District Rule 4702
(Internal Combustion Engines)

November 19, 2020

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)
- Combustion 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 internal combustion engines

Rule 4702 Overview

- District Rule 4702 applies to internal combustion (IC) engines rated at 25 bhp or greater
  - Spark-ignited (SI) engines
  - Compression-ignited engines
- Engines in Valley used to power pumps, compressors, or electrical generators at public and private facilities
- Many permitted compression-ignited engines used as emergency engines to provide backup power
- Rule limits emissions of NOx, CO, VOCs, and SOx

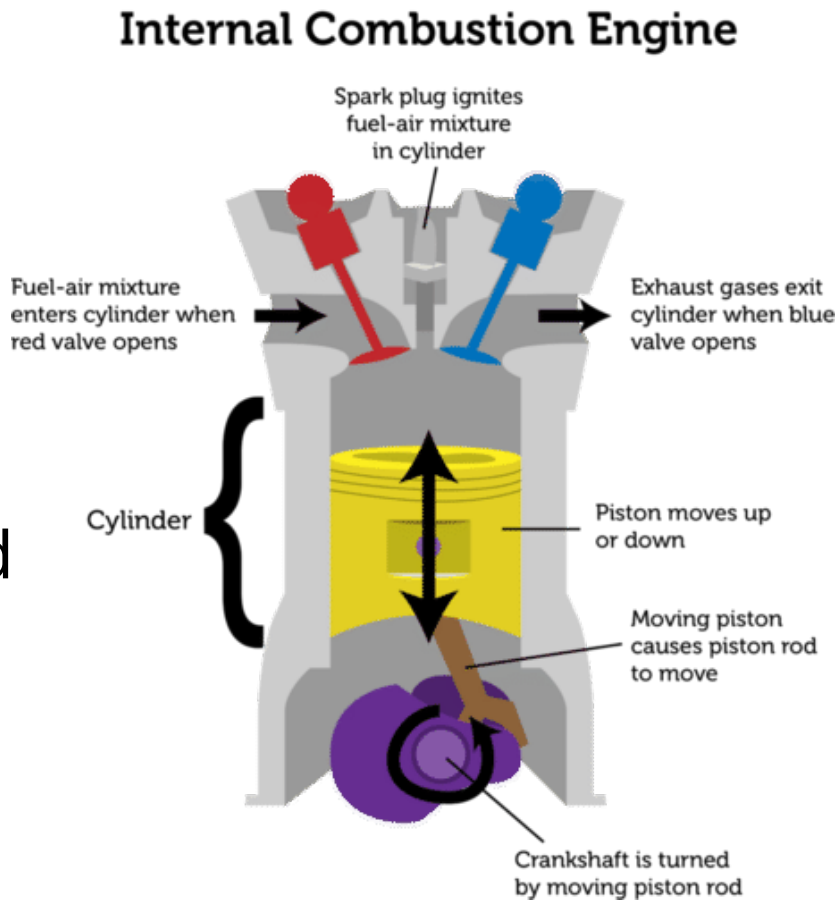


Image credit: C.Auyeung, 2019

Where do Internal Combustion Engines Operate?

- IC engines are used at the following facility types in the Valley:
  - Oil and gas production facilities
  - Petroleum refineries
  - Landfills and waste wastewater treatment plants
  - Water districts
  - Schools, universities
  - Electrical power generation facilities
  - Food processing operations
  - Agricultural operations

Image credit: EPA, 2013

Current Rule 4702 Requirements

- District Rule 4702 adopted August 2003, sixth generation rule
  - Rule limits emissions of NOx, CO, VOCs, and SOx
  - Past amendments established lower NOx limits for non-agricultural engines between 25-50 ppmv (rich-burn) and 65-75 ppmv (lean-burn)
  - 2011 amendment further strengthened rule by requiring NOx limits as low as 11 ppmv for non-agricultural spark-ignited engines
  - Rule achieved significant reductions in NOx and PM emissions from agricultural engines, with significant investment by agricultural operators – past amendments have established limits between 90 – 150 ppmv for ag engines
- Through Rule 4702, NOx emissions from IC engines already reduced significantly
  - Achieved 90-96% NOx emissions control for non-agricultural rich burn engines, 85-90% emissions control for non-agricultural lean burn engines
  - NOx emissions from agricultural engines reduced by 84%

