbol{Emissions\ Avoided\ (Tons)} =$$

$$3\%\ of\ Total\ PV\ Potential\ MWh * Emission\ Factor\ \left(\frac{lb}{MWh}\right) * \frac{Tons}{lb} * 10\ Years$$

(Note: 3% of Total PV Potential MWh is calculated from Tables C-7 and C-8. Emission Factor is from Table C-10. Divide by 2000 pounds to convert to US tons.)

Divided 2200 pounds to convert to metric tons.

Example NO_x 10 Year Emissions Avoided Calculation

$$Emissions\ Avoided\ (Tons) = 113\ MW * 2231\ Hrs * 0.18 \frac{lb}{MWh} * \frac{Tons}{2000\ lbs} * 10\ Yrs$$
$$= \mathbf{227}$$

References

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California Energy Commission. California Power Plants. https://cecgis-caenergy.opendata.arcgis.com/datasets/california-power-plants. (CEC, 2020)

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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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APPENDIX E

WORKSHOP NOTICE PROPOSED 2020 SUGGESTED CONTROL MEASURE FOR ARCHITECTURAL COATINGS

February 14, 2020

To All Interested Parties:

The California Air Resources Board (CARB) staff invites you to participate in a public workshop to discuss proposed updates to the Architectural Coatings Suggested Control Measure (SCM). The SCM is a model rule used by California air districts to develop architectural coatings rules to reduce volatile organic compound (VOC) emissions across the state. At this workshop, staff will discuss a new proposed coating category definition for Photovoltaic Coatings and the proposed VOC limit.

The workshop will be held at the time and location shown below:

Date: Wednesday, February 26, 2020
Time: 1:00 p.m.-4:00 p.m.
Location: CARB Monitoring and Laboratory Building
1327 13th Street
Sacramento, California, 95814

Those unable to attend in person may register for the webinar.

Materials for this workshop, including a meeting agenda, will be posted to our program web page prior to the workshop. Notification will be sent via the Architectural Coatings email list serve when the materials become available. To receive notices of upcoming activities on the Architectural Coatings Program, please sign up for the list serve.

Summary: CARB's Architectural Coatings Program assists air districts in reducing the amount of smog-forming volatile organic compounds (VOCs) emitted from the use of architectural coatings in California. Architectural coatings include house paints, stains, industrial maintenance coatings, traffic coatings, and many other products. Control of VOC emissions from architectural coatings is the responsibility of the air districts, and CARB provides assistance by developing a SCM. The Board approved an SCM for architectural coatings in 1977 and updated it in 1985, 1989, 2000, 2007, and 2019. Currently, fifteen air districts have implemented the 2007 SCM. Based on a survey CARB conducted in 2014, VOC emissions from architectural coatings have decreased from 95 tpd in 2004 to 30 tpd in 2013.

For more information about the Architectural Coatings Program, visit the architectural coatings web page.

If you require special accommodation or need this document in an alternate format or language, please contact Ms. Candace Clawson at (916) 322-6021 or candace.clawson@arb.ca.gov as soon as possible. TIY/TDD/Speech to Speech users may dial 711 for California Relay Service.

Staff welcomes and encourages your participation in this effort. If you have questions, please contact Mr. Glen Villa, Air Resources Engineer, at (916) 324-8177 or at glen.villa@arb.ca.gov or Mr. Jose Gomez, Manager, Technical Development Section, at (916) 324-8033 or at jose.gomez@arb.ca.gov.

Sincerely,

/s/

Ravi Ramalingam, Chief
Consumer Products and Air Quality Assessment Branch
Air Quality Planning and Science Division

cc: Mr. Jose Gomez, Manager
Technical Development Section
Air Quality Planning and Science Division

Mr. Glen Villa, Air Resources Engineer
Technical Development Section
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