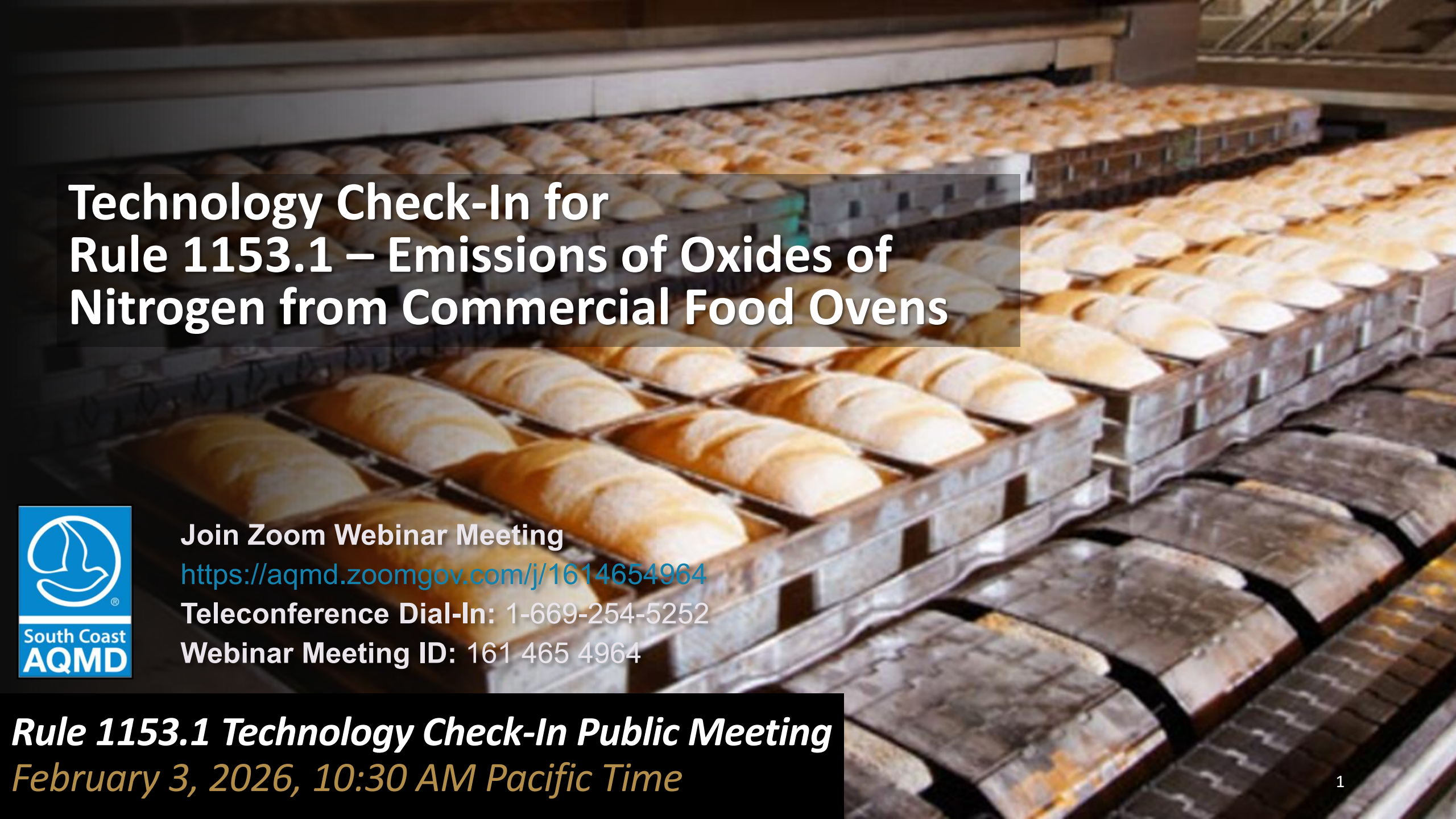
Technology Check-In for Rule 1153.1 – Emissions of Oxides of Nitrogen from Commercial Food Ovens



