Potential Amendments to District Rule 4354 (Glass Melting Furnaces)

September 30, 2021

San Joaquin Valley Air Pollution Control District

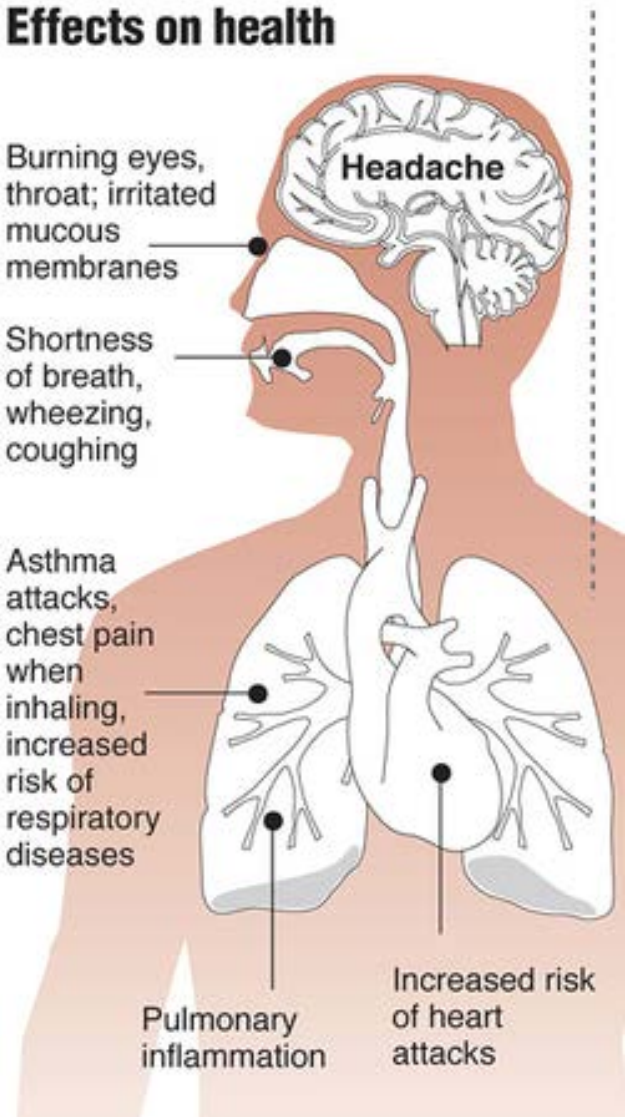
webcast@valleyair.org

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 (PM2.5)
  - Substantial emission reductions needed to achieve federal standards – need to go beyond already strict control limits
- Combustion is a significant source of NOx emissions, primary precursor to ozone and PM2.5 formation
  - Comprehensive strategy in *2018 PM2.5 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 PM2.5 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
  - NOx emissions are key precursor to formation of ammonium nitrate, which is large portion of total PM2.5 winter
  - NOx 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 PM2.5 and Ozone, and help to protect public 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.

