

Potential Amendments to District Rule 4354 (Glass Melting Furnaces)

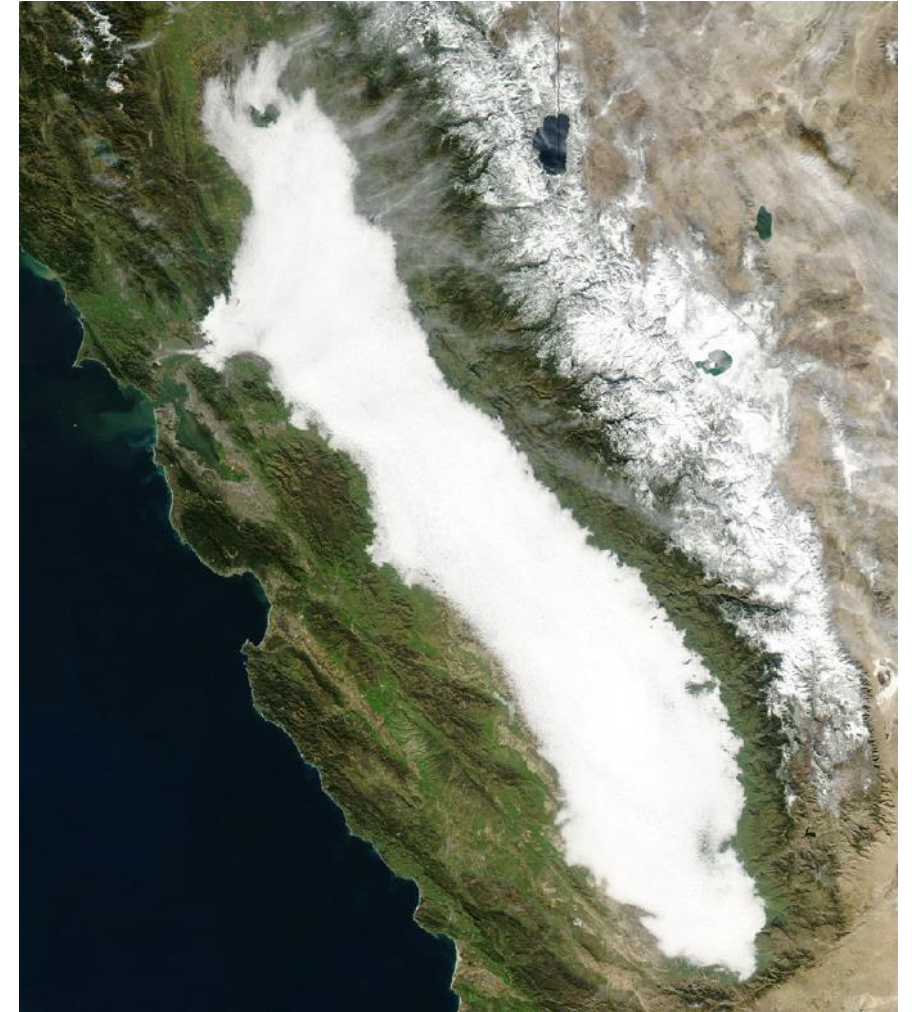
November 4, 2021

San Joaquin Valley Air Pollution Control District

webcast@valleyair.org

Valley's Air Quality Challenges

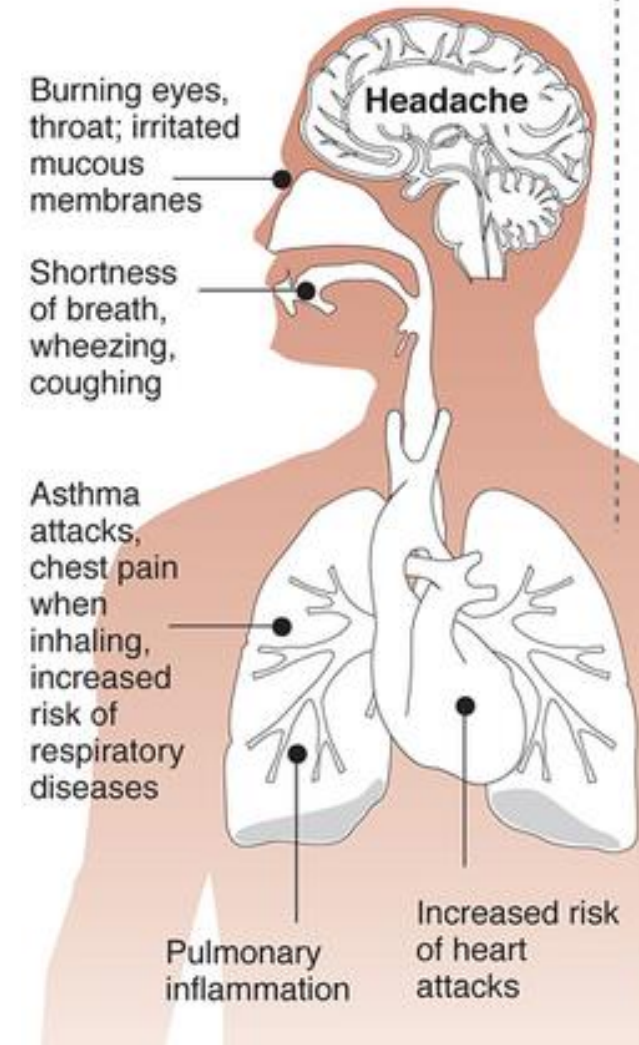
- Valley's challenges in meeting federal air quality standards unmatched due to unique geography, meteorology, and topography
- Valley designated as “Extreme” non-attainment of the 8-hour Ozone NAAQS; “Serious” non-attainment of federal standards for fine particulate matter (PM_{2.5})
 - Substantial emission reductions needed to achieve federal standards – need to go beyond already strict control limits
- Combustion is a significant source of NO_x emissions, primary precursor to ozone and PM_{2.5} formation
 - Comprehensive strategy in *2018 PM_{2.5} Plan* includes commitment to reduce emissions from mobile sources and a number of stationary source categories, including glass melting furnaces