Join Zoom Webinar Meeting
https://aqmd.zoomgov.com/j/1614654964
Teleconference Dial-In: 1-669-254-5252
Webinar Meeting ID: 161 465 4964

Rule 1153.1 Technology Check-In Public Meeting
February 3, 2026, 10:30 AM Pacific Time

Rule 1153.1 Background

- Adopted November 7, 2014, last amended August 4, 2023
- Implements Control Measure CMB-05 of the 2022 Air Quality Management Plan
  - Seeks zero-emission or near-zero emission technologies where feasible
- 2023 Amendment lowered NOx emission limits and included zero-NOx emission limits for smaller commercial food ovens
  - NOx limits established in two phases
  - Emission reductions 0.11 tons per day
- First South Coast AQMD rule requiring zero-emission limits
  - Provides a future emission target for vendors and encourages future technology development

Rule 1153.1 Commercial Food Oven category and Universe

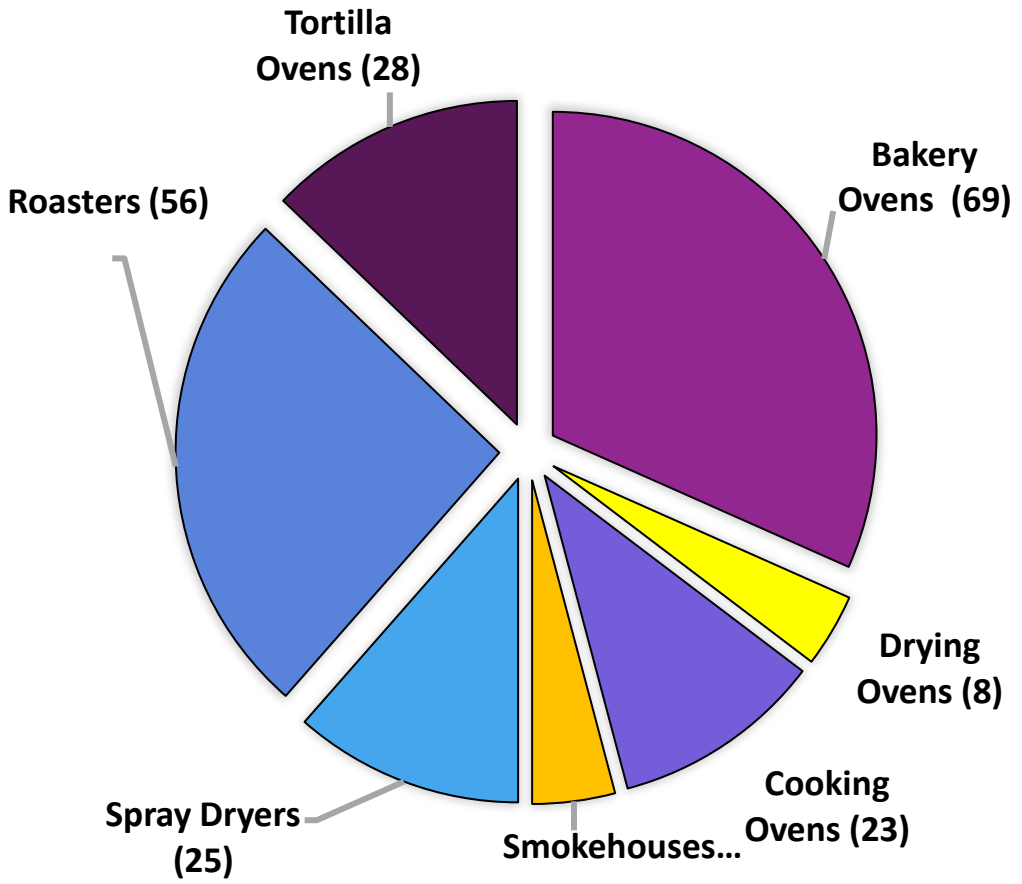
Table 1 – NOx and CO Emission Limits (ppmv)[1]

