DATE: December 16, 2021

TO: SJVUAPCD Governing Board

FROM: Samir Sheikh, Executive Director/APCO
Project Coordinator: Jonathan Klassen

RE: ITEM NUMBER 11: ADOPT PROPOSED AMENDMENTS TO RULE 4354 (GLASS MELTING FURNACES)

RECOMMENDATIONS:

1. Adopt proposed amendments to Rule 4354 (Glass Melting Furnaces).

2. Authorize the Chair to sign the attached Resolution.

BACKGROUND:

The *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*, or Plan) was adopted by your Board on November 15, 2018. The development of the *2018 PM2.5 Plan* utilized extensive science and research, state of the art air quality modeling, and the best available information in developing a strategy for bringing the Valley into attainment with the federal health-based 1997, 2006, and 2012 PM2.5 National Ambient Air Quality Standards (NAAQS, or standards) as expeditiously as practicable by the respective federal deadlines of 2020, 2024, and 2025. The attainment strategy in the Plan includes a combination of innovative regulatory and non-regulatory measures for both stationary and mobile sources that built upon stringent air quality measures already in place from earlier District attainment plans and measures adopted by your Board. The *2018 PM2.5 Plan* was developed through an extensive public process, with wide-ranging input and support from involved parties representing environmental, business, and community interests. Among these measures is a commitment from the District to seek additional emission reductions from glass melting furnaces through amendments to District Rule 4354.

Today's proposed amendments to Rule 4354 include even more stringent nitrogen oxide (NOx), particulate matter (PM10), and sulfur oxide (SOx) emission limits for glass melting facilities operating in the Valley. The proposed regulatory amendments satisfy the District's control measure commitment in the District's *2018 PM2.5 Plan*, and go beyond the commitments in the Plan to support expeditious attainment of the health-based federal PM2.5 and ozone air quality standards. In addition, the proposed amendments address commitments included in Board/CARB-approved South Central Fresno Community Emissions Reduction Program developed through the AB 617 community engagement process.

These amendments were developed through a public engagement process that solicited feedback from the public through a variety of forums, including workshops, meetings with affected sources and other interested parties, Citizens' Advisory Committee meetings, and community engagement through AB 617 steering committees.

The purpose of this item is to seek your Board's approval of the proposed amendments to District Rule 4354.

DISCUSSION:

The San Joaquin Valley is home to six glass manufacturing facilities that represent three different glass industry types: container glass, flat glass and fiberglass. There are twelve glass melting furnaces at these six facilities that are subject to Rule 4354. The glass manufacturing process starts with the receiving and storage of raw materials consisting mainly of silica sand, limestone, soda ash and salt cake. The raw materials are mixed and conveyed to the glass melting furnace where they are heated and melted down in to molten glass. Glass melting furnaces typically operate at temperatures ranging from 2,700 °F to 3,100 °F. The molten glass is removed from the melting furnace and then shaped or formed based on the products that are being manufactured at a specific facility. The different end products vary widely in raw material additives, processing equipment and conditions, and product quality requirements.

Glass melting furnaces contribute to over 99% of the total emissions from a glass plant, including both particulates and gaseous pollutants. Particulates result from volatilization of materials in the melt that combine with gases and form condensates. NOx results from the combustion of fuels in the furnace burners and when nitrogen and oxygen react in the high temperatures of the furnace. SOx results from oxidation of sulfur in fuel, raw material, and a refining agent called salt cake, and also from direct application of gaseous SO_2 in annealing ovens (lehrs) to achieve the desired glass properties.

Emissions from these facilities are currently reduced through the installation of control technologies required to meet the emissions limits currently contained in Rule 4354, and to comply with District permitting requirements. Rule 4354 was adopted on September 14, 1994, and has been amended several times, in April 1998, February 2002, August

2006, October 2008, September 2010, and May 2011, to establish increasingly stringent NOx, SOx, PM10, CO, and VOC emission limits that units must comply with to operate in the District. As part of these regulatory efforts, glass melting furnaces in the Valley have been equipped with the best available control technologies. Through the requirements of Rule 4354, NOx emissions from glass melting furnaces subject to Rule 4354 have been reduced by 75% to date. As illustrated in Table 1, the proposed amendments achieve significant additional emissions reductions by 2024 and 2030.

Table 1 – Estimated Emission Reductions

Pollutant	2024 % Reduction	2024 (tons/day)	2030 % Reduction	2030 (tons/day)
NOx	18%	0.64	43%	1.67
SOx	4%	0.07	4%	0.07
PM10	49%	0.13	49%	0.13
PM2.5	58%	0.13	58%	0.13

Control Technology for Glass Melting Furnaces

There are two primary methods that the glass manufacturing facilities within the Valley currently employ for controlling NOx emissions from their glass melting furnaces. Four facilities have retrofitted their glass furnaces to be fired on oxy-fuel instead of regular natural gas and two facilities have installed a selective catalytic reduction system (SCR) on the exhaust of their glass furnaces. These controls reduce the overall amount of NOx generated from a glass furnace during the combustion/raw material melting process or reduce the amount of NOx in the exhaust stream from a glass furnace before it is emitted into the atmosphere. Emissions of particulate matter are typically controlled by an electrostatic precipitator (ESP) or a filtration system. SOx emissions are controlled through the injection of a sorbent into the exhaust stream, and/or through the use of scrubbers.

Summary of Proposed Amendments to Rule 4354

Today's proposed rule amendments would lower emission limits for NOx, SOx, and PM10 emission limits for glass melting furnaces operated in the Valley. Emissions limits are proposed based on the results of a comprehensive review of the existing permit inventory in the Valley, available control technology, requirements in other air districts, and a cost-effectiveness analysis of requiring further controls for existing units (as further discussed in Appendix C of the attached Staff Report). The proposed updated emission limits for each pollutant are included the tables below.

Table 2 – Proposed NOx Emission Limits in pounds NOx per ton glass produced

Type of Glass Produced	Phase I NOx limit (by no later than 12/31/2023)	Phase II NOx limit (by no later than 12/31/2029)
Container Glass	1.1 [B]	0.75 [B]
Fiberglass	1.3 [A, C] 3.0 [A, D]	1.3 [A, C] 3.0 [A, D]
Flat Glass (Standard)	2.8 [A] 2.5 [B]	1.7 [A] 1.5 [B]

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Not subject to California Public Resources Code Section 19511
[D] Subject to California Public Resources Code Section 19511

Table 3 – Proposed SOx Emission Limits, in pounds SOx per ton glass produced, in effect on and after January 1, 2024

Type of Glass Produced	SOx Limit
Container Glass	0.85 [B]
Fiberglass	0.90 [C]
Flat Glass	1.7 [A] 1.2 [B]

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Rolling 24-hour average

Table 4 – Proposed PM10 Emission Limits, in pounds total PM10 per ton glass produced, effective on and after January 1, 2024

Type of Glass Produced	PM10 Limit
Container Glass	0.20
Fiberglass	0.50
Flat Glass	0.20

The proposed amendments to Rule 4354 would add language to clarify definitions, remove expired language, and establish compliance timelines. The existing PM10 and SOx emissions limits are proposed to be lowered to further reduce emissions from glass melting furnaces in the District, with full compliance with the updated emission limits required by 2024. The emissions limits for NOx are proposed to be lowered in a phased approach, with limits established based on the type of glass melting operation, taking into account the feasibility and cost-effectiveness of further emissions controls. Compliance with the proposed Phase I NOx emissions limits is proposed to be required by January 1, 2024, with marginal costs and operational impacts expected to be associated with meeting these interim NOx emissions limits.

The timeframes established in the proposed rule for facilities to meet the proposed PM10, SOx, and Phase I NOx emissions limits reflect the time necessary for facilities to plan for full compliance with the proposed emission limits, including budgeting for any required modifications to the facility or facility operations, modifying existing controls or facility control practices, and installing any required further control technologies. Additionally, the 2024 compliance deadline supports fulfillment of the District's *2018 PM2.5 Plan* commitments.

Compliance with the more stringent Phase II NOx emissions limits is proposed to be required upon the date of the next planned furnace rebuild after 2024, and no later than 2030. The emission limits proposed for Phase II would likely require the installation of costly control equipment, with estimated capital costs ranging from $2.1 million - $7 million per facility, depending on the existing plant design and existing control equipment. As discussed further in Appendix C of this staff report, due to the high cost of controls required to meet the proposed Phase II emissions limits, an extended timeframe is being proposed for compliance with the Phase II emissions limits to ensure that the proposed requirements are cost-effective and economically feasible.

As demonstrated in the *2018 PM2.5 Plan* and subsequent EPA action, Rule 4354 currently meets federal BACM (Best Available Control Measures) and Most Stringent Measures (MSM). Additionally, Rule 4354 also meets state BARCT (Best Available Retrofit Control Technology) requirements, including with respect to container glass furnaces under the proposed amendments. Based on District staff review of other air district requirements, the proposed updates would establish requirements that are more stringent than any other rule in non-attainment areas in California and in the nation. Adoption of the proposed amendments will ensure that Rule 4354 continues to meet or exceed BACM, MSM, and BARCT levels of emissions control.

Health Benefits of Implementing Plan Measures

Exposure to PM2.5 and ozone has been linked to a variety of health issues, including aggravated asthma, increased respiratory symptoms (irritation of the airways, coughing, difficulty breathing), decreased lung function in children, development of chronic bronchitis, irregular heartbeat, non-fatal heart attacks, increased respiratory and cardiovascular hospitalizations, lung cancer, and premature death. PM2.5 is a major

health risk because it can be inhaled more deeply into the gas exchange tissues of the lungs, where it can be absorbed into the bloodstream and carried to other parts of the body. Studies have shown that even short-term exposure of less than 24 hours can cause premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, and restricted activity days. Children, older adults, and individuals with heart or lung diseases are the most likely to be affected by PM2.5 and ozone.

As NOx emissions are a key precursor in the formation of both ozone and PM2.5, continuing to assess the feasibility of achieving additional NOx reductions across the Valley is critical to improving PM2.5 and ozone throughout the region. PM2.5 emissions are characterized by a unique combination of direct and indirectly formed constituents. NOx emissions are a precursor to the formation of ammonium nitrate, which is a large portion of total PM2.5 during the Valley's peak winter season. NOx is also a precursor to ozone, which is formed when heat and sunlight interact with NOx and VOCs. Harmful ozone is predominantly formed at the surface during the summer season in the Valley. The District has long worked to reduce NOx emissions as the primary precursor for the formation of ozone and PM2.5 in the Valley.

To address federal health-based standards for ozone and PM2.5 and improve public health, the District develops attainment plans and implements control measures to lower direct and precursor emissions throughout the San Joaquin Valley. The proposed amendments will achieve additional reductions in NOx emissions as requirements are implemented by affected sources, and new technologies are installed. New regulatory and incentive-based measures proposed by both the District and CARB, combined with existing measures achieving new emissions reductions, are necessary to attain the health-based federal standards as expeditiously as practicable, and will improve public health as emissions reductions are realized.

COVID-19 Pandemic Considerations

The COVID-19 pandemic is first and foremost a human tragedy, which has sent society into uncharted territory, and the economic impacts to the United States and the world are significant and far-reaching. The Valley and nation are currently facing uncertain economic times that have the potential to be devastating to local Valley businesses and residents. As an essential public health agency and member of the Valley community, the District has a responsibility to continue providing essential public services while keeping our employees and our communities safe. As the COVID-19 situation continues to evolve, the District has remained open, providing essential services to the residents, businesses, and public agencies of the Valley through virtual tools and direct support from our employees working remotely. District staff also understand the major disruption to the Valley and nation's economy caused by the COVID-19 pandemic; and have committed to work closely with those that we regulate to understand the evolving situation and associated impacts, and develop options for meeting air quality obligations.

In response to COVID-19, the District has modified public participation processes to ensure continued development of measures included in District commitments in the federally approved *2018 PM2.5 Plan*. Beginning in March 2020, the District transitioned public workshop processes for this rule project to virtual online webinars with multiple options for public participation including video, phone, and email, with full translation services provided at public meetings. The District has continued to hold public workshops and to meet directly with stakeholders through virtual meeting tools throughout the pandemic to enable robust remote public participation.

While the pandemic has had far-reaching economic impacts, it is critical that the Valley continue to make progress towards attainment of the health-based federal ambient air quality standards. The health benefits of improved air quality, and the associated economic benefits, have been well documented. District staff have worked to develop proposed amendments to this rule that provides as much flexibility to affected industry as possible, while still ensuring that real emission reductions will be achieved to support increased air quality, and associated benefits to public health, throughout the Valley.

Supporting Regulatory Analyses

Cost Effectiveness Analysis

California Health and Safety Code (CH&SC) Section 40920.6(a) requires the District to conduct both an absolute cost effectiveness analysis and an incremental cost effectiveness analysis of available emission control options before adopting each BARCT rule. The purpose of conducting a cost effectiveness analysis is to evaluate the economic reasonableness of the pollution control measure or rule. The analysis also serves as a guideline in developing the control requirements of a rule. Cost effectiveness will depend on the current level of controls, unit size, fuel usage and final emission levels. Details of the cost effectiveness analysis is contained in Appendix C of the staff report.

Socioeconomic Impact Analysis

Pursuant to CH&SC Section 40728.5, “whenever a district intends to propose the adoption, amendment, or repeal of a rule or regulation that will significantly affect air quality or emissions limitations, that agency shall, to the extent data are available; perform an assessment of the socioeconomic impacts of the adoption, amendment, or repeal of the rule or regulation.” The socioeconomic analysis has been used to further refine the rule amendments. The final socioeconomic report is attached to the staff report as Appendix D.

Due to the high costs associated with compliance with the proposed Phase II NOx emissions limits, an extended compliance timeframe has been proposed to allow operators to plan for the facility modifications necessary to meet the proposed requirements.

Rule Consistency Analysis

Pursuant to CH&SC Section 40727.2, prior to adopting, amending, or repealing a rule or regulation, the District is required to perform a written analysis that identifies and compares

the air pollution control elements of the rule or regulation with corresponding elements of existing or proposed District and EPA rules, regulations, and guidelines that apply to the same source category. District staff has concluded that the proposed rules are not in conflict with nor inconsistent with other District rules, nor are the proposed rules in conflict with nor inconsistent with federal policy, rule, or regulations governing the same source category. The analysis is discussed further in Appendix E of the staff report.

Environmental Impacts
There are no other actions or rule requirements associated with this project. Based on the District's review, substantial evidence supports the District's conclusion that the amendments will not cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment, and as such is not a "project" as that term is defined under the California Environmental Quality Act (CEQA) Guidelines § 15378. In addition, substantial evidence supports the District's conclusion that, if one assumes the amendment is a "project" under CEQA in spite of our conclusion to the contrary, it will not have any significant adverse effects on the environment.

Rule Development Public Process

District staff conducted a public Scoping Meeting in December 2020, and held public workshops in September 2021, and November 2021. Information about public meetings was shared with members of the public, affected sources, manufacturers of control technologies, and other interested stakeholders. Information about the regulatory amendments and workshops were also made available at meetings of the Citizens' Advisory Committee, Environmental Justice Advisory Group, and AB 617 Community Steering Committees. Workshop announcements and public notices were provided in both English and Spanish, and interpretation services were made available upon request. At the public workshops, District staff presented the emission reduction and public health objectives of the proposed rulemaking project, and solicited feedback from the public on potential amendments. Initial draft amendments to Rule 4354 were published for public review on November 4, 2021, and an updated draft was published on November 16, 2021.

Throughout the rule development process, District staff solicited information from affected source operators, consultants, vendors and manufacturers of control technologies, and trade associations on the technological feasibility and compliance cost information that would be useful in developing amendments to Rule 4354. The comments received from the public, affected sources, and interested parties during the public outreach and workshop process were incorporated into the rule or addressed in the staff report as appropriate.

The proposed rule amendments and draft staff report with associated appendices were published for 30-day public review and comment prior to the public hearing to consider the adoption of the proposed amendments to Rule 4354 by the District Governing

Board. A summary of significant comments and District responses is available in Appendix A of the final draft staff report.

FISCAL IMPACT:

District staff expects no fiscal impact to result from this action.

Attachments:

Attachment A: Resolution for Proposed Amendments to Rule 4354 (5 pages)
Attachment B: Proposed Amendments to Rule 4354 (30 pages)
Attachment C: Final Draft Staff Report for Proposed Amendments to Rule 4354 (101 pages)

San Joaquin Valley Unified Air Pollution Control District
Meeting of the Governing Board
December 16, 2021

ADOPT PROPOSED AMENDMENTS TO RULE 4354 (GLASS MELTING FURNACES)

Attachment A:

Resolution for Proposed Amendments to Rule 4354

(5 PAGES)

BEFORE THE GOVERNING BOARD OF THE SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

IN THE MATTER OF: PROPOSED AMENDMENTS TO RULE 4354 (GLASS MELTING FURNCES)) **RESOLUTION NO. _____**

WHEREAS, the San Joaquin Valley Unified Air Pollution Control District (District) is a duly constituted unified air pollution control district, as provided in California Health and Safety Code (CH&SC) Sections (§) 40150 et seq. and 40600 et seq.; and

WHEREAS, said District is authorized by CH&SC §40702 to make and enforce all necessary and proper orders, rules, and regulations to accomplish the purpose of Division 26 of the CH&SC; and

WHEREAS, pursuant to federal Clean Air Act (CAA) §107, the San Joaquin Valley Air Basin (Valley) is designated as nonattainment for the national health-based air quality standards for ozone and particulate matter 2.5 microns and smaller (PM2.5); and

WHEREAS, the District Governing Board adopted 2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards (*2018 PM2.5 Plan*) on November 15, 2018 pursuant to the federal Clean Air Act; and

WHEREAS, the District's *2018 PM2.5 Plan* commits the District to amend Rule 4354 (Glass Melting Furnaces) to further reduce NOx, SOx, PM2.5 and PM10 emissions from this source category; and

WHEREAS, Sections 182(b)(2) and 182(f) of the federal Clean Air Act (CAA) require areas that are classified as moderate or above for ozone nonattainment to implement Reasonably Available Control Technology (RACT) for sources subject to U.S. Environmental Protection Agency (EPA) Control Techniques Guidelines (CTG) or for "major sources" of NOx and volatile organic compounds (VOC); and

WHEREAS, pursuant to California Assembly Bill 617 (AB 617), Rule 4354 is subject to Best Available Retrofit Control Technology (BARCT) requirements in conjunction with

PM2.5 Plan commitments; and

WHEREAS, the staff report and other supporting documentation was presented to the District Governing Board and the Board has reviewed and considered the entirety of this information prior to approving the project; and

WHEREAS, District staff conducted public workshops regarding Proposed Rule 4354 on December 3, 2020, September 30, 2021, and November 4, 2021; and

WHEREAS, a public hearing for the adoption of proposed amendments to Rule 4354 was duly noticed for December 16, 2021 in accordance with CH&SC §40725.

NOW, THEREFORE, BE IT RESOLVED AS FOLLOWS:

1. The Governing Board hereby adopts the proposed amendments to Rule 4354 (Glass Melting Furnaces). Said rule shall become effective on December 16, 2021.

2. The Governing Board hereby finds, based on the evidence and information presented at the hearing upon which its decision is based, that all notices required to be given by law have been duly given in accordance with CH&SC §40725, and the Governing Board has allowed public testimony in accordance with CH&SC §40726.

3. In connection with said rulemaking, the Governing Board makes the following findings as required by CH&SC §40727:

a. **NECESSITY.** The Governing Board finds, based on the staff report, public testimony, and the record for this rulemaking proceeding, that a need exists for said rule amendments. Amending Rule 4354 is necessary to meet the commitments of the SIP and requirements of the federal CAA and the California CAA. Said Rule amendments satisfy the commitment in the District's *2018 PM2.5 Plan*.

b. **AUTHORITY.** The Governing Board finds that it has the legal authority for said rulemaking under CH&SC §40000 and 40001.

c. **CLARITY.** The Governing Board finds that the Rule amendment is written or displayed so that the meaning can be easily understood by those persons or industries directly affected by the Rule.

d. **CONSISTENCY.** The Governing Board finds that the Rule is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations.

e. **NONDUPLICATION.** The Governing Board finds that the Rule does not impose the same requirements as any existing state or federal regulation.

f. **REFERENCE.** The Governing Board finds that said rulemaking implements federal CAA §172(c)(1) and CH&SC §40920.

4. The Governing Board hereby finds that the requirements of CH&SC §40728.5 and §40920.6 have been satisfied to the greatest extent possible, and that the Governing Board has actively considered and made a good faith effort to minimize any adverse socioeconomic impacts associated with the proposed rulemaking.

5. The Governing Board finds that, because this rulemaking will not cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment, the proposed actions do not constitute a project under the provisions of the California Environmental Quality Act (CEQA) Guidelines §15378. Furthermore, the proposed actions are exempt for actions taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the environment where the regulatory process involves procedures for protection of the environment (CEQA Guidelines §15308) (Actions by Regulatory Agencies for Protection of the Environment) and exempt from CEQA per the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment (CEQA Guidelines §15061 (b)(3)).

6. Pursuant to Section 15062 of the CEQA guidelines, the Executive Director/Air Pollution Control Officer is directed to file a Notice of Exemption with the County Clerks of each of the counties in the District.

7. The Executive Director/Air Pollution Control Officer is directed to file with all appropriate agencies certified copies of this resolution and the rule adopted herein and

is directed to maintain a record of this rulemaking proceeding in accordance with CH&SC §40728.

8. The Executive Director/Air Pollution Control Officer is directed to transmit said rule to the California Air Resources Board for incorporation into the SIP.

9. The Governing Board authorizes the Executive Director/Air Pollution Control Officer to include in the submittal or subsequent documentation any technical corrections, clarifications, or additions that may be needed to secure EPA approval, provided such changes do not alter the substantive requirements of the approved rule.

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THE FOREGOING was passed and adopted by the following vote of the Governing Board of the San Joaquin Valley Unified Air Pollution Control District this 16th day of December 2021, to wit:

AYES:

NOES:

ABSENT:

SAN JOAQUIN VALLEY UNIFIED
AIR POLLUTION CONTROL DISTRICT

By _____
Craig Pedersen, Chair
Governing Board

ATTEST:
Deputy Clerk of the Governing Board

By _____
Michelle Franco

SJVUAPCD
1990 E. Gettysburg Ave.
Fresno, CA 93726
(559) 230-6000

San Joaquin Valley Unified Air Pollution Control District
Meeting of the Governing Board
December 16, 2021

ADOPT PROPOSED AMENDMENTS TO RULE 4354 (GLASS MELTING FURNACES)

Attachment B:

Proposed Amendments to Rule 4354

(30 PAGES)

RULE 4354 GLASS MELTING FURNACES (Adopted September 14, 1994; Amended April 16, 1998; Amended February 21, 2002; Amended August 17, 2006; Amended October 16, 2008; Amended September 16, 2010; Amended May 19, 2011; Amended [*rule adoption date*])

1.0 Purpose

The purpose of this rule is to limit emissions of nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), oxides of sulfur (SOx), and particulate matter (PM10) from glass melting furnaces.

2.0 Applicability

The provisions of this rule shall apply to any glass melting furnace.

3.0 Definitions

3.1 Air-fuel Firing: operation of a glass melting furnace where greater than 50% of the oxidant for the fuel comes from ambient air. 100% air-fuel fired means operation of a glass melting furnace where the oxidant is exclusively ambient air.

3.2 Air Pollution Control Officer (APCO): as defined in Rule 1020 (Definitions).

3.3 Block 24-hour Average: the arithmetic average of the hourly emission rates of a furnace as measured over 24 one-hour periods, daily, from 12:00 AM to 11:59 PM, excluding periods of system calibration.

3.4 California Air Resources Board (CARB): as defined in Rule 1020 (Definitions).

3.5 Carbon Monoxide (CO): emissions of carbon monoxide, a colorless and odorless gas resulting from incomplete combustion of fuel.

3.6 Commercial Propane: a gaseous fuel composed primarily of propane.

3.7 Condensable PM10: PM10 that is vapor phase at stack conditions, but which condenses or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack.

3.8 Container Glass: any glass manufactured by pressing, blowing in molds, drawing, rolling, or casting which is used as a container.

3.9 Continuous Emissions Monitoring System (CEMS): ~~continuous emissions monitoring system.~~ The total equipment necessary for the determination of a gas or particulate matter concentration or emission rate using pollutant analyzer

measurements and a conversion equation, graph, or computer program to produce results in units of the applicable emission limitation or standard.

3.10 Dry Standard Cubic Foot or Feet (Dscf): dry gas volume corrected to standard conditions.

3.11 Environmental Protection Agency (EPA): United States Environmental Protection Agency, or any person designated to act on its behalf.

3.12 Fiberglass: material consisting of fine filaments of glass that are combined in yarn and woven or spun into fabrics, or that are used as reinforcement in other materials or in masses as thermal or as acoustical insulating products for the construction industry.

3.13 Filterable PM10: PM10 that is directly emitted by a source as a solid or liquid at stack or release conditions and captured on the filter of a stack test train.

3.14 Flat glass: any glass produced by the float, sheet, rolled, or plate glass process which is used in windows, windshields, tabletops, or similar products.

3.15 Furnace Battery: two or more glass melting furnaces that exhaust to a common stack.

3.16 Furnace Rebuild: a cold tank repair which is commenced after the end of a furnace campaign period or expected life cycle of a furnace.

3.17 Idling: the operation of a furnace at less than 25 percent of the permitted glass production capacity or fuel use capacity as stated on the Permit to Operate (PTO).

3.18 Key System Operating Parameter: a parameter used to ensure compliance with an emission limit. A key system operating parameter may be any operating parameter that would affect the emissions performance of the particular equipment unit to which the emission limit applies. Examples include, but are not limited to, temperature, pressure drop, airflow rate, or electrostatic precipitator voltage.

3.19 Liquefied Petroleum Gas (LPG): LPG is a general term for the following gases: commercial propane, commercial butane, propane-butane (PB) mixtures, and special duty propane, although some people consider commercial propane separate from LPG.

3.20 Multiple Furnaces: two or more glass melting furnaces at a single facility that do not exhaust to a common stack.

3.21 Normal Business Hours: Monday through Friday, 8:00 am to 5:00 pm.

3.22 Oxidant: a substance that oxidizes another substance or an oxidizing agent.

3.23 Oxides of Nitrogen (NOx): the sum of oxides of nitrogen in the flue gas, collectively expressed as nitrogen dioxide (NO_2).

