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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<sup>®</sup>, 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

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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<sub>x</sub>) 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.

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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**

<b>Coating Category</b>	<b>Current Limit (g/l)<sup>1,2</sup></b>	<b>Proposed Limit (g/l)<sup>2</sup></b>
<b>Coating Category:</b> Photovoltaic Coatings	120	<b>600</b>

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**

<b>Air District</b>	<b>Daily Volume Limit (Gallons)</b>	<b>Equivalent MW Coated Annually<sup>2</sup></b>
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 <sup>1</sup>	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**

<b>Energy Type</b>	<b>CO<sub>2</sub> (Metric Tons)</b>	<b>NO<sub>x</sub> (Tons)</b>	<b>SO<sub>x</sub> (Tons)</b>	<b>PM<sub>10</sub> (Tons)</b>	<b>PM<sub>2.5</sub> (Tons)</b>	<b>VOC (Tons)</b>	<b>CO (Tons)</b>
<b>CARB Electricity Mix</b>	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.

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## **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 than 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

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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



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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(I) determinations for air districts where potential projects with uncoated solar modules have been identified. Specifically, the CAA section 110(I) states: "Each

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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.

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## **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**

<b>Air District</b>	<b>Capacity (MW)</b>	<b>Number of Sites</b>
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
<b>Total</b>	<b>10,471</b>	<b>726</b>

(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**

<b>Air District</b>	<b>Capacity (MW)</b>	<b>Number of Sites</b>	<b>VOC (Tons)</b>
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
<b>Total</b>	<b>3,774</b>	<b>35</b>	<b>280.2</b>

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 <sup>1</sup>	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<sup>1</sup>. 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

<sup>1</sup> 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<sup>1</sup>**

<b>Energy Type</b>	<b>CO<sub>2</sub> (Metric Tons)</b>	<b>NO<sub>x</sub> (Tons)</b>	<b>SO<sub>x</sub> (Tons)</b>	<b>PM<sub>10</sub> (Tons)</b>	<b>PM<sub>2.5</sub> (Tons)</b>	<b>VOC (Tons)</b>	<b>CO (Tons)</b>
<b>CARB Electricity Mix</b>	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<sub>2e</sub> 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<sup>1</sup>**

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 <sup>2</sup>	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

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

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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

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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.

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## **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.

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## **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

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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.

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## **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.



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## 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**

<b>Coating Category</b>	<b>Current VOC Limit (g/l)</b>	<b>Proposed VOC Limit (g/l)</b>
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)**

<b>U.S. EPA</b>	<b>SCAQMD</b>	<b>SCM<sup>1</sup></b>
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.

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### 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

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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.

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**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.

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**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.

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## 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) (<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.

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## 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.



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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

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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 sunseting 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**

<b>Air District</b>	<b>CEQA Threshold (tpd)</b>	<b>CEQA Threshold (tpy)</b>	<b>Daily Volume Limit (Gallons)</b>
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 <sup>1</sup>	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

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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

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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(I) 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.

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- (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 sunseting 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, sunseting 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

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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

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- 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

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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**

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

(CARB, 2019)

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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).

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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.



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## **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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