Equipment Categories		Phase I		Phase II	
		NOx	CO	NOx	CO
Direct Fired Bakery Ovens	≤3 MMBtu/hr	30	800	0	0
	>3 MMBtu/hr	30	800	N/A	N/A
Indirect-Fired Bakery Ovens		30	800	0	0
Griddle Oven		30	800	N/A	N/A
Tortilla Ovens	Heated solely by IR Burners	15	800	N/A	N/A
	All Other Tortilla Ovens	30	800	N/A	N/A
Cooking Ovens	≤3 MMBtu/hr	30	800	0	0
	>3 MMBtu/hr	30	800	N/A	N/A
Drying Ovens		30	800	N/A	N/A
Smokehouses		30	800	0	0
Dryers		30	800	N/A	N/A
Roasters		30	800	N/A	N/A

[1] Parts per million by volume (ppmv) corrected to three percent oxygen, dry

Number of Units by Category

(97 facilities with 218 Total Units)



Rule 1153.1 NOx Limits and Phases

Phase I Limits – Effective November 7, 2023

- 30 – 15 ppm NOx, based on category
- Achievable with commercially available low-NOx burners
- Must meet limit when burners reaches 10 years of age

Phase II Limits – Effective January 1, 2027

- Zero-emission limits for smaller oven categories
  - Baking and Cooking Ovens with a rated heat input less than 3.0 MMBtu/hour
  - Indirect Baking Ovens
  - Smokehouses
- Technology is commercially available but not widely in use
- Cost effective due to lower energy demand
  - Increased cost to operate units on electricity versus natural gas impacted ability to transition more categories to zero-emission equipment

Phase II Compliance Schedule

Phase II Zero Emission Limit – Compliance schedule

- Effective after January 1, 2027
- Required at end of equipment useful life but includes backstop date
  - Unit age 25 years and burner age 10 years
  - Backstop date: January 1, 2036

Considerations for compliance schedule and backstop date

- Further development of zero-emission ovens
- Required electrical grid upgrades
- Adjustments and product testing at commercial bakeries

Alternative Compliance Schedule Included

- Provides additional time (not to exceed 24-months) for facilities where utility cannot provide necessary power for zero-emission technology by compliance date

Upcoming Phase II Compliance Deadlines

- Staff anticipates three ovens to transition to zero-emission units within the next five calendar years
  - Two units with compliance deadlines of January 1, 2027, and one with a compliance deadline of January 1, 2030
    - Three separate facilities
- Several units subject to Phase II limits were less than 5 years old at time of amendment
  - Likely installed to comply with last rule amendment
- Based on existing permitted units, most will transition to zero in 10+ years, providing time to minimize impact to the grid

Upcoming Phase II Compliance Deadlines (cont)

Compliance Deadline	Number of Units	Number of Facilities	Equipment Category
Jan. 1, 2027	2	2	• 1 Bakery oven • 1 Cooking oven
Jan. 1, 2030	1	1	Bakery ovens
Jan. 1, 2033	1	1	
Jan. 1, 2035	1	1	
Jan. 1, 2036	16	11	• 13 Bakery Ovens • 3 Smokehouses

Oven Categories and Cost-Effectiveness

- During rule amendment, BARCT assessment conducted for all categories
- Phase I limits cost-effective for all oven categories
- Phase II, zero-NOx emission limit, technically feasible and cost effective for smaller ovens
- Zero-NOx emission requires transition from natural gas to electricity (fuel switching)
  - Electricity cost typically about 5x higher
- Fuel switching costs exceeded cost-effectiveness threshold for larger ovens

Phase I Limits

- Cost-Effectiveness ranged from $18,000 to $93,000 per ton of NOx

Phase II

- Cost-Effectiveness ranged from $60,000 to $290,000 per ton of NOx reduced
  - Below $325,000 threshold established in 2022 AQMP

Technology Check-in

Resolution directed staff to conduct a status update/technology check-in on zero-emission technology and report to the Stationary Source Committee

Evaluate the status of the technology, availability, costs, and utility rates and evaluate feasibility for transition of additional oven categories

Depending on results of the evaluation, staff may propose a rule amendment to allow more time before emission limits go into effect and/or require additional oven categories to transition to zero-emission