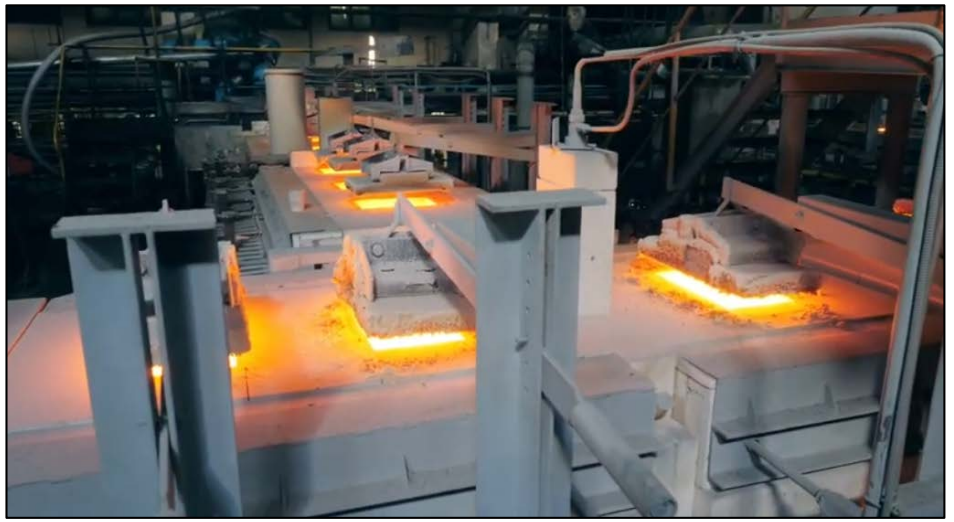
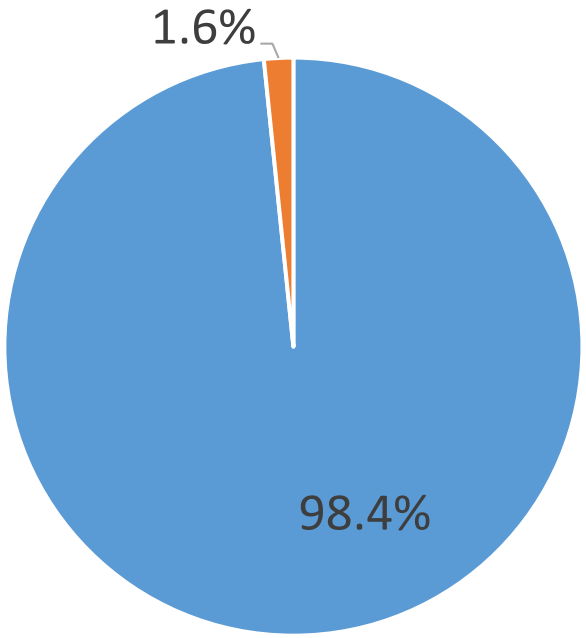


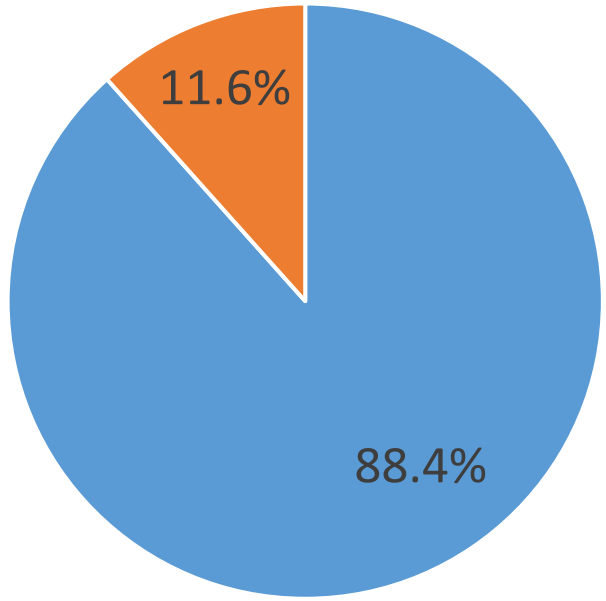
Image credit: Cesyco, 2020

NOx Emissions from Glass Melting Furnaces in the Valley

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



NOx Emissions from Stationary Sources



Rule 4354 Overview

- District Rule 4354 first adopted September 14, 1994
  - Sixth generation rule
- Rule limits emissions of NOx, CO, VOC, SOx, and PM10 from glass melting furnaces
  - Through rule requirements, NOx 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
  - Evaluating 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 emissions through injection of ammonia type reagent into furnace/exhaust stream