Health Benefits of Reducing Emissions in the Valley

- Exposure to PM_{2.5} and Ozone linked to a variety of health issues, including (but not limited to):
 - Asthma, chronic bronchitis, irregular heartbeat, and respiratory/cardiovascular hospitalizations
- District implements control measures to lower direct and precursor emissions throughout the Valley
 - NO_x emissions are key precursor to formation of ammonium nitrate, which is large portion of total PM_{2.5} winter
 - NO_x is also chemical precursor to formation of Ozone
- Proposed rule amendment will support goal of attaining health-based federal ambient air quality standards for both PM_{2.5} and Ozone, and help to protect public health

Effects on health



Glass Melting Facilities in San Joaquin Valley

- Valley home to six glass-making facilities with glass melting furnaces
 - **Container glass**: Any glass manufactured by pressing, blowing in molds, rolling, or casting (i.e. into bottles)
 - **Fiberglass**: Material consisting of fine filaments of glass
 - **Flat glass**: Glass produced by the float, sheet, rolled, or plate glass process - used in windows, windshields, etc.

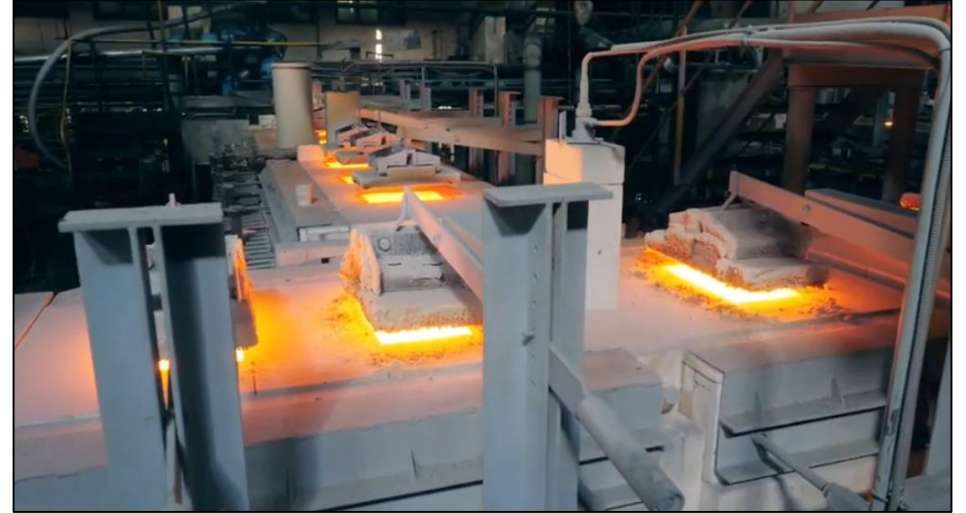
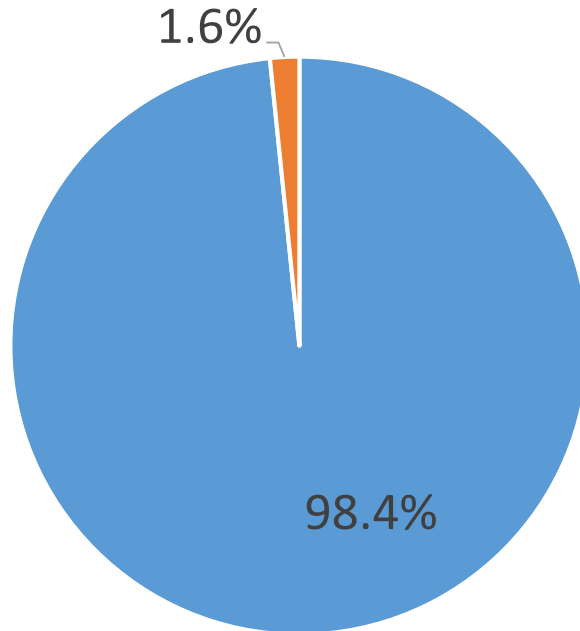