3.24 Oxides of Sulfur (SOx): the sum of compounds containing sulfur and oxygen, such as sulfur dioxide (SO2) and sulfur trioxide (SO3).

3.25 Oxygen-Assisted Combustion: operation of a glass melting furnace where the oxidant is greater than the oxygen content in ambient air or greater than 20.9 percent oxygen.

3.26 Oxy-fuel Fired: operation of a glass melting furnace where greater than 50% of the oxidant for the fuel is provided from enriched oxygen streams.

3.27 Parts Per Million by Volume (ppmv): the ratio of the number of gas molecules of a given species or group of species, to the number of millions of a total gas molecules.

3.28 Parts Per Million by Weight (ppm): the ratio of the weight of the given species or group of species, to the weight of total mixture and the ratio multiplied by one million.

3.29 Permitted Glass Production Capacity: the maximum pull rate as stated in the Permit to Operate (PTO).

3.30 PM10: as defined in Rule 1020 (Definitions).

3.31 Potential to Emit: as defined in Rule 2201 (New and Modified Stationary Source Review Rule).

3.32 Primary Furnace Combustion System: the burners in a furnace that are used during production of glass.

3.33 Permit to Operate (PTO): a Permit to Operate issued by the District.

3.34 PUC-quality Natural Gas: a gaseous fuel that meets the requirements specified in California Public Utilities Commission (PUC) General Order 58-A. PUC-quality natural gas also means that the sulfur content is no more than one-fourth (0.25) grain of hydrogen sulfide per one hundred (100) standard cubic feet and no more than five (5) grains of total sulfur per one hundred (100) standard cubic feet.

3.35 Pull Rate: the amount of glass coming out of a glass melting furnace, expressed in ~~short~~ tons per day.

3.36 Rolling Average: the arithmetic average of the emission rates of a furnace over a contiguous period, excluding periods of system calibration.

3.36.1 For rolling 30-day averages, the averaged emissions are daily emissions and the contiguous period is 30 days.

3.36.2 For rolling 24-hour averages, the averaged emissions are hourly emissions and the contiguous period is 24 hours.

3.36.3 For rolling three hour averages, the averaged emissions are hourly emissions and the contiguous period is three hours.

3.37 Shutdown: the period of time during which a glass-melting furnace is taken from an operational to a non-operational status by allowing it to cool down from its operating temperature to a cold or ambient temperature as the fuel supply is turned off.

3.38 Standard Conditions: as defined in Rule 1020 (Definitions).

3.39 Start-up: the period of time, after initial construction or a furnace rebuild, during which a glass melting furnace is heated to operating temperature by the primary furnace combustion system, and systems and instrumentation are brought to stabilization.

3.40 Stationary Source: as defined in Rule 2201 (New and Modified Stationary Source Review Rule).

3.41 Volatile Organic Compound (VOC): as defined in Rule 1020 (Definitions).

4.0 Exemptions

4.1 Except for Section 6.7~~8~~, the provisions of this rule shall not apply to electric glass melting furnaces where all the heat is supplied by an electric current from electrodes submerged in the molten glass, except that heat may be supplied by other fuels for start-up when the furnace contains no molten glass.

~~4.2 Except for Section 6.78, the provisions of this rule shall not apply to any glass melting furnace that is part of a stationary source with a total potential to emit, for all processes, less than ten (10.0) tons per year of NOx and less than ten (10.0) tons per year of VOC.~~

4.3~~2~~ ~~Except for Section 6.8, t~~The emission limits of Sections 5.3 and 5.4 and the monitoring requirements of Sections 5.9.3 and 5.9.4 shall not apply to a glass melting furnace that meets all of the following conditions:

4.3.1 The furnace has permitted glass production capacity less than five (5) tons per day;

4.3.2 The actual total NOx emissions for the facility are less than eight (8) tons per year; and

4.3.3 The actual total VOC emissions for the facility are less than eight (8) tons per year.

4.4 The emission limits in Tables 1 through 4 shall not apply during periods of start-up, shutdown, or idling, provided the operator complies with the applicable requirements of Sections 5.5, 5.6, 5.7 and 6.6~~7~~.

5.0 Requirements

5.1 NOx Emission Limits

5.1.1 Except as specified in Section 4.4, the operator of any glass melting furnace shall not operate a furnace in such a manner that results in NOx emissions exceeding the limits in Table 1. The deadlines to comply with the emission limits included in Table 2 are specified in Section 7.0.

Table 1 – NOx Emission Limits, in pounds NOx per ton glass produced, in effect until December 31, 2023

Type of Glass Produced	~~Tier 2 NOx limit~~	~~Tier 3 NOx limit~~	~~Tier 4 NOx limit~~	NOx limit
Container Glass	~~4.0 [A]~~	~~1.5 [B]~~	~~not available~~	1.5 [B]
Fiberglass	~~4.0 [A]~~	~~1.3 [A, C]~~ ~~3.0 [A, D]~~	~~not available~~	1.3 [A, C] 3.0 [A, D]
Flat Glass Standard Option	~~9.2 [A]~~ ~~7.0 [B]~~	~~5.5 [A]~~ ~~5.0 [B]~~	~~3.7 [A]~~ ~~3.2 [B]~~	3.7 [A] 3.2 [B]
Flat Glass Enhanced Option	~~9.2 [A]~~ ~~7.0 [B]~~	~~5.5 [A]~~ ~~5.0 [B]~~	~~3.4 [A]~~ ~~2.9 [B]~~	3.4 [A] 2.9 [B]
Flat Glass Early Enhanced Option	~~9.2 [A]~~ ~~7.0 [B]~~	~~not available~~	~~3.4 [A]~~ ~~2.9 [B]~~	

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Not subject to California Public Resources Code Section 19511
[D] Subject to California Public Resources Code Section 19511

Table 2 – NOx Emission Limits in pounds NOx per ton glass produced, in effect on and after January 1, 2024		
Type of Glass Produced	Phase I NOx limit	Phase II NOx limit
Container Glass	1.1 [B]	0.75 [B]
Fiberglass	1.3 [A, C] 3.0 [A, D]	1.3 [A, C] 3.0 [A, D]
Flat Glass (Standard)	2.8 [A] 2.5 [B]	1.7 [A] 1.5 [B]
Flat Glass (Enhanced)		

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Not subject to California Public Resources Code Section 19511
[D] Subject to California Public Resources Code Section 19511

~~5.1.2 Instead of each furnace individually meeting the applicable Table 1 Tier 2 NOx limit, an operator may choose to meet the Tier 2 NOx limit for multiple furnaces or furnace batteries by considering the multiple furnaces or furnace battery as a single unit. An operator choosing this option shall conform to the provisions of Sections 9.1 through 9.6.2 for Tier 2 NOx.~~

5.1.2~~3~~ Instead of each furnace individually meeting the applicable Table~~s~~ 1 and 2 ~~Tier 3~~ NOx limit, an operator of multiple furnaces or a furnace battery may choose to meet the applicable emission limit by considering the multiple furnaces or furnace battery as a single unit. An operator choosing this option shall conform to the provisions of Sections 9.~~6~~1 through 9.4.8.5~~7.8.5~~ for NOx.

5.1.3~~4~~ ~~A flat glass operator who commits to meet the Table 1 Tier 4 early enhanced option NOx limits shall comply with the limits according to the deadlines specified in Section 7.2.12. After January 1, 2011, an operator who commits to meet the early enhanced NOx limits schedule is not eligible to choose a different compliance option and applicable deadlines.~~

5.2 CO and VOC Emission Limits

5.2.1 Except as specified in Section 4.4, the operator of any glass melting furnace shall not operate a furnace in such a manner that results in CO or VOC emissions exceeding the limits in Table 3~~2~~.

Table 3~~2~~ - CO and VOC Emission Limits – rolling three hour average (ppmv limits are referenced at 8% O_2 and dry stack conditions)			
Type of Glass Produced	Firing Technology	CO Limit	VOC Limit
Container Glass or Fiberglass	100% air fired furnace	300 ppmv	20 ppmv
	Oxygen-assisted or Oxy-fuel furnace	1.0 lb/ton glass produced	0.25 lb/ton glass produced
Flat Glass	100% air fired furnace	300 ppmv	20 ppmv
	Oxygen-assisted or Oxy-fuel furnace	0.9 lb/ton glass produced	0.10 lb/ton glass produced

5.2.2 ~~On and after January 1, 2009, i~~Instead of each furnace individually meeting the applicable CO or VOC or both emission limit in Table 3~~2~~, an operator may choose to meet the CO or VOC or both emission limit for multiple furnaces or furnace batteries by considering the multiple furnaces or furnace battery as a single unit. An operator choosing this option shall conform to the provisions of Sections 9.~~6~~1 through 9.~~7.~~4.8.5 for CO emissions or VOC emissions or both.

5.3 SOx Emission Limits

~~5.3.1 Effective through December 31, 2010, in order to limit SOx emissions, all glass melting furnaces subject to Table 1 emission limits shall fire on PUC-quality natural gas, commercial propane, or LPG on and after March 31, 2008. Liquid fuel may be used as backup fuel or standby fuel provided the liquid fuel contains no more than 15 ppm of sulfur and the furnace exhaust is controlled by a SOx emission control system with control system efficiency of 50% or greater. If a furnace meets the applicable Table 3 SOx limit while firing on backup fuel or standby fuel, the 50% SOx emission control system efficiency requirement shall not apply.~~

5.3.1~~2~~ ~~Effective on and after January 1, 2011, e~~Except as specified in Section 4.4 ~~and Section 5.3.3~~, each furnace shall meet the applicable SOx emission limit from Table 4~~3~~. The deadlines to comply with the emission limits included in Table 5 are specified in Section 7.0.

Table 4~~3~~ - SOx Emission Limits, in pounds SOx per ton glass produced, in effect through December 31, 2023		
Type of Glass Produced	Firing Technology	SOx Limit
Container Glass	Oxy-fuel furnaces and ≥ 25.0% of total cullet is mixed color cullet	1.1 [B]
	All other container glass furnaces	0.90 [B]
Fiberglass	All technologies	0.90 [C]
Flat Glass	All technologies	1.7 [A] 1.2 [B]

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Rolling 24-hour average

Table 5 - SOx Emission Limits, in pounds SOx per ton glass produced, in effect on and after January 1, 2024		
Type of Glass Produced	Firing Technology	SOx Limit
Container Glass	All technologies	0.85 [B]
Fiberglass	All technologies	0.90 [C]
Flat Glass	All technologies	1.7 [A] 1.2 [B]

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Rolling 24-hour average

~~5.3.3 Effective January 1, 2011 and ending on the compliance date detailed in Section 7.2.2, a flat glass furnace operator electing the Tier 4 early enhanced option shall fire on PUC-quality natural gas, commercial propane, or LPG. Liquid fuel may be used as backup fuel or standby fuel provided the liquid fuel contains no more than 15 ppm of sulfur and the furnace exhaust is controlled by a SOx emission control system with control system efficiency of 50% or greater. If a furnace meets the applicable Table 3 SOx limit while firing on backup fuel or standby fuel, the 50% SOx emission control system efficiency requirement shall not apply. On and after the compliance date in Section 7.2.2, a flat glass furnace operator electing the Tier 4 early enhanced option shall be subject to the flat glass SOx emission limit in Table 3.~~

5.3.2~~4~~ The amount of mixed color cullet used shall be determined as a rolling 30-day average.

5.3.3~~5~~ Instead of each furnace individually meeting the applicable SOx limit in Tables 4 and 5~~3~~, an operator may choose to meet the SOx limit for multiple furnaces or furnace batteries by considering the multiple furnaces or furnace battery as a single unit. An operator choosing this option shall conform to the provisions of Sections 9.1~~6~~ through 9.4~~7~~.8.5 for SOx emissions.

5.4 PM10 Emission Limits

5.4.1 Except as specified in Section 4.4, the operator of any glass melting furnace shall not operate a furnace in such a manner that results in PM10 emissions exceeding the applicable limits in Table 6~~4~~, where total PM10 includes both filterable PM10 and condensable PM10. The deadlines to comply with the PM10 emission limits included in Table 7 are specified in Section 7.0.

Table 6~~4~~ - PM10 Emission Limits, in pounds total PM10 per ton glass produced Block 24-hour average, effective until December 31, 2023		
Type of Glass Produced	Firing Technology	PM10 Limit
Container Glass	All technologies	0.50
Fiberglass	All technologies	0.50
Flat Glass	All technologies	0.70

Table 7 - PM10 Emission Limits, in pounds total PM10 per ton glass produced Block 24-hour average, effective on and after January 1, 2024		
Type of Glass Produced	Firing Technology	PM10 Limit
Container Glass	All technologies	0.20
Fiberglass	All technologies	0.50
Flat Glass	All technologies	0.20

5.4.2 Instead of each furnace individually meeting the applicable PM10 limit in Tables 6 and 7~~4~~, an operator may choose to meet the PM10 limit for multiple furnaces or furnace batteries by considering the multiple furnaces or furnace battery as a single unit. An operator choosing this option shall conform to the provisions of Sections 9.1~~6~~ through 9.4~~7~~.8.5 for PM10 emissions.

5.5 Start-up Requirements

5.5.1 The operator shall submit a request for a start-up exemption to the APCO, ARB, and EPA in conjunction with or in advance of an application for Authority to Construct (ATC) associated with a furnace rebuild.

5.5.2 The operator shall submit to the APCO, ARB, and EPA any information deemed necessary by the APCO, ARB, or EPA to determine the appropriate length of start-up exemption. This information shall include, but is not limited to:

5.5.2.1 A detailed list of activities to be performed during start-up, and a reasonable explanation for the length of time needed to complete each activity;

5.5.2.2 A description of the material process flow rates, system operating parameters, etc., that the operator plans to evaluate during the process optimization;

5.5.2.3 Clearly identified control technologies or strategies to be utilized;

5.5.2.4 Explicit description of what physical conditions prevail during start-up periods that prevent the controls from being effective; and

5.5.2.5 Reasonably precise estimate as to when physical conditions will have reached a state that allows for the effective control of emissions.

5.5.3 Start-up exemptions shall begin upon activation of the primary combustion system.

5.5.4 The approved length of the start-up exemption shall be determined by the APCO, CARB, and EPA at the time of the ATC issuance, but in any case, it shall not exceed the amount of time specified in Table 8~~5~~. The approval for the startup exemption shall be in writing from each agency.

Table 8~~5~~ – Maximum Start-up Time

Type of Furnace	Maximum Start-up NOx control system that does not meet Section 5.5.4.2 provisions	Maximum Start-up NOx control system that meets Section 5.5.4.2 provisions
Container glass	70 days	100 days
Fiber-glass	40 days	105 days
Flat glass	104 days	208 days

5.5.4.1 Maximum start-up time for furnaces with NOx controls that do not meet any of the conditions of Section 5.5.4.2 is listed in the center column of Table 8~~5~~.

5.5.4.2 Maximum start-up time column as shown in the rightmost column of Table 8~~5~~ shall be the maximum startup time if the NOx control system meets one or more of the following conditions:

5.5.4.2.1 Is innovative,

5.5.4.2.2 Is not in common use,

5.5.4.2.3 Is not readily available from a commercial supplier,

5.5.4.2.4 Is funded as original research by a public agency.

5.5.5 During start-up period, the stoichiometric ratio of the primary furnace combustion system shall not exceed 5% excess oxygen, as calculated from the actual fuel and oxidant stream flow measurements for combustion in the glass melting furnace, except during the time when the oxidant stream for an oxy-fuel fired furnace contains at least 50% oxygen.

5.5.6 The emission control system shall be in operation as soon as technologically feasible during start-up to minimize emissions.

5.5.7 Notifications shall be performed and records kept in accordance with Section 6.6~~7~~.

5.6 Shutdown Requirements

5.6.1 The duration of shutdown, as measured from the time the furnace operations drop below the idle threshold specified in Section 3.17 to when all emissions from the furnace cease, shall not exceed 20 days.

5.6.2 The emission control system shall be in operation whenever technologically feasible during shutdown to minimize emissions.

5.6.3 Notifications shall be performed and records kept in accordance with Section 6.6~~7~~.

5.7 Idling Requirements

5.7.1 The emission control system shall be in operation whenever technologically feasible during idling to minimize emissions.

5.7.2 Emissions of NOx, CO, VOC, SOx, and PM10 during idling shall not exceed the amount as calculated using the following equation:

$$E_{i,\,max} = E_i * Capacity$$

Where

$E_{i,max}$ = maximum daily emission of pollutant *i* during idling, in pounds pollutant per day;

E_i = Applicable emission limit from Table 1, Table 2, Table 3, or Table 4 for pollutant *i,* in pounds pollutant per ton glass produced;

Capacity = Furnace's permitted glass production capacity in tons glass produced per day.

5.7.3 Notifications shall be performed and records kept in accordance with Section 6.6~~7~~.

5.8 Compliance Determination: Any source testing result, CEMS, or alternate emission monitoring method averaged value exceeding the applicable emission limits in Section 5.1, Section 5.2, Section 5.3, or Section 5.4 shall constitute a violation of the rule.

5.9 Monitoring Requirements

5.9.1 NOx Emission Monitoring Requirements

The operator of any glass melting furnace shall implement a NOx CEMS that is approved, in writing, by the APCO and EPA, and that meets the requirements of Section~~s~~ 6.5~~6~~. For a furnace battery, a single CEMS may be used to determine the total NOx emissions from all the furnaces provided the emission measurements are made at the common stack.

5.9.2 CO and VOC Emission Monitoring Requirements

Section 5.9.2 shall be in effect on and after January 1, 2009.

5.9.2.1 For each furnace subject to Table 2 CO limits, the operator shall implement a CO CEMS that meets the requirements of Section 6.5~~6~~.1, and that is approved, in writing, by the APCO.

5.9.2.2 For each furnace subject to Table 2 VOC limits, the operator shall implement a VOC CEMS that meets the requirements of Section 6.5~~6~~.1, and that is approved, in writing, by the APCO.

5.9.2.3 In lieu of installing and operating a CEMS for CO or CEMS for VOC or both, an operator may propose key system operating parameter(s) and frequency of monitoring and recording.

5.9.2.3.1 The alternate monitoring shall meet the requirements of Section 6.5~~6~~.2.

5.9.2.3.2 The operator shall obtain approval of the APCO and EPA for the specific key system operating parameter(s), monitoring frequency, and recording frequency used by the operator to monitor CO/VOC emissions.

5.9.2.3.3 The operator shall monitor approved key system operating parameter(s) at the approved monitoring frequency to ensure compliance with the emission limit(s) during periods of emission-producing activities.

5.9.2.3.4 Acceptable range(s) for key system operating parameter(s) shall be demonstrated through source test.

5.9.2.4 For the operator of multiple furnaces or a furnace battery utilizing Section 5.2.2 to comply with CO emission limits or VOC emission limits or both, a single parametric monitoring arrangement or a single CEMS may be used to determine the CO emissions or VOC emissions or both from all the furnaces provided that the multiple furnaces/furnace battery is subject to the provisions of Sections 9.6~~1~~ through 9.4~~7~~.8.5 and:

5.9.2.4.1 For units using a CEMS - the emission measurements are made at the common stack.

5.9.2.4.2 For units using a parametric monitoring arrangement – the key system operating parameters are representative of the combined exhaust stream.

5.9.3 SOx Emission Monitoring Requirements

~~Section 5.9.3 shall be in effect on and after January 1, 2011. Flat glass furnace operators electing the Tier 4 early enhanced option shall be subject to the requirements of this section by the compliance date in Section 7.2.2~~.

5.9.3.1 For each furnace subject to Section 5.3, the operator shall implement a SOx CEMS that meets the requirements of Section 6.5~~6~~.1 and that is approved, in writing, by the APCO and EPA.

5.9.3.2 In lieu of installing and operating a CEMS for SOx, an operator may propose key system operating parameter(s) and frequency of monitoring and recording.

5.9.3.2.1 The alternate monitoring shall meet the requirements of Section 6.5~~6~~.2.

5.9.3.2.2 The operator shall obtain approval of the APCO and EPA for the specific key system operating parameter(s), monitoring frequency, and recording frequency used by the operator to monitor SOx emissions.

5.9.3.2.3 The operator shall monitor approved key system operating parameter(s) at the approved monitoring frequency to ensure compliance with the emission limit(s) during periods of emission-producing activities.

5.9.3.2.4 Acceptable range(s) for key system operating parameter(s) shall be demonstrated through source test.

5.9.3.3 For the operator of multiple furnaces or a furnace battery utilizing Section 5.3.2~~4~~ to comply with SOx emission limits, a single parametric monitoring arrangement or a single CEMS may be used to determine the SOx emissions from all the furnaces provided that the multiple furnaces/furnace battery is subject to the provisions of Sections 9.1~~6~~ through 9.4~~7~~.8.5 and one of the following:

5.9.3.3.1 For units using a CEMS - the emission measurements are made at the common stack.

5.9.3.3.2 For units using a parametric monitoring arrangement – the key system operating parameters are representative of the combined exhaust stream.

5.9.4 PM10 Emission Monitoring Requirements

~~Section 5.9.4 shall be in effect on and after January 1, 2011. Flat glass furnace operators electing the Tier 4 early enhanced option shall be subject to the requirements of this section by the compliance date in Section 7.2.2.~~

5.9.4.1 The operator shall propose key system operating parameter(s) and frequency of monitoring and recording.

5.9.4.1.1 The parametric monitoring shall meet the requirements of Section 6.5~~6~~.2.

5.9.4.1.2 The operator shall obtain approval of the APCO and EPA for the specific key system operating parameter(s), monitoring frequency, and recording frequency used by the operator to monitor PM10 emissions.

5.9.4.1.3 The operator shall monitor approved key system operating parameter(s) at the approved monitoring frequency to ensure compliance with the emission limit(s) during periods of emission-producing activities.

5.9.4.1.4 Acceptable range(s) for key system operating parameter(s) shall be demonstrated through source test.

5.9.4.2 In lieu of parametric monitoring, the operator may elect to implement a PM10 CEMS that meets the requirements of Section 6.5~~6~~.1, and that is approved, in writing, by the APCO and EPA.

5.9.4.3 For the operator of multiple furnaces or a furnace battery utilizing Section 5.4.2 to comply with PM10 emission limits, a single parametric monitoring arrangement or a single CEMS may be used to determine the total PM10 emissions from all the furnaces provided that the multiple furnaces/furnace battery is subject to the provisions of Sections 9.1~~6~~ through 9.4~~7~~.8.5 and one of the following:

5.9.4.3.1 For units using a CEMS - the emission measurements are made at the common stack.

5.9.4.3.2 For units using a parametric monitoring arrangement – the key system operating parameters are representative of the combined exhaust stream.

5.10 Routine Maintenance of Add-On Emission Control Systems

During routine maintenance of an add-on emission control system, an operator of a glass melting furnace subject to the provisions of Sections 5.1 through 5.4 is exempt from these limits if:

5.10.1 Routine maintenance in each calendar year does not exceed 144 hours total for all add-on controls; and

5.10.2 Routine maintenance is conducted in a manner consistent with good air pollution control practices for minimizing emissions.

6.0 Administrative Requirements

6.1 Permitted Glass Production Capacity

Each glass melting furnace's PTO shall include the furnace's permitted glass production capacity in units of tons of glass pulled per day as a permit condition.

6.2 Operations Records

~~Section 6.2 shall be in effect through December 31, 2010.~~

~~6.2.1 Operators subject to the Table 1 Tier 2 NOx emission limits shall maintain the records specified in Sections 6.2.1.1 through 6.2.1.3 for a period of five years, make them available on site during normal business hours, and submit them to the APCO, ARB, or EPA upon request.~~

~~6.2.1.1 Daily records of the total hours of operation, type and quantity of fuel used in each furnace, and/or the quantity of glass pulled from each furnace whichever matches the permit condition in the furnace's PTO.~~

~~6.2.1.2 Daily records of NOx emission rate in lb/ton of glass pulled.~~

~~6.2.1.3 Records of source tests and operating parameters established during initial source test, maintenance and repair, malfunction, and idling, start-up and shutdown.~~

~~6.2.2 The following requirements shall apply from January 1, 2009 through December 31, 2010. Operators shall maintain daily records of:~~

~~6.2.2.1 CO emission rate in units matching Table 2 if CEMS is used for CO monitoring;~~

~~6.2.2.2 VOC emission rate in units matching Table 2, if CEMS is used for VOC monitoring;~~

~~6.2.2.3 For CO or VOC or both monitored using an approved parametric monitoring arrangement, operating values of the key system operating parameters.~~

~~6.2.3 The operator shall retain the records specified in Sections 6.2.1 and 6.2.2 for a period of five years, make them available on site during normal business hours to the APCO, ARB, or EPA, and submit them to the APCO, ARB, or EPA upon request.~~

~~6.3 Operations Records~~

~~Section 6.23 shall be in effect on and after January 1, 2011.~~

6.2~~3~~.1 Operators shall maintain daily records of the following items:

6.2~~3~~.1.1 Total hours of operation;

6.2~~3~~.1.2 The quantity of glass pulled from each furnace;

6.2~~3~~.1.3 NOx emission rate in lb/ton glass pulled;

6.2~~3~~.1.4 CO emission rate in units matching Table 2, if a CEMS is used;

6.2~~3~~.1.5 VOC emission rate in units matching Table 2, if a CEMS is used;

6.2~~3~~.1.6 SOx emission rate in lb/ton glass pulled, if a CEMS is used;

6.2~~3~~.1.7 PM10 emission rate in lb/ton glass pulled, if a CEMS is used;

6.2~~3~~.1.8 For container glass furnaces that are oxy-fuel fired:

6.2~~3~~.1.8.1 The weight of mixed color mix cullet used;

6.2~~3~~.1.8.2 The total amount of cullet used by weight; and

6.2~~3~~.1.8.3 The ratio, expressed in percent, of mixed color mix weight to total cullet weight.

6.2~~3~~.2 For pollutants monitored using an approved parametric monitoring arrangement, operators shall record the operating values of the key system operating parameters at the approved recording frequency.

6.2~~3~~.3 Operators shall maintain records of the following items:

6.2~~3~~.3.1 Source tests and source test results;

6.2~~3~~.3.2 The acceptable range for each approved key system operating parameter, as established during source test;

6.2~~3~~.3.3 Maintenance and repair; and

6.2~~3~~.3.4 Malfunction.