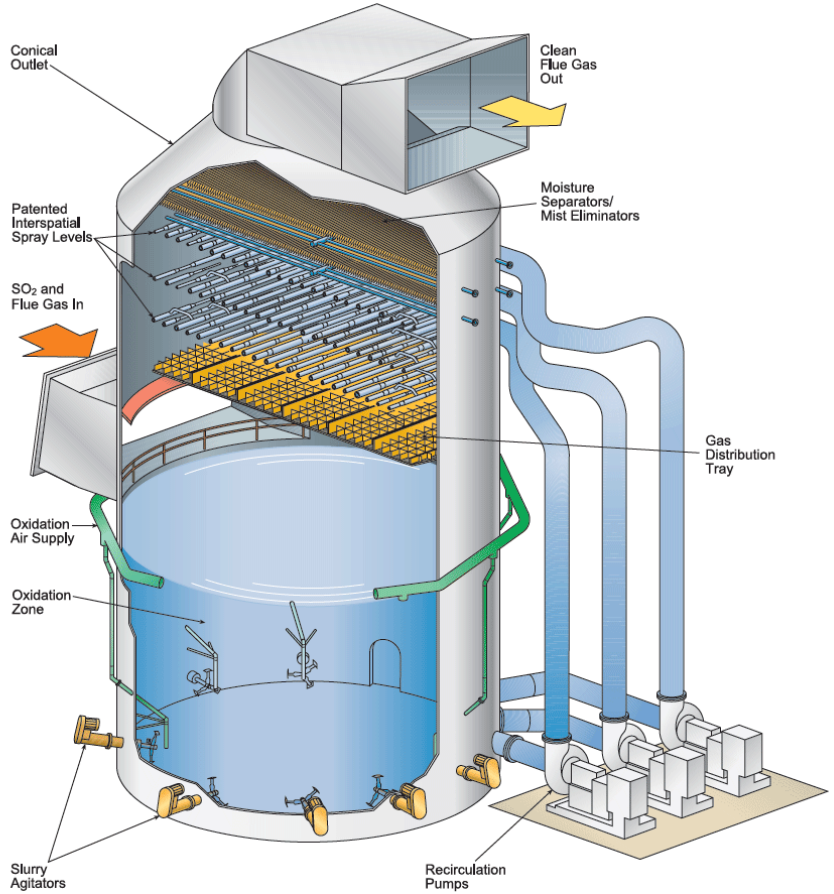


Image credit: Babcock & Wilcox, 2016

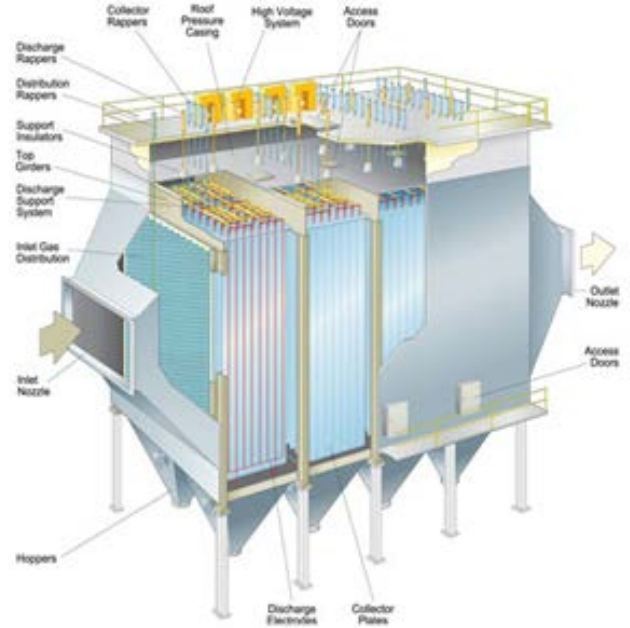
Additional Controls In Use At Valley Glass Plants