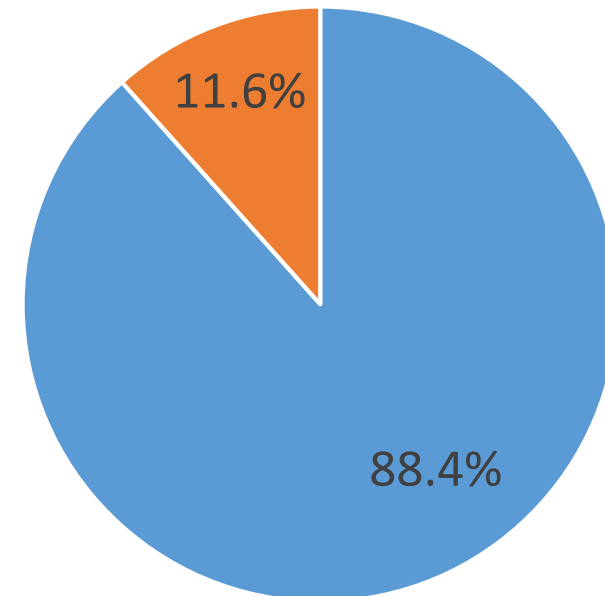
Image credit: Cesyco, 2020

NOx Emissions from Glass Melting Furnaces in the Valley

All NOx Emissions in the Valley Mobile, Stationary, & Area Sources



NOx Emissions from Stationary Sources



■ Other NOx Sources ■ Glass Melting Furnaces ■ Other Stationary Sources ■ Glass Melting Furnaces

Rule 4354 Overview

- District Rule 4354 first adopted September 14, 1994
 - Sixth generation rule
- Rule limits emissions of NO_x, CO, VOC, SO_x, and PM₁₀ from glass melting furnaces
 - Through rule requirements, NO_x emissions reduced by 75% to date
- Control technology required for glass melting furnaces to meet existing stringent limits
 - Rule requirements approved as meeting Most Stringent Measures (MSM) by U.S. EPA in July, 2020
- Specific types of glass melting furnaces have different limits, due to variations in the glass production process, residency time in the furnace, temperature requirements, etc.

Commitments from 2018 PM2.5 Plan

- Per 2018 PM2.5 Plan commitments, District pursuing potential opportunities to reduce NOx from *container* glass furnaces, as technologically and economically feasible
 - Proposing lowering NOx limit from 1.5 lb/ton to between 1.0-1.2 lb/ton glass pulled or lower, based on rolling 30-day average
- District also evaluating feasibility of lower NOx emission limits for other glass melting furnaces



Image credit: Peak Sensors, 2020

Current NOx Controls In Use At Valley Glass Plants

- Selective Catalytic Reduction (SCR)
 - Advanced active emissions control system that injects an ammonia-type reagent into a catalyst in the exhaust stream
- Oxy-Fuel fired furnaces
 - Furnace technology adds oxygen to fuel and reduces NOx emissions by minimizing the availability of nitrogen in combustion process
- Selective Non Catalytic Reduction (SNCR)
 - Reduces NOx through injection of reducing agent into exhaust stream