6.2~~3~~.4 The operator shall retain records specified in Sections 6.2~~3~~.1 through 6.2~~3~~.3 for a period of five years; make the records available on site during normal business hours to the APCO, CARB, or EPA; and submit the records to the APCO, CARB, or EPA upon request.

6.3~~4~~ Compliance Source Testing

6.3~~4~~.1 Each glass melting furnace or a furnace battery shall be source tested at least once every calendar year, but not more than every 18 months and not sooner than every 6 months to demonstrate compliance with the applicable requirements of Section 5.0. During annual source testing, compliance shall be demonstrated with the applicable short term emission limit (i.e. the applicable emission limit with the shortest averaging period). Sources exempt under Section 4.3~~2~~ are not required to source test for the exempted pollutants.

6.3~~4~~.2 Source test conditions shall be representative of normal operations, but not less than 60 percent of the permitted glass production capacity.

6.3~~4~~.3 For operators using alternative monitoring systems, during the source test, the operator shall monitor and record, at a minimum, all operating data for each parameter, fresh feed rate, and flue gas flow rate and submit this data with the test report.

6.3~~4~~.4 During source testing in accordance with Section 6.3~~4~~.1, the arithmetic average of three (3) 30-consecutive-minute test runs shall be used to determine compliance with NOx, CO, VOC, and SOx emission limits.

6.34.5 During source testing in accordance with Section 6.34.1, the arithmetic average of three (3) 60-consecutive-minute test runs shall be used to determine compliance with PM10 emission limits.

6.34.6 For a given pollutant, if two of the three runs individually demonstrate emissions above the applicable limit, the test cannot be used to demonstrate compliance for the furnace, even if the averaged emissions of all three test runs is less than the applicable limit.

6.45 Test Methods

Compliance with the requirements of Section 5.0 shall be determined in accordance with the following source test procedures or their equivalents as approved by the EPA, CARB, and the APCO:

6.45.1 Oxides of nitrogen – EPA Method 7E, EPA Method 19, or CARB Method 100.

6.45.2 Carbon monoxide (ppmv) – EPA Method 10, or CARB Method 100.

6.45.3 Volatile Organic Compound (ppmv) – EPA Method 25A expressed in terms of carbon or ARB Method 100. EPA Method 18 or CARB Method 422 shall be used to determine emissions of exempt compounds.

6.45.4 Stack gas oxygen, carbon dioxide, excess air, and dry molecular weight – EPA Method 3 or 3A, or CARB Method 100.

6.45.5 Stack gas velocity and volumetric flow rate – EPA Method 2.

6.45.6 Oxides of sulfur – EPA Method 6C, EPA Method 8, or CARB Method 100.

6.45.7 The SOx emission control system efficiency shall be determined using the following:

6.45.7.1 EPA Method 2 for measuring flow rates; and

6.45.7.2 EPA Method 6C or EPA Method 8 for measuring total SOx (expressed as SO_2) concentrations at the inlet and outlet of the control device.

6.45.7.3 The SOx emission control system efficiency shall be calculated using the following equation:

$$\% \text{ Control Efficiency} = [(C_{SO2,\ inlet} - C_{SO2,\ outlet}) / C_{SO2,\ inlet}] \text{ X } 100$$

Where:

$C_{SO2, inlet}$ = concentration of SOx (expressed as SO_2) at the inlet side of the SOx emission control system, in lb/dscf

$C_{SO2, outlet}$ = concentration of SOx (expressed as SO_2) at the outlet side of the SOx emission control system, in lb/dscf

6.4~~5~~.8 Sulfur content of liquid fuel – American Society for Testing and Materials (ASTM) D 6428-99 or ASTM D 5453-99.

6.4~~5~~.9 PM10 Test Methods

6.4~~5~~.9.1 Filterable PM10 emissions - EPA Method 5; EPA Method 201; or EPA Method 201A. An operator choosing EPA Method 5 shall count all PM collected as PM10.

6.4~~5~~.9.2 Condensable PM 10 emissions - EPA Method 202 with the following procedures:

6.4~~5~~.9.2.1 Purge the impinger with dry nitrogen for one hour. The one-hour purge with dry nitrogen shall be performed as soon possible after the final leak check of the system.

6.4~~5~~.9.2.2 Neutralize the inorganic portion to a pH of 7.0. Use the procedure, "Determination of NH4 Retained in Sample by Titration" described in Method 202 to neutralize the sulfuric acid. Neutralizing the inorganic portion to a pH of 7.0 determines the un-neutralized sulfuric acid content of the sample without over-correcting the amount of neutralized sulfate in the inorganic portion.

6.4~~5~~.9.2.3 Evaporate the last 1 ml of the inorganic fraction by air drying following evaporation of the bulk of the impinger water in a 105 degrees C oven as described in the first sentence of the Method 202 section titled "Inorganic Fraction Weight Determination."

6.5~~6~~ Emission~~s~~ Monitoring Systems

6.5~~6~~.1 An approved CEMS shall comply with all of the following requirements:

6.5~~6~~.1.1 Code of Federal Regulations Title 40 (40 CFR) Part 51;

6.5~~6~~.1.2 40 CFR Part 60.7 (Notification and Record Keeping);

6.5~~6~~.1.3 40 CFR Part 60.13 (Monitoring Requirements);

6.5~~6~~.1.4 40 CFR Part 60 Appendix B (Performance Specifications);

6.5~~6~~.1.5 40 CFR Part 60 Appendix F (Quality Assurance Procedures); and

6.5~~6~~.1.6 Applicable sections of Rule 1080 (Stack Monitoring).

6.5~~6~~.2 An approved alternate emission monitoring method shall be capable of determining the furnace emissions on an hourly basis and shall comply with the following requirements:

6.5~~6~~.2.1 40 CFR 64 (Compliance Assurance Monitoring); and

6.5~~6~~.2.2 40 CFR 60.13 (Monitoring Requirements).

6.6~~7~~ Notifications and Records for Start-up, Shutdown, and Idling

6.6~~7~~.1 The operator of any glass melting furnace claiming an exemption under Section 4.4 shall notify the APCO by telephone at least 24 hours before initiating idling, shutdown, or start-up. The notification shall include: date and time of the start of the exempt operation, reason for performing the operation, and an estimated completion date.

6.6~~7~~.2 The operator shall notify the APCO by telephone within 24 hours after completion of the start-up, shutdown, or idling.

6.6~~7~~.3 The operator claiming exemption under Section 4.4 shall maintain all operating records/support documentation necessary to support claim of exemption.

6.6~~7~~.4 Records/support documentation required by Section 6.6~~7~~.3 shall meet the following requirements:

6.6~~7~~.4.1 The records/support documentation shall be retained on-site for five years.

6.6~~7~~.4.2 The records/support documentation shall be made available to the APCO, CARB, or EPA during normal business hours.

6.67.4.3 The records/support documentation shall be submitted to the APCO, CARB, or EPA upon request.

6.78 Records for Exempt Furnaces

6.78.1 An operator claiming exemption under Section 4.1~~,~~ or Section 4.2~~, or Section 4.3~~ shall maintain records/documentation necessary to support claim of exemption.

6.78.2 Records/support documentation specified in Section 6.78.1 shall meet the following requirements:

6.78.2.1 The records/documentation shall be retained on site for five years.

6.78.2.2 The records/documentation shall be made available to the APCO, CARB, or EPA during normal business hours.

6.78.2.3 The records/documentation shall be submitted to the APCO, CARB, or EPA upon request.

7.0 Compliance Schedule

Glass melting furnaces subject to the requirements of Section 5 shall comply with applicable emissions limits in accordance to the schedule below.

7.1 NOx Limits

Table 9: NOx Emissions Limits Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Phase I NOx Emission Limits	June 1, 2022	January 1, 2024
Phase II NOx Emission Limits	For furnace rebuilds occurring after January 1, 2024, 18 months prior to the date of the furnace rebuild, but not later than June 1, 2028	Date of completion of next furnace rebuild occurring after January 1, 2024, or by January 1, 2030, whichever is sooner

7.1.1 For a furnace that is not meeting the applicable Phase I NOx limit in Section 5.1 Table 2 on January 1, 2022, the operator must submit a complete Authority to Construct (ATC) application by June 1, 2022; and be in full compliance with the applicable Section 5.1 Table 2 Phase I NOx limit by January 1, 2024.

7.1.2 For a container glass or flat glass furnace that will not meet the applicable Phase II NOx limit in Section 5.1 Table 2 by January 1,

2024, the operator must submit a complete ATC application eighteen (18) months prior to the date of the next planned furnace rebuild, not later than June 1, 2028, and be in full compliance with the Section 5.1 Table 2 Phase II limit by the completion of the furnace rebuild, or by January 1, 2030, whichever comes sooner.

7.2 SOx Limits

Table 10: SOx Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Table 5 SOx Emission Limits	June 1, 2022	January 1, 2024

7.2.1 For a furnace that is not meeting the applicable SOx limit in Section 5.3 Table 5 on January 1, 2022, the operator must submit a complete ATC application by June 1, 2022; and be in full compliance with the applicable SOx limit by January 1, 2024.

7.3 PM10 Limits

Table 11: PM10 Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Table 7 PM10 Emission Limits	June 1, 2022	January 1, 2024

7.3.1 For a container glass or flat glass furnace that is not meeting the applicable PM10 emission limit in Section 5.4 Table 7 on January 1, 2022, the operator must submit a complete ATC application, if needed, by June 1, 2022; and be in full compliance with the applicable PM 10 limit by January 1, 2024.

7.4 As shown in Tables 9, 10 and 11, the columns labeled:

"Authority to Construct" identifies the date by which the operator shall submit an Authority to Construct (if needed) for each furnace subject to Table 2, Table 5 and Table 7 emission limits, control and monitoring requirements.

"Compliance Deadline" identifies the date by which the operator shall demonstrate that each unit is in compliance with the Table 2, Table 5 and Table 7 emission limits as applicable.

~~7.0 Compliance Schedule~~

~~7.1 Container Glass and Fiberglass Furnaces~~

~~7.1.1 For container glass/fiberglass furnaces, the operator must submit a completed Authority to Construct (ATC) application, if needed, by June 1, 2012; and be in full compliance with the Section 5.1 Table 1 Tier 3 NOx limits by January 1, 2014.~~

~~7.1.2 For a container glass/fiberglass furnace that is not meeting the applicable SOx limit in Section 5.3 Table 3 on January 1, 2009, the operator must submit a completed ATC application, if needed, by June 1, 2009 and be in full compliance with the applicable SOx emission limit by January 1, 2011.~~

~~7.1.3 For a container glass/fiberglass furnace that is not meeting the applicable PM10 emission limit in Section 5.4 Table 4 on January 1, 2009, the operator must submit a completed ATC application, if needed, by June 1, 2009; and be in full compliance with the applicable PM10 limit by January 1, 2011.~~

~~7.2 Flat Glass Furnaces~~

~~7.2.1 A flat glass operator, who does not commit to the Tier 4 early enhanced option in Section 5.1 Table 1, shall comply with the applicable deadlines specified in Sections 7.2.1.1 through 7.2.1.6.~~

~~7.2.1.1 The operator must submit a completed ATC application, if needed, by June 1, 2009; and be in full compliance with the Section 5.1 Table 1 Tier 3 NOx limits by January 1, 2011.~~

~~7.2.1.2 By January 1, 2011, operators of flat glass furnaces shall submit, in writing, a letter signed by a responsible official. The letter shall include the following information:~~

~~7.2.1.2.1 Name and address of the facility;~~

~~7.2.1.2.2 A statement declaring whether the furnace will meet the Section 5.1 Table 1 Tier 4 standard option or the Tier 4 enhanced option;~~

~~7.2.1.2.3 The technology expected to be utilized to meet the stated Section 5.1 Table 1 Tier 4 option; and~~

~~7.2.1.2.4 Signature of responsible official with the person's printed name and title.~~

~~7.2.1.3 Operators utilizing the Section 5.1 Table 1 Tier 4 standard option shall submit a completed ATC application, if needed, by June 1, 2012; and be in full compliance with the Section 5.1 Table 1 Tier 4 standard option NOx limits by January 1, 2014.~~

~~7.2.1.4 Operators utilizing the Section 5.1 Table 1 Tier 4 enhanced option shall submit a completed ATC application, if needed, by June 1, 2016; and be in full compliance with the Section 5.1 Table 1 Tier 4 enhanced option NOx limits by January 1, 2018.~~

~~7.2.1.5 For a furnace that is not meeting the applicable SOx emission limit in Section 5.3 Table 3 on January 1, 2009, the operator must submit a completed ATC application, if needed, by June 1, 2009 and be in full compliance with the applicable SOx emission limit by January 1, 2011.~~

~~7.2.1.6 For a furnace that is not meeting the applicable PM10 emission limit in Section 5.4 Table 4 on January 1, 2009, the operator must submit a completed ATC application, if needed, by June 1, 2009; and be in full compliance with the applicable PM10 limit by January 1, 2011.~~

~~7.2.2 A flat glass operator, who commits to the Tier 4 early enhanced option in Section 5.1 Table 1, shall comply with the applicable emission limits by the compliance deadlines specified in Sections 7.2.2.1 through 7.2.2.3.~~

~~7.2.2.1 By November 1, 2010, operators of flat glass furnaces shall submit, in writing, a letter signed by a responsible official. The letter shall include the following information:~~

~~7.2.2.1.1 Name and address of the facility;~~

~~7.2.2.1.2 A statement declaring the furnace will meet the Tier 4 early enhanced option, Section 5.1 Table 1 Tier 4 NOx limit; Section 5.3 Table 3 SOx limit; and Section 5.4 Table 4 PM10 limit by January 1, 2014 or by the next furnace rebuild schedule, whichever is earlier;~~

~~7.2.2.1.3 The technologies expected to be utilized to meet the stated Early Enhanced Option, Section 5.1 Table 1,~~

~~Tier 4 NOx limit; Section 5.3 Table 3 SOx limit; and Section 5.4 Table 4 PM10 limit; and~~

~~7.2.2.1.4 Signature of responsible official with the person's printed name and title.~~

~~7.2.2.2 By June 1, 2012, the operator shall submit a completed ATC application, if needed, for any furnace modifications to comply with the applicable NOx, SOx and PM10 emission limits.~~

~~7.2.2.3 Full compliance with the Section 5.1 Table 1 Tier 4 early enhanced option NOx limits; Section 5.3 Table 3 SOx limit; and Section 5.4 Table 4 PM10 limit by January 1, 2014 or by the next furnace rebuild, whichever is earlier.~~

8.0 Calculations

8.1 The pollutant mass emission rate in lb/hr shall be converted to lb pollutant/ton of glass pulled according to the following equation:

$$lb\,emitted\,/\,ton\,of\;glass\;pulled\;=\;\frac{lb\,/\,hr\,emitted}{Pull\,rate\,in\,tons\,/\,hr}$$

8.2 100% air-fuel fired furnaces which have concentration limits in ppmv values shall be subject to the CO and VOC emission limits specified in Section 5.2. These limits are referenced at dry stack gas conditions and 8.0 percent by volume of stack oxygen. The CO and VOC emission concentrations shall be corrected to 8.0 percent oxygen by using the equation below, or an equivalent correction method that is approved, in writing, by each of the following: APCO, ARB, and EPA.

$$(\text{ppmv CO})_{\text{corrected}} = \frac{12.9\%}{20.9\% - (\%\,O_2)_{\text{measured}}} \text{ x } (\text{ppmv CO})_{\text{measured}}$$

$$(\text{ppmv VOC})_{\text{corrected}} = \frac{12.9\%}{20.9\% - (\%\,O_2)_{\text{measured}}} \; x \; (\text{ppmv VOC})_{\text{measured}}$$

8.3 The operator of a oxy-fuel fired furnace, oxygen-assisted combustion furnace, or a furnace utilizing any fuel oxidants other than 100% ambient air, shall submit to the APCO, ARB, and EPA for approval any methodologies and data that will be used to calculate emission rates for NOx, CO, and VOC if the methods are different than specified in Sections 8.1 or 8.2. Unless the operator received prior written approval from APCO, ARB, and EPA of all the calculation methods to be used that are different than specified in Sections 8.1 or 8.2, compliance with the

emissions limits cannot be fully demonstrated, and it shall be deemed to be a violation of the rule.

9.0 Furnace Battery or Multiple Furnaces Control

9.1 As an alternative to complying with the emission limits specified in Section 5.1 through 5.4 for each individual furnace Tier 2 NOx emission limits, the operator of a furnace battery or multiple furnaces shall operate the furnace battery or multiple furnaces pursuant to Sections 9.2 through 9.46.2. Any violation of the requirements below shall be considered a violation of this rule, and a violation of the aggregated emission limits shall constitute a violation for each furnace for the entire averaging time.

9.2 Any operator who elects to comply with Section 9.0 in lieu of complying with the requirements of Section 5.1 Tier 2 NOx emission limits shall be subject to a 10% environmental air quality benefit pursuant to 40 CFR 51 Subpart U. NOx emissions shall be at least 10% lower than the limits specified in Section 5.1 (NOx), Tier 2.

9.3 The daily aggregate NOx emissions, as determined in accordance with Section 9.6, shall be no greater than those obtained by controlling each furnace to comply individually with the limits in Section 5.1 Tier 2.

9.4 The operator shall conduct source testing of the furnace according to the requirements of Section 6.4.

9.25 Determination of Compliance

9.25.1 The operator shall calculate and record on a daily basis the aggregated emissions of furnaces which are subject to Section 9.32. Such records shall be kept for a period of five years. The operator shall notify the APCO of any violation of Section 9.43.3 within 24 hours. The notification shall include:

9.25.1.1 name and location of the facility;

9.25.1.2 identification of furnace(s) causing the exceedances;

9.25.1.3 the cause and the expected duration of exceedances;

9.25.1.4 calculation of actual NOx, CO and VOC emissions;

9.25.1.5 corrective actions and schedules to complete the work.

9.2~~5~~.2 The operator shall demonstrate compliance with the requirements of Section 9.3 through CEMS data or approved alternate emission monitoring methods, and source test results.

9.3~~6~~ Determination of Aggregated Emissions

9.3~~6~~.1 The aggregated emissions for a given pollutant of a furnace battery are the emissions for the pollutant as measured at the common stack divided by the sum of the daily glass pulled from each furnace.

9.3~~6~~.2 The aggregated emissions of multiple furnaces for a given pollutant are the sum of each furnace's daily emissions for the pollutant divided by the sum of the daily glass pulled from each furnace.

9.4~~7~~ Multiple Furnaces/Furnace Battery Requirements for ~~Tier 3~~ NOx, CO, VOC, SOx and PM10 Control

9.4~~7~~.1 An operator of either furnace battery or multiple furnaces that elects to meet the emission limits for the furnaces through the requirements of this section shall be subject to a 10% air quality benefit in accordance with 40 CFR Part 51 Subpart U. The maximum emission rate shall be at least 10% lower than the applicable limit specified in Section 5.1 (~~Tier 3~~ NOx), Section 5.2 (CO and VOC), Section 5.3 (SOx), or Section 5.4 (PM10), for each pollutant subject to this option.

9.4~~7~~.2 The operator of a furnace battery or multiple furnaces choosing the alternate emission limit shall operate the furnace battery or multiple furnaces according to Sections 9.4~~7~~.3 through 9.4~~7~~.8.5. Only those pollutants with emissions that are averaged across multiple furnaces/furnace battery are subject to all subparts of Section 9.4~~7~~. Pollutant emissions that are not averaged across multiple furnaces/furnace battery are subject to the applicable emission limits of Sections 5.1 through 5.4

9.4~~7~~.3 The daily aggregate emissions, as determined in accordance with Section 9.3~~6~~, shall be no greater than those obtained by controlling each furnace to comply individually with applicable emission limits, less the 10% air quality benefit.

9.4~~7~~.4 The operator shall demonstrate compliance with Section 9.4~~7~~.3 through source test results and monitoring by either CEMS or approved alternate emission monitoring methods.

9.4~~7~~.5 The operator shall conduct source testing of the furnaces according to the requirements of Section 6.3~~4~~.

9.4~~7~~.6 Records shall be kept in accordance with the applicable provisions of Section 6.0.

9.4~~7~~.7 Any violation of the aggregated emission limits shall constitute a violation of the rule for each furnace for the entire averaging period.

9.4~~7~~.8 The operator shall notify the APCO of any violation of Section 9.4~~7~~.3 within 24 hours. The notification shall include:

9.4~~7~~.8.1 Name and location of the facility;

9.4~~7~~.8.2 Identification of furnace(s) causing the violation;

9.4~~7~~.8.3 The cause and the expected duration of violation;

9.4~~7~~.8.4 Calculation of actual NOx, CO, VOC, SOx, and PM10 emissions during the violation;

9.4~~7~~.8.5 Corrective actions and schedules to complete the work.

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San Joaquin Valley Unified Air Pollution Control District
Meeting of the Governing Board
December 16, 2021

ADOPT PROPOSED AMENDMENTS TO RULE 4354 (GLASS MELTING FURNACES)

Attachment C:

Final Draft Staff Report with Appendices for Proposed Amendments to Rule 4354

(101 PAGES)

SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

FINAL DRAFT STAFF REPORT

Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

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San Joaquin Valley UNIFIED AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING™

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Table of Contents

I. SUMMARY

The San Joaquin Valley Unified Air Pollution Control District (District) is committed to protecting public health for all residents in the San Joaquin Valley (Valley) through efforts to meet health-based state and federal ambient air quality standards with efficient, effective, and entrepreneurial air quality management strategies. One such strategy includes a commitment in the District's *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (*2018 PM2.5 Plan*) to amend District Rule 4354 (Glass Melting Furnaces) to reduce emissions of oxides of nitrogen (NOx) from this source category.

In support of this commitment, District staff have conducted a comprehensive technical evaluation of controls capable of further reducing emissions from glass melting furnaces operating in the Valley, as well as an in-depth review of air district, state, and federal regulations for this source category, and a robust public process. Proposed amendments to the rule include more stringent NOx, sulfur oxide (SOx) and particulate matter (PM10) emission limits for glass melting furnaces in the Valley. Due to the high costs associated with the control technology necessary to comply with the proposed final NOx emissions limits, a phased compliance schedule is being proposed whereby operators must comply with lower Phase I NOx emissions limits by 2024, and then must comply with the final NOx emissions limits by 2030 or upon the completion of the next furnace rebuild, whichever is sooner.

A. Reasons for Rule Development and Implementation

The U.S. Environmental Protection Agency (EPA) periodically reviews and establishes health-based air quality standards for ozone, particulates, and other pollutants. Although the San Joaquin Valley's (Valley) air quality is steadily improving, the Valley experiences unique and significant difficulties in achieving these increasingly stringent standards. The Valley's challenges in meeting the national ambient air quality standards are unmatched in the nation due to the region's unique geography, meteorology and topography. In response to the latest federal mandates and to improve quality of life for Valley residents, the San Joaquin Valley Air Pollution Control District (District) has developed and implemented multiple generations of rules on various sources of air pollution. Valley businesses are currently subject to the most stringent air quality regulations in the nation. Since 1992, the District has adopted nearly 650 rules to implement an aggressive on-going control strategy to reduce emissions in the Valley, resulting in air quality benefits throughout the Valley. Similarly, the California Air Resources Board (CARB) has adopted stringent regulations for mobile sources. Together, these efforts represent the nation's toughest air pollution emissions controls and have greatly contributed to reduced ozone and particulate matter concentrations in the Valley.

Due to the significant investments made by Valley businesses and residents and stringent regulatory programs established by the District and CARB, the Valley's ozone and PM2.5 (particulate matter that is 2.5 microns or less in diameter) emissions are at

historically low levels, and air quality over the past few years has continued to set new clean air records. Despite the significant progress under these regulations, greatly aided by the efforts of Valley businesses and residents, many air quality challenges remain, including attainment of the federal air quality standards for PM2.5 that are addressed in the District's *2018 PM2.5 Plan.*

The *2018 PM2.5 Plan* contains a comprehensive set of local and state measures that build on existing measures to further reduce air pollution from stationary, area, and mobile sources throughout the Valley. Attaining the multiple federal PM2.5 standards by the mandated deadlines is not possible without significant additional reductions in directly emitted PM2.5 and key PM2.5 precursors like NOx. The attainment strategy includes a suite of innovative regulatory and incentive-based measures, supported by robust public education and outreach efforts to reduce emissions of PM2.5 in the Valley. One of the measures included in the plan is to amend District Rule 4354 (Glass Melting Furnaces) as a necessary measure for further reducing NOx and bringing the Valley into attainment with federal PM2.5 standards within the mandated federal deadlines.

In addition, through the District's implementation of AB 617 and the development of the South Central Fresno Community Emissions Reduction Program (CERP), the District heard concerns from community residents and other community stakeholders regarding glass melting furnace operations. These discussions with the community led to specific measures being included within the South Central Fresno CERP to evaluate Rule 4354 for potential further emissions reductions. The proposed amendments to Rule 4354 address this measure within the South Central Fresno CERP.

Based on a comprehensive technical analysis, in-depth review of local, state, and federal regulations, and a robust public process, District staff are proposing several modifications to Rule 4354 to reduce emissions from glass melting furnaces operating in the San Joaquin Valley. This rule amendment project is proposed to satisfy the commitments in the District's *2018 PM2.5 Plan*, and to ensure that Rule 4354 requires the implementation of state and federal standards of Reasonably Available Control Technology (RACT), Best Available Retrofit Control Technology (BARCT), and Most Stringent Measures (MSM). In addition, the proposed amendments address commitments included in Board/CARB-approved South Central Fresno Community Emissions Reduction Program developed through the AB 617 community engagement process.

B. Health Benefits of Implementing Plan Measures

Exposure to PM2.5 and ozone has been linked to a variety of health issues, including aggravated asthma, increased respiratory symptoms (irritation of the airways, coughing, difficulty breathing), decreased lung function in children, development of chronic bronchitis, irregular heartbeat, non-fatal heart attacks, increased respiratory and cardiovascular hospitalizations, lung cancer, and premature death. PM2.5 is a major health risk because it can be inhaled more deeply into the gas exchange tissues of the

lungs, where it can be absorbed into the bloodstream and carried to other parts of the body. CARB explains that even short-term exposure of less than 24 hours can cause premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, and restricted activity days. Children, older adults, and individuals with heart or lung diseases are the most likely to be affected by PM2.5 and ozone.