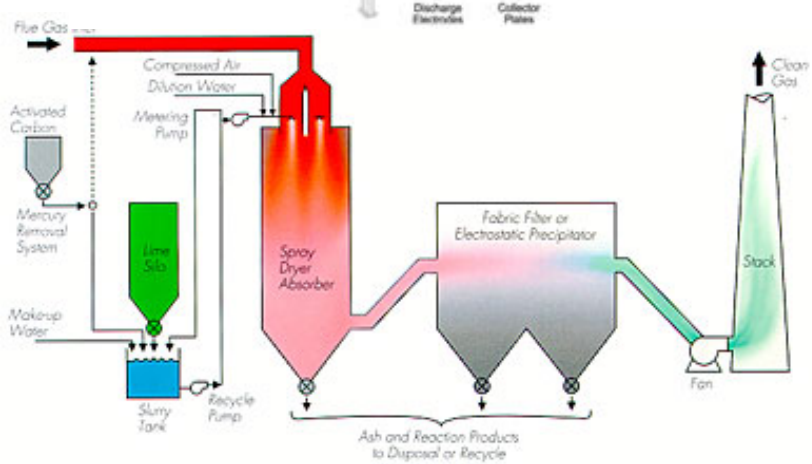
Particulate Matter Control Technologies

- 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

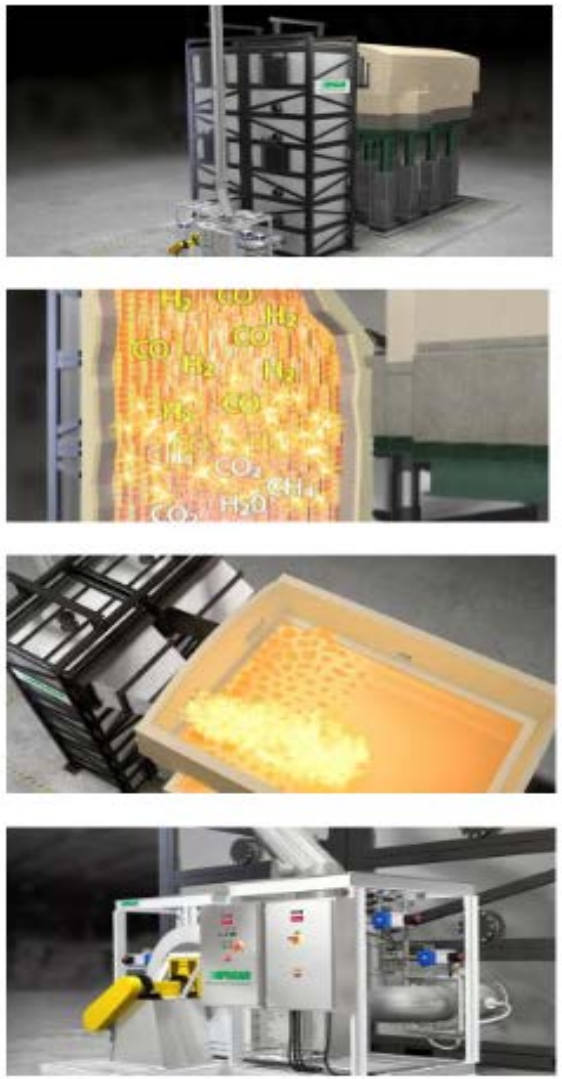


Image credit: Praxair, 2016

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, SOx, NOx, 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