Technology Status Update

Technology Check-In Process

- Staff's technology check-in include:
  - Meetings with various bakeries and a manufacturer of zero-NOx emission ovens to:
    - Discuss state of commercial cooking technology
    - Discuss industry and market acceptance of zero-emission oven technology
    - Discuss approach Phase II compliance deadlines with bakery facilities
  - Meeting with electric utility providers to confirm ability to support the applicable transition to zero-NOx emission ovens, as previously stated during rule amendment
  - Researching industrial electricity rates in California and previous year's trends
    - Staff relied on data from the California Energy Commission (CEC) and the U.S. Energy Information Administration (EIA)
  - Researching commercially available zero-NOx emission ovens in various equipment categories and sizes

Technology Status and Commercial Availability Update

- Staff confirmed zero-NOx emission cooking and baking ovens rated at or below 3.0 MMBTU/hour, and smokehouses commercially available
- Confirmed two additional manufacturers of zero-NOx emission equipment and two additional commercially available zero-NOx emission units
  - Bakery ovens (<3.0 MMBtu/hr)
- Staff is aware of one zero-NOx emission tortilla oven that is currently in the R&D phase
  - No estimated completion date or timeline able to be provided at this time
  - Still in research and development stage
  - Project is not highly prioritized, but subject to change depending on customer interest
- Commercial cooking facilities not aware of any technological advances in commercial-scale zero-NOx emission cooking equipment

Grid Impacts and Utility Rates

Utility Meeting Summary

- Staff met with Southern California Edison (SCE) to discuss the technology check-in and approaching Phase II compliance deadlines
  - Confirmed no changes to previous statements regarding electricity demand increase threshold that would require utility-side infrastructure upgrades
    - Electrical upgrade requirements may vary by location and local circuit
  - SCE not yet contacted by any facilities regarding any ancillary upgrades needed for zero-NOx emission equipment subject to Rule 1153.1
  - Not aware of any new or emerging zero-NOx emission equipment subject to Rule 1153.1 and beyond the equipment categories subject to Phase II zero-emission limits
  - Food Service Technology Center still available for SCE customers to test product quality using zero-emission cooking equipment
  - SCE has been in contact with facilities in service area and is still able to support facilities expecting to transition to zero-NOx emission ovens

Utility Meeting Summary (cont)

- Staff discussed the technology check-in and approaching Phase II compliance deadlines with Los Angeles Department of Water and Power (LADWP) members and confirmed the following:
  - LADWP would be able to support the facilities in their service territory
  - Scope of work and cost estimates would vary from facility to facility

Other Utility-Side Considerations

- Established compliance schedule provides phased-in approach (end of equipment useful life) to mitigate impacts on electrical grid
  - Allows time for gradual electrical grid upgrades
- Includes an alternative compliance schedule to allow facilities to apply for a longer compliance schedule if utility cannot provide required power to comply with rule deadline

Electricity Service Distribution

Electricity Service Provider	Number of Units	Number of Facilities
Industry Public Utilities	1	1
SCE	13	9
City of Glendale W&P	2	1
LADWP	4	3
City of Vernon Public Utilities	1	1

Cost Effectiveness Updates

Cost-Effectiveness Threshold

- 2022 AQMP established NOx cost-effectiveness threshold of $325,000/ton of NOx reduced (2021 dollars)
  - Guide for rulemaking
  - Derived based on public health benefit-cost approach which is consistent with U.S. EPA and CARB
  - Cost-effectiveness threshold is adjusted for CPI
- 2023 rule amendment cost-effectiveness threshold was $349,000/ton of NOx (2022 adjusted for CPI)
- Current NOx cost-effectiveness threshold is $383,000/ton of NOx reduced (2024-dollar year*)

**2025 CPI not available until mid-February 2026, so 2024-dollar year used*

Cost-Effectiveness Considerations

- Cost-effectiveness is a measure that compares costs of pollution reduction to amount of pollutant reduced
  - Measure in cost per ton of pollutant
- South Coast AQMD typically uses the *Discounted Cash Flow Method* to calculate cost-effectiveness
  - **Cost-Effectiveness** = Present Worth Value/Emissions Reduced Over Equipment Life
  - **Present Worth Value** = Total Equipment Cost + (Annual Operating Costs x *Present Worth Value Formula*)
  - **Present Worth Value Formula** = $\frac{1-\frac{1}{(1+r)^n}}{r}$
    - r = interest rate
    - n = number of cycles (useful life)