As NOx emissions are a key precursor in the formation of both ozone and PM2.5, continuing to assess the feasibility of achieving additional NOx reductions across the Valley is critical to improving PM2.5 and ozone throughout the region. PM2.5 emissions are characterized by a unique combination of direct and indirectly formed constituents. NOx emissions are a precursor to the formation of ammonium nitrate, which is a large portion of total PM2.5 during the Valley's peak winter season. NOx is also a precursor to ozone, which is formed when heat and sunlight interact with NOx and volatile organic compounds (VOC). Harmful ozone is predominantly formed at the surface during the summer season in the Valley. The District has long worked to reduce NOx emissions as the primary precursor for the formation of ozone and PM2.5 in the Valley.

To address federal health-based standards for ozone and PM2.5 and improve public health, the District develops attainment plans and implements control measures to lower direct and precursor emissions throughout the San Joaquin Valley. The proposed amendments will achieve additional reductions in NOx emissions as requirements are implemented by affected sources, and new technologies are installed. New regulatory and incentive-based measures proposed by both the District and CARB, combined with existing measures achieving new emissions reductions, are necessary to achieve the emissions reductions required to attain the health-based federal standards as expeditiously as practicable, and will improve public health as emissions reductions are realized.

C. Description of Project

The District Governing Board first adopted Rule 4354 on September 14, 1994, and the rule has subsequently been amended six times, with the last amendment occurring in 2011. Through recent federal review, Rule 4354 has been found to implement or exceed RACT levels of control.[1] In February 2020, EPA also found that this rule implements Best Available Control Measures (BACM) and MSM, as further discussed in EPA's TSD for the approval of the *San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS*.[2]

[1] U.S. Environmental Protection Agency: Air Plan Approval; California; San Joaquin Valley Unified Air Pollution Control District; Reasonably Available Control Technology Demonstration. August 2018.
[2] U.S. Environmental Protection Agency: Technical Support Document for EPA's Technical Support Document "EPA Evaluation of BACM/MSM" for the San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQA. February 2020.

Rule 4354 applies to any glass melting furnace and limits NOx, carbon monoxide (CO), VOC, SOx, and PM10 emissions from any glass melting furnace. Industrial glass making is a continuous process with raw materials supplied to the furnace at the front end, and product taken off the line at the back end of the process. The raw materials for making glass are silica sand, soda ash, limestone and salt cake. Melting these basic materials and forming them into the desired product geometry creates the final glass product. The different end products vary widely in raw material additives, processing equipment, conditions, and product quality requirements. The emission limits of Rule 4354 depend on the type of glass produced, furnace firing technology and the emission averaging period.

During the development of the *2018 PM2.5 Plan,* the District evaluated all potential control technologies and all control technologies achieved in practice in other areas, as well as those included in other state implementation plans for this category. The District's evaluation of the South Coast Air Quality Management District (SCAQMD) container glass facility found that potential further control technologies, such as the pairing of the Tri-Mer UltraCat ceramic catalytic filtration system in combination with an oxy-fuel furnace, to be practicable and achievable. On June 5, 2020, SCAQMD amended their District Rule 1117 (Emissions from Container Glass Melting and Sodium Silicate Furnaces) to include:

- Transition the Regional Clean Air Incentive Market (RECLAIM) program to a command-and-control regulatory structure
- Establish NOx and SOx emission standards for container glass melting and sodium silicate furnaces
- Update monitoring, reporting and recordkeeping requirements,
- Establish provisions for idling, startup, and shutdown of the furnaces

While the current District rule meets or exceeds state and federal control requirements for this source category, given the enormity of reductions needed to demonstrate attainment with the latest PM2.5 standards, the District committed in the *2018 PM2.5 Plan* to go beyond Most Stringent Measures to pursue the following potential opportunities to reduce NOx emissions from container glass facilities. The District will go one step further to reduce emissions in the Valley, and will also pursue emission reductions from other glass melting source categories, such as those from flat glass facilities, to the extent that additional NOx controls are technologically and economically feasible. The *2018 PM2.5 Plan* commitments for container glass melting furnaces include:

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

The proposed amendments to Rule 4354, which satisfy commitments in the *2018 PM2.5 Plan*, include lowering the existing NOx, PM10, and SOx emissions limits with a phased compliance schedule for container and flat glass facilities. The proposed

emissions limits and compliance timeframes have been established based on the results of a comprehensive technical evaluation, as further discussed later in this staff report and associated appendices. The limits proposed would require the installation of advanced combustion technology and permit modification. An evaluation was also conducted as to the feasibility of requiring alternative technologies.

Through the implementation of the proposed Rule 4354 amendments, from this source category an estimated 18% reduction of NOx, 49% reduction of PM10, 58% reduction of PM2.5, and 4.1% reduction in SOx emissions will be achieved from the baseline emissions inventory by 2024. An estimated total 43% reduction of NOx emissions will occur by 2030. The proposed rule amendments would result in estimated emissions reductions of 0.64 tpd NOx in 2024, and total emissions reductions of 1.67 tpd NOx by 2030. Emission reductions of 0.13 tpd PM10, 0.13 tpd PM2.5, and 0.07 tpd SOx would also be achieved by 2024. Emission reductions achieved through the proposed requirements of this rule amendment will contribute towards the Valley's attainment of the health-based federal PM2.5 and ozone standards, and satisfy the commitments in the *2018 PM2.5 Plan.*

D. Rule Development Process

District staff conducted a public Scoping Meeting in December 2020, and held public workshops in September 2021, and November 2021. Information about public meetings was shared with members of the public, affected sources, manufacturers of control technologies, and other interested stakeholders. Information about the regulatory amendments and workshops were also made available at meetings of the Citizens' Advisory Committee, Environmental Justice Advisory Group, and AB 617 Community Steering Committees. Workshop announcements and public notices were provided in both English and Spanish, and interpretation services were made available upon request. At the public workshops, District staff presented the emission reduction and public health objectives of the proposed rulemaking project, and solicited feedback from the public on potential amendments. Initial draft amendments to Rule 4354 were published for public review on November 4, 2021, and an updated draft was published on November 16, 2021.

Throughout the rule development process, District staff solicited information from affected source operators, consultants, vendors and manufacturers of control technologies, and trade associations on the technological feasibility and compliance cost information that would be useful in developing amendments to Rule 4354. The comments received from the public, affected sources, and interested parties during the public outreach and workshop process were incorporated into the rule or addressed in the staff report as appropriate.

The proposed rule amendments and draft staff report with associated appendices were published for 30-day public review and comment prior to the public hearing to consider the adoption of the proposed amendments to Rule 4354 by the District Governing

Board. A summary of significant comments and District responses is available in Appendix A of the final draft staff report.

In addition, pursuant to state law, the District is required to perform a socioeconomic impact analysis prior to adoption, amendment, or repeal of a rule that has significant air quality benefits or that will strengthen emission limitations. As part of the District's socioeconomic analysis process, the District hired a socioeconomic consultant to prepare a socioeconomic impact report. The results of the socioeconomic analysis are included in this report (Appendix D).

DISCUSSION

A. Source Category

The San Joaquin Valley is home to six glass manufacturing facilities that represent three different glass industry types: container glass, flat glass and fiberglass. There are twelve glass melting furnaces at these six facilities that are subject to Rule 4354.

The glass manufacturing process starts with the receiving and storage of raw materials consisting mainly of silica sand, limestone, soda ash and salt cake. The raw materials are mixed and conveyed to the glass melting furnace where they are heated and melted down in to molten glass. Glass melting furnaces typically operate at temperatures ranging from 2,700 °F to 3,100 °F. The molten glass is removed from the melting furnace and then shaped or formed based on the products that are being manufactured at a specific facility. The different end products vary widely in raw material additives, processing equipment and conditions, and product quality requirements.

Glass melting furnaces contribute to over 99% of the total emissions from a glass plant, including both particulates and gaseous pollutants. Particulates result from volatilization of materials in the melt that combine with gases and form condensates. NOx results from the combustion of fuels in the furnace burners and when nitrogen and oxygen react in the high temperatures of the furnace. SOx results from oxidation of sulfur in fuel, raw material, and a refining agent called salt cake (sodium sulfate, chemical formula Na2SO4), and also from direct application of gaseous SO_2 in annealing ovens (lehrs) to achieve the desired glass properties.

B. Emissions Control Technologies

Over the years, the District has adopted numerous generations of rules and rule amendments for glass melting furnaces that have significantly reduced emissions from this source category. As part of these regulatory efforts, all of the glass melting furnaces in the Valley have been equipped with the best available NOx, SOx and PM control technologies. There are two primary methods that the glass manufacturing facilities within the Valley currently employ for controlling NOx emissions from their

glass melting furnaces. Four facilities have retrofitted their glass furnaces to be fired on oxy-fuel instead of regular natural gas and two facilities have installed a selective catalytic reduction system (SCR) on the exhaust of their glass furnaces. These controls reduce the overall amount of NOx generated from a glass furnace during the combustion/raw material melting process or reduce the amount of NOx in the exhaust stream from a glass furnace before it is emitted into the atmosphere. Emissions of particulate matter are typically controlled by an electrostatic precipitator (ESP) or a filtration system. SOx emissions are controlled through the injection of a sorbent into the exhaust stream, and/or through the use of scrubbers.

The following sections discuss the control technologies evaluated as a part of this regulatory development effort in further detail.

NOx Emission Control Technologies

Oxy-Fuel Firing

An oxy-fuel furnace reduces NOx emissions by minimizing the availability of nitrogen during the combustion process. Ambient air is made up of approximately 78% nitrogen. In an uncontrolled furnace, ambient air is introduced into the furnace with the fuel gas for combustion. NOx emissions are formed by the chemical reaction of the nitrogen in the combustion air during the combustion process. In an oxy-fuel furnace, ambient air is replaced with 100% oxygen, which reduces the amount of nitrogen in the combustion air. With less nitrogen in the combustion air, the overall NOx emissions created from the combustion process is also reduced. The oxy-fuel furnace is designed, maintained, and operated to minimize the infiltration of the ambient air into the combustion zone.

Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) is a way to reduce NOx in the exhaust gases from glass melting furnaces. NOx is reduced to molecular nitrogen by adding an exhaust gas treatment system consisting of a catalyst module and a reagent injection system to add the reagent to the glass melting furnace exhaust. SCR units must operate at a certain temperature range to effectively reduce NOx in the exhaust gas by injecting either ammonia stored in aqueous form, anhydrous form, generated on demand, or released from urea into the post-combustion zone of the engine.

Catalytic Ceramic Filtration Systems

Ceramic Catalytic Filtration Systems (CCFS) is another method of reducing NOx in the exhaust gases from glass melting furnaces. CCFS are typically designed as modular housing units that are made up of numerous individual ceramic catalytic filters. Inside of each filter, nanobits of catalyst material are embedded throughout the filter walls. A reagent, typically anhydrous ammonia, is injected in to the exhaust stream before the gases pass through the CCFS. As the exhaust gases and reagent pass through the

ceramic catalytic filter walls, a chemical reaction occurs on the catalyst surface that reduces NOx to molecular nitrogen and water (H_2O).

Electric Glass Melting Furnaces

As part of researching potential amendments to Rule 4354, District staff considered the feasibility of reducing emissions through the use of electric furnaces. One of the container glass manufacturing facilities in the Valley is permitted to operate an electric glass melting furnace. However, this electric furnace has been out of glass production operation for more than ten years. During staff research, it was found that electric furnaces require a limited pull rate, and have a production capacity limited to a maximum of about 300 tons of glass per day. Furthermore, District staff found that electric furnace technology is only compatible with container glass manufacturing, and is not able to be utilized for flat glass production due to the technological design of electric furnaces and the need for a substantial float to provide heat insulation. District staff are not aware of any electric furnaces operating as the primary glass melting unit for flat glass manufacturing facilities. For container glass operations, multiple electric furnaces would need to be purchased to replace one existing natural-gas fired furnace, and operators would incur significant additional operation and maintenance costs, as compared to the operation of a furnace fired on natural gas. The typical electric furnace life is 4 years, compared to 10-12 years of that of a natural gas furnace with electric boost, further increasing the costs associated with operating an electric furnace in lieu of a natural gas-fired furnace.

Furthermore, electric furnaces consume more total energy per ton of glass, and would require much higher electricity capacity than is currently available from the electrical grid. For example, a modern 230 ton per day electric furnace has an electricity consumption rating of approximately 7.5 megawatts (MW), compared to a 430 ton per day natural gas furnace with electric boost where the maximum energy consumption is about 2.6 MW. More than 10 MW of additional electrical capacity at a glass production plant would be required to replace just one 430 ton per day furnace. The associated draw on the electrical grid to support required glass production levels for plants operating in the Valley would not be feasible or able to be supported through the current electrical infrastructure or electrify generation capacity in the region. While electric furnaces may be utilized for small production operations, or to provide additional heating boosts as an auxiliary unit at large manufacturing plants, District have found that the use of electric furnaces as the primary glass melting furnace for large production operations is not currently feasible or cost effective due to the above considerations.

Particulate Matter (PM) Emission Control Techniques

The airflow through a glass melting furnace can be on the order of 30,000 standard cubic feet per minute. With airflow this high, un-melted raw material in the furnace can be lifted off the surface of the molten glass to go directly into the furnace's exhaust stream. Operators can influence the rate at which raw materials become directly

emitted PM through raw materials specification, control of the raw material moisture at the point the material is delivered to the furnace, and design of the furnace's material charging system.

The reduced PM10 emission limits are based off emission test data from each facility and the test data shows they are already capable of meeting the revised PM10 emission limits without major modifications to controls. Therefore, a detailed discussion of PM10 emission control techniques will not be included as a part of this analysis. Facilities will continue to employ the PM emission control techniques they currently use, which can consist of the following: raw material particle size selection, raw material moisture content control, properly designed charging system, reduction of raw material volatilization, and post combustion PM removal with an ESP or similar filter device.

SOx Emissions Control Techniques

Dry Sorbent Injection (DSI)

In dry sorbent injection, dry sorbent material, such as calcium hydroxide (also known as hydrated lime) or trona (raw form of sodium bicarbonate), is dispensed from a silo, fluidized, and injected through a port into the exhaust gas or into a reaction chamber where it reacts with SO_2 to form sodium sulfate (when trona is injected), or calcium sulfate (when calcium hydroxide is injected). The reaction products are captured by a downstream PM control such as an ESP or ceramic dust collectors (CDC). Additional reactions and SO_2 absorption may occur at the surface of the CDC or ESP. A properly engineered DSI system could achieve up to 80% reduction in sulfur dioxide emissions.

Based on the type of glass plant, all or a portion of the reaction products (e.g. sodium sulfate, calcium sulfate, etc.) is recycled into the batch. This recycling reduces the need to purchase and deliver raw ingredients. Flat glass plants recycle most of their reaction products into a glass batch, whereas, only a limited amount of these materials are able to be recycled at container glass facilities due to production processes.

Semi-Dry Absorbers (SDA)

Semi-Dry Absorbers operate by mixing a small amount of water with dry sorbent such as soda ash or lime to make slurry solution. Slurry is atomized into the absorber. The SO_2 is absorbed into the slurry and reacts to form sodium (when soda ash is used) or calcium (when lime is used) salts. These salts are captured by a particulate matter control system such as ESP or ceramic dust collectors (CDC) which is located downstream. Additional reactions and SO_2 absorption may occur at the surface of the CDC or ESP. A properly engineering system could be effective to reduce up to 80% sulfur dioxide emissions.

II. PROPOSED AMENDMENTS TO RULE 4354

A. Current Rule 4354

Rule 4354 was adopted in September 1994, and was last amended May 19, 2011. The rule applies to any glass melting furnace, but the rule exempts electric glass furnaces, glass furnaces that are located at a stationary source with a total potential to emit, for all processes, of less than ten tons per year (tpy) of NOx or less than ten tpy of VOCs. The current rule limits emissions of NOx, VOC, CO, SOx and PM10.

The emission limits currently established in the rule depend on type of glass produced, furnace firing technology and emission averaging period. Table 1 shows the existing range of emission limits for the various pollutants. The rule also contains testing, monitoring, and reporting provisions. Where operations have multiple furnaces connected through a battery or where averaging provisions are utilized across multiple furnaces, operators are required to comply with emissions limits 10% lower that the stated emission limits in the rule to ensure environmental benefits.

Table 1 – Current Rule 4354 Selected Emission Limits

Glass Type	NOx Limit (lb/ton glass)	CO Limit	VOC Limit	SOx Limit (lb/ton glass)	PM10 Limit (lb/ton glass)
Container	1.5	300 ppm/1.0 lb/ton glass	20 ppm /0.25 lb/ton glass	0.9 - 1.1	0.5
Fiberglass	1.3 - 3.0	300 ppm/1.0 lb/ton glass	20 ppm/0.25 lb/ton glass	0.9	0.5
Flat (Float)	2.9 - 3.2	300 ppm/0.9 lb/ton glass	20 ppm/0.10 lb/ton glass	1.2	0.7

B. Proposed Amendments to Rule 4354

As a result of the comprehensive regulatory analysis conducted in support of the commitments in the *2018 PM2.5 Plan*, District staff are recommending several amendments to existing Rule 4354. The following paragraphs detail the proposed modifications to existing rule language and requirements. For further information on how proposed limits were determined, please see the Incremental Cost Analysis in Appendix C. Additionally, in an effort to simplify rule language and clarify existing requirements, expired language would be removed in several sections of the rule. See Proposed Rule 4354 for exact language.

Purpose (Section 1.0)

No changes proposed at this time.

Applicability (Section 2.0)

No changes proposed at this time.

Definitions (Section 3.0)

Minor updates and clarifications to existing definitions have been made.

The definition of Continuous Emissions Monitoring System (CEMS) has been updated to provide clarity as follows:

> *Continuous Emissions Monitoring System (CEMS): The total equipment necessary for the determination of a gas or particulate matter concentration or emission rate using pollutant analyzer measurements and a conversion equation, graph, or computer program to produce results in units of the applicable emission limitation or standard*

Exemptions (Section 4.0)

Section 4.2 – Proposed updates would amend this section to remove exemptions for any glass melting furnace that is part of a stationary source with a total potential to emit for all process less than 10.0 tpy of NOx and less than 10.0 tpy of VOC. There is one facility in the Valley that would be newly subject to the requirements of Rule 4354 through the removal of this exemption.

Requirements (Section 5.0)

Updates in this section specify the proposed updated emission limits for the pollutants controlled though the rule, with proposed updated emission limits included for NOx, PM10, and SOx. The proposed emissions limits included in this section of the rule are based on an in-depth technical analysis, and a thorough public process. District staff have found control technologies necessary to achieve the proposed limits to be reasonably available, economically feasible, and cost effective. Please see the evaluation included in Appendix C for further information on how proposed limits were established. Compliance with the proposed requirements would be required per the schedule detailed in Section 7 of the rule. Proposed amendments would also update this section to remove outdated requirements.

Due to the results of the District's technical evaluation of feasible further control technologies, emission limits for fiberglass melting furnaces are not proposed to be changed as a part of this rule project, although these emission limits may be further evaluated as part of future regulatory development efforts.

Proposed Container Glass Melting Furnace Emissions Limits

The current container glass NOx limit of 1.5 lb-NOx/ton of glass pulled will be lowered in Phase I to the proposed limit of 1.1 lb-NOx/ton lb-NOx/ton of glass pulled based on a rolling 30-day average with a compliance deadline of January 1, 2024. The Phase II proposed limit of 0.75 lb-NOx/ton of glass pulled is based on a rolling 30-day average, with a phased in compliance schedule based on the furnace rebuild schedule starting in 2024, but no later than 2029. The proposed PM10 emission limits will lower the current container glass PM10 limits from 0.5 lb-PM10/ton of glass pulled to a proposed limit in the range of 0.2 lb-PM10/ton of glass pulled based on a 24-hour block average starting in 2024.

Regarding the assessment of potential changes to the current SOx emissions limits in the rule, in initial workshops during the rulemaking process, preliminary rule concepts and potential emissions limits were discussed. As the technical and feasibility analyses of further SOx emissions reductions continued, the final draft proposed Rule 4354 lowered the SOx emissions limits from the current 1.1 lbs/ton of glass pulled to 0.85 lbs/ton of glass pulled on a rolling 30 day average, with compliance required by 2024.

Proposed Flat Glass Melting Furnace Emissions Limits

Similarly, the proposed amendments to the flat glass category include lowering the existing NOx emission limits in two phases. The current limit of 3.2 lb/ton of glass pulled on a 30-day average will change to the proposed Phase I limit of 2.5 lb-NOx/ton of glass pulled (30-day rolling average) with the compliance deadline of January 1, 2024. The proposed Phase II limit will be set at 1.5 lb-NOx/ton glass pulled (30-day rolling average) phased in by the furnace rebuild schedule starting in 2024, but no later than 2029. Starting in 2024, the proposed PM10 emission limits will be lowered from the current limit of 0.7 lb-PM10/ton of glass pulled to 0.2 lb-PM10/ton of glass pulled based on a 24-hour block average.

After careful evaluation of the current control technology and the feasibility of further emissions controls, District staff recommends no changes to the SOx emissions limit for flat glass due to the nature of the current control operations at the flat glass facilities. During the analysis, staff found that the achievable SOx emission levels are directly related to the NOx control technologies a facility employs. It was determined that SOx emissions levels lower than the current 1.2 lb/ton rule limit are only achievable for facilities that utilize a semi-dry scrubber system. Semi-dry scrubber systems are only used at facilities that operate oxy-fuel fired furnaces and/or ceramic filter systems for NOx emission control. The use of SCR systems as a NOx control technology require that the exhaust stream be at a higher temperature, to ensure effective NOx control. The use of a semi-dry scrubbing system can lower the exhaust temperature to a level that is below what is required for the SCR system to operate efficiently. For flat glass facilities utilizing SCR as a NOx control system, meeting a lower SOx emissions limit would require replacing their current NOx control system. As shown in Appendix C of

this staff report, this is an extremely costly control option and is not a cost-effective compliance option. Therefore, District staff are recommending that the current SOx limits for flat glass melting furnaces be maintained.

The current CO and VOC limits included in the rule would be maintained for both container and flat glass melting furnaces. Requiring additional reductions in CO and VOC emissions could jeopardize the ability for glass furnaces to achieve further NOx, SOx , PM2.5 and PM10 emission reductions, which are critical to meet *2018 PM2.5 Plan* goals. Keeping the existing CO and VOC emission limits in the current rule would allow operators the much-needed flexibility to be able to achieve more stringent NOx, SOx and PM10 emissions limits under varying field operating conditions and applications.

The proposed limits for both types of glass melting furnace would require Phase I permit modifications and potential upgraders or tuning to existing facility control technologies. In Phase II, compliance with proposed limits would require the installation or enhancements of advanced emission control technologies such as oxy-fuel combustion, ceramic catalytic filters, selective catalytic reduction or a combination of control technologies. The following tables outline the specific emissions limits proposed. *Section 5.1* – This section has been updated to specify proposed updates to NOx emissions limits. Expired language has been deleted from the section. Table 1 has been updated to remove expired provisions, and Table 2, included below, has been added to the rule to detail the phased NOx emissions limits.

Rule 4354 Table 2 – NOx Emission Limits in pounds NOx per ton glass produced, in effect on and after January 1, 2024		
Type of Glass Produced	Phase I NOx limit	Phase II NOx limit
Container Glass	1.1 [B]	0.75 [B]
Fiberglass	1.3 [A, C] 3.0 [A, D]	1.3 [A, C] 3.0 [A, D]
Flat Glass (Standard)	2.8 [A] 2.5 [B]	1.7 [A] 1.5 [B]
Flat Glass (Enhanced)		

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Not subject to California Public Resources Code Section 19511
[D] Subject to California Public Resources Code Section 19511

Section 5.3.1: This section has been updated to specify proposed updates to SOx control requirements. The existing SOx emissions limits in the rule are specified in Rule 4354 Table 4, which was renumbered, and a new Table 5 has been added to the rule to specify the proposed SOx emissions limits.

Rule 4354 Table 5 - SOx Emission Limits, in pounds SOx per ton glass produced, in effect on and after January 1, 2024		
Type of Glass Produced	Firing Technology	SOx Limit
Container Glass	All technologies	0.85 [B]
Fiberglass	All technologies	0.90 [C]
Flat Glass	All technologies	1.7 [A] 1.2 [B]

[A] Block 24-hour average
[B] Rolling 30-day average
[C] Rolling 24-hour average

Section 5.4 – Section 5.4 has been updated to include the proposed updated PM10 control requirements. Tables in this section have been renumbered, and expired provisions have been removed. Table 7, copied below, has been added to the rule to specify the proposed updated PM10 emissions limits.

Rule 4354 Table 7 - PM10 Emission Limits, in pounds total PM10 per ton glass produced, Block 24-hour average, effective on and after January 1, 2024		
Type of Glass Produced	Firing Technology	PM10 Limit
Container Glass	All technologies	0.20
Fiberglass	All technologies	0.50
Flat Glass	All technologies	0.20

Administrative Requirements (Section 6.0)

This section has been updated to remove expired language

Compliance Schedule (Section 7.0)

This section has been updated to remove outdated language, and to establish compliance timeframes required for full compliance with the proposed emission limits established in Section 5.0. Furnaces subject to the requirements of Section 5 shall comply with applicable emissions limits in accordance to the schedule included in Table 9, 10, and 11 of the proposed rule, as included below.

Rule 4354 Table 9: NOx Emissions Limits Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Phase I NOx Emission Limits	June 1, 2022	January 1, 2024

Rule 4354 Table 9: NOx Emissions Limits Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Phase II NOx Emission Limits	For furnace rebuilds occurring after January 1, 2024, 18 months prior to the date of the furnace rebuild, but not later than June 1, 2028	Date of completion of next furnace rebuild occurring after January 1, 2024, or by January 1, 2030, whichever is sooner

Rule 4354 Table 10: SOx Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Table 5 SOx Emission Limits	June 1, 2022	January 1, 2024

Rule 4354 Table 11: PM10 Compliance Schedule		
Emission Level	Authority to Construct	Compliance Deadline
Table 7 PM10 Emission Limits	June 1, 2022	January 1, 2024

Timeframes established in the proposed rule reflect the time necessary for facilities to plan for full compliance with the proposed emission limits, including budgeting for any required modifications to the facility or facility operations, and modifying existing controls or facility control practices, and installing any required further control technologies. As discussed further in Appendix C of this staff report, due to the high cost of controls required to meet the proposed Phase II emissions limits, an extended timeframe is being proposed for compliance with the Phase II emissions limits to ensure that the proposed requirements are cost-effective and economically feasible.