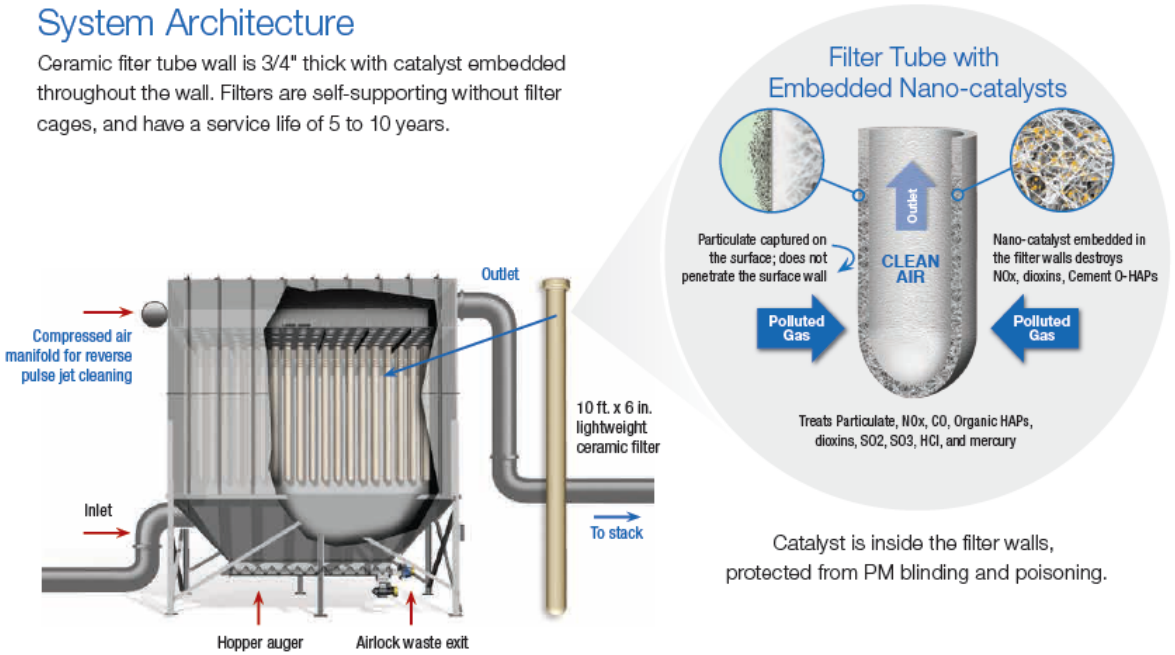
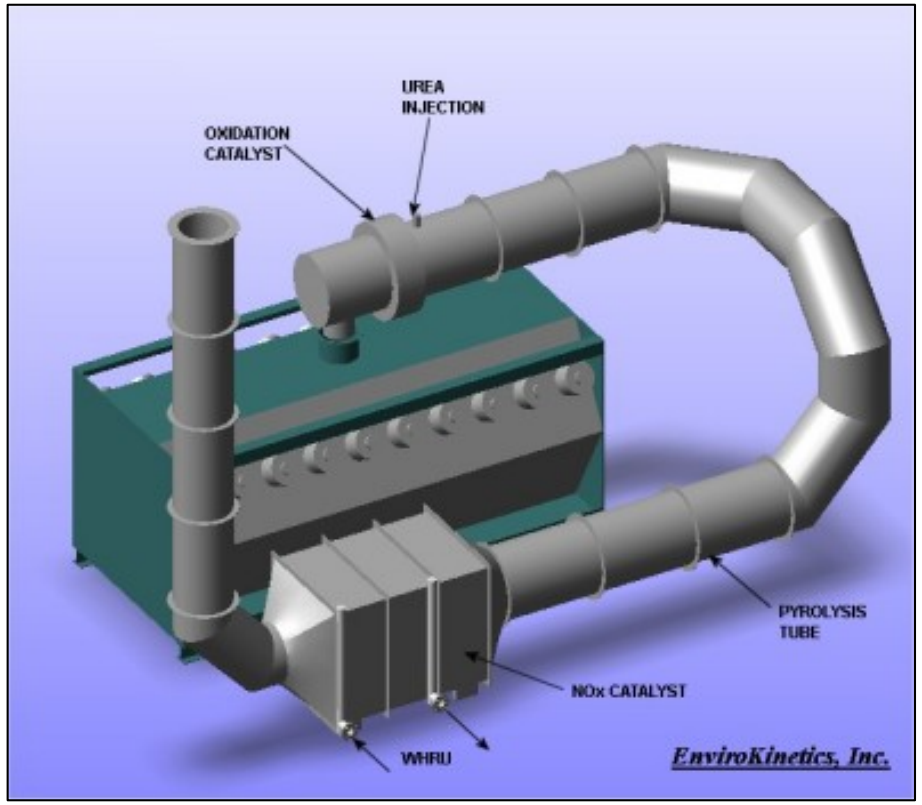


Image credit: Tri-Mer CORPORATION

Selective Catalytic Reduction

- Selective Catalytic Reduction (SCR)
  - Reduces NOx emissions through injection of ammonia type reagent into furnace
  - Total Capital Cost: $2M-$6.9M
  - Operation & Maintenance Cost: $6K-1M

