

## PROPOSED AMENDED RULES 1147 AND 1100 WORKING GROUP MEETING #6

MAY 14, 2020  
SOUTH COAST AQMD  
DIAMOND BAR, CA

**Zoom Meeting:** <https://scaqmd.zoom.us/j/91164890213>  
**Meeting ID:** 911 6489 0213

**Conference Call:** 1 (669) 900-6833 US (San Jose)  
1 (346) 248-7799 US (Houston)

## AGENDA

- ❑ Clarification and Correction to Previous Working Group
- ❑ BARCT Analysis
  - Additional Analysis of New Equipment Categories
  - Cost-Effectiveness Methodology
- ❑ Cost-Effectiveness Analysis
  - Oven, Dryer, Heater, Furnace, Kiln, and Heated Process Tank
- ❑ Next Steps



## PREVIOUS WORKING GROUP RECAP

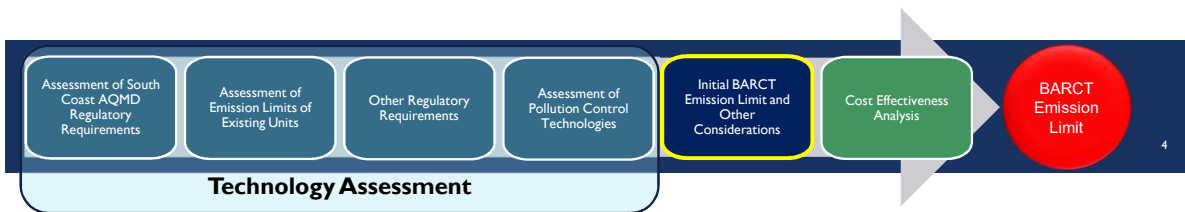
### Working Group #5

- Compared requirements of Rule 1147 with existing regulatory requirements of other agencies located across the United States
- Presented assessments of available pollution control technologies
- Presented initial BARCT limits for applicable equipment categories going into cost-effectiveness analysis
- Identified three potential new equipment categories (autoclaves, absorption chillers, and microturbines)

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## REVISION AND FURTHER ASSESSMENT DIESEL FIRED TAR POT

Initial BARCT Emission Limit



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## ASSESSMENT REVISION DIESEL FIRED TAR POT

Initial BARCT Emission Limit

**Previous Working Group:**

- Identified diesel fired tar pots in RECLAIM as subject to Rule 1146.2 due to size

**Correction:**

- Rule 1146.2 is only applicable to natural gas fired equipment
- Diesel fired tar pot will be evaluated under PAR 1147

Initial BARCT assessment will be conducted under PAR 1147 from available equipment information and current Rule 1147 limit for liquid fuels

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## FURTHER ASSESSMENT DIESEL FIRED TAR POT

Initial BARCT Emission Limit

Operating Temp	Existing Units <sup>^</sup>		Rule 1147 Limit <sup>^</sup>	Other Regulatory <sup>#</sup>	BARCT Technology Review <sup>^</sup>	Initial BARCT Limit <sup>^</sup>
	Source Test Results	Units Meeting Initial BARCT Limit				
<1,200° F	N/A	N/A	40 ppm	114 ppm <sup>^</sup> (~20 lb/mgal)	40 ppm	40 ppm
≥1,200° F	N/A	N/A	40 ppm	114 ppm <sup>^</sup> (~20 lb/mgal)	40 ppm	40 ppm

Unable to identify existing source test results

Applicable rule limit from existing Rule 1147

South Coast AQMD AER Reporting Factor<sup>2</sup>

Based on existing Rule 1147 limit for liquid fuels

Cost-Effectiveness Analysis is needed

<sup>\*</sup> Emissions data collected from source test results  
<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry  
<sup>#</sup> Oxygen corrections for NOx concentrations vary depending on regulatory agency  
<sup>2</sup> South Coast AQMD Annual Emissions Reporting (AER) emission factor derived from either US EPA AP-42 or Ventura APCD:  
[http://www3.aqmd.gov/webapp/help/newaer/index.html?external\\_combustion.htm](http://www3.aqmd.gov/webapp/help/newaer/index.html?external_combustion.htm)

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Initial BARCT Emission Limit

## FURTHER ASSESSMENT OF SINGEING MACHINES

Previous Working Group

- Identified two existing singeing machines in RECLAIM and none were identified in non-RECLAIM
- Reporting with RECLAIM default emission factor of 130 lb/mmscf (~102 ppm)

Further Assessment

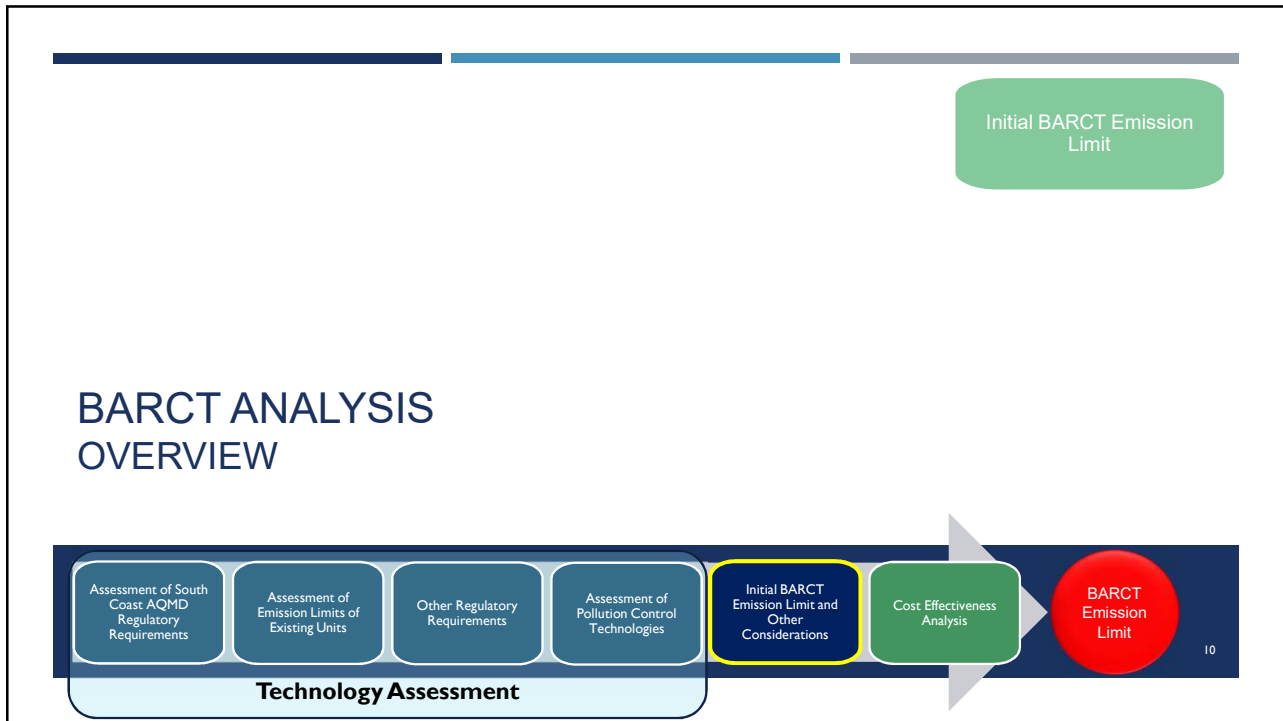
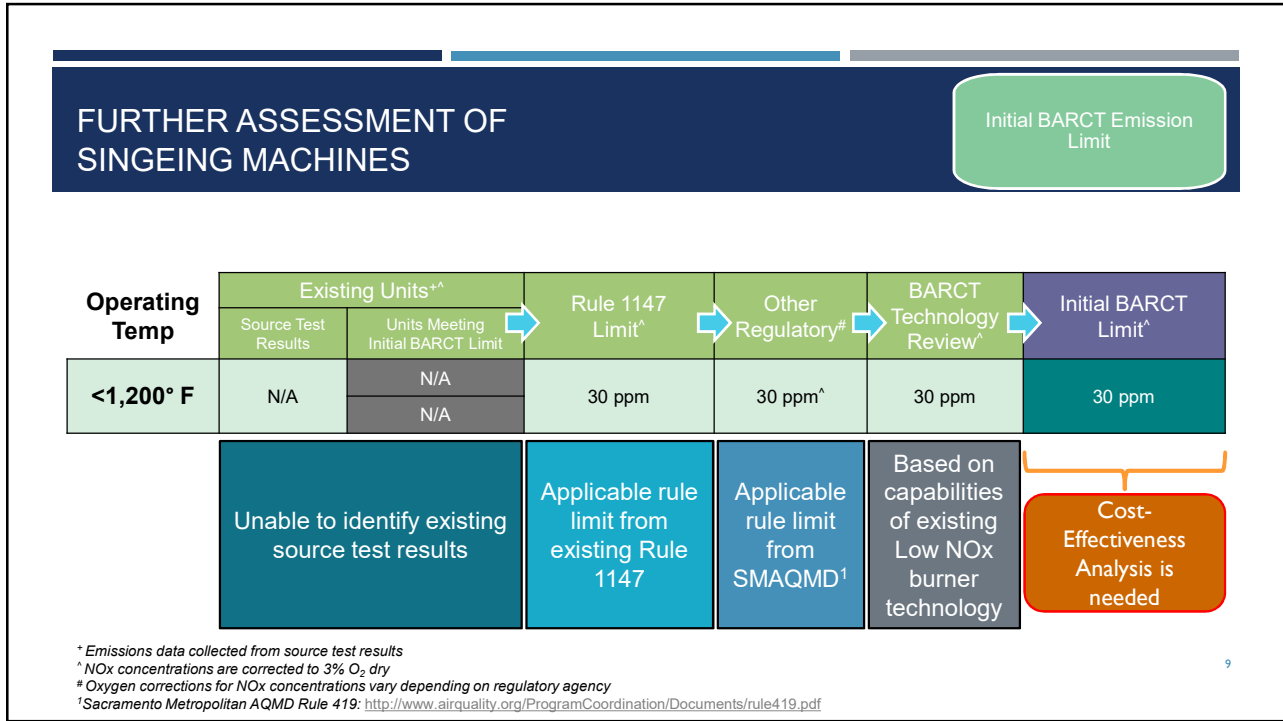
- Staff recommends singeing machines to be subject to the “Other Unit or Process Temperature operating <1,200° F” category in Rule 1147
- Permit applications for these units notes the burners are “low NOx”, no source test results to verify current emissions
- Staff is seeking input from Working Group