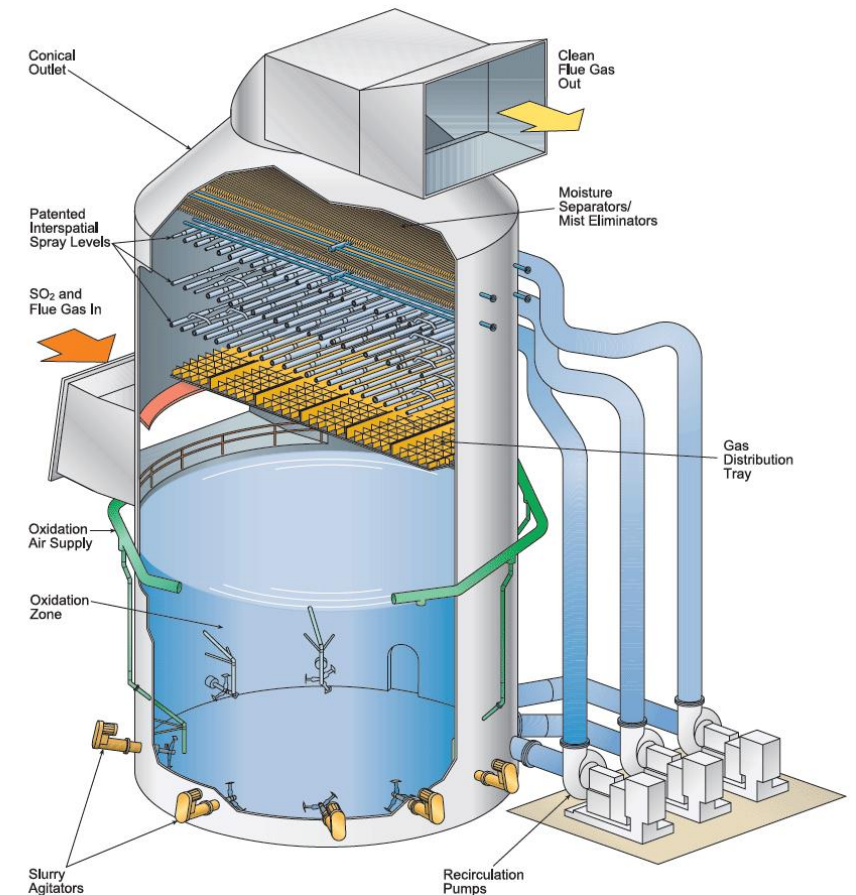


Image credit: Babcock & Wilcox, 2016

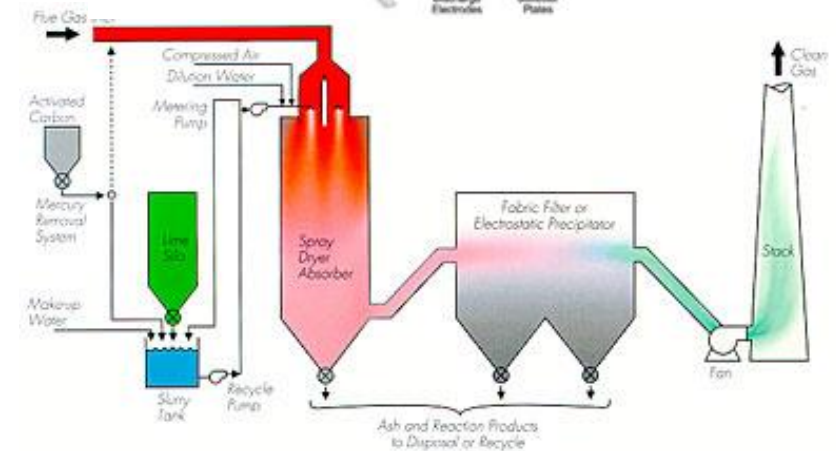
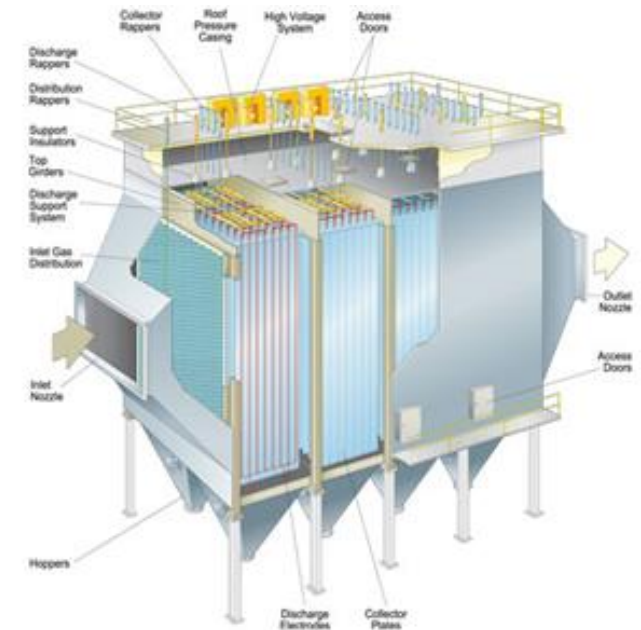
Additional Controls In Use At Valley Glass Plants

Particulate Matter Control Technologies

- Electrostatic Precipitator (ESP)
 - Removes particles from a gas stream by using electrical energy to charge particles and attract them to oppositely charged collector plates
- Ceramic filter system
 - Removes particles from gas stream through direct impaction

SOx Control Technologies

- Dry Scrubber Systems
- Semi-dry Scrubbers Systems
 - Powdered alkaline sorbent injected into exhaust stream to reduce sulfur compound emissions



Images credit: Babcock & Wilcox, 2016

Further NOx Control Technology Under Evaluation

- Ceramic Catalytic Filters
 - Tri-Mer UltraCat Catalytic Filter System
- Oxy-Fuel Combustion
- Selective Catalytic Reduction (SCR)
- Combination of control technologies