Along with the tables outlining the proposed compliance timeframes, language in this section has been added or modified to provide more clarity with the proposed changes to the rule, including definitions for Authority to Construct and Compliance Deadlines referenced in the proceeding tables.

Calculations (Section 8.0)

No changes proposed at this time.

Furnace Battery or Multiple Furnaces Control (Section 9.0)

Draft amendments would update this section to remove expired language no longer applicable. No additional amendments to Section 9.0 are proposed in this rule amendment, as the section in the current Rule 4354 meets or exceeds all state and federal requirements. Due to glass plant design and control operations, it is common

practice for the emissions from multiple furnaces to be controlled through one integrated control system. This is referred to as a furnace battery. Section 9.0 of the rule requires that operations where a furnace battery is employed, or where averaging provisions are used across multiple furnaces, that a 10% environmental benefit be achieved and therefore operators must comply with emissions limits 10% lower than the emission limits detailed in Section 5.0 of the rule.

Section 9.1 – 9.10 Outdated language has been removed, and various language has been added or modified to provide more clarity with the proposed changes to the rule.

III. ANALYSIS

A. Emission Reduction Analysis

In order to determine the emission reductions associated with the proposed changes, District staff queried the District Permit Services Databases for all glass melting furnaces, and then sorted the furnaces into categories based on the types of glass melting operation (container, flat, and fiber glass). Based on existing permitted limits, District staff calculated the potential to emit for each affected unit, and then, based on the proposed new emissions limit for each pollutant, calculated the percent reduction that would be achieved through compliance with the proposed rule updates.
For State Implementation Plan (SIP) purposes, the percent reduction achieved through compliance with the proposed rule was applied to the baseline emissions inventory used in the District's *2018 PM2.5 Plan.* Based on these calculations, the SIP-creditable emission reductions estimated to be achieved from the proposed amendments to the Rule 4354 are illustrated in the table below, in tons per day (tpd) on an annual average basis. Please see Appendix B of this draft staff report for further details.

Estimated Emission Reductions								
Pollutant	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
NOx	0.64	0.64	0.64	0.64	0.64	0.64	1.67	1.67
SOx	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
PM10	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
PM2.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13

B. Cost Effectiveness Analysis

The California Health and Safety Code (CH&SC) Section 40920.6(a) requires the District to conduct both an absolute cost effectiveness analysis and an incremental cost effectiveness analysis of available emission control options before adopting each BARCT rule. The purpose of conducting a cost effectiveness analysis is to evaluate the economic reasonableness of the pollution control measure or rule. The analysis also serves as a guideline in developing the control requirements of a rule. Details of the cost effectiveness analysis is contained in Appendix C to this report.

C. Socioeconomic Analysis

State law requires the District to analyze the socioeconomic impacts of any proposed rule or rule amendment that significantly affects air quality or strengthens an emission limitation. The socioeconomic analysis has been used to further refine the rule amendments. The final socioeconomic report is attached to this staff report as Appendix D.

D. Environmental Impact Analysis

Based on the District's assessment of the Rule Amendment, the District concludes that the Rule Amendment will not cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment, and as such is not a "project" as that term is defined under the CEQA Guidelines § 15378.

The Rule Amendment to Rule 4354 will lower the existing NOx, PM10, and SOx emission limits and will result in obtaining NOx emission reductions. According to Section 15061 (b)(3) of the CEQA Guidelines, a project is exempt from CEQA if, "(t)he activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA." As such, substantial evidence supports the District's assessment that assuming the Rule Amendment is a "project" under CEQA, it will not have any significant adverse effects on the environment.

In Furthermore, the Rule Amendment is an action taken by a regulatory agency, the San Joaquin Valley Air Pollution Control District, as authorized by state law to assure the maintenance, restoration, enhancement, or protection of air quality in the San Joaquin Valley where the regulatory process involves procedures for protection of air quality. CEQA Guidelines §15308 (Actions by Regulatory Agencies for Protection of the Environment), provides a categorical exemption for "actions taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the environment where the regulatory process involves procedures for protection of the environment. Construction activities and relaxation of standards allowing environmental degradation are not included in this exemption." No construction activities or relaxation of standards are included in this Rule Amendment.

Therefore, for all the above reasons, the Rule Amendment is exempt from CEQA. Pursuant to Section 15062 of the CEQA Guidelines, District staff will file a Notice of Exemption upon Governing Board approval of Rule Amendment.

E. Rule Consistency Analysis

Prior to adopting, amending, or repealing a rule or regulation, California Health and Safety Code § 40727.2 requires a written analysis that identifies and compares requirements of the proposed rule with corresponding, existing and proposed District rules and corresponding EPA rules, regulations, and guidelines. Based on the analysis, District staff concludes that the proposed amendments to Rule 4354 are consistent with other District rules and are not in conflict with these rules. Further, the proposed rule amendments are consistent with EPA rules, regulations, and guidelines that apply to the same source category. The analysis is presented in Appendix E of the Final Draft Staff Report.

F. Most Stringent Measures (MSM) and Best Available Retrofit Control Technology (BARCT) Analyses

As previously discussed, on November 15, 2018, the District adopted the District's *2018 PM2.5 Plan* to satisfy Clean Air Act requirements for the PM2.5 national ambient air quality standards. As a part of the *2018 PM2.5 Plan*, the District demonstrated that Rule 4354 continued to satisfy BACM (Best Available Control Measures) and performed a Most Stringent Measures (MSM) analysis for all rules that contain emission limits or requirements for NOx or PM. EPA defines MSM as, "*the maximum degree of emission reductions that has been required or achieved from a source or source category in any other attainment plans or in practice in any other states and that can feasibly be implemented in the area.*"

In February 2020, EPA published the *Technical Support Document - EPA Evaluation of BACM/MSM, San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS*,[3] and determined that Rule 4354 establishes BACM and MSM control requirements for glass melting furnaces.

In addition to federal control requirements, most existing stationary sources in California non-attainment areas such as the San Joaquin Valley have been subject to state Best Available Retrofit Control Technology (BARCT) requirements since the 1980s. California Health and Safety Code Section 40406 defines BARCT as follows:

> *"Best Available Retrofit Control Technology (BARCT) is an air emission limit that applies to existing sources and is the maximum degree of reduction achievable, taking into account environmental, energy and economic impacts by each class or category of source."*

[3] Technical Support Document - EPA Evaluation of BACM/MSM, San Joaquin Valley PM2.5 Plan for the 2006 PM2.5 NAAQS (February 2020)

In December 2018, District staff conducted a comprehensive review of requirements in other air districts, and found that Rule 4354 meets or exceeds BARCT.[4] As discussed above, the District and EPA have determined that the current requirements of Rule 4354 satisfy MSM and BACM for NOx and PM precursors. However, these conclusions were made prior to June 2020. Since that time, the South Coast Air Quality Management District (SCAQMD) amended their Rule 1117 – Emissions from Container Glass Melting and Sodium Silicate Furnaces on June 5, 2020 to lower the NOx emissions limit for container glass melting furnaces to 0.75 lb/ton of glass pulled averaged over a rolling 30-day period.

Among other changes, the proposed amendments to District Rule 4354 will lower the NOx and PM emissions limits to:

- 0.75 lb-NOx/ton of glass pulled for container glass furnaces (30-day rolling average)
- 1.5 lb-NOx/ton of glass pulled for flat glass furnaces (30-day rolling average)
- 0.2 lb-PM10/ton of glass pulled for both container and flat glass furnaces (block 24-hour average)

The proposed amendments will make the NOx, PM, and SOx emission limits in Rule 4354 as stringent or more stringent than SCAQMD Rule 1117. Based on District staff review of other air district requirements, the proposed updates would establish requirements that are more stringent than any other rule in non-attainment areas in California and in the nation. Consequently, the proposed version of Rule 4354 will continue to meet or exceed BARCT requirements for NOx and PM emissions. Adoption of the proposed amendments will also ensure that Rule 4354 continues to meet or exceed BACM and MSM levels of emissions control.

[4] SJVAPCD, *Final Draft Staff Report: Expedited Best Available Retrofit Control Technology Implementation Schedule Under AB 617,* (December 16, 2018). Available at http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2018/December/final/13.pdf

APPENDIX A

Summary of Significant Comments and Responses for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

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SUMMARY OF SIGNIFICANT COMMENTS
DRAFT AMENDMENTS TO RULE 4354
(GLASS MELTING FURNACES)
November 16, 2021

The District published the proposed rule November 16, 2021 for 30-day public review and comment.

No comments were received.

SUMMARY OF SIGNIFICANT COMMENTS
DRAFT AMENDMENTS TO RULE 4354
(GLASS MELTING FURNACES)
November 4, 2021

The District held a public workshop to present, discuss, and receive comments on the draft amendments to Rule 4354 on November 4, 2021. Summaries of significant comments received during the public workshop and associated comment period are summarized below.

Comments were received from the following:
Ardagh Glass Inc. (Ardagh)
E&J Gallo Winery (Gallo)
Manufacturers of the Central Valley (MCCV)

1. **COMMENT:** The District should consider all costs associated with the proposed emission limits, including taking into consideration the 10% emissions penalty if a combined furnace limit is selected. (Ardagh)

   RESPONSE: The District appreciates the comment and has included all appropriate and documented costs in the cost-effectiveness analysis.

2. **COMMENT:** The District should use a rolling 24-hour period for PM10 emissions measurement, rather than a 24-hour block average, since the 24-hour block average could be more punitive. (Ardagh)

   RESPONSE: The District does not agree that the 24-hour block average results in a more punitive requirement. Compliance with the proposed PM10 emission limits may be demonstrated through approved EPA test methods, as outlined in Section 5.9.4 of Rule 4354.

3. **COMMENT:** Rule 4354 should account for non-standard operating conditions, including maintenance, start-up/shutdown, idling, and below-standard production for foreseen or unforeseen conditions. The District allows for such practices under the current rule, and exceptions to measurement periods for theses non-standard operating conditions should continue as a part of the proposed amendments to Rule 4354. (Ardagh)

   RESPONSE: District Rule 4354 currently allows for such practices under the current rule and is not proposing any changes to these provisions.

4. **COMMENT:** The SOx emission rate should be carefully evaluated based on the effectiveness of controls and 10% additional emissions reduction requirement under the proposed rule. (Gallo)

   RESPONSE: The District appreciates the comment and is proposing a more stringent emissions limitation based on the feasibility and effectiveness of available controls.

5. **COMMENT:** Additional time and information is needed to understand the operational impacts and costs, as well as the socioeconomic impacts associated with the draft rule. (MCCV, Ardagh)

   RESPONSE: The District appreciates the comments and has continued to engage with affected stakeholders to answer questions and seek additional feedback. The District has conducted engineering evaluations with costs reviewed and provided by affected operators, technology vendors and manufacturers to understand the potential costs of compliance of the proposed regulation. Additionally, the District worked closely with a third party economic consultant to understand the potential regional economic impacts from the proposed regulations. Public comments are welcomed and have been solicited beginning in December 2020, and through the latest public workshops held in September and November 2021. District staff welcome additional comment up to and including at the December public hearing for Governing Board consideration of the proposed amendments.

SUMMARY OF SIGNIFICANT COMMENTS
DRAFT AMENDMENTS TO RULE 4354
(GLASS MELTING FURNACES)
September 30, 2021

The District held a public workshop to present, discuss, and receive comments on the draft amendments to Rule 4354 on September 30, 2021. Summaries of significant comments received during the public workshop and associated comment period are summarized below.

Comments were received from the following:
Group Comment Letter[1]
Glass Packaging Institute (GPI)
Guardian Glass (Guardian)

1. **COMMENT:** Consideration should be provided to public health and other adverse economic impacts of air pollution when weighing the technological and economic feasibility of rules with a particular focus on environmental justice implications. (Group Comment Letter)

   RESPONSE: The District appreciates the comment and is proposing the regulatory amendments consistent with established state and federal requirements and guidance, and as part of ongoing efforts to meet health-based state and federal ambient air quality standards to protect public health in communities across the Valley.

2. **COMMENT:** We support the container and flat glass proposed emission limits for NOx, PM10, and SOx. However, we recommend NOx limits be enacted immediately as opposed to two phases in 2024 and 2029. (Group Comment Letter)

   RESPONSE: The District appreciates the comment and through the proposed amendments would be establishing the most stringent emissions limitations anywhere in the nation. To ensure feasibility, the District is proposing a phased compliance schedule that achieves rapid near-term reductions in the first phase while allowing operators adequate time to design and install the next generation of very costly control technologies under the strict timeframe established under the second phase of 2029, or furnace “rebricking”, whichever comes first. Given the once-per-furnace lifetime rebricking schedules for glass manufacturing facilities, it is expected that some facilities will install, and emissions reductions will be achieved, ahead of the proposed backstop deadlines of 2024 and 2029.

[1] Comment letter was submitted by the following: CVAQ, Little Manila Rising, Mi Familia Vota, Valley Improvement Projects

3. **COMMENT:** While we support the proposed lower emissions limits for nitrogen oxides (NOx), particulate matter 10 (PM10), and sulfur oxides (SOx), we continue to encourage direct PM2.5 emissions control limits, particularly for industrial biomass facilities. With the fast-approaching deadline to meet federal air quality standards, it is essential that emission reduction strategies be applied to all pollutants. (Group Comment Letter)

   RESPONSE: The proposed Rule 4354 contains lower NOx and SOx emissions limitations (precursors to PM2.5), as well as lower emissions limits for direct PM10. The direct PM10 from glass melting furnaces is primarily PM2.5 (~97%), and SOx reductions also reduce the formation of secondary PM2.5. Therefore, the rule amendments will achieve significant reductions in direct PM2.5, as well as PM2.5 precursor emissions.

4. **COMMENT:** More stringent SOx emissions limits should be established for flat glass melting furnaces, as well as for container glass melting furnaces. (Group Comment Letter, GPI)

   RESPONSE: For flat glass furnaces, the SOx emissions limit in proposed Rule 4354 will be retained at the current level required by the rule as the maximum feasible control available for the two facilities in the Valley.

5. **COMMENT:** SJVAPCD should continue improving public outreach and engagement processes, by including direct outreach community members near all glass manufacturing locations in the appropriate language. (Group Comment Letter)

   RESPONSE: These amendments were developed through a public engagement process that solicited feedback from the public through a variety of forums, including workshops, meetings with affected sources and other interested parties, Citizens' Advisory Committee meetings, and community engagement through AB 617 steering committees. Public notices were also translated to Spanish, and interpretation services were available at District public meetings upon request. The District continues to work to improve public outreach, and appreciates these comments.

6. **COMMENT:** All workshops should be recorded and uploaded to an online archive readily accessible for the public to accommodate varying schedules and eliminate delays associated with email requests of recordings. (Group Comment Letter)

   RESPONSE: The District appreciates the comment and is making workshop videos available to the public in order to accommodate different schedules.

7. **COMMENT:** The compliance deadlines for Phase 1 and Phase 2 should be delayed from taking effect as proposed, and the compliance deadlines should instead shift from Jan. 1, 2024 to Jan. 1 2026 for Phase 1 NOx emissions limits, and from Jan. 1, 2029 to Jan. 1, 2031 for Phase 2 NOx emissions limits. (GPI)

RESPONSE: Per commitments in the District's *2018 PM2.5 Plan*, the emission reductions resulting from compliance with the proposed Phase I NOx emissions limits need to be achieved by the 2024 compliance deadline. However, to ensure feasibility for the even more stringent limits in the proposed amendments, the District is proposing a Phase II compliance deadline of January 1, 2030, or upon the date of the next planned furnace rebricking, whichever is sooner.

8. **COMMENT:** Glass container plants operating two different furnace systems would be required to reduce emissions to 0.75 lb/ton for both furnace designs, essentially multiplying the cost estimates outlined. We ask that those costs be reassessed prior to formal issuance of the proposed rule. (GPI)

RESPONSE: The District conducts a cost-effectiveness analysis on an individual unit-by-unit basis, and has included all appropriate costs in the cost-effectiveness analysis, as attached in Appendix C of this staff report.

9. **COMMENT:** The proposed Phase II NOx emissions limit for flat glass melting furnaces has not been achieved in practice. The District should consider a 1.6 lb NOx/ton of glass pulled limit for the Phase II compliance instead. (Guardian)

RESPONSE: Through the District's engineering analysis, staff found that the compliance with the proposed Phase II NOx emission limits of 1.5 lbs/ton on a rolling 30-day average is technologically feasible through the use of available control technologies, and that the proposed requirements are cost-effective.

10. **COMMENT:** The commenter supports the proposed PM10 emission limit of 0.2 lb/ton of glass pulled based on a 24-hour block average starting in 2024, but would like to inform the District that any lower PM10 limit could cause serious issues for the facility and is not recommended. (Guardian)

RESPONSE: The District thanks you for your comment and appreciates this recommendation.

APPENDIX B

Emission Reduction Analysis for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

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I. SUMMARY

The District committed to amending Rule 4354 as part of the *2018 PM2.5 Plan.* This appendix details the calculations and assumptions used to estimate the NOx, SOx, PM10, and PM2.5 emission reductions associated with the proposed amendments to Rule 4354.

Table B-1 summarizes the estimated emission reductions from each of these pollutants from the baseline emissions inventory in the *2018 PM2.5 Plan*. The calculation methodology is outlined in Section III of this appendix. When fully implemented, the proposed amendments are estimated to total approximately 1.67 tons per day (tpd) of NOx emissions reductions (43% of baseline emission inventory), SOx emissions reductions of 0.07 tpd (4.1% of baseline emission inventory), PM10 emissions reductions of 0.13 tpd (49% of baseline emission inventory), and PM2.5 emissions reductions of 0.13 tpd (58% of baseline emission inventory). Since PM2.5 is a subset of PM10, and since for glass melting furnaces the majority of PM10 emissions are PM2.5 emissions, the emissions reduction estimates for PM2.5 are nearly the same as PM10. This is further described in Section III of this appendix.

Table B-1 – Emission Reductions

Pollutant	2024	2025	2026	2027	2028	2029	2030	2031
NOx	0.64	0.64	0.64	0.64	0.64	0.64	1.67	1.67
SOx	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
PM10	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
PM2.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13

II. BACKGROUND

The San Joaquin Valley is home to six glass manufacturing facilities that represent three different glass industry types: container glass, flat glass and fiberglass. There are 12 glass melting furnaces at these six facilities that are subject to Rule 4354. For the purposes of this analysis, the furnaces at each facility will be aggregated into a single calculation. Of the six facilities, three produce container glass, two flat glass, and one fiberglass. Since emissions limits are not being lowered for glass melting furnaces at fiberglass facilities, this analysis will focus on the five remaining facilities with annual throughput limits as indicated in Table B-2.

Table B-2 – Affected Facility Annual Throughput Limits	
Glass Category	**Permitted Glass Throughput (ton/yr)**
Container Glass Facility	736,571
Container Glass Facility	357,335
Container Glass Facility	351,890
Flat Glass Facility	255,500
Flat Glass Facility	237,250

The District's *2018 PM2.5 Plan* emissions inventory from the 2016 California Emissions Projection Analysis Model (CEPAM) version 1.05 is used throughout this analysis, as this was the foundation for the *2018 PM2.5 Plan*. The emissions inventories for the two affected categories are represented by two emissions inventory codes (EICs). Table B-3 shows the emissions inventory for the two EICs affected by this proposed amendment.

Table B-3 – Emissions Inventory for Affected Facility Types (tons per day)[1]									
Glass Category	**Pollutant**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Container Glass EIC: 460-460-7037-0000	NOx	1.791	1.791	1.791	1.791	1.791	1.791	1.791	1.791
	SOx	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032
	PM10	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074
	PM2.5	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
Flat Glass EIC: 460-460-7039-0000	NOx	1.713	1.713	1.713	1.713	1.713	1.713	1.713	1.713
	SOx	0.732	0.732	0.732	0.732	0.732	0.732	0.732	0.732
	PM10	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122
	PM2.5	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118

III. EMISSIONS AND EMISSION REDUCTION METHODOLOGY

This section of the report outlines the procedures used to calculate the current emissions and the estimated emission reductions associated with the proposed amendments to Rule 4354.

The emissions reduction percentages resulting from this rule amendment can be applied directly to the baseline emissions inventory from the *2018 PM2.5 Plan*. These "SIP Currency" reductions (Table B-1) are being credited to the aggregate emissions reduction commitments from the *2018 PM2.5 Plan* (*2018 PM2.5 Plan* Table 4-3, page 4-12).

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a

[1] 2016 CEPAM v.1.05

unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., pounds of NOx emitted per hour). Such factors facilitate an estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).

In general emissions can be calculated from the activity rate and emissions factor as:

$$E = A \times EF \quad (1)$$

Where:

E = emissions;
A = activity; and
EF = emissions factor

For glass melting furnaces, emissions factors will be determined from permit limits for existing permit units and compared to proposed rule limits in the proposed amended rule. These emissions factors will be in pounds of pollutant per ton of glass produced (lb/ton) for NOx, SOx, PM2.5 and PM10. Permits for glass melting furnaces also identify an annual throughput limit in tons of glass (ton/yr) which will serve as the activity to calculate annual emissions.

For this analysis, Equation 1 shall be applied to each affected facility for the permitted activity rate at the current permit limit and at the proposed amended limit(s) to calculate potential emissions from each facility at each limit. The total potential current emissions and the total of the potential emissions at the proposed limits summed for each glass category will be used to determine a percent reduction for each pollutant from each affected glass category, as follows:

$$\%_{Reduced} = \frac{(\sum E_{Current} - \sum E_{Proposed})}{\sum E_{Current}} \quad (2)$$

Where:

$\%_{Reduced}$ = percent reduction;
$E_{Current}$ = current potential emissions, per Equation 1; and
$E_{Proposed}$ = the potential emissions at proposed limits, per Equation 1.

Finally, the emissions reductions will be calculated by multiplying the emissions inventory defined in Table B-3 by the calculated percent reductions determined with Equation 2, as follows:

$$ER = EI \times \%_{Reduced} \quad (3)$$

Where:

ER = emission reduction;
EI = emission inventory; and
$\%_{Reduced}$ = calculated percent reductions, per Equation 2.

A. NOx Emission Reduction Calculations

Proposed emission limits for NOx will be implemented in two phases. Phase I will lower the NOx limit to 1.1 lb/ton for container glass and 2.5 lb/ton for flat glass starting in 2024, and Phase II will lower the NOx limit to 0.75 lb/ton for container glass and 1.5 lb/ton for flat glass starting in 2030. Table B-4 shows calculations for potential NOx emissions using Equation 1 for each facility, and converting the emissions into ton/yr.

Table B-4 – NOx Emission Potentials for Affected Facilities

Glass Category	Permitted Glass Throughput (ton/yr)	Permitted NOx Limit (lb/ton)	Permitted NOx Potential (ton/yr)	Proposed Phase I NOx Limit (lb/ton)	Phase I NOx Potential (ton/yr)	Proposed Phase II NOx Limit (lb/ton)	Phase II NOx Potential (ton/yr)
Container	736,571	1.3	478.8	1.1	405.1	0.75	276.2
Container	357,335	1.5	268.0	1.1	196.5	0.75	134.0
Container	351,890	1.3	228.7	1.1	193.5	0.75	132.0
Flat	255,500	3.2	408.8	2.5	319.4	1.5	191.6
Flat	237,250	2.9	344.0	2.5	296.6	1.5	177.9

Table B-5 shows the total potential NOx emissions, summed over the glass categories, and the percent reduced by each phase by applying Equation 2.

Table B-5 – Percent NOx Reductions

Glass Category	Permitted NOx Potential (ton/yr)	Phase I NOx Potential (ton/yr)	Phase II NOx Potential (ton/yr)	Phase I NOx $\%_{Reduced}$	Phase II NOx $\%_{Reduced}$
Container	975.5	795.2	542.2	18.5%	44.4%
Flat	752.8	615.9	369.6	18.2%	50.9%

Table B-6 shows the results of Equation 3 with the percent reductions in Table B-5 applied to the NOx emissions inventory in Table B-3.

Table B-6 – NOx Emission Reductions								
Glass Category	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Container	0.331	0.331	0.331	0.331	0.331	0.331	0.796	0.796
Flat	0.311	0.311	0.311	0.311	0.311	0.311	0.872	0.872
Total	**0.643**	**0.643**	**0.643**	**0.643**	**0.643**	**0.643**	**1.668**	**1.668**

B. SOx Emission Reduction Calculations

Proposed emissions limits will lower the SOx limit to 0.85 lb/ton for container glass with limits for flat and fiberglass to remain unmodified. Table B-7 shows calculations for potential SOx emissions using Equation 1 for each facility, and converting the emissions into ton/yr. One facility has an existing permit lower than the proposed 0.85 lb/ton rule limit. The reduction of the rule limit to 0.85 lb/ton will not allow that facility to increase their permit limit, so the new SOx potential for that facility will remain based on the 0.8 lb/ton limit in their current permit.

Table B-7 – SOx Emission Potentials for Affected Facilities					
Glass Category	**Permitted Glass Throughput (ton/yr)**	**Permited SOx Limit (lb/ton)**	**Permited SOx Potential (ton/yr)**	**Proposed SOx Limit (lb/ton)**	**New SOx Potential (ton/yr)**
Container	736,571	0.95	349.9	0.85	313.0
Container	357,335	0.9	160.8	0.85	151.9
Container	351,890	0.8	140.8	0.8	140.8

Table B-8 shows the total potential SOx emissions, summed over the glass categories, and the percent reduced by each phase by applying Equation 2.

Table B-8 – Percent SOx Reductions			
Glass Category	**Permitted SOx Potential (ton/yr)**	**New SOx Potential (ton/yr)**	**SOx $\%_{Reduced}$**
Container	651.4	605.7	7.0%

Table B-9 shows the results Equation 3 with the percent reductions in Table B-8 applied to the SOx emissions inventory in Table B-3.