Non-Ag Engines in the San Joaquin Valley

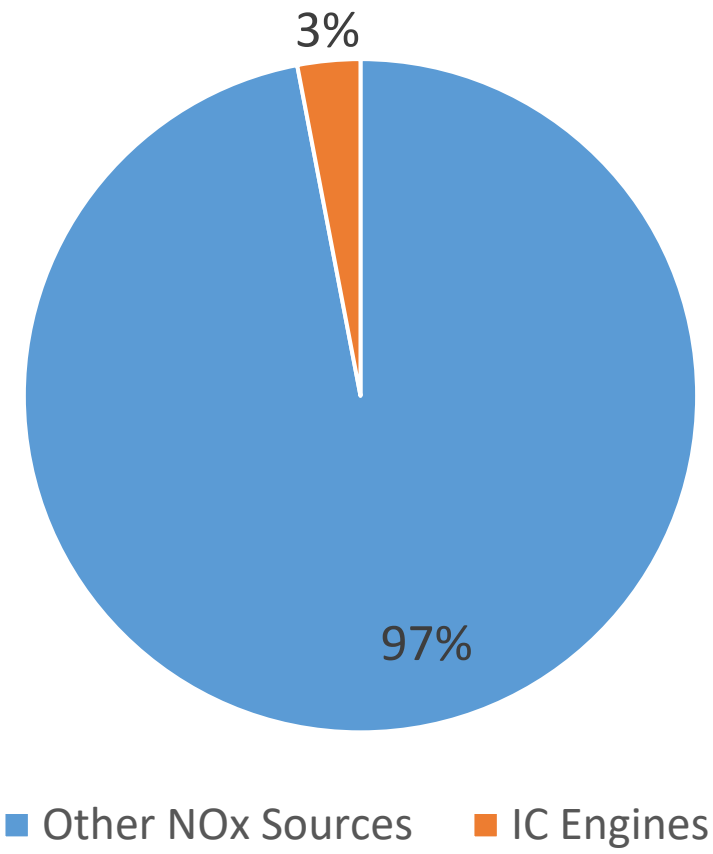
Engine Type	Total #
Rich Burn Spark Ignited Engines	
Waste Gas	0
Cyclic Loaded, Field Gas Fueled	7
Limited Use	20
Not Listed Above	202
Lean Burn Spark Ignited Engines	
Two-Stroke, Gaseous Fueled, >50 bhp and <100 bhp	0
Limited Use	0
Gas Compression	38
Waste Gas	14
Not Listed Above	19

Ag Spark-Ignited Engines in the San Joaquin Valley

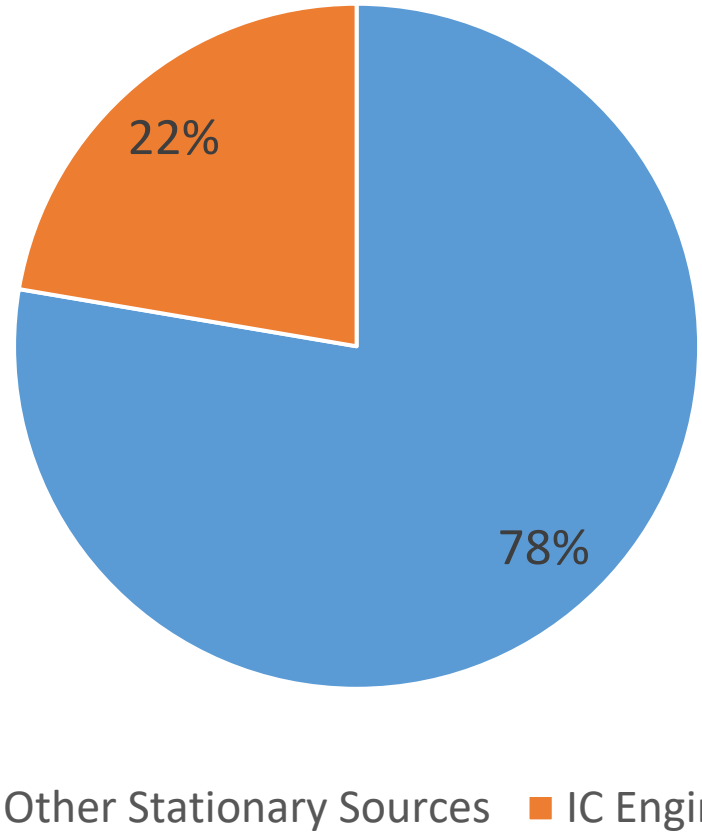
Engine Type	# of Permitted units	# of PEER units	Total # of Units
Rich Burn Spark Ignited	330	46	362
Lean Burn Spark Ignited	115	34	143
Total	445	80	505