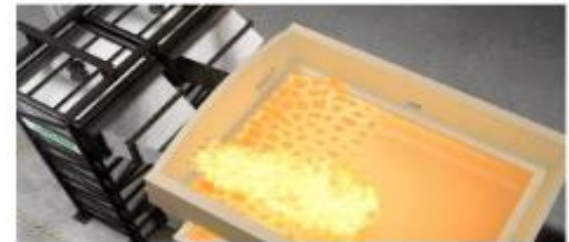


Image credit:
Praxair, 2016

Cost Assessment of Further Control Technology

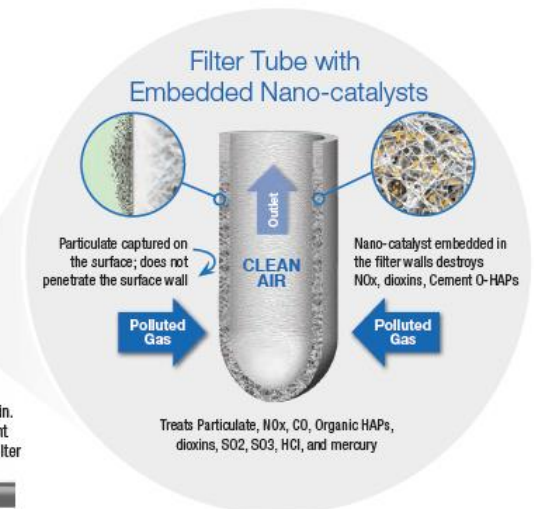
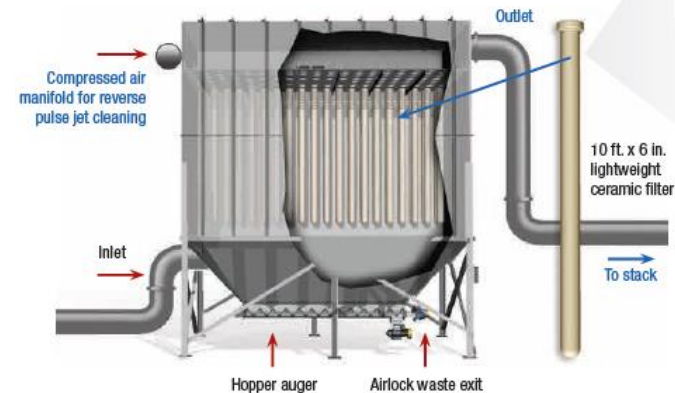
- Sources for costs
 - Actual costs provided by facilities, engineering estimates, and control technology vendors & manufacturers
 - Various sources for the cost of electricity, fuel, and replacement parts
 - Cost factors from EPA's Office of Air Quality Planning and Standards
- Staff held virtual meetings with facilities, vendors, manufacturers, and other stakeholders to gather cost figures

Ceramic Catalytic Filter

- Ceramic Catalytic Filters
 - Tri-Mer UltraCat Catalytic Filter System; controls PM, SO_x, NO_x, and more with a single integrated system
 - Total Capital Cost:
 - \$5M (housing already installed)-
\$17.5M (full system cost)
 - Operation & Maintenance Cost:
 - \$600K - \$2.4M

System Architecture

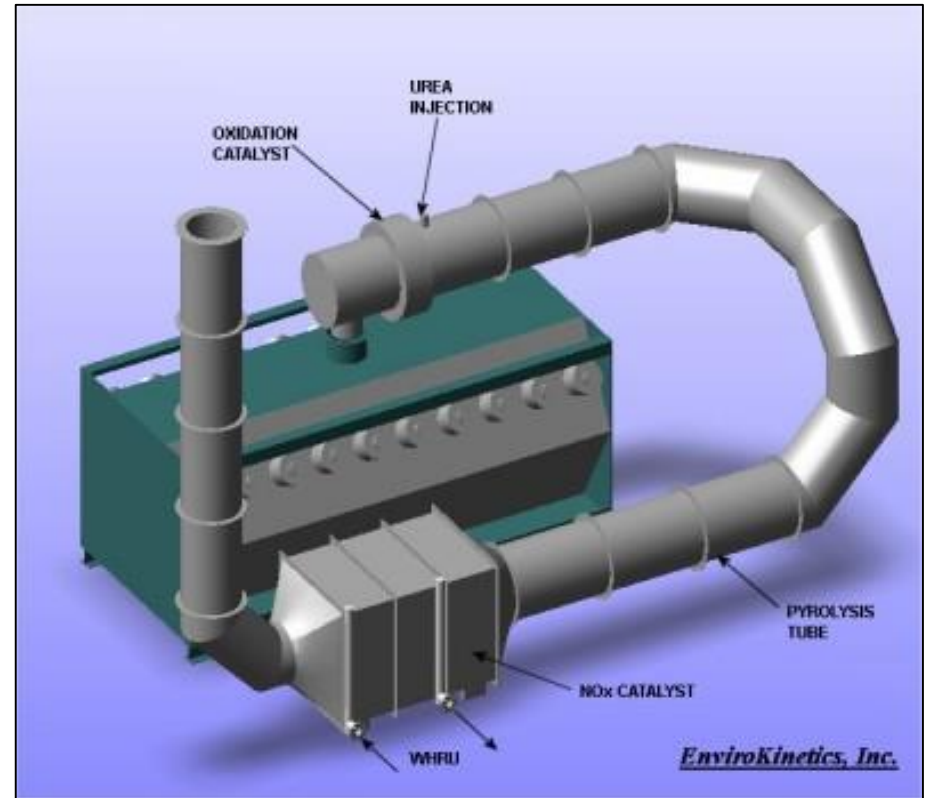
Ceramic filter tube wall is 3/4" thick with catalyst embedded throughout the wall. Filters are self-supporting without filter cages, and have a service life of 5 to 10 years.



Catalyst is inside the filter walls, protected from PM blinding and poisoning.