Table B-9 – SOx Emission Reductions								
Glass Category	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Container	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
Total	**0.073**	**0.073**	**0.073**	**0.073**	**0.073**	**0.073**	**0.073**	**0.073**

C. PM Emission Reduction Calculations

Particulate matter permit and rule limits for glass melting furnaces are for the size fraction of PM10. Since PM2.5 is directly proportional to and is a subset of PM10, the emissions controls to reduce PM10 will likewise reduce PM2.5. Within the emissions inventory established for the *2018 PM2.5 Plan*, a ratio is used to convert PM10 into PM2.5. For this analysis, Equation 1 and Equation 2 will use PM10 limits to determine a percent reduction, and will apply that percent reduction with Equation 3 to both the PM10 and PM2.5 planning inventories to determine emission reductions.

Proposed emissions limits will lower the PM10 limit to 0.2 lb/ton for both container and flat glass with limits for fiberglass to remain unmodified. Table B-7 shows calculations for potential PM10 emissions using Equation 1 for each facility, and converting the emissions into ton/yr.

Table B-9 – PM10 Emission Potentials for Affected Facilities					
Glass Category	**Permitted Glass Throughput (ton/yr)**	**Permitted PM10 Limit (lb/ton)**	**Permitted PM10 Potential (ton/yr)**	**Proposed PM10 Limit (lb/ton)**	**New PM10 Potential (ton/yr)**
Container	736,571	0.45	165.7	0.20	73.7
Container	357,335	0.50	89.3	0.20	35.7
Container	351,890	0.45	79.2	0.20	35.2
Flat	255,500	0.70	89.4	0.20	25.6
Flat	237,250	0.70	83.0	0.20	23.7

Table B-11 shows the total potential PM10 emissions, summed over the glass categories, and the percent PM10 reduced by each phase by applying Equation 2.

Table B-10 – Percent PM10 Reductions			
Glass Category	**Permitted PM10 Potential (ton/yr)**	**New PM10 Potential (ton/yr)**	**PM $\%_{Reduced}$**
Container	334.2	144.6	56.7%
Flat	172.5	49.3	71.4%

Table B-12 shows the results of Equation 3 with the percent reductions in Table B-11 applied to the PM10 emissions inventory in Table B-3.

Table B-11 – PM10 Emission Reductions								
Glass Category	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Container	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Flat	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087
Total	**0.129**	**0.129**	**0.129**	**0.129**	**0.129**	**0.129**	**0.129**	**0.129**

Table B-13 shows the results Equation 3 with the percent reductions in Table B-11 applied to the PM2.5 emissions inventory in Table B-3.

Table B-12 – PM2.5 Emission Reductions								
Glass Category	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Container	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
Flat	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Total	**0.126**	**0.126**	**0.126**	**0.126**	**0.126**	**0.126**	**0.126**	**0.126**

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APPENDIX C

Cost Effectiveness Analysis for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

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COST EFFECTIVENESS ANALYSIS FOR PROPOSED RULE 4354 (GLASS MELTING FURNACES)

I. SUMMARY

The California Health and Safety Code 40920.6(a) requires the San Joaquin Valley Air Pollution Control District (District) to conduct both an absolute cost effectiveness analysis and an incremental cost effectiveness analysis of available emission control options prior to adopting each Best Available Retrofit Control Technology (BARCT) rule. The purpose of conducting a cost effectiveness analysis is to evaluate the economic reasonableness of the pollution control measure or rule. The analysis also serves as a guideline in developing the control requirements of a rule.

Absolute cost effectiveness of a control option is the added annual compliance cost to meet the proposed rule requirements, in dollars per year ($/year), of a control technology or technique, divided by the emission reduction achieved in tons reduced per year. The costs includes capital equipment costs, engineering design costs, labor and maintenance costs.

Incremental cost effectiveness (ICE) is intended to measure the change in costs (in $/year) and emissions reductions (in tons reduced/year) between two progressively more effective control options or technologies. ICE compares the differences in costs and the differences in emissions reductions of candidate control options. ICE does not reveal the emission reduction potential of the control options. Unlike the absolute cost effectiveness analysis that identifies the control option with the greatest emission reduction, ICE does not present any correlation between emissions reductions and cost effectiveness. Therefore, the relative values produced in the ICE analysis and the absolute cost effectiveness values are not comparable and cannot be evaluated in the same way as absolute cost effectiveness numbers.

Table 1 shows the summary of the cost effectiveness analysis for glass melting furnaces to comply with the proposed rule. The ‘cost effectiveness range’ shown in the table below represents the values for the technologies that are expected to be installed at glass melting furnaces in the San Joaquin Valley.

Table C-1: Summary of Cost Effectiveness

Compliance Scenarios (Current Permitted Limits to Proposed New Limits)	Cost Effectiveness Range* ($/ton)
Container Glass – NOx limit	$6,293/ton -$22,660/ton
Container Glass – SOx limit	$10,543/ton - $12,245/ton
Container Glass – PM10 limit	N/A*
Flat Glass – NOx limit	$3,945/ton - $9,501/ton
Flat Glass – PM10 limit	N/A*

*Values taken from tables C-4 through C-7.

**Facilities are already operating in compliance with the proposed PM_{10} emission limits. Some modifications to facility controls or operations may be required to ensure an adequate margin of compliance with the updated emissions limits, however costs are not expected to be significant. Therefore, a cost effectiveness analysis is not required.

Table 2 shows the total direct and indirect capital cost associated with the various technologies. Facilities are likely to install technologies highlighted in italicized text in the table below to comply with the proposed emission limits.

Table C-2: Estimated Capital Cost for Control Technology by Glass Category

Glass Category	NOx Reduction Technology	Total Direct and Indirect Capital Costs
Container Glass	Install Ceramic Catalytic Filters (CCF) with Housing	$14,983,125
	Install New SCR System	*$6,223,644*
	Install CCF without Housing	*$5,075,545*
	Enhancements of Existing SCR System (for three furnaces)	*$6,369,158*
	Oxy-Fuel Conversion	$24,177,454
Flat Glass	*Enhancements to existing SCR system (for one furnace)*	*$2,123,053*
	Oxy-fuel conversion	$28,307,370
	Install SCR	*$5,246,382*
	Install CCF	$13,235,844
Glass Category	**SOx Reduction Technology**	**Total Direct and Indirect Capital Costs**
Container Glass	*Enhancements to dry sorbent injection system (DSI) using hydrated lime*	*$141,537*
	Enhancements to DSI using Trona	*$424,611*

II. BACKGROUND

Proposed Rule 4354 would implement more stringent NOx, SOx, and PM10 limits for container glass melting furnaces and more stringent NOx and PM10 limits for flat glass melting furnaces. These facilities will require a significant investment to install new control equipment or make significant modifications to their existing equipment in order to meet the proposed emission limits. After careful evaluation, District staff found requiring the lowest limits immediately is not cost effective, and instead staff recommends incorporating the requirements in two phases, with the most costly equipment upgrades to begin in Phase II. The longer compliance schedule allows operators to better combine the control system modifications with their normal furnace rebuild schedule, rather than have the significant additional expense of off-schedule furnace shutdowns and cold restarts. These facilities are expected to be capable of achieving the Phase I proposed NOx and PM10 limits with existing equipment, with marginal costs associated with control tuning, testing and monitoring, as well as permit modifications. These facilities will be required to upgrade their NOx control technology as early as 2024, and no later than 2030, and in addition will be required to make permit modifications for the Phase I SOx emission limits by 2024.

For flat glass furnaces, the SOx emissions limit in proposed Rule 4354 will be retained at the same level that is currently required by the rule. Use of a semi-dry scrubbing technology that could potentially lower the SOx emissions cannot be deployed at one of the facility utilizing natural gas and an SCR system without making cost prohibitive changes to their NOx control system. Such NOx control system changes may include conversion to oxy-fuel firing, which is estimated to cost upwards of 28 million dollars to retrofit this plant. Per facility personnel, the exhaust gas temperature must be maintained in the range of 630 ºF to 650 ºF at the SCR catalyst to effectively reduce NOx emissions. Since this facility is currently using SCR to control NOx, using semi-dry scrubbing technology will lower the exhaust gas temperatures below the required range needed for the SCR system to operate effectively.

A. Estimated Compliance Cost

District staff used cost information provided by control equipment manufacturers, vendors, and from stakeholders to conduct a cost effectiveness analysis of the proposed NOx, SOx, and PM10 limits in Proposed Rule 4354. Specifically the data used in the analysis came from the following sources:

1. Guardian Industries LLC
2. Gallo Glass Company
3. Tri-Mer Corporation
4. GEA Systems North America LLC
5. Precision Partners LLC

Cost information submitted to the District was used to establish the costs located in Tables C-4 through C-7.

III. GLASS FURNACE STATUS RELATIVE TO PROPOSED EMISSION LIMITS

There are six facilities that manufacture glass within the District, five that will be impacted by this proposed rule amendment. These five facilities produce glass from a total of 11 furnaces – nine are container glass and two are flat glass. A summary of these five facilities, their control equipment and their current permitted emission limits are shown in the table below:

Table C-3: Summary of Existing Glass Plants in San Joaquin Valley

Facility	Pollutant	Current Reduction Technology	Current Permitted Throughput (ton/year)	Current Permitted Emission Limits (lb/ton)
Container Glass Facility 1	NOx	Oxy-Fuel Firing	736,531	1.3
	PM10	Ceramic Filters		0.45
	SOx	DSI (hydrated lime)		0.95
Container Glass Facility 2	NOx	Oxy-Fuel Firing	351,890	1.3
	PM10	ESP		0.45
	SOx	SDA (soda ash)		0.8
Container Glass Facility 3	NOx	SCR	357,335	1.5
	PM10	ESP		0.5
	SOx	DSI (trona)		0.9
Flat Glass Facility 1	NOx	Oxy-Fuel Firing	237,250	2.9
	PM10	ESP		0.7
	SOx	SDA (soda ash)		1.2
Flat Glass Facility 2	NOx	SCR	255,500	3.2
	PM10	ESP		0.7
	SOx	DSI (trona)		1.2

IV. Cost Effectiveness Analysis Procedure

To illustrate the cost effectiveness of complying with the proposed limits, District staff's analysis provides varying cost effectiveness values depending on the size of the unit, and the annual capacity factor that the unit is operated. The actual compliance costs and cost effectiveness values would depend on several factors such as the type of unit, site-specific operating conditions, and the appropriate emission limits the unit has to meet.

A. Absolute Cost Effectiveness (ACE) Calculation Method

Absolute cost effectiveness examines the cost of reaching the proposed emission limits using the current emissions as a baseline. Cost effectiveness is calculated as the added annual cost (in $/year) of a control technology or technique, divided by the

emission reduction achieved (in tons reduced/year). The annual costs include annualized capital equipment costs and engineering design costs plus the annual labor and maintenance costs.

The absolute cost effectiveness of a control technology is calculated as follows:

1. Determine an equivalent annual equipment cost using a capital recovery factor based on an assumed interest rate of 4 percent and equipment life of 10 years.
2. Determine the annual electricity, fuel, and operation and maintenance costs of a control technology.
3. Calculate the total annual cost by adding the costs calculated in Step 1 and Step 2.
4. Calculate the emission reduction in tons/year. Appendix B provides a detailed explanation of the calculations performed to determine the emission reductions for the potential rule limits.
5. Calculate the absolute cost effectiveness by dividing the total annual cost in Step 3 by the emissions reduction in Step 4.

B. Incremental Cost Effectiveness (ICE) Calculation Method

Incremental cost effectiveness (ICE) indicates the additional cost for further controlling a unit from the proposed limit to the lowest possible level. Costs are evaluated similar to absolute costs but are only calculated for the controls and reductions beyond what is required to comply with the rule. ICE does not reveal the emission reduction potential of the control options, but examines the more stringent options which were not considered to be cost effective. Due to the increased costs and marginal emission reductions, the ICE calculations typically result in a much higher cost effectiveness than the absolute cost effectiveness values, and are not directly comparable.

The incremental cost effectiveness of a control technology is calculated as follows:

1. Identify the complying control options appropriate for the existing equipment.
2. Estimate the annual average cost of each control option by using Steps 1 to 3 of the ACE calculation method.
3. Calculate the potential emission reduction for each control option. The potential emission reductions (PE) are the difference between the current emissions and the potential emissions using the new control technology.

V. Absolute Cost Effectiveness

District staff reviewed the Permit Services Permits Database to determine the existing control technology and current permitted limits for glass melting furnaces operating in

the Valley to determine which facilities would require to be retrofitted to comply with the proposed emission limits.

Compliance costs include both one-time costs and on-going annual operation and maintenance costs. Examples of one-time costs are the purchase of equipment and installation costs. On-going costs include maintenance costs, reagent purchases, and the additional fuel burned because of the control technology (fuel penalty). In order to determine a single figure for costs, District staff use a capital recovery factor to allocate the one-time costs over the life of the equipment. For all cost analyses in this report, District staff used a 4 percent rate of return and a 10-year equipment life to convert the capital costs to equivalent annual cost.

A. NOx Compliance Costs

For compliance with the proposed NOx limits, District staff assumed that operators with furnaces that did not meet the proposed NOx limits based on their recent emission monitoring and source test data would either install a selective catalytic reduction (SCR) system, install a ceramic catalytic filter (CCF) system or enhance their existing SCR system to achieve better NOx emission reductions. Although some operators may consider converting from oxygen assisted firing to full oxy-fuel firing, District staff estimated that the capital cost plus annual operating costs of the conversion to oxy-fuel firing are higher than converting to an SCR/CCF system, therefore operators would choose the option with the lowest cost, in this case choosing SCR/CCF systems over oxy-fuel firing.

Due to the high costs of complying with the lower Phase II NOx emissions limits and the costs associated with performing a furnace rebuild, District staff are proposing a phased compliance schedule, with longer timeframes allowed for facilities to comply with the final NOx limits. The interior of a glass furnace is made up of refractory bricks that hold the pool of molten glass and raw materials that helps to retain heat within furnace combustion chamber, thus improving the overall thermal efficiency of the furnace. The refractory bricks have an expected life of approximately 10 to 15 years. Rebuilding a glass furnace and replacing the refractory brick costs $15 million dollars or more depending on furnace size, design, and scope of work. In addition, during a furnace rebuild, the facility cannot produce any glass for up to three months, so there is additional dollars in lost revenue.

The proposed rule requires facilities to meet a Phase I NOx limit in 2024, and then a more stringent limit upon the completion of the next furnace rebuild, or by 2030, whichever comes sooner. Complying with the Phase II emissions limits will require major modifications to facility furnaces and control technologies. By allowing these modifications to occur at the time the furnace is already planned to be shut down and out of operation, the compliance cost is greatly reduced, ensuring that the proposed requirements are cost-effective and economically feasible. If the District was to require that operations meet the Phase II limits on a more expedited timeframe, additional costs

would be incurred, including an additional estimated $15 million dollar cost per facility to shutdown and rebuild their furnaces outside of their regularly schedule rebricking cycle.

Unless otherwise stated, all costs shown in Table C-4 and Table C-5 are various technologies that could be potentially used to comply the proposed Tier II NOx limits in this rule.

1. Oxy-Fuel Fired Glass Furnaces

Three of the existing glass plants (two container glass and one flat glass) are currently equipped with oxy-fuel firing combustion technology to reduce NOx emissions. In order for these facilities to comply with the proposed NOx emission limits, it is expected that they would either install SCR or install a CCF system.

Table C-4: NOx Compliance Costs for Oxy-Fuel Fired Glass Furnace Retrofits

Facility	Technology Evaluated	Capital Cost	O&M Cost ($/yr)	Annualized Cost ($/yr)	Emission Reductions (tons/yr)	Cost-Effectiveness ($/ton NOx)
Container Glass Facility 1	Install SCR	$5,497,996	$1,009,094	$1,686,997	202.6	$8,327
	Install CCF without Housing[1]	$5,075,545	$648,974	$1,274,789		$6,293
Container Glass Facility 2	Install CCF with Housing	$17,532,031	$2,417,925	$5,270,387	96.8	$54,446
	Install SCR	$6,949,291	$1,062,170	$2,192,819		$22,660
Flat Glass Facility 1	Install CCF with Housing	$13,235,844	$1,954,575	$3,586,555	166.1	$21,592
	Install SCR	$5,246,382	$931,045	$1,577,924		$9,500

2. Natural Gas Fired Glass Furnaces Served by SCR

Two of the existing glass plants (one container glass and one flat glass) are currently equipped with regular natural gas firing combustion technology with SCR systems installed on each glass furnace exhaust stack to reduce NOx emissions. In order for these facilities to comply with the proposed NOx emission limits, it is expected that they would either enhance their existing SCR system or convert their glass furnaces over to oxy-fuel firing.

[1] This facility has already installed the CCF system housing, and so costs for housing required to convert their control system from utilizing ceramic filters to catalytic ceramic filters are not included. Therefore, the cost analysis was performed for installing a CCF system without the housing for this facility.

Table C-5: NOx Compliance Costs for Glass Furnaces Equipped with SCR

Facility	Technology Evaluated	Capital Cost	O&M Cost ($/yr)	Annualized Cost ($/yr)	Emission Reductions (tons/yr)	Cost-Effectiveness ($/ton NOx)
Container Glass Facility 3	Oxy-Fuel Furnace Conversion	$24,177,454	$2,981,080	$6,128,825	134.0	$45,738
	Enhancement of Existing SCR[2]	$6,369,158	$785,317	$1,819,921		$13,582
Flat Glass Facility 2	Oxy-Fuel Furnace Conversion	$28,307,370	$3,676,829	$7,167,128	217.2	$32,998
	Enhancement of Existing SCR	$2,123,053	$595,088	$856,860		$3,945

C. PM10 Compliance Costs

Facilities subject to Rule 4354 have already installed the highest level of controls feasible, and are expected to be able to comply with the lower PM10 emission limits without major modifications to their existing PM control equipment, which includes either Electrostatic Precipitators (ESP) or ceramic dust collectors. In some cases, fine tuning of the current emission controls may be required to ensure compliance with the lower PM10 emissions limits. Costs incurred in such tuning are expected to be minimal. The capital costs associated with the PM10 emission limits attributed to permit modification fees are summarized in the table below by plant type.

D. SOx Compliance Costs

Use of semi-dry adsorber (SDA) or dry sorbent injection (DSI) systems are prevalent among glass manufacturing facilities in the valley. SDA systems uses soda ash and water solution, whereas, DSI systems use dry trona or hydrated lime. The District believes that the existing systems could be enhanced by upgrading feed conveying systems, installing more injection ports, upgrading blower fans, in order to optimize the use of current sorbent material. Costs incurred in enhancing the existing control equipment are summarized in Table C-7.

[2] This facility operates three glass furnaces with three separate SCR systems. Therefore, the cost analysis was performed by summing the costs associated with modifying all three of their furnaces and/or emission control systems.

Table C-7: SOx Compliance Costs

Facility type	Current Sorbent	Capital Cost ($)	O&M ($/yr)	Annualized Cost ($/yr)	Emission Reductions (tons/year)	Cost Effectiveness ($/ton SOx)
Container Glass Facility 1	Hydrated lime	$141,537	$658,997	$17,451	55.2	$12,245
Container Glass Facility 2[3]	Soda ash	--	--	--	--	--
Container Glass Facility 3	Trona	$424,611	$136,017	$52,354	18.0	$10,543

VI. ALTERNATIVE CONTROL TECHNOLOGIES EVALUATED

The District has identified and evaluated all practically feasible NOx, PM, and SOx control technologies that have been successfully deployed at the glass manufacturing operations. Based on the review of other District, State and Federal regulations, proposed Rule 4354 will have the most stringent NOx, PM10 and SOx emission limits in the nation. In addition, facilities will be employing the state of the art control technologies for this source category. The costs associated with these control technologies is already enumerated in the tables in section V above. The District believes that there are no other alternative control technologies that need further evaluation at this time.

VII. INCREMENTAL COST EFFECTIVENESS ANALYSIS

Health and Safety Code section 40920.6 requires an incremental cost-effectiveness analysis for Best Available Retrofit Control Technology (BARCT) rules or emission reduction strategies when there is more than one control option which would achieve the emission reduction objective of the proposed amendments. The incremental cost effectiveness is the difference in cost between successively more effective controls divided by the additional emission reductions achieved. District staff believes that the provisions of Proposed Rule 4354 meet Best Available Retrofit Control Technology, and therefore there is no more stringent option than the proposed provisions. For this reason, an incremental cost effectiveness analysis would serve no useful purpose because there is no more stringent option available to glass manufacturers.

[3] This facility is already meeting the proposed SOx emissions limit with existing control technology, and so no additional costs are expected to be incurred.

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APPENDIX D

Socioeconomic Analysis for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

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POTENTIAL AMENDMENTS TO RULE 4354—GLASS MELTING FURNACES

SOCIOECONOMIC IMPACT ANALYSIS

Final

December 9, 2021

Submitted to:

San Joaquin Valley Air Pollution Control District
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District Agreement No. 21-4-22

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1. EXECUTIVE SUMMARY

This report contains ERG's analysis of the socioeconomic impacts of potential amendments to the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) Rule 4354—Glass Melting Furnaces. Potential amendments to Rule 4354 are planned to take place in two stages, with reductions in sulfur oxide emissions (SOx), nitrogen oxide (NOx), and particulate matter (PM10) emissions starting in 2024, and further reductions in nitrogen oxide (NOx) emissions required by 2030.

After providing an overview of demographic and economic trends in the District as a whole and describing how the COVID-19 pandemic has impacted the District economically, ERG estimates the impacts of the potential amendments on entities that would incur costs under the potential amendments by comparing compliance costs to profits.

As shown in Table 1, both the "Flat Glass" and "Glass Container" sectors would experience significant adverse socioeconomic impacts, defined as costs that amount to 10 percent or more of profits (Berck, 1995).

Table 1. Summary of Socioeconomic Impacts due to Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Total Facilities	Facilities w/ Costs	Total Annualized Cost [a]	Average Annualized Cost per Facility	Average Profits per Facility	Cost as % Profits
Flat Glass	2	2	$1,898,273	$949,136	$2,536,800	37.41%
Glass Container	3	3	$5,059,749	$1,686,583	$8,839,780	19.08%
Fiberglass	1	0	$0	$0	$5,791,644	0.00%
Total/Average	**6**	**5**	**$6,958,021**	**$1,159,670**	**$6,230,764**	**18.61%**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.
[a] The total annualized cost is calculated by summing annualized one-time costs (annualized over a 10-year period using a 10 percent discount rate) and annual costs.

As a secondary measure of impacts, ERG also used the IMPLAN (2021) input-output model to assess how facilities with costs under the potential amendments might react by reducing employment, as well as a "ripple effect" felt if affected facilities reduce purchases from their suppliers, and their suppliers in turn reduce their own purchases. These impacts make up less than **0.01 percent** of District-wide revenue and employment.

ERG also conducted a sensitivity analysis to assess how varying degrees of recovery from the effects of the COVID-19 pandemic might affect the results of the analysis. Impacts would change slightly with a less than full recovery.

2. INTRODUCTION AND BACKGROUND

This report provides economic data and analysis in support of the San Joaquin Valley Air Pollution Control District's (SJVAPCD or District) assessment of the socioeconomic feasibility of potential amendments to existing Rule 5354 for glass melting furnaces. This work was performed by ERG under District Agreement No. 21-4-22.

Facilities with glass melting furnaces in the District produce container glass, flat glass, and fiberglass (SJVAPCD, 2020). Existing District rule 4354 (last revised in 2011) limited NOx, CO, VOC, SOx, and PM10 emissions from these furnaces (SJVAPCD, 2011; SJVAPCD, 2020). The potential amendments to Rule 4354 would satisfy the commitments included in the 2018 PM2.5 Plan to reduce SOx and NOx emissions from container and flat glass furnaces (SJVAPCD, 2020).

This analysis was prepared to meet the requirements of California Health and Safety Code §40728.5, which requires an assessment of the socioeconomic impacts of the adoption, amendment, or repeal of air district rules. It begins by providing an overview of demographic and economic trends in the District, and then estimates the economic impacts on specific entities subject to the potential rule amendments (including small entities), and how those economic impacts might affect the surrounding communities, including at-risk populations.

3. REGIONAL DEMOGRAPHIC AND ECONOMIC TRENDS

In this section ERG considers larger demographic and economic trends in the District, which includes eight counties that are home to over 4 million people.[1] These counties have become more populous over the last decade, and the median income (adjusted for inflation) has also increased. Utilities, wholesale and retail trade, and transportation, along with agriculture and oil and gas extraction, are the predominant industries within the District both in terms of establishments and employment.

3.1. REGIONAL DEMOGRAPHIC TRENDS

This section presents the demographic shifts within the District's jurisdiction over the past decade. The District has experienced a greater population growth rate than the state as a whole, but the median income has lagged the state. The poverty rate throughout the district, while decreasing over time, is doing so at a slower pace than California as a whole.

The San Joaquin Valley contains almost 11 percent of the state of California's population. Table 2 shows how this population has changed over the last 10 years. Table 2 also shows the compound annual growth rate (CAGR) between 2010 and 2019. The CAGR is the constant rate the population would have changed annually to go from the 2010 level to the 2019 level.

Overall, the region has seen annual average population growth marginally higher than the state of California. Kings and Madera counties, the two counties with the smallest population of the counties in the District, saw little growth in their populations from 2010 to 2019, and were the only counties to have population declines in any one year over the last ten years. San Joaquin County saw the most growth, increasing at 1.16 percent annually.

[1] While only part of Kern County falls into the District's boundaries, all of Kern County is included in the data presented in this section, as the data were only available at the county level.

Table 2. Population Trends by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	932,039	939,406	945,045	951,514	960,567	969,488	976,830	985,238	991,950	999,101	0.78%
Kern [a]	840,996	847,970	853,606	862,000	869,176	876,031	880,856	887,356	893,758	900,202	0.76%
Kings	152,370	151,868	150,991	150,337	149,495	150,085	149,382	149,665	151,382	152,940	0.04%
Madera	150,986	151,675	151,527	151,370	153,456	153,576	153,956	155,423	156,882	157,327	0.46%
Merced	256,721	259,297	260,867	262,026	264,419	266,353	267,628	271,096	274,151	277,680	0.88%
San Joaquin	687,127	694,354	699,593	702,046	711,579	722,271	732,809	743,296	752,491	762,148	1.16%
Stanislaus	515,145	517,560	520,424	523,451	528,015	533,211	539,255	544,717	548,126	550,660	0.74%
Tulare	442,969	446,784	449,779	452,460	455,138	457,161	459,235	462,308	464,589	466,195	0.57%
SJVAPCD [a]	**3,978,353**	**4,008,914**	**4,031,832**	**4,055,204**	**4,091,845**	**4,128,176**	**4,159,951**	**4,199,099**	**4,233,329**	**4,266,253**	**0.78%**
California	**37,319,502**	**37,638,369**	**37,948,800**	**38,260,787**	**38,596,972**	**38,918,045**	**39,167,117**	**39,358,497**	**39,461,588**	**39,512,223**	**0.64%**

Source: U.S. Census Bureau, 2020a.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Table 3 shows the median income by county for 2010 through 2019 (U.S. Census Bureau, 2020b). Median income growth rates varied across counties from 2010 to 2019, though the counties in the District as a whole had a CAGR of 1.32 percent overall; this is lower than the growth rate of median income for the state of California (2.23 percent). Kern County is the only county that experienced a decline in median income (-0.03 percent) while all other counties experienced some level of growth. Merced County has a notably higher growth rate of 2.66 percent. It is the only county in the District where median income increased at a rate faster than the state.