NOx Emissions from Internal Combustion Engines in the Valley

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



NOx Emissions from Stationary Sources



Emission Reductions Needed

- Valley's challenges in meeting federal air quality standards unmatched due to unique geography, meteorology, and topography
- Substantial reductions needed to achieve federal PM2.5 standards – need to go beyond already strict limits
- Commitment in *2018 PM2.5 Plan* to further evaluate emissions reduction opportunities from variety of source categories, including IC engines
- District staff have conducted comprehensive review of requirements in other air districts, lowest emission limits being achieved in installations statewide, and costs and feasibility of most effective emission control technologies available

Public Process to Amend Rule 4702

- *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards*
  - Adopted: November 15, 2018
- Public scoping meeting held December 5, 2019
- Public Workshop held on September 24, 2020
- Regular updates provided at Citizens Advisory Committee (CAC), Environmental Justice Advisory Group (EJAG), and District Governing Board meetings
- Ongoing opportunities for public input throughout rule development process

Available Ag Pump Replacement Incentive Program

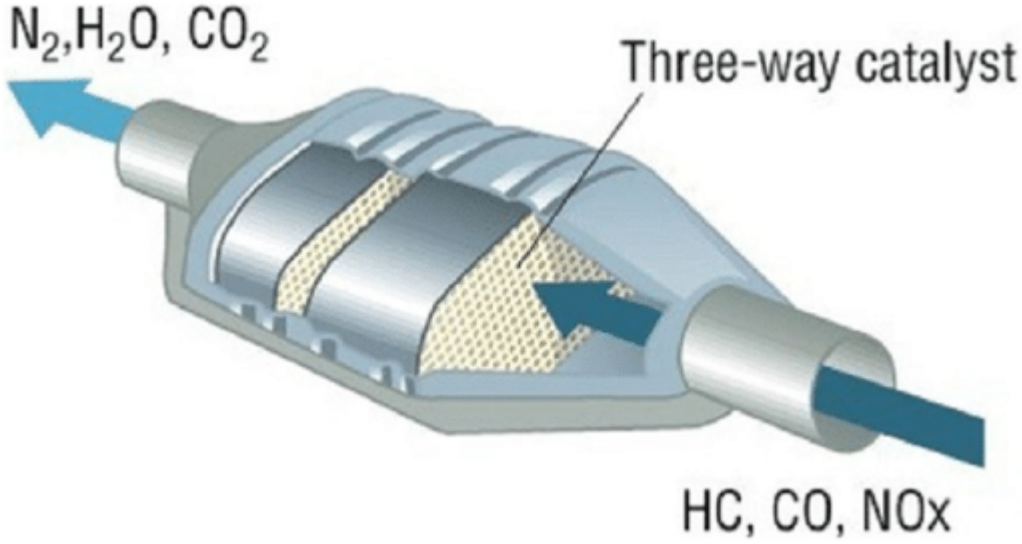
- District operates robust incentive program to provide funding for replacement of older ag engines with Tier 4 engines or electric motors
- Total program funding of over $120,000,000
- Funding amounts based on dollar per horsepower from $90/hp - $150/hp (additional funding for line extension)

- Incentives have replaced over 7,100 engines, with over 3,000 replaced with electric motors (more info: http://www.valleyair.org/grants/agpump.htm)
- District will continue to provide incentives to transition engines to latest TIER or electric motors

Engine Add-On Control Technologies

- **3-Way Catalyst (NSCR)**
  Applicable for Rich-Burn Engines: oxidizes hydrocarbons and carbon monoxide, and reduces nitrogen oxides into water, nitrogen and carbon dioxide

- **SCR System**
  Applicable for Lean-Burn Engines: injects reagent though a catalyst to convert NOx in exhaust to nitrogen & water