Selective Catalytic Reduction

- Selective Catalytic Reduction (SCR)
 - Reduces NO_x emissions through injection of ammonia type reagent into furnace
 - Total Capital Cost: \$2M-\$6.9M
 - Operation & Maintenance Cost: \$600K-1M



Oxy Fuel Combustion

- Oxy-Fuel Combustion
 - Adds oxygen to fuel and reduces NO_x emissions by minimizing the availability of nitrogen
 - Total Capital Cost: \$24M
 - Operation & Maintenance Cost: ~\$3.1M

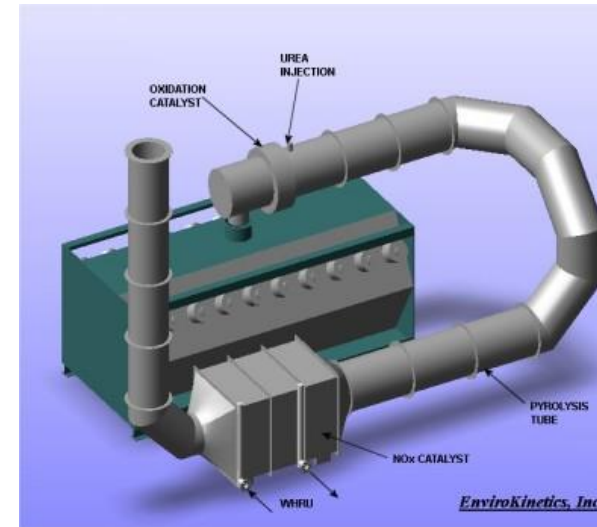
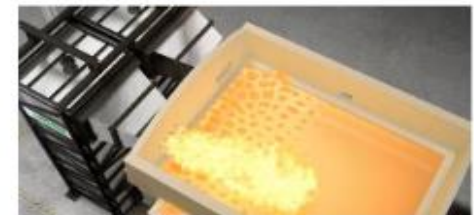
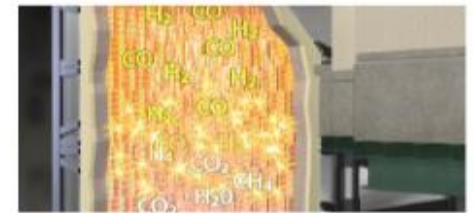
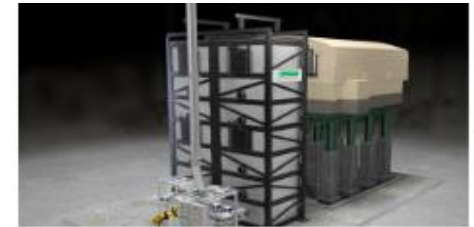
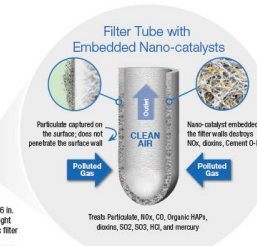
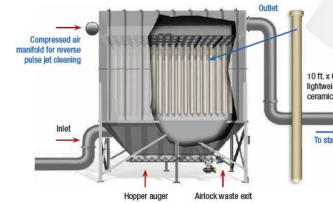


Combination of Controls

- Combination of control technologies such as Oxy-fuel and Ceramic Catalyst Filtration have the potential to achieve significantly lower emission limits

System Architecture

Ceramic filter tube wall is 3/4" thick with catalyst embedded throughout the wall. Filters are self-supporting without filter cages, and have a service life of 5 to 10 years.



Electric Furnace Technology Evaluation

- District in process of conducting analysis of potential feasibility of conversion to electric furnace technology
- Preliminary analysis shows:
 - Electric furnaces not available in size needed to support plant production throughput levels
 - Commercially available technology does not support use of recycled glass
 - Current electric furnace design not suitable for flat glass production
 - More than 10 MW of electrical capacity needed to replace one furnace at Valley plant (enough to power 2,600 homes for a year)
 - Significant cost of electricity to operate electric furnaces
 - Life of electric furnaces significantly shorter than traditional
- District continuing to evaluate electric furnace technology