- **Present Worth Value** = 15.62
  - r = 4%
  - n = 25 years for equipment life

Cost-Effectiveness Considerations (continued)

Considered the following cost:

Total Equipment cost

For Phase II, cost difference of new gas-fired unit and new zero-emission unit

Installation

- Assumed 25% of capital cost

Facility electrical upgrade

- Assumed 10% of capital cost

Utility-side upgrade

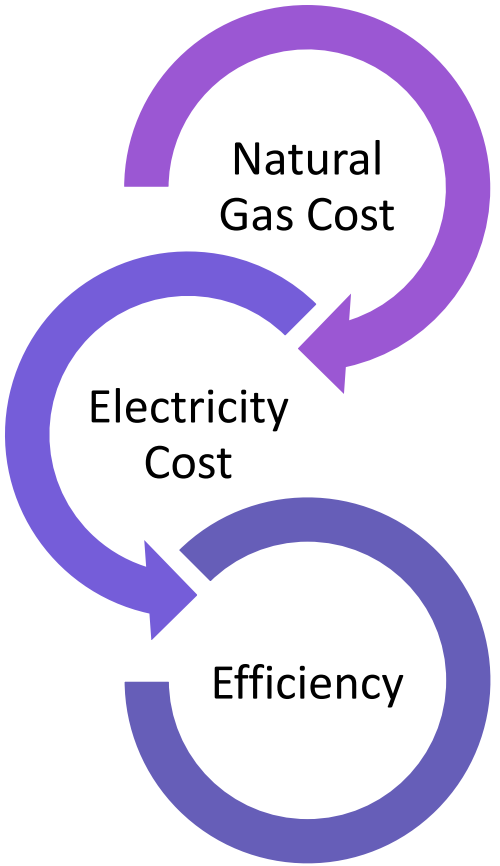
- Utility-side upgrades will be case-by-case depending on grid location and available capacity at that location
  Smaller units less likely to require utility-side upgrades but included costs to address concern
  ≤ 3 MMBtu/hr: $2,000
  > 3 MMBtu/hr: $50,000

Annual Operating Cost (recurring costs)

For Phase II, fuel switching cost (difference in electricity cost with efficiency gain and natural gas costs)

Zero-Emission Oven and Fuel Switching Costs

- Direct facility cost for zero-emission ovens remains relatively unchanged
  - Zero-emission oven cost varies by type, size, and energy requirements
    - Oven cost ranged from ~$300,000 to $ 8,000,000
  - Installation costs ranged from $75,000 to $2,000,000
  - Facility and utility electric upgrades ranged from $2,000 to $830,000
- Annual operating cost
  - Facilities will transition from natural gas to electricity
  - Cost to operate units on electricity versus natural gas (fuel-switching cost)
    - More costly to operate ovens on electricity than natural gas
    - Fuel-switching cost has major impact on cost-effectiveness
    - Efficiency gains mitigate some of the increased cost due fuel-switching
      - Electric units more efficient than combustion units (~20%)
  - Large units that require more energy have higher fuel switching cost