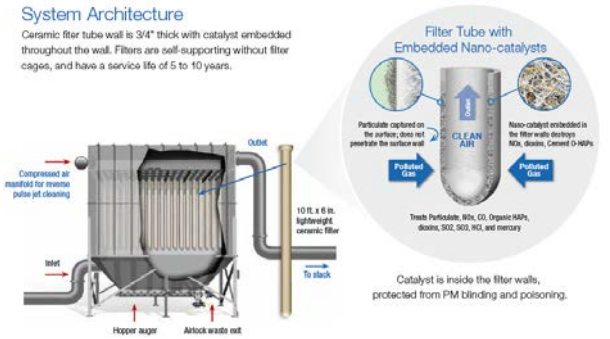


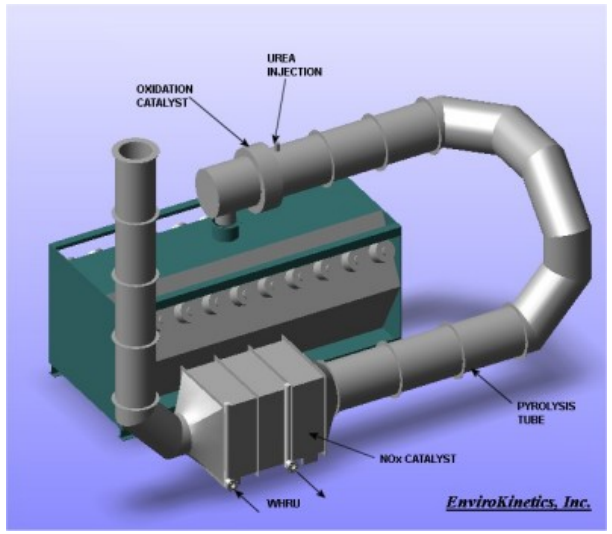
Oxy Fuel Combustion

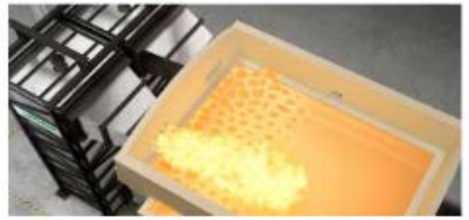
- Oxy-Fuel Combustion
  - Adds oxygen to fuel and reduces NOx emissions by minimizing the availability of nitrogen
  - Total Capital Cost: $24M
  - Operation & Maintenance Cost: ~$3.1M

Combination of Controls

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







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 (process limits furnace capacity under 300 tons/day)
  - 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 just 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