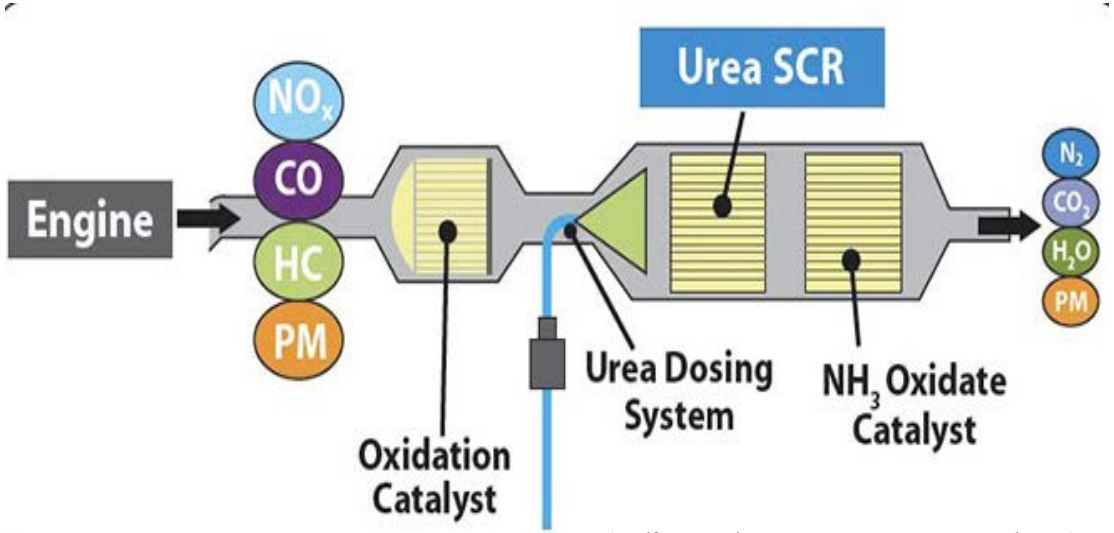


Figure Credits (from top): Laurenzi, 2018 ; Tomorrow's Technician, 2015

Available Control Options for IC Engines

- Lean-burn Spark-ignited engines
  - Replace with electric motor where electricity is available
  - Retrofit with SCR system
  - Replace with new rich burn engine with NSCR
- Rich-burn Spark-ignited engines
  - Replace with electric motor where electricity is available
  - Retrofit with 3-way catalyst
  - Replace with new well-controlled engine
- Cost-effectiveness varies greatly based on feasibility of retrofit vs. engine replacement

Cost Assessment of NOx Control Technology

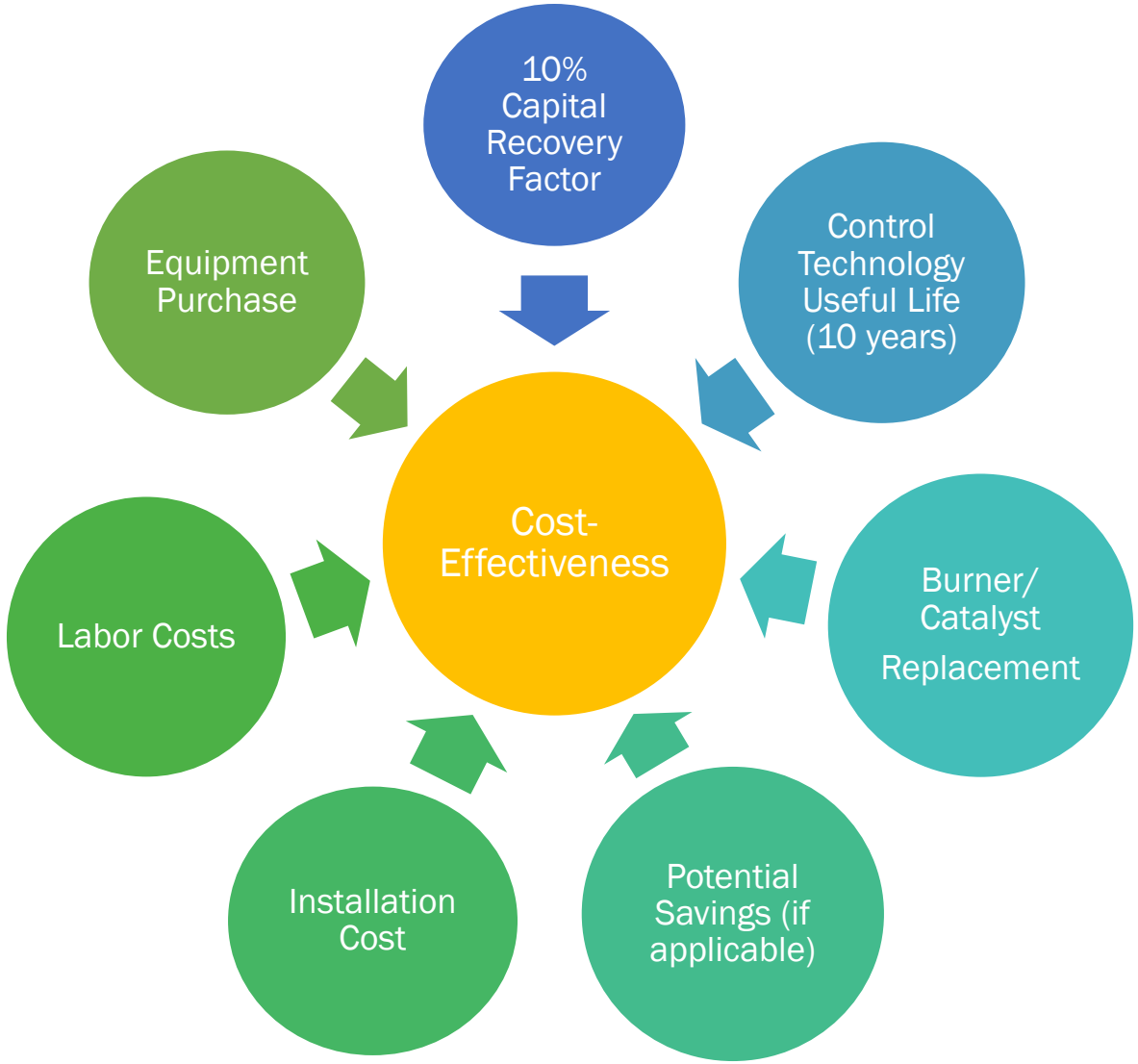
- Sources for costs
  - Actual costs provided by facilities, engineering estimates, and control technology vendors & manufacturers
  - Various sources for the cost of electricity, fuel, and replacement parts
  - Cost factors from EPA's Office of Air Quality Planning and Standards
- Staff held numerous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