Table 3. Median Income by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	$53,461	$49,572	$47,299	$49,049	$47,607	$50,988	$52,357	$54,645	$54,217	$58,215	1.07%
Kern [a]	$53,820	$52,371	$52,165	$52,348	$52,235	$55,759	$53,633	$52,592	$53,136	$53,710	-0.03%
Kings	$52,738	$58,302	$52,194	$51,114	$46,907	$49,682	$57,213	$60,716	$63,524	$59,161	1.45%
Madera	$57,064	$53,930	$47,767	$44,396	$46,522	$51,206	$55,518	$54,099	$58,004	$65,612	1.76%
Merced	$50,184	$46,385	$49,537	$45,433	$48,332	$45,610	$51,308	$50,356	$59,488	$61,908	2.66%
San Joaquin	$59,124	$58,890	$57,633	$57,432	$56,637	$58,325	$63,967	$64,523	$66,054	$69,833	2.10%
Stanislaus	$56,799	$51,042	$52,728	$53,557	$56,007	$56,868	$58,364	$62,782	$62,142	$63,801	1.46%
Tulare	$51,305	$47,673	$45,793	$44,021	$46,717	$46,062	$49,311	$48,807	$50,290	$58,391	1.63%
SJVAPCD [a]	**$54,605**	**$52,046**	**$51,001**	**$50,891**	**$51,126**	**$53,112**	**$55,339**	**$56,292**	**$57,503**	**$60,627**	**1.32%**
California	**$68,224**	**$66,341**	**$66,275**	**$67,211**	**$67,136**	**$70,049**	**$72,803**	**$75,748**	**$77,549**	**$81,414**	**2.23%**

Source: U.S. Census Bureau, 2020b.

Notes:

[a] Inflated values to 2020$ using the BEA (2020) GDP deflator.

[b] While the SJVAPCD only includes a portion of Kern county, the data shown here are for the whole of the county.

[c] Median income for SJV is a weighted average by population

Poverty rates by county for the last decade are shown in Table 4. The poverty rate decreased in every county in the District in that time frame. The poverty rate within the District is higher than the state average and declining at a slower rate overall compared to the state of California's rate of -3.58 percent. Fresno and Tulare Counties have consistently had among the highest poverty rates in the District while Stanislaus and San Joaquin Counties have had the two lowest. These two counties, plus Kings and Merced Counties, have CAGRs lower than the state's. Despite its notable CAGR of median household income, Merced County had high poverty rates for most of the past decade. That trend changed in 2019, with the county poverty rate dropping from 22.0 percent in 2018 to 16.8 percent in 2019.

Many of the District's leading industries, including agriculture, transportation, and manufacturing, typically employ a higher percentage of low income and less educated employees, and have unstable or seasonal employment needs (Abood, 2014), likely leading to the higher rates of poverty seen in the District.

Table 4. Poverty Rate by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	26.8%	25.8%	28.4%	28.8%	27.7%	25.3%	25.6%	21.1%	21.5%	20.6%	-3.24%
Kern [a]	21.2%	24.5%	23.8%	22.8%	24.8%	21.9%	22.7%	21.4%	20.6%	19.1%	-1.30%
Kings	22.2%	20.5%	21.2%	21.4%	26.6%	23.6%	16.0%	18.2%	19.2%	15.2%	-4.62%
Madera	21.0%	24.3%	23.6%	23.6%	22.2%	23.4%	20.3%	22.6%	20.9%	17.6%	-2.18%
Merced	23.0%	27.4%	24.3%	25.2%	25.2%	26.7%	20.3%	23.8%	22.0%	16.8%	-3.85%
San Joaquin	19.2%	18.1%	18.4%	19.9%	20.9%	17.4%	14.4%	15.5%	14.2%	13.7%	-4.13%
Stanislaus	19.9%	23.8%	20.3%	22.1%	18.0%	19.7%	14.2%	13.5%	15.6%	12.7%	-5.46%
Tulare	24.5%	25.7%	30.4%	30.1%	28.6%	27.6%	25.2%	24.6%	22.5%	18.8%	-3.26%
SJVAPCD [a]	**22.5%**	**23.8%**	**24.2%**	**24.6%**	**24.3%**	**22.7%**	**20.6%**	**19.7%**	**19.3%**	**17.3%**	**-3.25%**
California	**15.8%**	**16.6%**	**17.0%**	**16.8%**	**16.4%**	**15.3%**	**14.3%**	**13.3%**	**12.8%**	**11.8%**	**-3.58%**

Source: U.S. Census Bureau, 2020c.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Table 5 shows the population below the poverty line from 2010 to 2019. While there has been a decline in the number of people below the poverty line from 2010 to 2019, the number has fluctuated during this period. The number of people in poverty grew by over 100,000 between 2010 and 2014, but has been in decline since 2014.

The CAGR of population below the poverty line varies across counties. Fresno County has the largest population below the poverty line as of 2019, which coincides with its large population and relatively higher poverty rate. Conversely, Stanislaus, Kings, and Merced Counties have experienced a decline in poverty at a faster rate than California as a whole.

Table 5. Population Below Poverty Line by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2018
Fresno	246,196	238,706	264,738	270,072	263,220	242,083	247,507	205,291	209,799	202,698	-2.40%
Kern [a]	171,950	201,230	196,625	189,484	208,388	186,501	193,133	184,619	178,239	166,768	-0.38%
Kings	30,425	27,101	27,819	28,473	35,623	31,453	21,565	24,935	26,299	21,063	-4.49%
Madera	29,936	34,148	33,936	34,242	32,432	34,227	29,736	33,482	31,191	26,093	-1.70%
Merced	58,360	70,243	62,448	64,552	65,405	70,118	53,314	63,485	59,283	45,396	-3.09%
San Joaquin	128,748	123,258	126,610	137,663	146,601	123,817	103,399	113,136	104,622	101,591	-2.92%
Stanislaus	101,335	122,212	104,559	114,628	94,586	104,801	76,191	73,254	85,073	69,572	-4.59%
Tulare	107,660	113,515	135,194	135,066	129,485	125,728	114,290	112,524	103,711	86,315	-2.72%
SJVAPCD [a]	**874,610**	**930,413**	**951,929**	**974,180**	**975,740**	**918,728**	**839,135**	**810,726**	**798,217**	**719,496**	**-2.41%**
California	**5,783,043**	**6,118,803**	**6,325,319**	**6,328,824**	**6,259,098**	**5,891,678**	**5,525,524**	**5,160,208**	**4,969,326**	**4,552,837**	**-2.95%**

Source: U.S. Census Bureau, 2020c.

Notes:

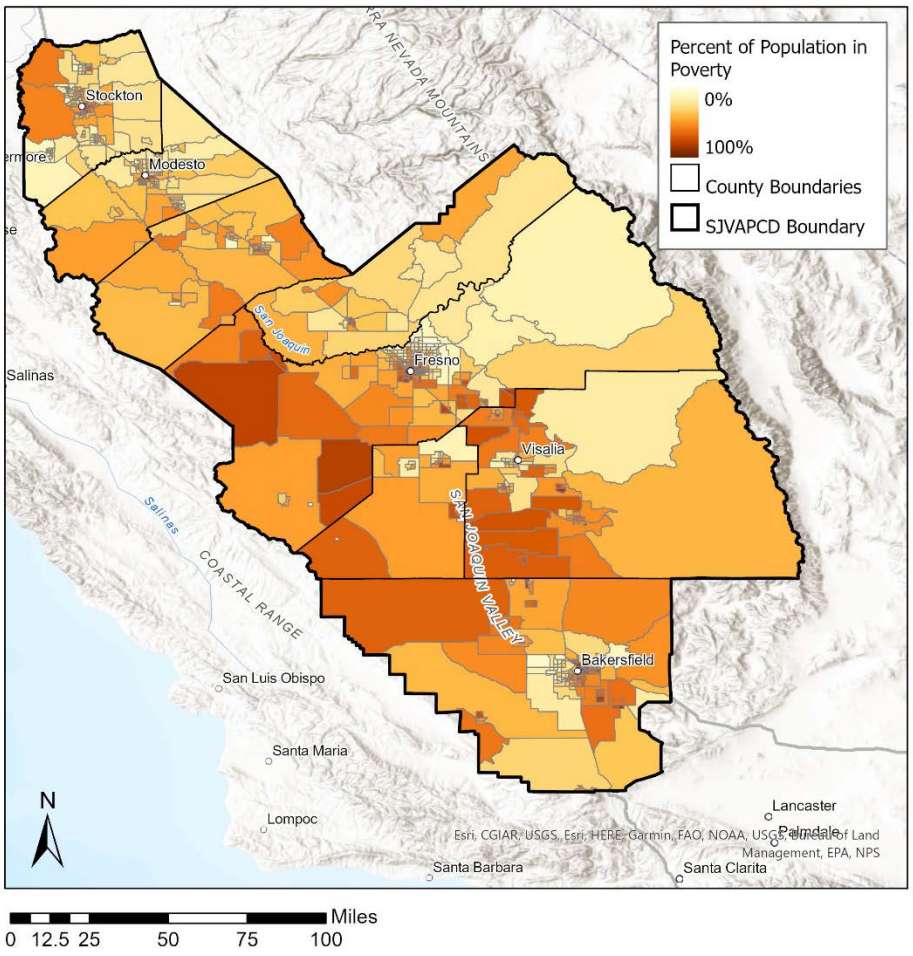
[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Figure 1 shows where the population in poverty or at risk of poverty lives within the District[2] using CalEnviroScreen 4.0 (OEHHA, 2021a) data on the percent of population living below two times the federal poverty limit. CalEnviroScreen poverty data is derived from the US Census Bureau's American Community Survey 5-year estimates for 2015 to 2019. CalEnviroScreen uses a poverty threshold of two times the poverty level to account for the higher cost of living in California compared to other parts of the country (OEHHA, 2021b).

As shown in Table 4 above, roughly 20 percent of the District population is below the federal poverty limit, depending on the year. Using the higher CalEnviroScreen 4.0 threshold, nearly half (44.9 percent) of District residents are below twice the federal poverty limit (OEHHA, 2021a-b), reflected in the high poverty rates in the map in Figure 1 below.

[2] Note that only the part of Kern County included in the SJVAPCD is shown. There are four census tracts on the eastern border of Kern County that are in the Eastern Kern Air Pollution Control District. The portions of these census tracts that fall outside of the SJVAPCD border are not shown.

Figure 1. Percentage of the Population Living below Two Times the Federal Poverty Level by Census Tract (2015–2019)



Source: OEHHA, 2021a.
Map created by ERG using ArcGIS® software by Esri.

3.2. REGIONAL ECONOMIC TRENDS

This section tracks the economic trends of the District over the past decade. Total employment growth in the District is slightly below that of California. Overall, employment, the number of establishments, and average pay have all increased across the District during that period.

Table presents employment trends over the same 10-year span. During that period, overall employment throughout the District has also increased. The District as a whole saw a CAGR of 1.48 percent in employment over the last decade, slightly below that of the entire state of California (1.64 percent). No individual county experienced a decline in employment, although Kings County has a notably lower growth rate (0.71 percent) than the other counties in the region.

San Joaquin County was the only county in the District to experience an employment growth rate greater than that of California as a whole. This may be in part due to the California Central Valley Economic Development Corporation's (CCVEDC) efforts to encourage companies to locate within the District through tax credits and incentives and grants (CCVEDC, 2020). A few large employers (Amazon, Tesla, etc.) have moved to San Joaquin County in recent years, creating numerous job opportunities within the county. Some people have also moved from the more expensive Bay Area and Los Angeles-San Diego area to the Central Valley, with San Joaquin County being one of the more popular areas to relocate (Lillis, 2019).

Table 6. Employment Trends by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	366,200	370,200	373,500	379,900	387,500	395,300	402,400	406,900	412,800	418,100	1.48%
Kern [a]	313,400	325,700	340,400	347,200	351,700	350,100	347,700	349,100	354,900	360,800	1.58%
Kings	49,900	49,700	50,000	50,400	50,600	51,600	51,400	52,200	53,000	53,200	0.71%
Madera	51,400	52,000	53,500	54,400	54,900	53,500	55,400	56,000	57,000	57,700	1.29%
Merced	93,200	94,500	96,200	98,000	99,700	101,100	102,200	104,500	105,600	106,900	1.54%
San Joaquin	260,000	261,000	267,100	274,600	279,200	286,400	292,400	300,700	304,600	307,900	1.90%
Stanislaus	202,200	202,400	205,900	209,800	213,700	218,000	221,800	224,100	227,500	228,800	1.38%
Tulare	168,100	168,700	168,800	172,200	172,100	178,500	180,500	183,200	183,300	184,400	1.03%
SJVAPCD [a]	1,504,400	1,524,200	1,555,400	1,586,500	1,609,400	1,634,500	1,653,800	1,676,700	1,698,700	1,717,800	1.48%
California	16,091,900	16,258,100	16,602,700	16,958,400	17,310,900	17,660,700	17,980,100	18,257,100	18,460,700	18,627,400	1.64%

Source: CAEDD, 2021.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Table 7 shows the economic trends by industry in the District by presenting three snapshots from 2009 to 2019 using data from the Bureau of Labor Statistics' (BLS, 2020) Quarterly Census of Employment and Wages (QCEW). The recent influx of new employers explains the continued growth in the utilities, trade and transportation industries. These industries have been the largest employers in the District for the last 11 years, followed closely by agriculture and oil and gas extraction. The education, health and social services industry has seen the greatest increase of establishments in the District over the past decade, although it is the one industry that has experienced a decrease in average pay over that same time frame. The information sector is the smallest industry in the district and has gotten smaller over the last 11 years.

Table 7. Economic Trends in the San Joaquin Valley, 2009-2019 [a]

NAICS	Sector	2009			2014			2019		
		Establish-ments	Employ-ment	Average Annual Pay [c]	Establish-ments	Employ-ment	Average Annual Pay [c]	Establish-ments	Employ-ment	Average Annual Pay
11, 21	Agriculture, Oil and Gas Extraction	7,789	189,766	$29,692	7,438	217,769	$33,068	7,430	217,649	$36,568
23	Construction	6,099	50,178	$55,144	5,377	56,011	$54,022	6,637	70,498	$59,475
31-33	Manufacturing	2,640	105,142	$52,640	2,531	107,702	$53,749	2,715	110,892	$55,863
22, 42, 44-45, 48-49	Utilities, Trade and Transportation	14,041	219,813	$40,871	14,500	246,596	$41,428	16,026	282,861	$43,587
51	Information	602	13,482	$59,608	510	11,035	$68,525	498	6,127	$60,315
52-53	Finance Activities	5,747	44,703	$52,430	5,652	41,123	$55,695	6,443	42,638	$59,747
54-56	Profession and Business Services	7,944	97,494	$45,994	8,391	106,412	$45,985	9,054	116,895	$50,424
61-62	Educational, Health and Social Services	7,503	140,416	$54,050	39,280	184,959	$47,321	53,489	223,552	$48,667
71-72	Leisure and Hospitality	5,960	97,885	$17,407	6,224	111,610	$16,859	7,424	130,279	$19,906
81	Other Services	38,938	53,413	$24,934	5,124	32,856	$33,084	5,603	24,860	$35,245
99	Unclassified	1,730	2,112	$34,651	1,917	3,006	$31,870	4	4	$25,752
SJVAPCD Total/Average [b]		**98,993**	**1,014,404**	**$40,664**	**96,944**	**1,119,079**	**$41,095**	**115,323**	**1,226,255**	**$43,903**

Source: BLS, 2020.

Notes:

[a] Includes all of Kern County.

[b] Annual average pay is a weighted average of the eight counties in the SJV APCD weighted by employment in sector.

[c] Annual average pay is adjusted to 2019 dollars using the BEA (2020) GDP deflator.

Table 8 presents the CAGR of the economic data from Table 7. The number of establishments, employment, and average annual pay have all increased over the last 11 years across the District. Health, education, and social services has seen the greatest growth in establishments and employment over that time frame, but it is the one industry that experienced a decrease in average pay (outside of the unclassified businesses). There are fewer establishments in the agriculture, oil, and gas extraction industry today than there were a decade ago, but employment and pay have both increased. The information industry has experienced the greatest decrease in employment across the District.

Table 8. Compound Annual Growth Rate of Establishments, Employment, and Annual Pay [a]

NAICS	Sector	Establishments			Employment			Average Annual Pay		
		2009-2014	2014-2019	2009-2019	2009-2014	2014-2019	2009-2019	2009-2014	2014-2019	2009-2019
11, 21	Agriculture, Oil and Gas Extraction	-0.92%	-0.02%	-0.47%	2.79%	-0.01%	1.38%	2.18%	2.03%	2.10%
23	Construction	-2.49%	4.30%	0.85%	2.22%	4.71%	3.46%	-0.41%	1.94%	0.76%
31-33	Manufacturing	-0.84%	1.41%	0.28%	0.48%	0.59%	0.53%	0.42%	0.77%	0.60%
22, 42, 44-45, 48-49	Utilities, Trade and Transportation	0.65%	2.02%	1.33%	2.33%	2.78%	2.55%	0.27%	1.02%	0.65%
51	Information	-3.26%	-0.48%	-1.88%	-3.93%	-11.10%	-7.58%	2.83%	-2.52%	0.12%
52-53	Finance Activities	-0.33%	2.65%	1.15%	-1.66%	0.73%	-0.47%	1.22%	1.41%	1.32%
54-56	Profession and Business Services	1.10%	1.53%	1.32%	1.77%	1.90%	1.83%	0.00%	1.86%	0.92%
61-62	Educational, Health and Social Services	39.25%	6.37%	21.70%	5.67%	3.86%	4.76%	-2.62%	0.56%	-1.04%
71-72	Leisure and Hospitality	0.87%	3.59%	2.22%	2.66%	3.14%	2.90%	-0.64%	3.38%	1.35%
81	Other Services	-33.34%	1.80%	-17.62%	-9.26%	-5.42%	-7.36%	5.82%	1.27%	3.52%
99	Unclassified	2.07%	-70.90%	-45.50%	7.31%	-73.40%	-46.58%	-1.66%	-4.17%	-2.92%
SJVAPCD Total/Average		**-0.42%**	**3.53%**	**1.54%**	**1.98%**	**1.85%**	**1.91%**	**0.21%**	**1.33%**	**0.77%**

Source: BLS, 2020.

Notes:

[a] Includes all of Kern County.

3.3. REGIONAL TRENDS IN GLASS MELTING FURNACES

The number of glass manufacturers has decreased both statewide and regionally since 2009 (US Census, 2019). Financial burdens experienced by manufacturers as a result of air quality regulation compliance contribute to the decline of glass manufacturing regionally (Campbell, 2014).

3.4. IMPACTS OF THE COVID-19 PANDEMIC

The COVID-19 pandemic has affected virtually every industry to some degree, including the glass product manufacturers that would have costs under the potential amendments to Rule 4354.

Demand for glass packaging has remained steady during the pandemic. One of the most significant reasons for this is the increased level of beer consumption globally (ReportLinker, 2021). While beer sales in the US dropped from $120 billion in 2019 to about $100 billion in 2020, the sales of beer and other alcoholic drinks in glass bottles took only a small hit relative to other alcoholic drink sources; glass bottles represented 29 percent and 28 percent of all alcoholic beverage sales in 2019 and 2020, respectively (NBWA, 2021). This can be attributed to a sales source shift away from bars and restaurants toward liquor stores.

Restaurant closures also put a greater emphasis on packaging for food products. With people eating much more often from home, packaged food sales increased. This development increased glass demand and put a greater emphasis on recycling programs, which struggled to supply glass manufacturers with recycled materials at the outset of the pandemic (O-I Glass, 2020). Since the share of recycled glass shifted away from businesses and more toward homes, recycling companies have experienced a greater degree of contamination due to 'wishcycling' and reduced amounts of recyclable scrap (Bothwell, 2021). Recycled glass supplies decreased dramatically across the country, with some states seeing as high as a 62 percent decrease in supplies. Bottle bill states like California resumed their recycling programs after the initial stages of the pandemic though, and with redemption centers opening again, the system has seen about 80 percent of pre-pandemic recycled glass quantities (Bothwell, 2021).

While 90 percent of glass containers are used for food and beverage packaging, glass vials are a priority item during the pandemic (Research and Markets, 2020). Pharmaceutical glass is collected separately from standard glass and is kept in a closed-loop production process to ensure that these materials are not mixed in with others not suitable for use in vials (Bothwell, 2021). Medical-grade vial production needs to increase by 5 to 10 percent within the next two years in order to handle global vaccine delivery systems (Rowland, 2020). Hundreds of millions of dollars is being poured into this effort. To conserve glass supply, the most common size of vials produced can hold 8 to 15 doses of a given vaccine (Rowland, 2020).

4. SOCIOECONOMIC IMPACT ANALYSIS

ERG calculated the direct impacts of the proposed rule amendments by comparing the costs of compliance to profits of affected facilities. ERG estimated potential employment impacts using IMPLAN's (2021) input-output model. Additionally, ERG used the IMPLAN model to capture indirect and induced impacts (i.e., impacts that might arise if directly impacted entities reduce purchases from their suppliers and households adjust their spending as a result of changes in earnings).

4.1. DATA SOURCES AND METHODOLOGY

To estimate socioeconomic impacts, ERG compares the costs of compliance with the potential amendments with profits per facility. ERG sought to create a profile for each affected sector, including employment, revenue, profits, and average pay per employee. The process of estimating each of these endpoints also requires other data to be used (e.g., facility name, address).

This section describes the data sources used to create the baseline industry profile and how socioeconomic impacts were estimated. The sections that follow detail the resulting profile of affected entities and the socioeconomic impacts of compliance with the potential rule amendments.

4.1.1. Baseline Industry Profile Estimates

SJVAPCD (2021) provided ERG with an initial list of affected facilities, including fields for facility ID, facility description, Standard Industrial Classification (SIC) code, number of emissions sources, and unit location. ERG converted the SIC codes to the North American Industry Classification System (NAICS) codes that are used with other sources of economic data used in the analysis using U.S. Census Bureau (2020d) concordances.[3] (See Table A-2 for a list of the NAICS code(s) that mapped to each SIC code.)

ERG estimated facility revenues and profits using the same method the District has used for prior analyses. Dividing industry "sales, value of shipments, or revenues" by "number of employees taken from the 2017 Economic Census for the relevant NAICS codes results in estimated output per employee. This was inflated to represent 2020 dollars using the U.S. Bureau of Economic Analysis (BEA) gross domestic product implicit price deflator (BEA, 2021). The data used for these calculations are presented in Appendix B. Multiplying output per employee by the number of employees in each facility results in estimated facility revenues.

ERG estimated profits for private industries by multiplying revenue figures by the average profit rate for each NAICS for 2015 through 2020 (see Appendix B). The profit rate was calculated using data from the Risk Management Association's (RMA) 2020 Annual Statement Studies, which are prepared standardized income statements from data submitted by individual enterprises to assess risk and evaluate financial performance relative to other enterprises in the same industry.

[3] SIC codes were last updated in 1987, and NAICS codes were first issued in 1997. The U.S. Census Bureau's (2020d) concordances map 1987 SIC codes to 1997 NAICS codes, and from there to the NAICS codes that are revised every five years (thus far in 2002, 2007, 2012, and 2017). SIC and NAICS codes are available at different levels of granularity. The SIC codes used in SJVAPCD's (2020a) data are 4-digit SIC codes, and ERG mapped these to 6-digit NAICS codes.

4.1.2. COVID-19 and Baseline Industry Profile Estimates

To reflect the impact of the COVID-19 pandemic, ERG examined the need to create a **"COVID-adjusted" baseline**, which would alter employment, revenue, and payroll figures for each facility using IMPLAN (2021) data. IMPLAN's "Evolving Economy" data use economic data points from the third quarter of 2020 to reflect the impacts on the pandemic, taking into account industry losses, shifts in household spending and behavior, stimulus checks and unemployment benefits, and Paycheck Protection Program (PPP) loans (Demski, 2021). IMPLAN uses only the third quarter 2020 data, adjusts it for seasonality, and annualizes the single quarter of data to an entire year.

Using outputs of the IMPLAN model, ERG estimates the percentage change in employment, revenue, and payroll by NAICS between 2019 (the most recent full year for which data are available) and 2020 Q3 (the "Evolving Economy" dataset, the most recent estimate). District-wide, this approach suggests that revenue contracted by 4.5 percent, and employment contracted by 8.9 percent (see Table 9).

Table 9. District-Wide COVID-19 Impacts

	2019	2020 Q3 [a]	% Change
Revenue	$345.0 billion	$329.5 billion	-4.5%
Employment	2.0 million	1.8 million	-8.9%

Source: IMPLAN, 2021

Note:

[a] Data are modeled for an entire year as if it were like the third quarter of 2020.

To estimate the impacts of the COVID-19 pandemic on individual industries, ERG multiplied the percentage change from 2019 to the third quarter of 2020 in the IMPLAN model by the baseline data to produce "COVID-adjusted" estimates for each NAICS code (which was then mapped onto SIC codes for use in conjunction with the cost data provided by SJVAPCD (2021)).

In most industries, this results in a decrease in revenue and employment, but an *increase* in average payroll per employee, reflecting the fact that more workers in lower-paid occupations have been laid off than workers in higher-paid administrative and executive occupations (Clouse, 2020).

The industries with the largest decrease in revenue and employment between 2019 and the third quarter of 2020 include restaurants (a 30.6 percent decrease in revenue and 33.6 percent decrease in employment) and dry cleaning and laundry services (a 44.6 percent decrease in revenue and a 77.1 percent decrease in employment).