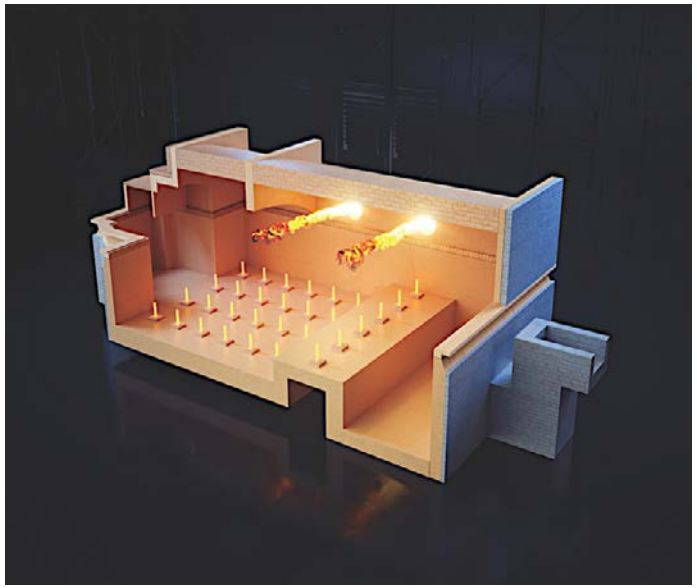
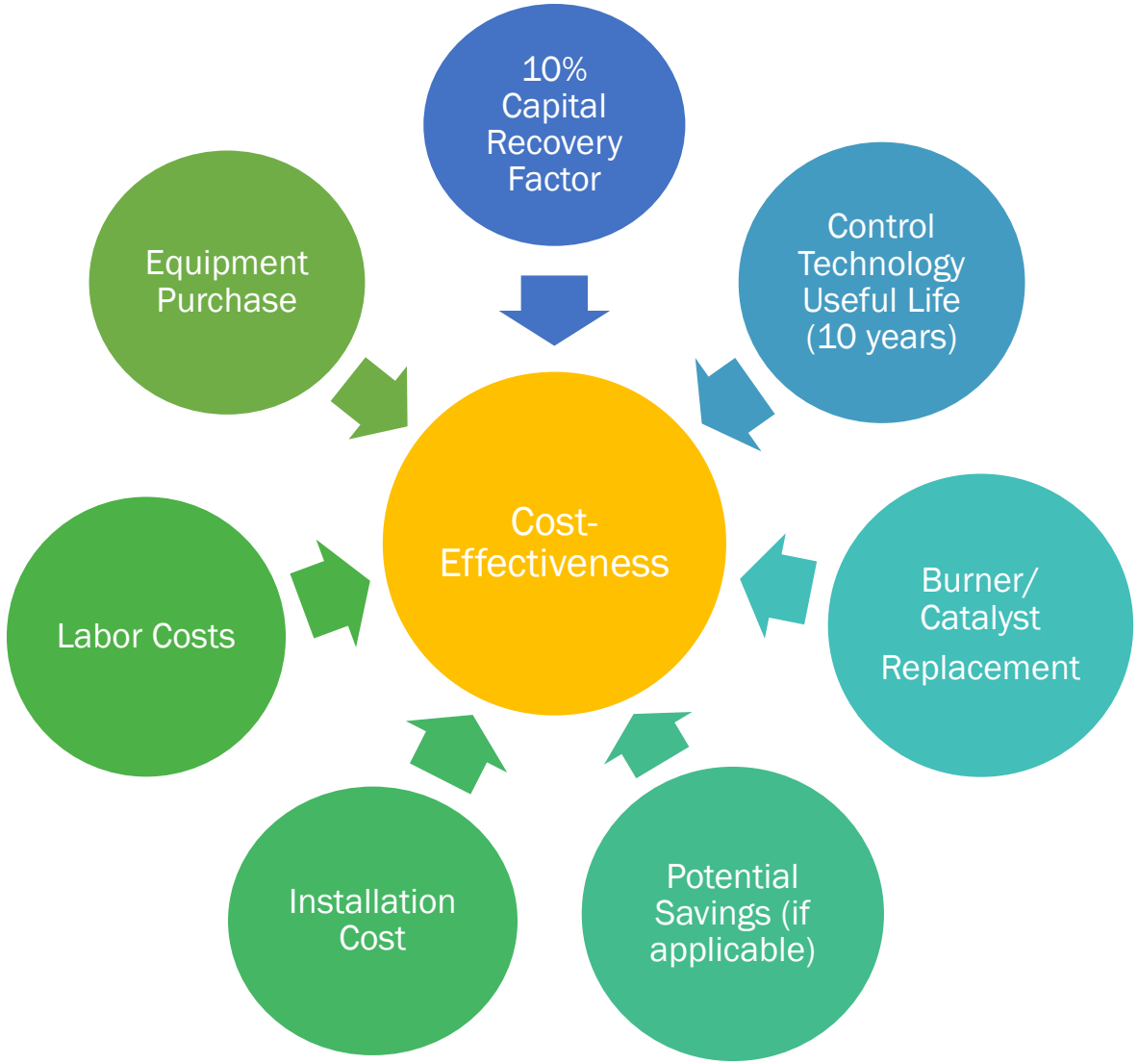


Image credit: Glass Worldwide, 2021

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 NOx emissions limits with phased compliance schedule for container glass facilities
  - Current NOx limit 1.5 lb/ton glass pulled
  - Proposed **Phase I limit** between 1.0-1.2 lb-NOx/ton glass pulled based on rolling 30-day average (Jan. 1, 2024 compliance deadline)
  - Proposed **Phase II limit** 0.75 lb-NOx/ton glass pulled based on rolling 30-day average
    - Phase-in by furnace rebuild schedule starting in 2024, no later than 2029
- Proposing to lower existing PM10 emission limits
  - Current limit 0.5 lb/ton glass pulled
  - Considering lowered limit of 0.15 - 0.2 lb/ton based on 24-hr block avg. (2024)
- Proposing to lower existing SOx emission limits
  - Current rule limit for SOx 1.1 lbs/ton glass pulled
  - Considering limit between 0.6 lbs/ton – 0.8 lbs/ton on 24-hr block avg. (2024)