Initial BARCT Emission Limit

## FURTHER ASSESSMENT OF SINGEING MACHINES

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graph LR
    subgraph Technology_Assessment [Technology Assessment]
        A[Assessment of South Coast AQMD Regulatory Requirements]
        B[Assessment of Emission Limits of Existing Units]
        C[Other Regulatory Requirements]
        D[Assessment of Pollution Control Technologies]
    end
    E[Initial BARCT Emission Limit and Other Considerations]
    F[Cost Effectiveness Analysis]
    G[BARCT Emission Limit]
    
    Technology_Assessment --> E
    E --> F
    F --> G
            
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## OVERVIEW OF INITIAL BARCT LIMITS PRESENTED AT PREVIOUS WORKING GROUP MEETING

Initial BARCT Emission Limit

Equipment Category	Operating Temperature	Equipment Size	Current Rule Limit <sup>^</sup>	Initial BARCT Limit <sup>^</sup>	Cost-Effectiveness Analysis
Oven, Dryer, Heater, Furnace, Kiln, and Heated Process Tank	<1,200°F	≥40 MMBtu/hr	30 ppm	5 ppm	Pending
		<40 MMBtu/hr	30 ppm	20 ppm	Pending
	≥1,200°F	≥40 MMBtu/hr	60 ppm	5 ppm	Pending
		<40 MMBtu/hr	60 ppm	30 ppm	Pending
Afterburner, Thermal Oxidizer, RTO, and Oxidizer	All	All	60 ppm	20 ppm	Pending
Evaporator, Fryer, Heated Process Tank, and Parts Washer	All	All	60 ppm	30 ppm	Pending
Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner	All	All	60 ppm	30 ppm	Pending
Tenter Frame, Fabric or Carpet Dryer	All	All	30 ppm	20 ppm	Pending
Other Unit and Process Temperature	<1,200°F	All	30 ppm	No Change	Pending <sup>11</sup>
	≥1,200°F	All	60 ppm		

<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry

## BARCT ANALYSIS PROGRESS OF BARCT ANALYSIS

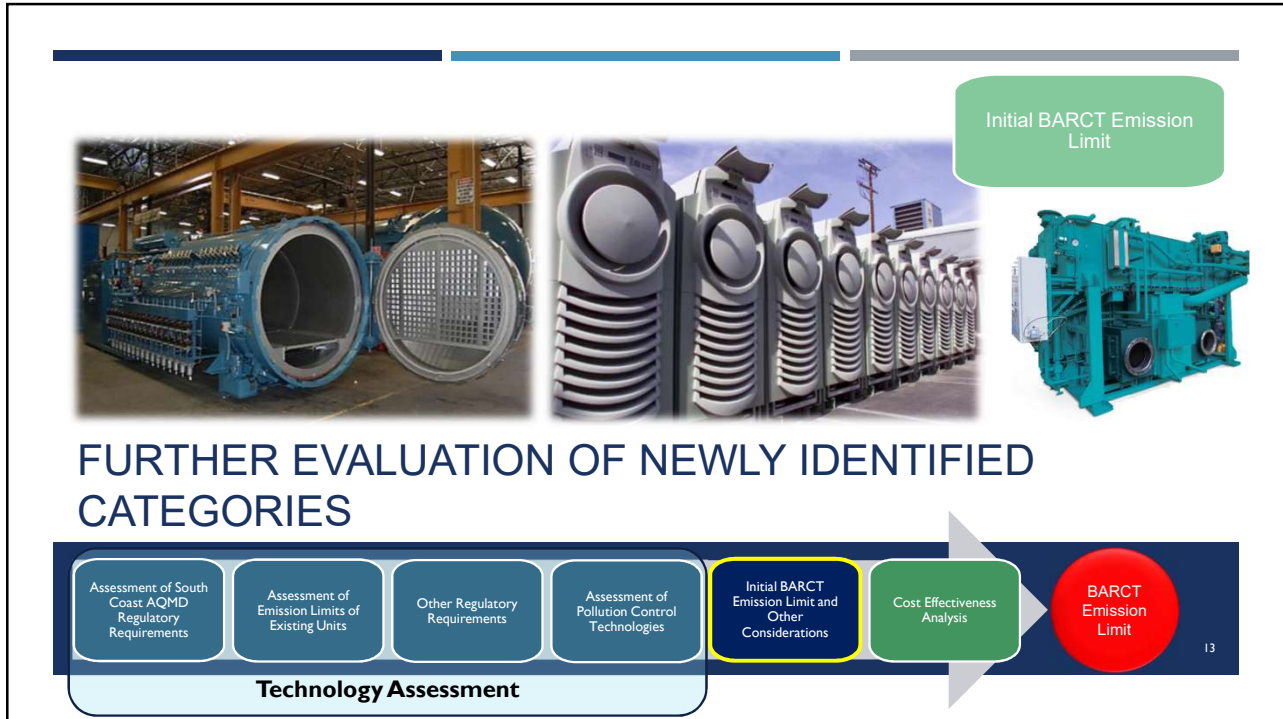
Initial BARCT Emission Limit

- ❑ Completed the technology assessment and presented initial BARCT limits for six equipment categories
- ❑ Based on stakeholder input, three additional equipment categories were identified:
  - ✓ Micro-turbines (Natural Gas and Diesel)
  - ✓ Absorption Chillers
  - ✓ Autoclaves
- ❑ Next Steps:
  - Evaluate newly identified equipment categories to determine initial BARCT limits



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<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry



**FURTHER EVALUATION OF NEWLY IDENTIFIED CATEGORIES**

Initial BARCT Emission Limit

New equipment categories were introduced during previous working group

- Categories were determined with stakeholder and internal staff input
- Further evaluation of each category is necessary to determine initial BARCT limit