Engine Add-On Control Technologies

- **Rich-Burn Engines**
  - Costs and emissions range based on size of engine, age of engine, current controls, type of use
    - Total Capital Cost $9,800 - $95,000
    - Additional operating and maintenance costs for controls: nominal
- **Lean-Burn Engines**
  - Costs and emissions range based on size of engine, age of engine, current controls, type of use
    - Total Capital Cost $22,000 - $190,000
    - Additional operating and maintenance costs for controls: $2,916 - $102,213/yr

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



Proposed Rule 4702 Requirements

- Lower NOx limits for various categories based on technological feasibility and cost-effectiveness
- Lower VOC limits to 90 ppmv for all categories
- Rule compliance schedule
  - Non-ag Rich-Burn Engines: December 31, 2023
  - Non-ag Lean-Burn Engines: December 31, 2023
  - Ag Rich-Burn Engines: December 31, 2023
  - Ag Lean-Burn Engines: December 31, 2029
- Removal of emissions fee compliance option for all engine categories

Proposed NOx Limits and Cost Effectiveness (CE) for Non-AO Rich-Burn Spark-Ignited Engines

Non-AO Rich Burn Spark Ignited Engines	Affected Units	Permitted Above Proposed Limit	Current Rule 4702 NOx Limit ppmv	Proposed Rule 4702 NOx Limit ppmv	Current VOC Limit (ppmv)	Proposed VOC Limit (ppmv)	CE per ton NOx
Waste Gas	0	0	50	11	250	90	-
Cyclic Loaded, Field Gas Fueled	7	7	50	11	250	90	-
Limited Use	20	20	25	11	250	90	$6,675
Not Listed Above	202	-	11	11	250	90	-

Proposed NOx Limits and CE for Non-AO Lean-Burn Spark-Ignited Engines

Non-AO Lean Burn Spark Ignited Engines	Affected Units	Permitted Above Proposed Limit	Current NOx Limit (ppmv)	Proposed NOx Limit (ppmv)	Current VOC Limit (ppmv)	Proposed VOC Limit (ppmv)	CE per ton NOx
Two-Stroke, Gaseous Fueled, >50 bhp and <100 bhp	0	0	75	11	750	90	-
Limited Use	0	0	65	11	750	90	-
Gas Compression	38	33	65	40	750	90	$4,117-$7,081
Waste Gas	14	10	65	40	750	90	$2,656-$14,766
Not Listed Above	19	-	11	11	750	90	-