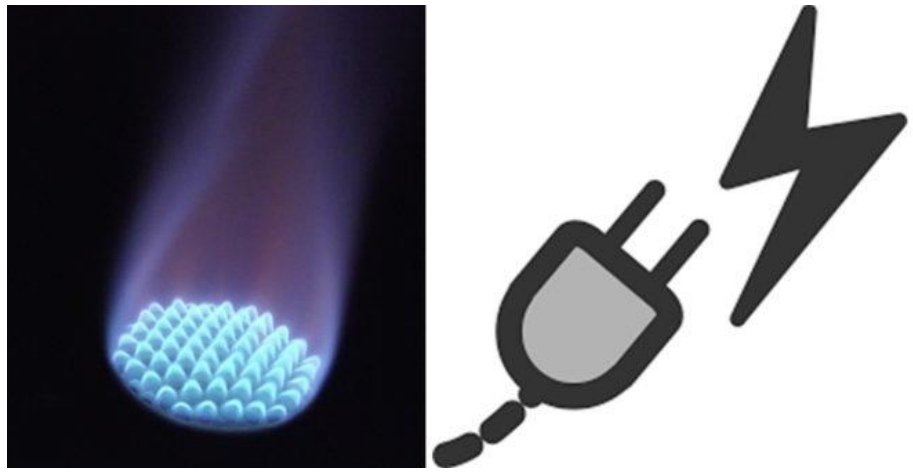


Electricity vs. Natural Gas Rates

- Electricity and gas rates are calculated using a different metric, must convert to a common denominator for direct comparison
- Electricity is billed in kilowatt-hours (kWh)
  - Amount of energy an equipment using 1000 watts would need per hour
- Natural gas is billed in therms
  - Calculated based on the amount of heat the gas can provide per cubic foot
- Rates are also separated into residential, commercial, or industrial
- Most facilities subject to PAR 1153.1 are classified as industrial as defined by the U.S. Energy Information Administration (EIA)
- Prices for both utilities can vary based upon location and sourcing factors which cause price fluctuations
- Overall, natural gas is less expensive than electricity

Electricity vs. Natural Gas Price Forecast (Then vs Now)

- Staff relied on cost data from the California Energy Commission (CEC) and U.S. Energy Information Administration (EIA) industrial rates
  - 12 electric utility providers throughout South Coast AQMD
  - Each with varying rates
- 2023 rule amendment, industrial utility rates:
  - Electricity rate was $0.15/kWh
  - Natural gas rate was $0.017/kWh-equivalent
- 2025 (most current) industrial utility rates:
  - Electricity rate is $0.23/kWh
  - Natural gas rate is $0.044/kWh-equivalent



U.S. Energy Information Administration - California State Average Electricity Price by End-Use Sector
U.S. Energy Information Administration - California Natural Gas Industrial Price Data

Phase II Cost-Effectiveness Update – Then vs. Now

- 2022 AQMP established NOx cost-effectiveness threshold of $325,000/ton of NOx reduced (2021 dollars)
  - Cost-effectiveness threshold is adjusted for CPI
- 2023 rule amendment cost-effectiveness threshold was $349,000/ton of NOx (2022 adjusted for CPI)
- Current NOx cost-effectiveness threshold is **$383,000/ton of NOx reduced** (2024-dollar year*)
- Fuel-switching cost is significant factor in cost-effectiveness calculations

Equipment Categories		Previous Cost-Effectiveness ($349,000)	Current Cost-Effectiveness ($383,000)
Bakery Ovens	**(≤ 3 MMBtu/hr)**	$290, 000	$362,000
	(> 3 MMBtu/hr)	$400,000	$533,000
Indirect-Fired Bakery Ovens		Currently Achieving	--
Tortilla Ovens	**(IR Burners Only)**	$514,000	$536,000
	(Ribbon & IR Burners)		
Cooking Ovens	**(≤ 3 MMBtu/hr)**	$190,000	$236,000
	(> 3 MMBtu/hr)	$560,000	$730,000
Drying Ovens		$350,000	$449,000
Dryers		--	--
Smokehouses		$60,000	$78,000
Roasters		$820,000	$1,040,000

**2025 CPI not available until mid-February 2026, so 2024-dollar year used*

Conclusions, Staff Recommendation, and Next Steps

- Phase II requirements still cost-effective for equipment categories
- Zero-emission requirement for additional oven categories not cost-effective
- Electric-utilities capable of supporting facility zero-emission transition
- Fuel-switching costs and status of current technology limit expansion of Phase II requirements for other categories
- Staff recommending no changes or amendments to rule
- Will present recommendation to March Stationary Source Committee

Rule Staff Contacts

Chris Bradley
Air Quality Specialist
cbradley@aqmd.gov
909.396.2185

Heather Farr
Planning and Rules Manager
hfarr@aqmd.gov
909.396.3672

Sarady Ka
Program Supervisor
ska@aqmd.gov
909.396.2331

Michael Krause
Assistant Deputy Executive Officer
mkrause@aqmd.gov
909.396.2706