Equipment Category	Operating Temperature	Equipment Size	Current Rule Limit <sup>^</sup>	Initial BARCT Limit <sup>^</sup>
Absorption Chillers	All	All	30 ppm	Pending Assessment
Micro-Turbines (Natural Gas)	All	All	N/A	Pending Assessment
Micro-Turbines (Diesel)	All	All	40 ppm	Pending Assessment
Auto-Claves	All	All	30 ppm	Pending Assessment

<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry  
<sup>\*</sup> NOx concentrations are corrected to 15% O<sub>2</sub> dry

## FURTHER EVALUATION ABSORPTION CHILLERS

Initial BARCT Emission Limit

- ❑ Absorption chillers are currently considered as “other unit or process temperature”
  - Three permitted natural gas fired units in RECLAIM
  - One permitted natural gas fired unit in non-RECLAIM
- ❑ All identified units have permit limits of 20 ppm<sup>^</sup>
  - Permit limits are in line with Best Available Control Technology (BACT)
  - Three available source test results from RECLAIM units show emissions between 4 to 10 ppm<sup>^</sup>
    - Unable to identify source test for non-RECLAIM unit

<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry

## INITIAL BARCT NOX LIMIT ABSORPTION CHILLERS

Initial BARCT Emission Limit

Operating Temp	Existing Units <sup>^</sup>		Rule 1147 Limit <sup>^</sup>	Other Regulatory <sup>#</sup>	BARCT Technology Review <sup>^</sup>	Initial BARCT Limit <sup>^</sup>
	Source Test Results	Units Meeting Initial BARCT Limit				
<1,200° F	4 to 10 ppm	3 of 3 RECLAIM	30 ppm	30 ppm <sup>^</sup>	20 ppm	20 ppm
		No Source Test for Non-RECLAIM				

Applicable rule limit from existing Rule 1147	Applicable rule limit from SMAQMD <sup>1</sup>	Based on existing equipment permit limits and burner technology	No further action required for identified units
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<sup>\*</sup> Emissions data collected from source test results

<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry

<sup>#</sup> Oxygen corrections for NOx concentrations vary depending on regulatory agency

<sup>1</sup> Sacramento Metropolitan AQMD Rule 419: <http://www.airquality.org/ProgramCoordination/Documents/rule419.pdf>



## FURTHER EVALUATION MICROTURBINES

Initial BARCT Emission Limit

- ❑ Permitted micro-turbines are not currently subject to any command and control rule
  - Below Rule 1134 applicability of  $\geq 0.3$  MW
  - Not applicable to Rule 219(b)(1) exemption
- ❑ Identified 29 permitted micro-turbines (17 RECLAIM and 12 non-RECLAIM) potentially impacted by PAR 1147
  - ✓ 26 natural gas fired (9 ppm permit limit\*)
    - Source tested between 3 to 6 ppm
  - ✓ 3 diesel fired (77 ppm permit limit\*) – **All in RECLAIM**
    - Source tested between 65 to 68 ppm

\* NOx concentrations are corrected to 15% O<sub>2</sub> dry

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## INITIAL BARCT NOX LIMIT MICRO-TURBINES (NATURAL GAS)

Initial BARCT Emission Limit

Fuel Type	Existing Units*		Rule 1147 Limit <sup>†</sup>	Other Regulatory <sup>‡</sup>	BARCT Technology Review <sup>§</sup>	Initial BARCT Limit <sup>¶</sup>
	Source Test Results	Units Meeting Initial BARCT Limit				
Natural Gas	3 to 6 ppm	6 of 6 RECLAIM	N/A	43 ppm* (~54.4 lb/mmscf)	9 ppm	9 ppm
		11 of 11 Non-RECLAIM				
			Unable to identify existing rule requirements from South Coast AQMD	South Coast AQMD AER Reporting Factor <sup>2</sup>	Based on turbine technologies from OEM guarantees	Cost-Effectiveness Analysis is needed

\* Emissions data collected from source test results

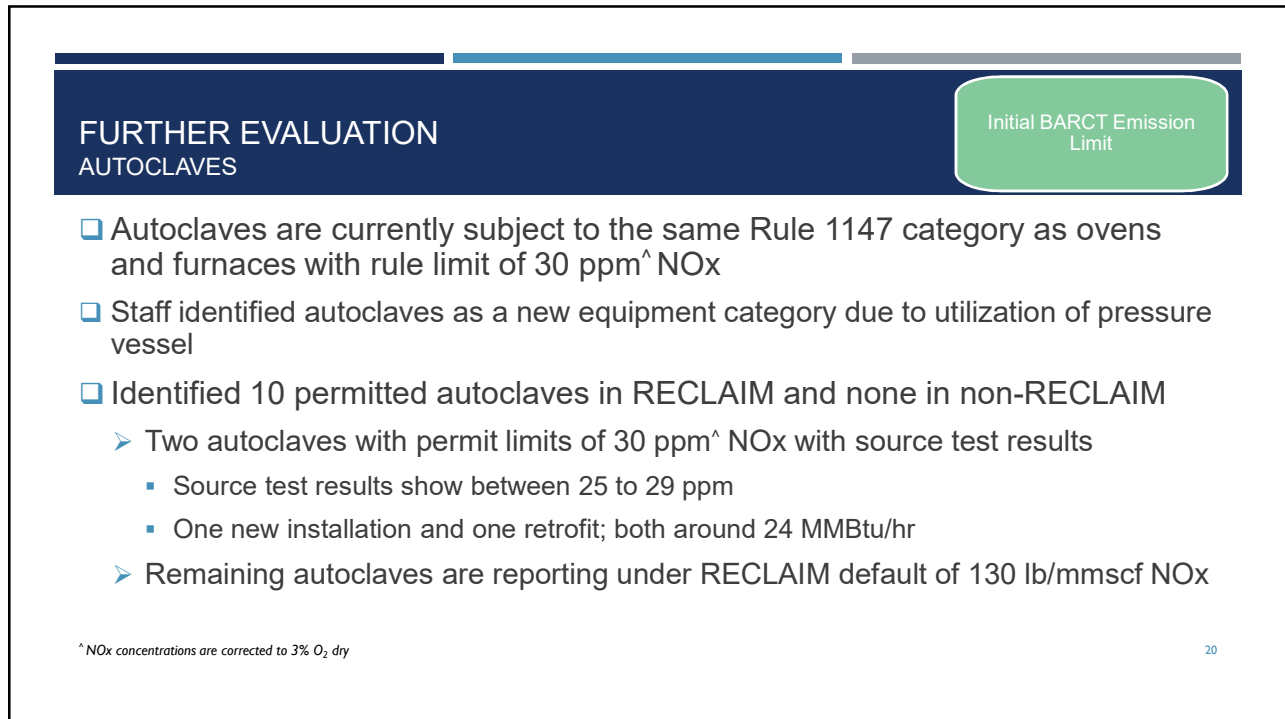
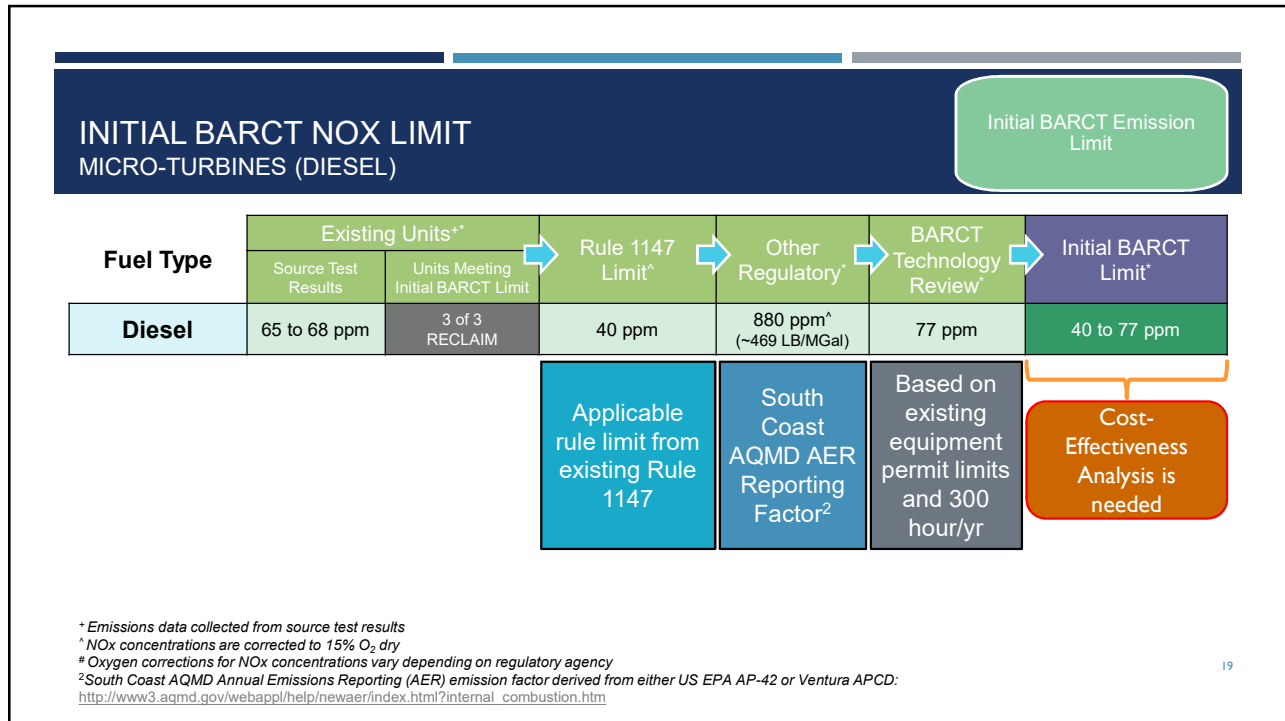
<sup>†</sup> NOx concentrations are corrected to 15% O<sub>2</sub> dry