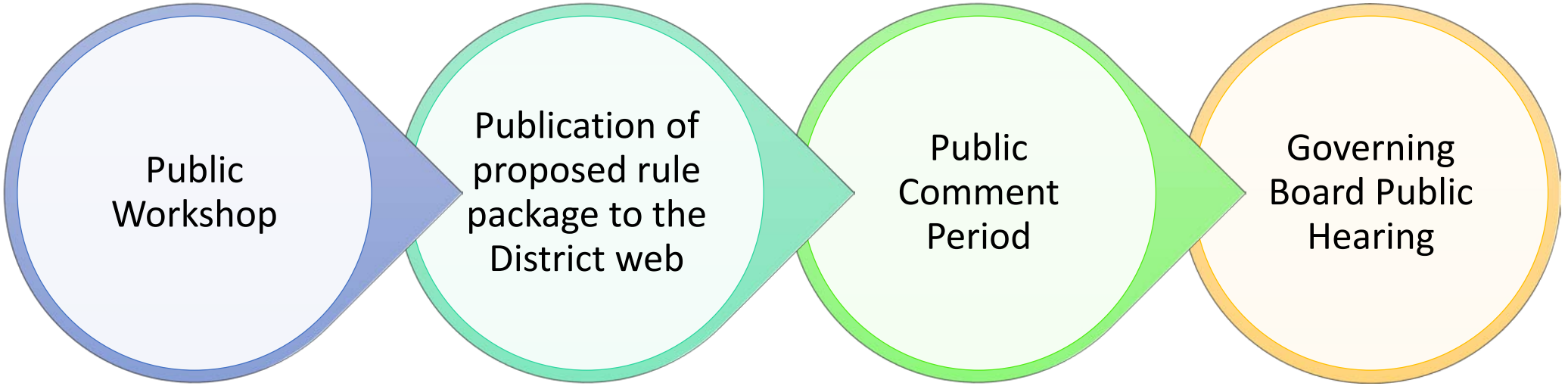
Rule 4354 Amendments Under Consideration: Flat Glass Melting Furnaces

- District proposing to lower existing NOx emissions limits with phased compliance schedule for flat glass facilities:
  - Current NOx rule limit 3.2 lb/ton glass pulled (2.9 for Early Enhanced Schedule) on 30-day average
  - Proposed **Phase I limit** of 2.5 lb-NOx/ton glass pulled (30-day rolling avg.)
    - January 1, 2024 compliance deadline
  - Proposed **Phase II limit** as low as 1.5 lb-NOx/ton glass pulled (30-day rolling avg.)
    - Phase in by furnace rebuild schedule starting in 2024, no later than 2029
- Lower existing PM10 emission limits
  - Current limit 0.7 lb/ton glass pulled
  - Considering limit of 0.2 lb/ton glass pulled based on 24-hr block avg. (2024)
- No proposed changes to SOx limits for flat glass melting furnaces

Next Steps

- Requesting comment on rule concepts by October 14
  - Draft rule to be published in coming weeks, with associated comment period
- Continued analysis of costs, cost-effectiveness of various controls, and feasibility of control requirements
- Socioeconomic Impact Analysis underway by third-party consultant to evaluate the regional economic impacts of proposed amendments
  - Characterization of the Valley's economic climate
  - Evaluation of economic impacts
  - Socioeconomic Impact Analysis report
  - Results of analysis will be included with proposed rule packages
- Ongoing public engagement process

Next Steps: Public Engagement Process for Rule 4354 Amendments



Public Participation and Comment Invited throughout Process

Contact

Contact: Ariana Hooks
Mail: San Joaquin Valley APCD
1990 E. Gettysburg Ave
Fresno, CA 93726
Phone: (559) 230-5800
Fax: (559) 230-6064
Email: Ariana.hooks@valleyair.org

Listserv: http://lists.valleyair.org/mailman/listinfo/glass_melting_furnaces

Comments/Questions

webcast@valleyair.org