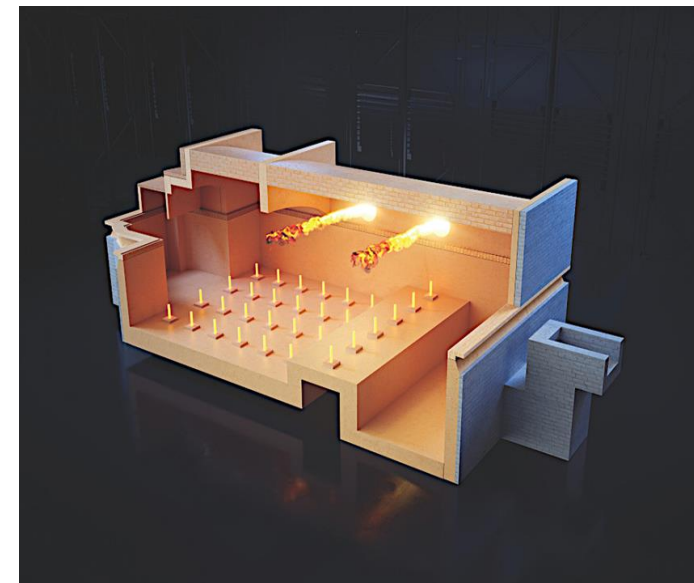
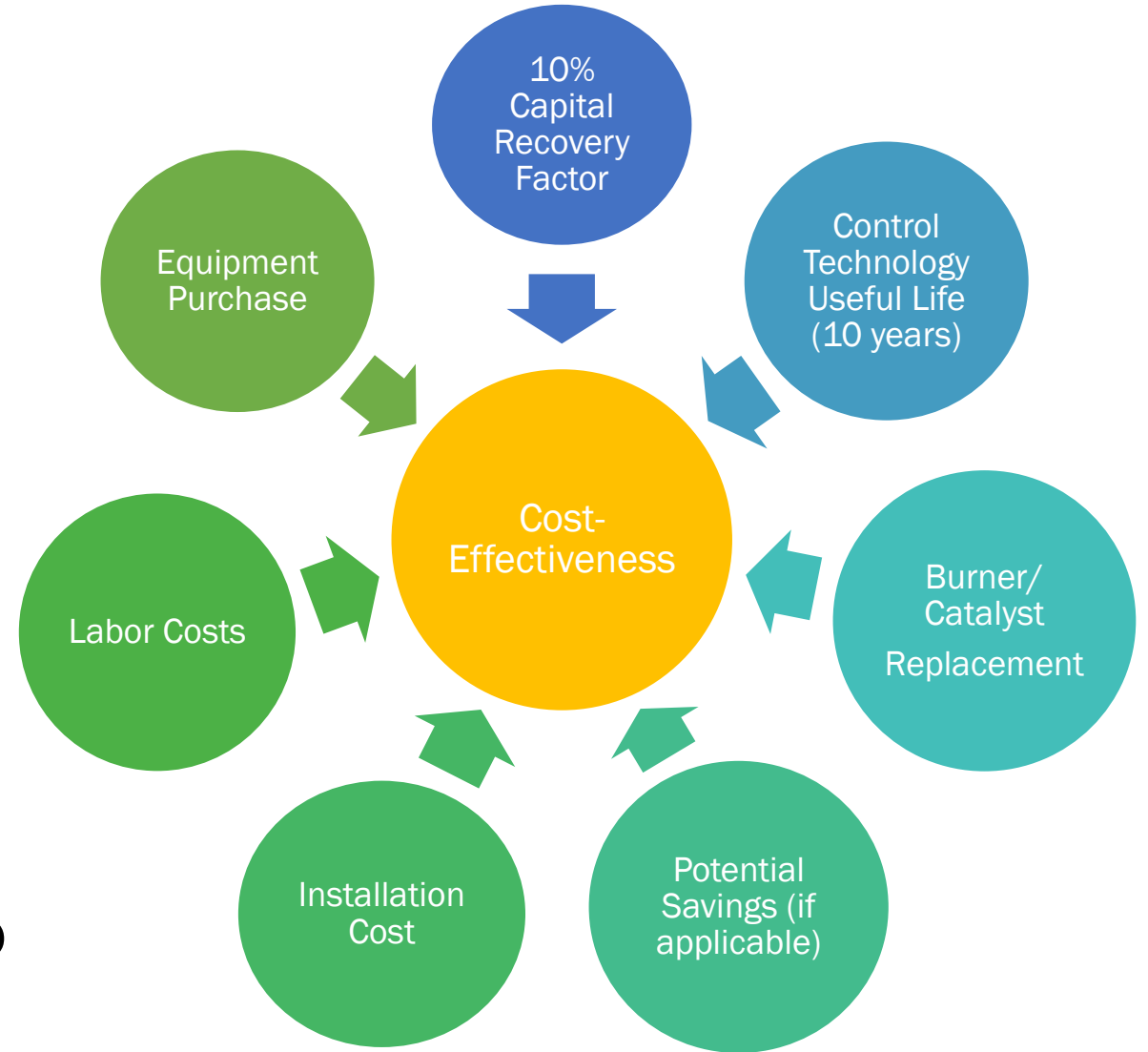


Image credit: Glass Worldwide, 2021

Cost-Effectiveness (CE) Analysis

- Cost-Effectiveness is cost (capital and annual) over emission reductions for the life of the equipment (\$/ton)
- Two major cost elements
 - Capital Costs (Equipment, Infrastructure, Engineering, Installation, Tax, Freight)
 - Annual Costs (Operation & Maintenance)
- Emission reductions based on current emission levels (baseline) to proposed emission limit



Rule 4354 Amendments Under Consideration: Container Glass Melting Furnaces

- District proposing to lower existing NO_x emissions limits with phased compliance schedule for container glass facilities
 - Current NO_x limit 1.5 lb/ton glass pulled
 - Proposed Phase I limit of 1.1 lb-NO_x/ton glass pulled based on rolling 30-day avg. (Jan. 1, 2024 compliance deadline)
 - Proposed Phase II limit of 0.75 lb-NO_x/ton glass pulled based on rolling 30-day avg.
 - Phase-in by furnace rebuild schedule starting January 1, 2024, no later than December 31, 2029
- Proposing to lower existing PM₁₀ emission limits
 - Current limit 0.5 lb/ton glass pulled
 - Proposed limit of 0.2 lb/ton glass pulled based on 24-hr block avg. (2024)
- Proposing to lower existing SO_x emission limits
 - Current rule limit for SO_x 1.1 lb/ton glass pulled
 - Proposed limit of 0.8 lb/ton glass pulled on 30-day avg. (2024)

Rule 4354 Amendments Under Consideration: Flat Glass Melting Furnaces

- District proposing to lower existing NO_x emissions limits with phased compliance schedule for flat glass facilities:
 - Current NO_x rule limit:
 - 3.2 lb/ton glass pulled (2.9 for Early Enhanced Schedule) on 30-day average
 - 3.7 lb/ton glass pulled (3.4 for Early Enhanced Schedule) on 24-hr block avg.
 - Proposed Phase I limit - January 1, 2024 compliance deadline
 - 2.5 lb/ton glass pulled on 30-day rolling avg.
 - 2.8 lb/ton glass pulled on 24-hr block avg.
 - Proposed Phase II limit - phase in by furnace rebuild schedule starting January 1, 2024, no later than December 31, 2029
 - 1.5 lb/ton glass pulled on 30-day rolling avg.
 - 1.7 lb/ton glass pulled on 24-hr block avg.