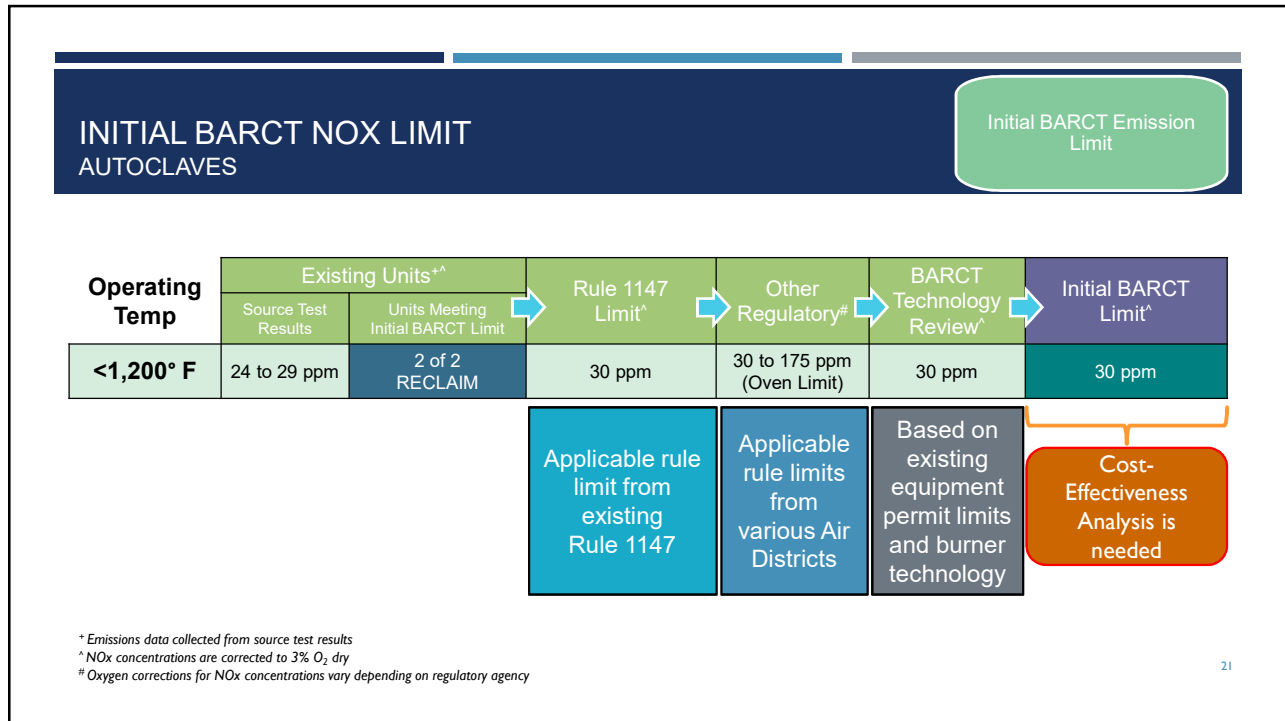
<sup>‡</sup> Oxygen corrections for NOx concentrations vary depending on regulatory agency

<sup>2</sup>South Coast AQMD Annual Emissions Reporting (AER) emission factor derived from either US EPA AP-42 or Ventura APCD:

[http://www3.aqmd.gov/webapp/help/newaer/index.html?internal\\_combustion.htm](http://www3.aqmd.gov/webapp/help/newaer/index.html?internal_combustion.htm)