Proposed NOx Limits and CE for AO Spark-Ignited Engines

AO Engines	Total #	Current NOx Limit (ppmv)	Proposed NOx Limit (ppmv)	Current VOC Limit (ppmv)	Proposed VOC Limit (ppmv)	CE per ton NOx
Rich Burn Spark Ignited	362	90	11	250	90	$2,500 - $37,930*
Lean Burn Spark Ignited	143	150	35	750	90	$9,400- $20,390

*Highest costs based on installation of new rich-burn engine with NSCR, rather than retrofit

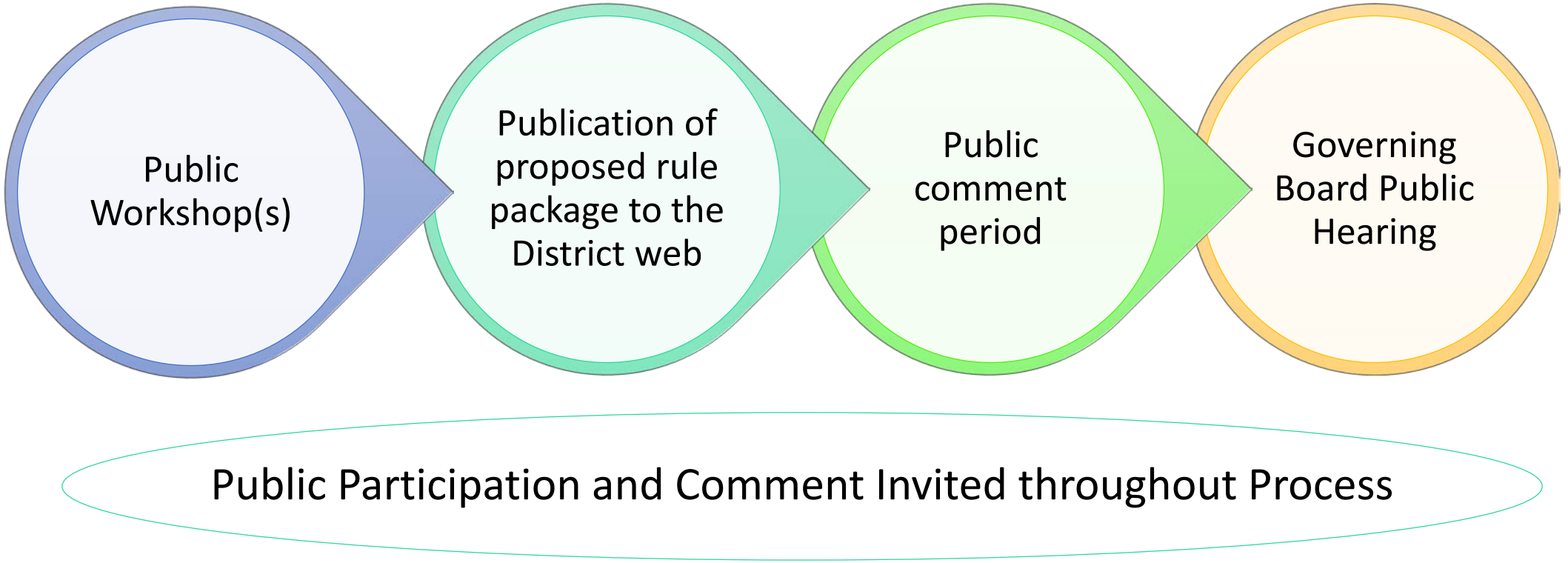
Estimated NOx Emission Reductions

- NOx Emission Reductions from Rule 4702 in 2023
  - 0.56 tons per day
- NOx Emission Reductions from Rule 4702 in 2029
  - 0.15 tons per day
- Total Estimated NOx Emission Reductions
  - 0.71 tons per day

Rule Process and Socioeconomic Impact Analysis

- Socioeconomic Impact Analysis underway to support feasibility analysis
  - Characterization of the Valley's economic climate
  - Evaluation of economic impacts
  - Socioeconomic Impact Analysis report
  - Presentation to Governing Board
- **Timeline:**
  - Analysis and Outreach: November 2020
  - Post Draft Rule: December 2020
  - Governing Board Hearing: January 2021

Next Steps: Public Engagement Process for Rule 4702 Amendment



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Comments/Questions

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