Rule 4354 Amendments Under Consideration: Flat Glass Melting Furnaces (cont'd)

- Lower existing PM10 emission limits – compliance by January 1, 2024
 - Current limit 0.7 lb/ton glass pulled based on 24-hr block avg.
 - Proposed limit of 0.2 lb/ton glass pulled based on 24-hr block avg.
- No proposed changes to SOx limits for flat glass melting furnaces
 - Facilities already employing maximum control feasible to reduce SOx emissions
 - Further SOx emissions control not technologically feasible based on plant design and NOx control systems

Estimated Emission Reductions

Glass Type	NOx Emission Reductions (tons/day)
Container Glass	0.464
Flat Glass	0.568
TOTAL	1.032

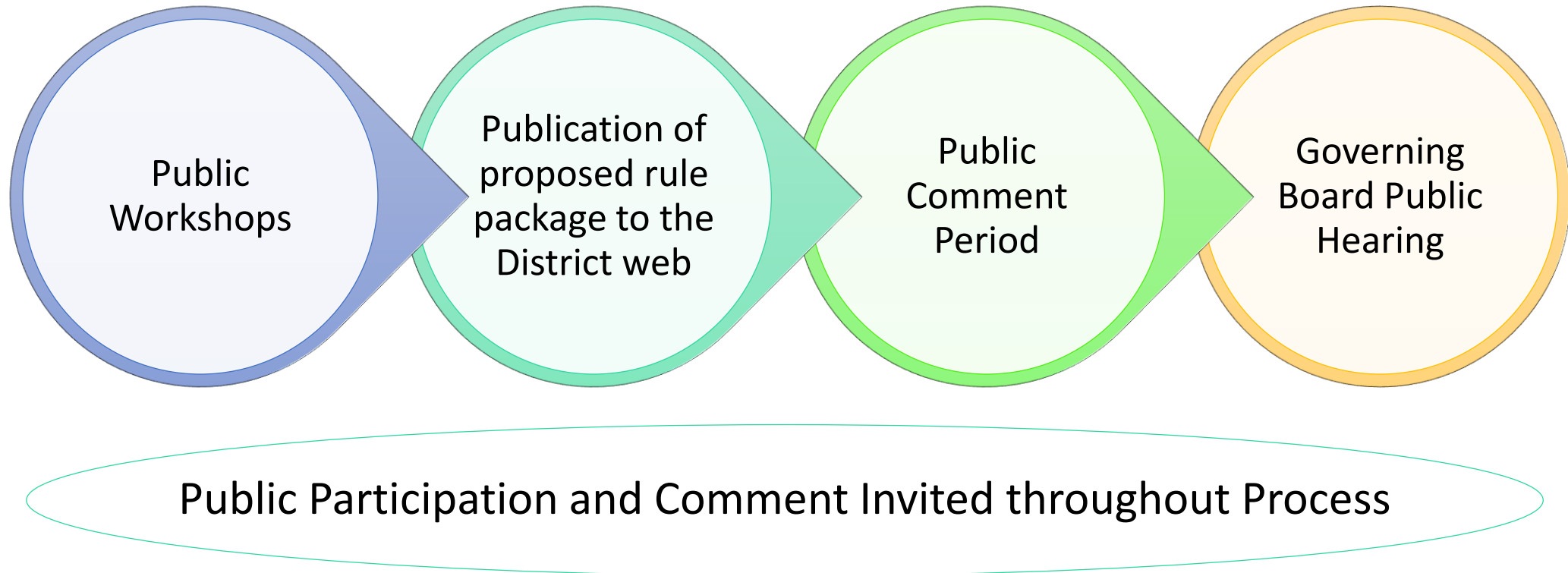
Glass Type	SOx Emission Reductions (tons/day)
Container Glass	0.230
TOTAL	0.230

Glass Type	PM10 Emission Reductions (tons/day)
Container Glass	0.042
Flat Glass	0.087
TOTAL	0.129

Next Steps

- Requesting comments on rule concepts by November 11, 2021 for incorporation into final draft rule
 - Comments welcomed through public hearing date
 - Governing Board Meeting anticipated December 16, 2021
- Continued analysis of costs, cost-effectiveness of various controls, and feasibility of control requirements
- Socioeconomic Impact Analysis being finalized by third-party consultant to evaluate the regional economic impacts of proposed amendments
- Ongoing public engagement process

Next Steps: Public Engagement Process for Rule 4354 Amendments



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Comments/Questions

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