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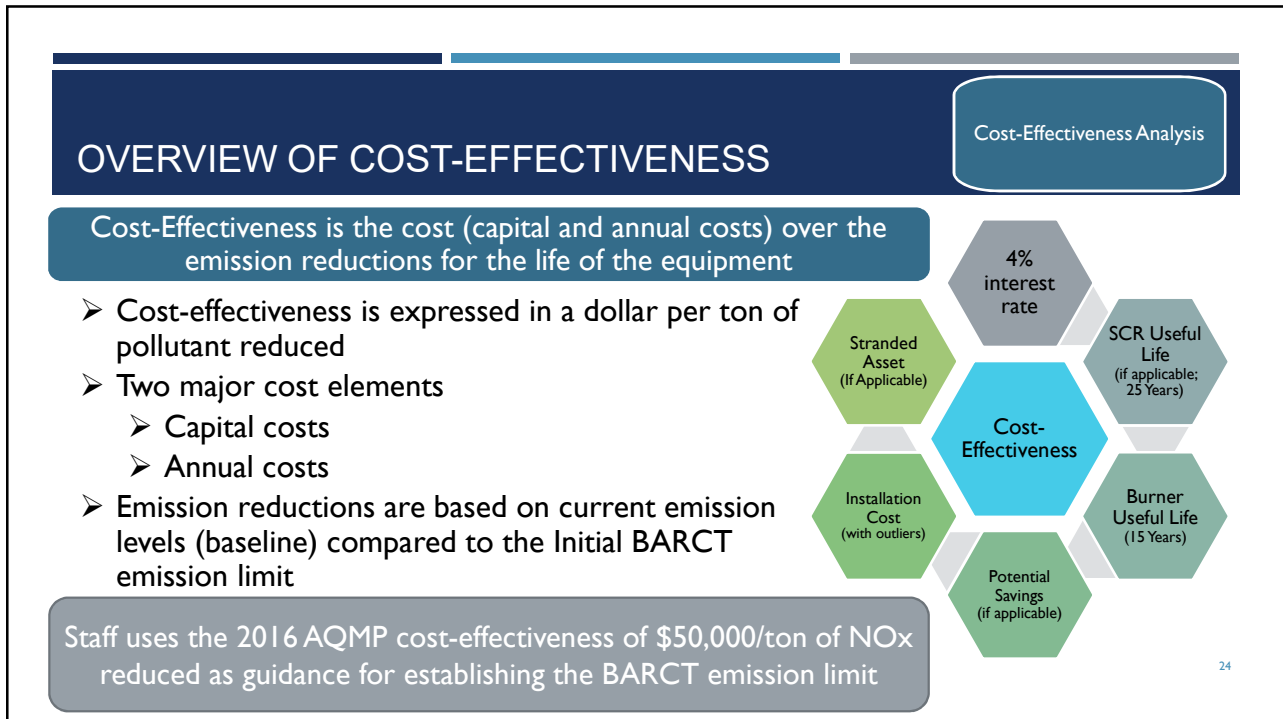
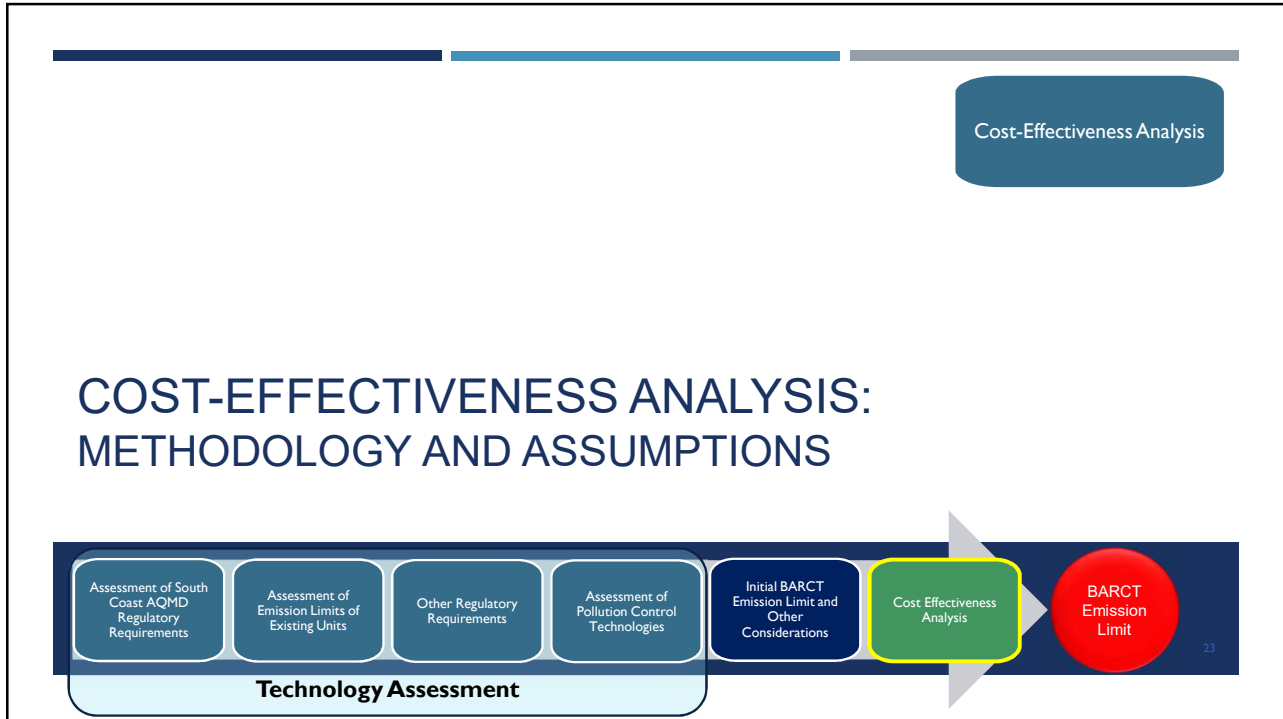
## OVERVIEW OF INITIAL BARCT LIMITS NEWLY IDENTIFIED CATEGORIES

Initial BARCT Emission Limit

Equipment Category	Operating Temperature	Equipment Size	Current Rule Limit <sup>^</sup>	Initial BARCT Limit <sup>^</sup>	Cost-Effectiveness Analysis
Absorption Chillers	All	All	30 ppm	20 ppm	<b>Pending</b>
Micro-Turbines (Natural Gas)	All	All	N/A	9 ppm*	<b>Pending</b>
Micro-Turbines (Diesel)	All	All	40 ppm	40 to 77 ppm*	<b>Pending</b>
Auto-Claves	All	All	30 ppm	30 ppm	<b>Pending</b>

<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry  
<sup>\*</sup> NOx concentrations are corrected to 15% O<sub>2</sub> dry

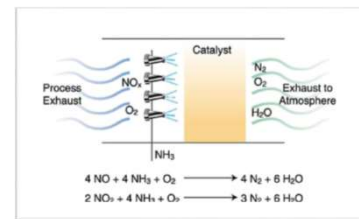
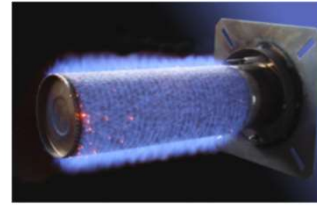
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## EMISSION CONTROL TECHNOLOGIES

Cost-Effectiveness Analysis

- ❑ Cost-effectiveness will be conducted based on anticipated technologies available to achieve the initial BARCT limits
- ❑ Technology will be determined by equipment size and baseline emissions
- ❑ Pollution control technologies:
  - Low-NO<sub>x</sub> Burners
  - Selective Catalytic Reduction



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## LOW-NO<sub>x</sub> BURNER COST ASSUMPTIONS

Cost-Effectiveness Analysis

### Burner Replacement (Low-NO<sub>x</sub>)

- Burner and installation costs to be evaluated based off of equipment application
- Analysis assumes that burners are replaced at 15 years
- No additional operating & maintenance costs for replacing burners with low NO<sub>x</sub> burners

\* Rule 301. <http://www.aqmd.gov/docs/default-source/rule-book/reg-iii/rule-301-July-2019.pdf>

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## SELECTIVE CATALYTIC REDUCTION COST ASSUMPTIONS

Cost-Effectiveness Analysis

### Selective Catalytic Reduction (SCR)

- Costs for SCR systems and installation are obtained through the US EPA SCR Cost Manual<sup>1</sup> and the 2018 Rule 1146 Staff Report<sup>2</sup>
- Analysis assumes 25 year useful life of the SCR system
- Costs associated with this technology includes operating & maintenance as well as consumables such as reagent & catalyst

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<sup>1</sup>EPA SCR Cost Manual- [https://www3.epa.gov/ttn/ecas/docs/SCRCostManualchapter7thEdition\\_2016.pdf](https://www3.epa.gov/ttn/ecas/docs/SCRCostManualchapter7thEdition_2016.pdf)

<sup>2</sup>Board Package for 2018 Amendment of Rule 1146 dated December 7, 2018- <http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2018/2018-dec7-028.pdf?sfvrsn=6>