Notably, some sectors saw revenue and employment *growth* when comparing 2019 and the third quarter of 2020. These sectors include oil and gas extraction (a 74.5 percent increase in revenue and 69.5 percent increase in employment), dog and cat food manufacturing (an 84.9 percent increase in revenue and 22.5 percent increase in employment), and tree nuts (an 11.1 percent increase in revenue and 71.6 percent increase in employment).

While IMPLAN's "Evolving Economy" dataset represents their best available estimate of the economy in 2020 based on the economic data that are currently released, the modeling approach has limitations. For instance, using third quarter of 2020 data and applying it to the entire year does not capture any lagging impacts of the COVID-19 pandemic that may take time to be seen in the data (for

example, companies that were able to stay open for much of the pandemic but ultimately closed). Given the shortcomings of the dataset, IMPLAN suggests using both the pre-pandemic (2019) and 2020 data to compare the results (Clouse, 2020).

However, while the pattern that complete recovery from the COVID-19 pandemic will take is unknown, many sectors will have recovered significantly by the time this analysis is performed and even more so by the time compliance is required with the potential rule amendments. Therefore, ERG started with a baseline assuming 100 percent recovery from COVID-19 (i.e., return to the 2019 baseline), but also performed a sensitivity analysis assuming 70 percent recovery (with the results presented in Section 4.4.3).

See Appendix C for detail on the revenue, employment, and payroll adjustments for the sectors affected by the potential amendments.

4.1.3. Estimating Impacts on Affected Entities

Cost estimates (i.e., the direct cost of the potential rule amendments by SIC code) were provided by SJVAPCD (2021). Total costs were calculated by summing the one-time capital costs and one-time permit costs (annualized over a 10-year period using a 4 percent discount rate) with ongoing annual costs. Costs to meet the NOx emissions limits starting in 2029 were discounted using a 4 percent rate to account for the fact that those costs would not start being incurred until 7 years following the start of the revised limits. To estimate impacts, the direct costs of the rule (i.e., the cost of compliance with the rule) are compared to profits for each SIC code.

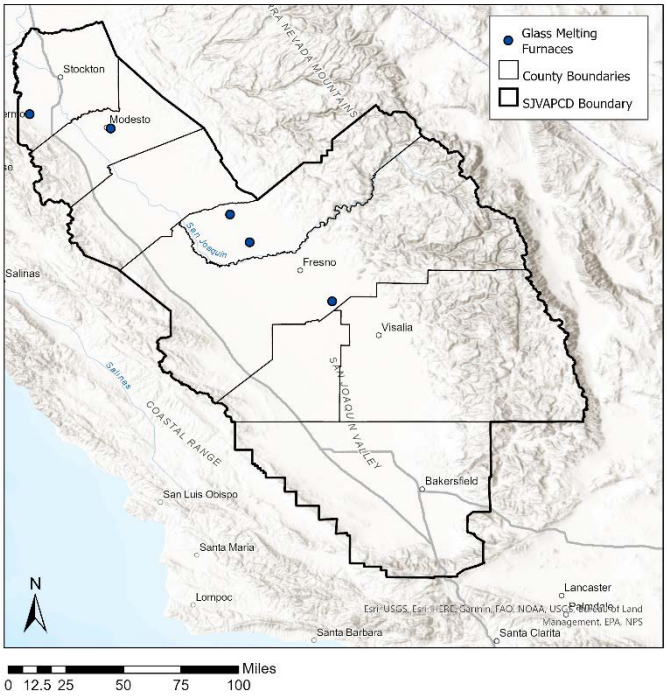
To estimate both direct employment impacts of the potential rule amendments and indirect and induced effects, ERG used IMPLAN's (2021) input-output model. IMPLAN "is a regional economic analysis software application that is designed to estimate the impact or ripple effect (specifically backward linkages) of a given economic activity within a specific geographic area through the implementation of its Input-Output model" (IMPLAN, 2020).

Based on the costs to affected facilities, the IMPLAN model estimates how many jobs might be lost in reaction to the costs to affected firms. It also estimates indirect costs (i.e., the impact to affected firms' suppliers when the direct cost of rule compliance causes affected firms to reduce their purchases from those companies) and induced impacts (i.e., how households that have lost income in turn adjust their purchases).

4.2. PROFILE OF AFFECTED ENTITIES

Figure 2 presents the facilities operating glass melting furnaces (whether affected by potential rule changes or not). Facilities were mapped using the geocoding function in ArcGIS Pro 2.6.0. Five out of six facilities are displayed. The majority of facilities are located outside of major metropolitan areas. No county has more than one facility. There are no affected facilities in Kern, Kings, Merced and Tulare Counties.

Figure 2. Map of Facilities Operating Glass Melting Furnaces



Source data: SJVAPCD, 2021.
Map created by ERG using ArcGIS® software by Esri.

Table 10 includes a profile of facilities affected by the potential amendments to Rule 4354 (i.e., those that will incur compliance costs). A total of five facilities will incur retrofit and permit fee costs.

Table 10. Profile of Facilities Affected by Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Total Facilities	Facilities w/ Costs	% w/ Costs	Total, All Facilities		
				Employees	Revenue	Profits
Flat Glass	2	2	100%	322	$129,693,262	$5,073,600
Glass Container	3	3	100%	1,328	$677,897,241	$26,519,340
Fiberglass	1	0	0%	371	$146,698,188	$5,791,644
Total	**6**	**5**	**83%**	**2,021**	**$954,288,692**	**$37,384,585**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.
[a] Calculated from the 2017 Economic Census as estimated revenues per employee for NAICS 327211, 327213, and 327993 (U.S. Census Bureau, 2020e), inflated to 2020 dollars (BEA 2021); see Appendix B for details. Revenue per employee multiplied by the number of facility employees (NAICS.com, 2021).
[b] Calculated as facility revenue multiplied by average profit rates from 2015 to 2020 (RMA, 2021); see Appendix B for details.

Table 11 shows the characteristics of the average facility affected by the potential amendments to Rule 4354. (The exact characteristics of individual facilities could be either higher or lower than these average estimates.)

Table 11. Characteristics of Facilities with Costs due to the Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Average per Facility			Average Annual Pay per Employee
	Employees	Revenue	Profits	
Flat Glass	161	$64,846,631	$2,536,800	$55,863
Glass Container	443	$225,965,747	$8,839,780	$55,863
Fiberglass	371	$146,698,188	$5,791,644	$55,863
Average	**337**	**$159,048,115**	**$6,230,764**	**$55,863**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

4.3. COMPLIANCE COST ESTIMATES

Compliance costs were estimated by SJVAPCD (2021), and include:

- One-time costs for units retrofit by December 31, 2023.
- One-time costs for units retrofit by December 31, 2029.
- One-time permit costs.
- Annual operating and maintenance (O&M) costs for the units retrofit in 2023, beginning in 2023 and continuing indefinitely.
- Annual O&M costs for the units retrofit in 2029, beginning in 2029 and continuing indefinitely.

Total costs are calculated by annualizing the one-time retrofit costs that will be incurred in either 2023 or 2029 over a 10-year period using a 4 percent interest rate, and then summing annualized one-time costs and annualized costs to yield the total. Costs to meet the NOx emissions limits starting in 2029 were discounted using a 4 percent rate because they would not start being incurred until 7 years following the start of the revised SOx limits.

Table 12 shows the one-time, annual, and total annualized costs incurred by sector. Costs would total **$7.0 million**, with the majority of these incurred by the "Glass Container" sector.

Table 12. Costs of Compliance with Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Permit Modification [a]	Capital Costs [b]	O&M Costs [c]	Total Annualized Costs [d]
	One-Time	One-Time	Annual	Annualized One-Time + Annual
	2023 & 2029	2023 & 2029	2023 & 2029	2023 & 2029
Flat Glass	$16,000	$7,369,974	$1,526,133	$1,898,273
Glass Container	$30,000	$19,103,074	$3,825,062	$5,059,749
Total	**$46,000**	**$26,473,047**	**$5,351,195**	**$6,958,021**

Source: SJVAPCD, 2021.

[a] Includes costs to modify the permit to reflect actual emissions.

[b] Includes one-time capital costs in 2029.

[c] Includes the costs to operate and maintain the new equipment.

[d] The total annualized cost is calculated by summing annualized one-time costs (annualized over a 10-year period using a 4 percent discount rate) and annual costs.

4.4. IMPACTS ON AFFECTED ENTITIES

This section first discusses our primary impacts test, which compares compliance costs to profits for affected facilities. ERG then discusses indirect and induced impacts to related industries, and the results of sensitivity analyses that examine results under varying degrees of economic recovery from the COVID-19 pandemic.

4.4.1. Direct Impacts

One possible measure of determining economic feasibility is a comparison of total annualized costs to profits for affected facilities, with a threshold of 10 percent of profits indicating a finding of significant adverse impact (Berck, 1995). Therefore, ERG uses this comparison to aid in the District's determination of economic feasibility of the rule amendments.

As shown in **Table 13**, overall rule impacts are approximately **18.6 percent of profits.** Both the "Flat Glass" and "Glass Container" sectors face impacts greater than 10 percent of profits, with "Flat Glass" facing the highest impacts, at **37.4 percent** of profits.

Table 13. Economic Impacts for Entities Affected by Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Average Annualized Cost per Facility	Average Profits per Facility	Cost as % Profits
Flat Glass	$949,136	$2,536,800	37.41%
Glass Container	$1,686,583	$8,839,780	19.08%
Fiberglass	$0	$5,791,644	0.00%
Average	**$1,159,670**	**$6,230,764**	**18.61%**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

4.4.2. Employment, Indirect, and Induced Impacts

In addition to the primary test of direct impacts of costs on revenue, ERG also assessed potential direct impacts on employment, indirect impacts, and induced impacts using IMPLAN's (2020a) input-

output model. The IMPLAN model uses the direct costs of the rule to estimate "ripple effect (specifically backward linkages) of a given economic activity within a specific geographic area through the implementation of its Input-Output model" (IMPLAN, 2020b).

Outputs from the IMPLAN model include:

- **Direct employment impacts**, if facilities with compliance costs under the potential amendments were to attempt to offset these costs by reducing the number of employees.
- **Indirect revenue and employment impacts** that capture how directly affected firms might react to the direct cost of rule compliance by reducing purchases from their suppliers, and how those suppliers might in turn reduce employees.
- **Induced revenue and employment impacts** that capture how households will adjust their spending as a result of any changes in earnings.

Table 14 summarizes these impacts, which, taken together, could have a total impact on the District economy of **$7.0 million and 21 jobs.**

Table 14. Direct, Indirect, and Induced Impacts of Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Direct		Indirect		Induced		Total	
	Revenue (Costs)	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment
Flat Glass	$1,898,273	6	$8,255	0	$14	0	$1,906,542	6
Glass Container	$5,059,749	15	$25	0	$125	0	$5,059,899	15
Fiberglass	$0	0	$131	0	$57	0	$188	0
Total	**$6,958,021**	**21**	**$8,411**	**0**	**$196**	**0**	**$6,966,629**	**21**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

Table 15 compares these impacts to the total size of the District's economy (as estimated in the IMPLAN model). These impacts represent **less than 0.01 percent** of revenue and employment District-wide.

Table 15. Comparison of Total Impacts against the District-Wide Economy for Potential Amendments to Rule 4354—Glass Melting Furnaces

	Total Rule Impacts	District-Wide [a]	% of District-Wide
Revenue	$6,966,629	$329,543,696,694	0.002%
Employment	21	1,844,909	0.001%

Source: ERG estimates based on IMPLAN, 2021.

Note:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here include the whole of the county.

4.4.3. COVID-19 Sensitivity Analysis

As discussed in Section 4.1.2, the primary estimates used in this analysis reflect a 100 percent recovery from COVID-19. ERG also conducted a sensitivity analysis that reflects COVID-19-adjusted

economic factors, reflecting a 70 percent recovery from COVID-19 using the percentage change between IMPLAN's (2021) 2019 and third quarter of 2020 "Evolving Economy" model.

Table 16 shows how the results of the analysis would vary under these economic recovery scenarios. Both indirect and induced cost impacts increase with a lower level of economic recovery, as would be expected. Costs comprise a greater portion of profits with a lower level of recovery from the pandemic, another expected outcome.

Table 16. Results of COVID-19 Sensitivity Analyses for the Impacts of Rule 4354—Glass Melting Furnaces

Analysis	Recovery from COVID-19 Baseline	Direct			Indirect		Induced		Total	
		Revenue (Costs)	Costs % Profits	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment
Primary Estimate	100%	$6,958,021	18.61%	21	$8,411	0	$196	0	$6,966,629	21
Sensitivity Analysis 1	70%	$6,958,021	18.90%	21	$8,848	0	$204	0	$6,967,073	21

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

4.5. IMPACTS ON SMALL ENTITIES

The entities affected by the potential amendments may include small entities (i.e., small businesses and/or small government entities).

For private entities, small businesses are defined in the California Small Business Procurement and Contract Act (Cal. Gov't Code § 14837) as an independently owned and operated, non-dominant business with principal office located in California with fewer than 100 employees and earning less than $15 million in revenues. Although the average facility values presented in **Table 11** suggest some facilities appear to be small, all five affected facilities are owned by larger corporations, some of which are multinational.

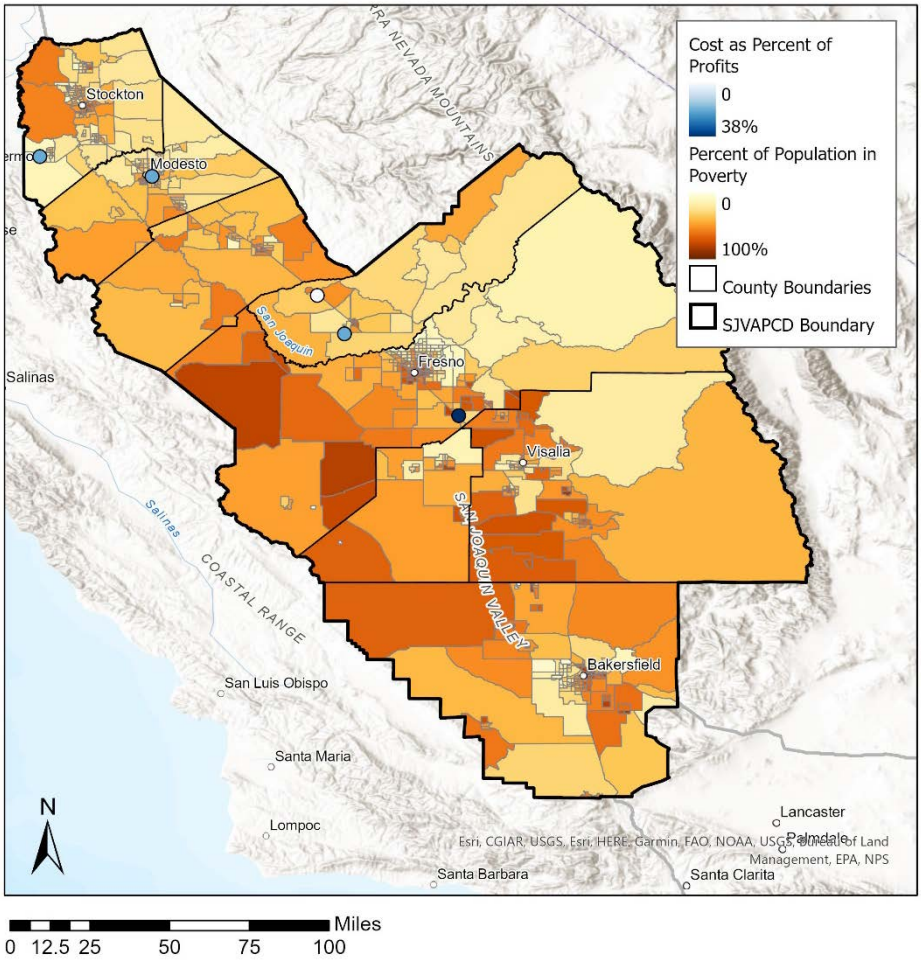
4.6. IMPACTS ON AT-RISK POPULATIONS

Cal. Gov't Code § 65040.12 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."

The entities affected by the potential amendments may operate facilities in areas with a high number of at-risk populations. To help further the District's environmental justice goals, ERG overlaid data on the impacts of the rule with data on poverty using data from CalEnviroScreen 4.0 (OEHHA, 2021a). (Note that not every facility in a given industry will necessarily be impacted by the rule, but this analysis does not include an assessment of impacts on individual facilities.)

Figure 3 presents a map of the potentially affected facilities overlying the percent of population living two times the federal poverty level. The facilities are colored in blue based on the estimated cost of compliance as a percent of profit. There is no correlation between the location of facilities and percent of the population living in poverty. However, the overall percentage of population living in poverty in the District is higher than the percentage for the state of California overall, and potentially impacted facilities are located in areas with fairly high poverty rates. Impacts are highest for the two "Flat Glass" facilities, which are both located in Fresno County (one of these facilities is not mapped). This could impact vulnerable populations in Fresno County.

Figure 3. Map of Facilities in Relation to Population Living in Poverty



Source data: SJVAPCD, 2021; ERG estimates; OEHHA, 2021a
Map created by ERG using ArcGIS® software by Esri

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APPENDIX A. SECTOR, SIC CODE, AND NAICS CODE CONCORDANCES

Table A-1 shows the concordance between SIC codes and sectors developed by SJV APCD (SJVAPCD, 2020). (SIC codes that were not in the original concordance but that might have indirect and induced impacts were assigned the sector "Other Industries.")

Table A-1. SIC Code to Sector Concordance used to Analyze the Impacts of Rule 4354—Glass Melting Furnaces

SIC Code	SIC Industry	Sector
3211	Flat Glass	Flat Glass
3221	Glass Containers	Flat Glass
3296	Mineral Wool	Flat Glass

Source: SJVAPCD, 2020.

Table A-2 shows the NAICS codes that map to the SIC codes used in the analysis (limited to the NAICS codes assigned to the facilities in the District that may be affected by the potential amendments). This concordance was primarily developed using the U.S. Census Bureau's (2020d) SIC to NAICS concordances. Where multiple NAICS codes map to one SIC code, ERG used information on companies' websites or other search tools about what type of industry they are engaged in to assign a NAICS code.

Table A-2. SIC to NAICS Concordance for Facilities that may be Affected by Potential Amendments to Rule 4354—Glass Melting Furnaces

SIC Code	SIC Industry	Corresponding NAICS
3211	Flat Glass	3272 Glass and Glass Product Manufacturing
3221	Glass Containers	3272 Glass and Glass Product Manufacturing
3296	Mineral Wool	3279 Other Nonmetallic Mineral Product Manufacturing

Source: ERG estimates based on SJVAPCD, 2021; Manta, 2021a.

APPENDIX B. PROFIT RATES BY NAICS INDUSTRY

Table B-1 presents the 2017 U.S. Economic Census data for flat glass manufacturing (NAICS 327211), glass container manufacturing (327213), and mineral wool manufacturing (327993) in California, along with the calculation of revenue per employee used to estimate revenue per establishment for these facilities in the District.

Table B-1. Number of U.S. Firms, Establishments, Revenue, Payroll and Employees for Glass Manufacturing Related NAICS, 2017

NAICS	Industry	Geographic Region	Number of Firms	Number of Estab.	Sales, value of shipments, or revenue ($1,000)	Annual Payroll ($1,000)	Number of Employees	Number of Production Employees	Revenue per Employee[a]
327211	Flat glass manufacturing	California	11	13	$387,715	$68,877	1,280	1,017	$381,328
327213	Glass container manufacturing	California	3	4	$698,338	$114,752	1,696	1,433	$484,033
327993	Mineral wool manufacturing	California	23	26	$637,641	$122,183	1,979	1,701	$374,973

Source: U.S. Census Bureau, 2020e

[a] ERG Calculation

Table B-2 tabulates the GDP implicit price deflator used to convert the Economic Census 2017-dollar values to the 2020-dollar values used in this analysis.

Table B-2. GDP Implicit Price Deflator, 2017 - 2020

Year	GDP Implicit Price Deflator Index (2012 = 100)	Multiplier to Convert to 2020 Value
2017	107.747	1.055
2018	110.321	1.030
2019	112.294	1.012
2020	113.648	1.000

Source: BEA, 2021

Table B-3 shows the profit rates used for private industry, which were estimated using the average rate for 2015 through 2020 data from RMA (2021).

Table B-3. Calculation of Average Profit Rate, NAICS 3272 and 3279, 2015 - 2020

NAICS	Industry	Average	2015	2016	2017	2018	2019	2020
3272	Glass and Glass Product Manufacturing	3.91%	4.10%	4.61%	4.39%	3.67%	3.10%	3.60%
3279	Other Nonmetallic Mineral Product Manufacturing	3.95%	3.17%	3.38%	4.39%	4.32%	3.96%	4.46%

Source: RMA, 2021

APPENDIX C. COVID-19 BASELINE ADJUSTMENTS BY NAICS INDUSTRY

Table C-1 shows the percentage change in revenue, employment, and average pay per employee by NAICS code, derived by comparing IMPLAN's (2021) datasets for 2019 and the "Evolving Economy" dataset developed using data for the third quarter of 2021.

Table C-3. COVID-19 Adjustments by NAICS Industry for Facilities Affected by Rule 4354—Glass Melting Furnaces

NAICS	Industry	COVID-19-Adjusted Change in Sensitivity Analysis		
		Revenue	Employment	Average Pay
3272	Glass and Glass Product Manufacturing	-0.70%	-3.91%	0.44%
3279	Other Nonmetallic Mineral Product Manufacturing	-5.91%	-6.83%	-2.22%

Source: ERG estimates based on IMPLAN, 2021.

APPENDIX E

Rule Consistency Analysis for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

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Rule Consistency Analysis for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

I. REQUIREMENTS OF ANALYSIS

Pursuant to Section 40727.2 of the California Health and Safety Code, prior to adopting, amending, or repealing a rule or regulation, the District is required to perform a written analysis that identifies and compares the air pollution control elements of the rule or regulation with corresponding elements of existing or proposed District and United States Environmental Protection Agency (EPA) rules, regulations, and guidelines that apply to the same source category. The rule elements analyzed are emission limits or control efficiency, operating parameters and work practices, monitoring and testing, and recordkeeping and reporting requirements.

II. RULE CONSISTENCY ANALYSIS

A. District Rules

Glass melting furnaces could be subject to other District rules including:

- Rule 2010 (Permits Required),
- Rule 2201 (New and Modified Stationary Source Review Rule),
- Rule 4101 (Visible Emissions),
- Rule 4102 (Nuisance),
- Rule 4201 (Particulate Matter Concentration),
- Rule 4202 (Particulate Matter Emission Rate),
- Rule 4301 (Fuel Burning Equipment), and
- Rule 4801 (Sulfur Compounds)

The above-listed rules are not in conflict nor are they inconsistent with the requirements of Proposed Rule 4354.

B. Federal EPA Rules and Regulations

1. Federal Control Techniques Guideline (CTG)

Beginning in 1975, EPA staff has issued more than 35 CTGs covering a variety of VOC sources. None of the CTGs cover glass melting furnaces, therefore, the proposed rule is not in conflict with nor inconsistent with a federal CTG for this source category.

2. EPA Alternative Control Techniques (ACT) Document

EPA-453/R-94-037 (ACT Document – NO_X Emissions from Glass Manufacturing)

This document outlines the available control techniques for three types of glass melting furnaces – container glass, flat glass and pressed-and-blown glass. The document does not contain specific NO_X emission limit requirements. However, it does discuss various control technologies that are feasible for glass furnaces and their estimated percent NO_X reductions from uncontrolled emission levels. Upon review of control technologies discussed in this document, none were found that would bring the NOx emissions from the glass furnaces operating within the District to levels lower than what is already being proposed with this rule amendment.

3. Federal New Source Performance Standards (NSPS)

40 CFR 60 Subpart CC (Standard of Performance for Glass Manufacturing Plants)
40 CFR 60 Subpart PPP (Standards of Performance for Wool Fiberglass Insulation Plants)

These NSPSs establish requirements and emission limits for the control of particulate matter. As such, they do not prescribe standards for NOx, SOx, CO, or VOC for this source category. Therefore, the District rule provisions for NOx, SOx, CO, and VOC emissions are more stringent than the federal NSPS requirements of these subparts.

The District evaluated both NSPSs with respect to PM for emission limits, monitoring and testing, and recordkeeping and reporting requirements. No requirements were found in either of the subparts that were more stringent than those already in the proposed amended version of Rule 4354.

4. National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

40 CFR 61 Subpart N (National Emission Standard for Inorganic Arsenic Emissions from Glass Manufacturing Plants)

This NESHAP specifically targets inorganic arsenic emissions. As such, it does not prescribe any standards for NOx, SOx, PM10, CO, or VOC for this source category. Therefore, the proposed Rule 4354 provisions for NOx, SOx, PM10, CO, and VOC emissions are more stringent than the federal NESHAP requirements of this subpart.

40 CFR 63 Subpart NN (National Emission Standards for Hazardous Air Pollutants for Wool Fiberglass Manufacturing at Area Sources)

This MACTs only regulates chromium compound emissions. As such, it does not regulate NOx, SOx, PM10, CO, or VOC for this source category. Therefore, the proposed Rule 4354 requirements for NOx, SOx, PM10, CO, and VOC emissions are more stringent than the federal NESHAP requirements of this subpart.

40 CFR 63 Subpart NNN (National Emission Standards for Hazardous Air Pollutants for Wool Fiberglass Manufacturing Plants)
40 CFR 63 Subpart SSSSSS (National Emission Standards for Hazardous Air Pollutants for Glass Manufacturing Area Sources).

The portions of these MACTs that apply to the glass melting furnaces are particulate emission limits and subsequent recordkeeping. As such, they do not regulate NOx, SOx, CO, or VOC for this source category. Therefore, the proposed Rule 4354 requirements for NOx, SOx, CO, and VOC emissions are more stringent than the federal MACT requirements of these subparts.

The District evaluated both NSPSs with respect to PM for emission limits, monitoring and testing, and recordkeeping and reporting requirements. No requirements were found in either of these subparts that were more stringent than those already in the proposed amended version of Rule 4354.

III. CONCLUSION

Based on the above analysis, District staff concludes that the proposed amendments to Rule 4354 would not conflict with any District or federal rules, regulations, or policies covering similar stationary sources.

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