## OTHER COST ASSUMPTIONS

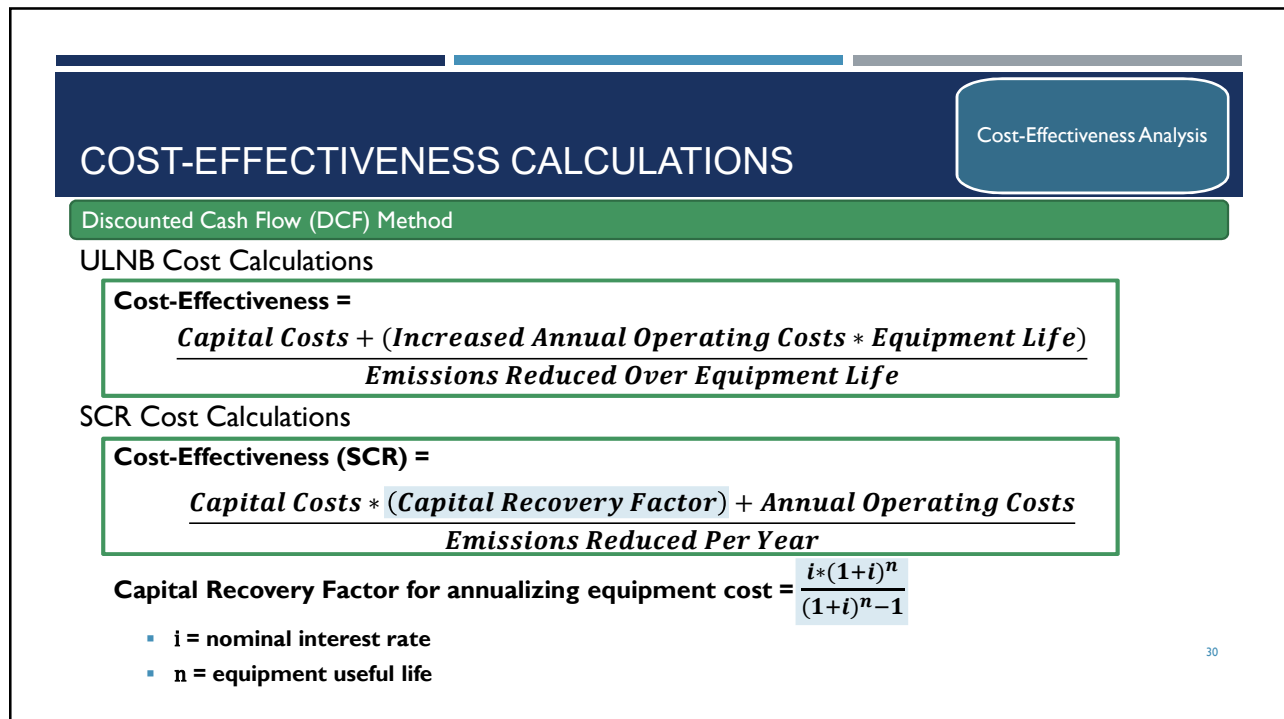
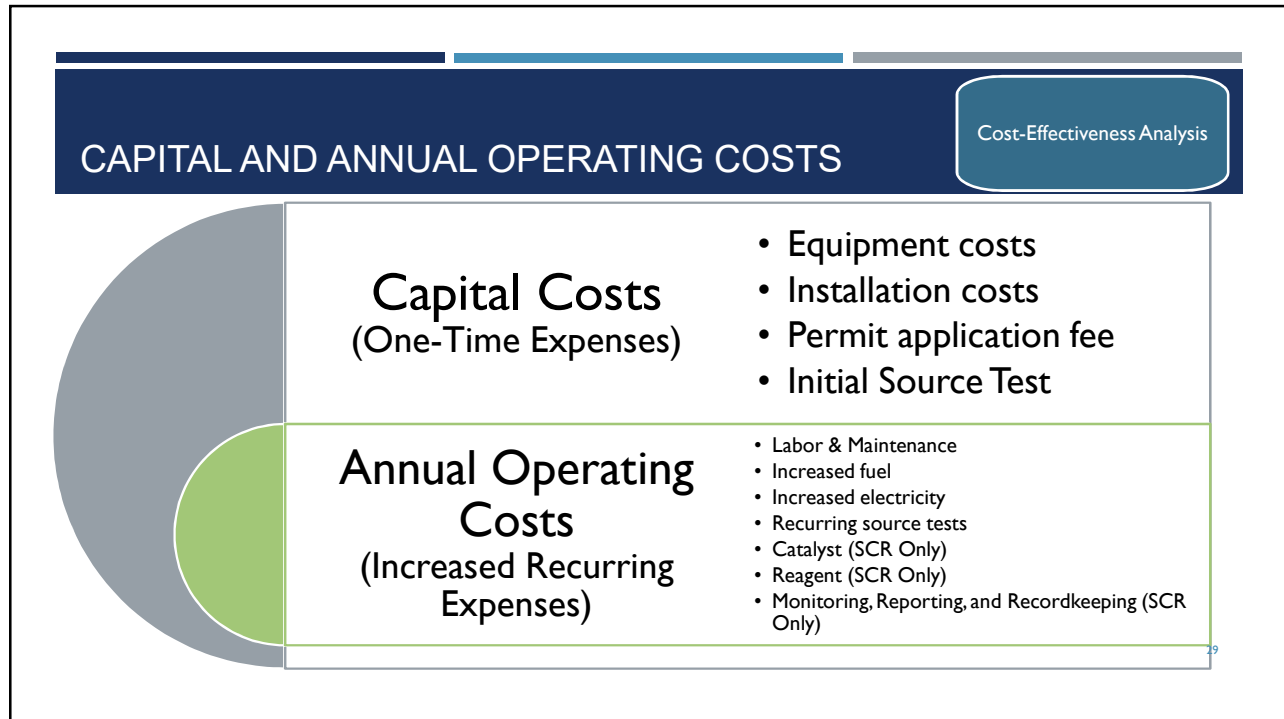
Cost-Effectiveness Analysis

### Interest Rate and Permitting

- 4% nominal interest rate
- Rule 301\* Schedule A specifies a one-time modification permit processing fee of between \$3,000 - \$8,000
- Assume no change in annual renewal costs

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\*Rule 301- <http://www.aqmd.gov/docs/default-source/rule-book/reg-iii/rule-301-July-2019.pdf>



## EMISSION REDUCTION CALCULATION ASSUMPTIONS

Cost-Effectiveness Analysis

- ❑ Emission reductions calculated for the assumed useful life of the specific control technology that can achieve the Initial BARCT limit
  - Burner useful life of 15 years
  - SCR useful life of 25 years
- ❑ Reductions only calculated for units with source test results or permit limits above the initial BARCT limits

```

            graph TD
            A[Current NOx Level] --> B[Source test NOx results]
            B --> C[Permit NOx limit]
            C --> D[RECLAIM default 130 lbs/MMscf NOx (~102 ppm)]
            
            E[Baseline Emissions] --> F[Fuel usage reported in Annual Emissions Report (AER)]
            F --> G[Equipment fuel usage scaled to operating capacity of 80%¹]
            
            B -- "If Not Available" --> C
            G -- "If Not Available" --> C
            
```

¹Federal Reserve Statistical Release G.17, Industrial Production and Capacity Utilization [http://www.federalreserve.gov/releases/g17/cap\\_notes.htm](http://www.federalreserve.gov/releases/g17/cap_notes.htm) as printed on February 7, 2011.

## EMISSION REDUCTION CALCULATION METHODOLOGY

Cost-Effectiveness Analysis

<b>Step 1</b>	Obtain Fuel Usage from Annual Emissions Reporting (AER)	If no AER data available, use estimated equipment fuel usage scaled to operating capacity of 80% <sup>1</sup>
<b>Step 2</b>	Determine Baseline Emissions	Baseline Emissions (lbs/yr) = <b>Current NOx Level</b> * Fuel Usage <b>Current NOx Level</b> (lb/MMBtu) is RECLAIM Default, Source Test Result, or Permit Limit [Which ever is lower]
<b>Step 3</b>	Proposed Emission Level	Proposed Emissions (lbs/yr) = Initial BARCT Emission Limit * Fuel Usage
<b>Step 4</b>	Calculate Emissions Reduction	Emissions Reduction (lbs/yr) = Proposed Emissions - Baseline Emissions

¹Federal Reserve Statistical Release G.17, Industrial Production and Capacity Utilization [http://www.federalreserve.gov/releases/g17/cap\\_notes.htm](http://www.federalreserve.gov/releases/g17/cap_notes.htm) as printed on February 7, 2011.



## COST-EFFECTIVENESS APPROACH

Cost-Effectiveness Analysis

Based on a “bottom up approach” using actual emissions data for each unit to calculate the cost-effectiveness for each unit

Calculated the average cost-effectiveness for each class and category of equipment, based on the data from each unit

Initial sensitivity assessments were conducted to remove outliers that were >> \$50,000 per ton of NOx reduced

Outliers to be addressed through either a different implementation approach or possible exemption

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## EXISTING RULE 1147 COMPLIANCE PATHWAY

Cost-Effectiveness Analysis

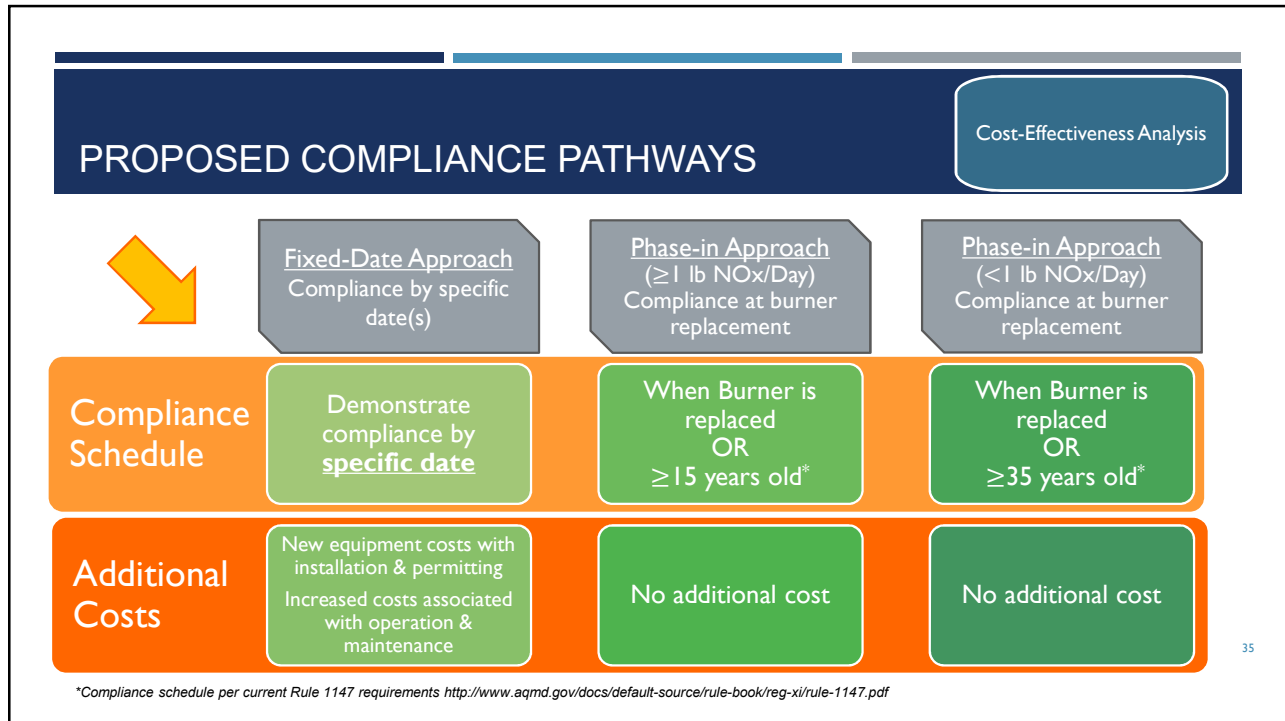
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graph LR
    R1147[Rule 1147] --> B1["<325,000 BTU/HR"]
    R1147 --> B2["≥325,000 BTU/HR"]
    B1 --> N1["Not Subject to Rule Limits"]
    B2 --> B3["≥1 Pound/Day"]
    B2 --> B4["<1 Pound/Day"]
    B3 --> F1["Fixed Date"]
    B3 --> P1["Phase-In"]
    P1 --> P1_1["When Unit is 15 Years Old"]
    P1 --> P1_2["At Burner Replacement"]
    B4 --> P2["Phase-In"]
    P2 --> P2_1["When Unit is 35 Years Old*"]
    P2 --> P2_2["At Burner Replacement"]
    
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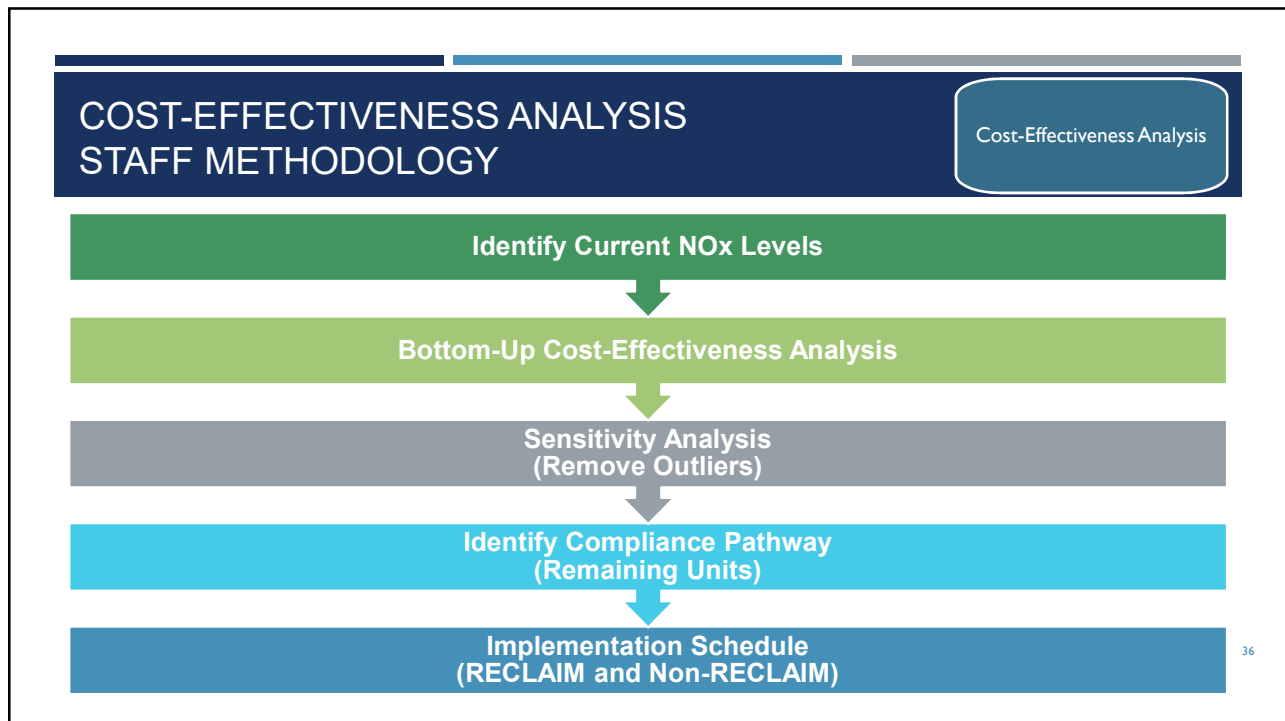
- ❑ Compliance for existing Rule 1147 divides applicable equipment between <1 LB/Day and ≥1 LB/Day
- ❑ Rule 1147 was adopted on December 5, 2008 with first set of permitting requirements by December 1, 2011 (roughly 3 years after rule adoption)
  - PAR 1147 and 1100 will follow a similar approach

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*\*In-use units may continue to operate beyond 35 years of age provided facility conduct bi-ennial emissions test no later than 180 days before the unit becomes 35 years of age;  
 Rule 1147(c)(16)(B) - <http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1147.pdf>*



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Cost-Effectiveness Analysis

# COST-EFFECTIVENESS ANALYSIS

Oven, Dryer, Heater, Furnace, Kiln, and Heated Process Tank

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## SUMMARY OF INITIAL BARCT LIMIT OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis

Operating Temp	Existing Units <sup>+</sup>		Rule 1147 Limit <sup>*</sup>	Other Regulatory <sup>#</sup>	Technology Assessment <sup>+</sup>		Initial BARCT NOx Limit <sup>+</sup>	
	Source Test Results	Units Meeting Initial BARCT Limit			≥40 MMBtu/hr	<40 MMBtu/hr	≥40 MMBtu/hr	<40 MMBtu/hr
<1,200° F	5 to 54 ppm	11 of 31 RECLAIM	30 ppm	30 to 175 ppm	5 ppm (via SCR <sup>*</sup> )	30 ppm (via LNB <sup>1</sup> )	5 ppm (via SCR <sup>*</sup> )	20 ppm (via LNB <sup>1</sup> )
		76 of 169 Non-RECLAIM						
≥1,200° F	10 to 80 ppm	1 of 8 RECLAIM	60 ppm	30 to 175 ppm	5 ppm (via SCR <sup>*</sup> )	30 ppm (via LNB <sup>1</sup> )	5 ppm (via SCR <sup>*</sup> )	30 ppm (via LNB <sup>1</sup> )
		3 of 4 Non-RECLAIM						

<sup>+</sup> Emissions data collected from source test results

<sup>\*</sup> Staff assumption of 95% efficiency for SCR reductions from default emission factor of 130 lb/mmssc (~102 ppm)

<sup>#</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry

<sup>+</sup> Oxygen corrections for NOx concentrations vary depending on regulatory agency

<sup>1</sup> Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations

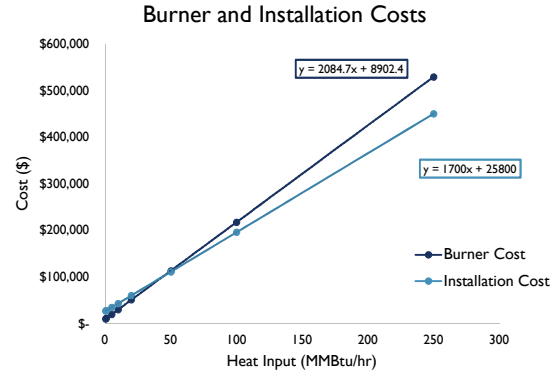
Cost-Effectiveness Analysis is needed <sup>38</sup>

# BASIS FOR BURNER COSTS

OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis

- ❑ Burner costs were obtained from two burner manufacturers
  - Staff utilized a conservative approach and utilized higher cost figures for cost-effectiveness analysis
  - Costs for larger equipment were extrapolated from provided cost figures
- ❑ Staff utilized installation cost from Rule 1146 equipment as a conservative estimate to installation costs of Rule 1147 applicable equipment

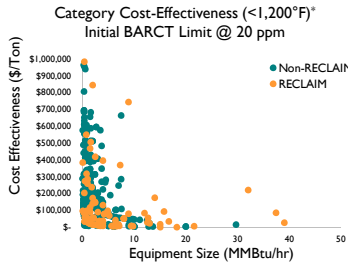


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# COST-EFFECTIVENESS ANALYSIS

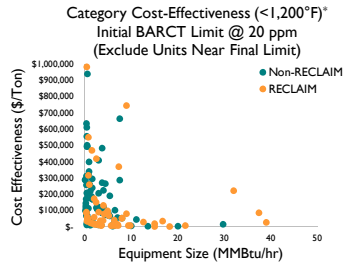
OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis



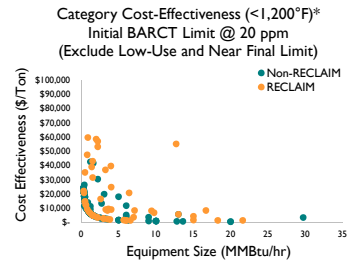
**Average Cost-Effectiveness** \$1.07B/Ton

Initial BARCT Limit	Units
❌ Source Test or Permit Limit ≤20 ppm	107
Source Test or Permit Limit ≤30 ppm	322
Low-Use (<1 LB NOx/Day)	75



**Average Cost-Effectiveness** \$4.69M/Ton

Initial BARCT Limit	Units
❌ Source Test or Permit Limit ≤20 ppm	107
❌ Source Test or Permit Limit ≤30 ppm	322
Low-Use (<1 LB NOx/Day)	75



**Average Cost-Effectiveness** \$12.635/Ton

Initial BARCT Limit	Units
❌ Source Test or Permit Limit ≤20 ppm	107
❌ Source Test or Permit Limit ≤30 ppm	322
❌ Low-Use (<1 LB NOx/Day)	75

\* Excludes equipment rated ≥ 40 MMBtu/hr

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PROPOSED NO<sub>x</sub> BARCT LIMIT AND IMPLEMENTATION APPROACH FOR OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis

Operating Temp	Existing Units <40 MMBtu/hr	# of Units*	No Further Action	Meet 20 PPM at Burner Replacement	Meet 20 PPM by Specified Date
<b>&lt;1,200° F</b>	Source Tested or Permit Limit ≤20 ppm	107	✓		
	Source Tested or Permit Limit ≤30 ppm and >20 ppm	322		✓	
	Low-Use (<1 LB NO <sub>x</sub> /Day)	75		✓	
	Remaining Units	204			✓

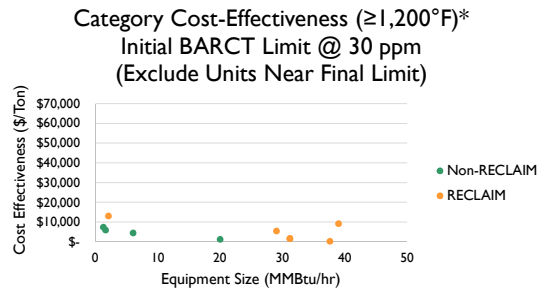
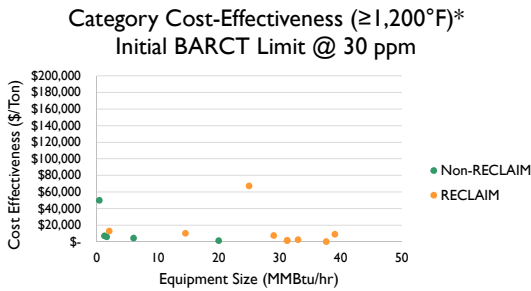
**Average Cost-Effectiveness: \$12,635/Ton**

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\*Excludes equipment rated ≥40 MMBtu/hr

COST-EFFECTIVENESS ANALYSIS  
OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis



**Average Cost-Effectiveness** \$14,054/Ton

	Initial BARCT Limit	Units
✗	Source Test or Permit Limit ≤30 ppm	4
	Source Test or Permit Limit ≤60 ppm	4

**Average Cost-Effectiveness** \$5,565/Ton

	Initial BARCT Limit	Units
✗	Source Test or Permit Limit ≤30 ppm	4
✗	Source Test or Permit Limit ≤60 ppm	4

\* Excludes equipment rated ≥ 40 MMBtu/hr

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PROPOSED NO<sub>x</sub> BARCT LIMIT AND IMPLEMENTATION APPROACH FOR OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis

Operating Temp	Existing Units <40 MMBtu/hr	# of Units*	No Further Action	Meet 30 PPM at Burner Replacement	Meet 30 PPM by Specified Date
<b>≥1,200° F</b>	Source Tested or Permit Limit ≤30 ppm	4	✓		
	Source Tested or Permit Limit ≤60 ppm and >30 ppm	4		✓	
	Remaining Units	9			✓

**Average Cost-Effectiveness: \$5,565/Ton**

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\*Excludes equipment rated ≥40 MMBtu/hr

COST-EFFECTIVENESS ANALYSIS  
OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis

Identified two units rated >40 MMBtu/hr, both in RECLAIM, none in Non-RECLAIM

Equipment	Size	Operating Temperature	Current Permit Limit	Annual NO <sub>x</sub> Emission*		Proposed BARCT	Cost-Effectiveness (\$/Ton)
				Lbs/Yr	Tons/Yr		
<b>Kiln (Major Source)</b>	84 MMBtu/hr	≥1,200° F	9.47 ppm (CEMS Max)	14,980	7.49	5 ppm (via SCR)	Pending
<b>Furnace<sup>^</sup> (Large Source)</b>	50 MMBtu/hr	<1,200° F	130 lbs/mmscf	679	0.34	5 ppm (via SCR)	

\*Annual NO<sub>x</sub> emissions obtained from 2018 to 2019 RECLAIM Audit  
<sup>^</sup>Unit does not see continuous operation

Additional cost assessment is required

## SUMMARY

OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Cost-Effectiveness Analysis

Equipment Category	Operating Temperature	Equipment Size	Rule 1147 Limit <sup>^</sup>	Initial BARCT Limit <sup>^</sup>	Proposed BARCT Limit <sup>^</sup>
Oven, Dryer, Heater, Furnace, Kiln, and Heated Process Tank	<1,200°F	≥40 MMBtu/hr	30 ppm	5 ppm	<b>Pending</b>
		<40 MMBtu/hr	30 ppm	20 ppm	<b>20 ppm (Via LNB<sup>!</sup>)</b>
	≥1,200°F	≥40 MMBtu/hr	60 ppm	5 ppm	<b>Pending</b>
		<40 MMBtu/hr	60 ppm	30 ppm	<b>30 ppm (Via LNB<sup>!</sup>)</b>

<sup>^</sup> NOx concentrations are corrected to 3% O<sub>2</sub> dry

<sup>!</sup> Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations

## NEXT STEPS

- Conduct cost-effectiveness analysis for remaining categories
- Continue to hold stakeholder meetings
- Next Working Group Meeting – Late June

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