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)

1

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

2

PREVIOUS WORKING GROUP RECAP

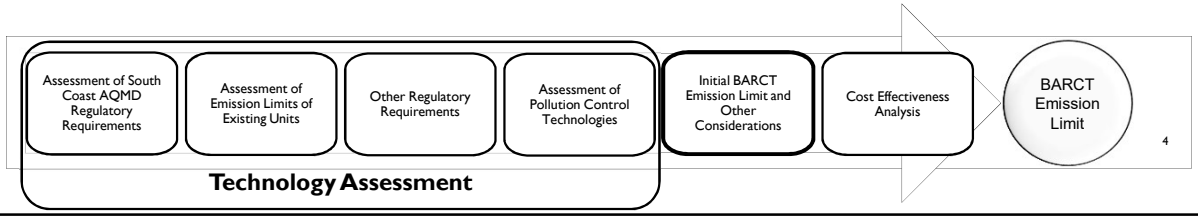
Working Group #5

- 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)

3

Initial BARCT Emission Limit

REVISION AND FURTHER ASSESSMENT
DIESEL FIRED TAR POT



4

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

5

FURTHER ASSESSMENT
DIESEL FIRED TAR POT

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		Rule 1147 Limit^	Other Regulatory#	BARCT Technology Review^	Initial BARCT Limit^
	Source Test Results	Units Meeting Initial BARCT Limit				
<1,200° F	N/A	N/A	40 ppm	114 ppm^ (~20 lb/mgal)	40 ppm	40 ppm
≥1,200° F		N/A				
	Unable to identify existing source test results		Applicable rule limit from existing Rule 1147	South Coast AQMD AER Reporting Factor[2]	Based on existing Rule 1147 limit for liquid fuels	Cost-Effectiveness Analysis is needed

+ Emissions data collected from source test results
^ NOx concentrations are corrected to 3% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency
[2]South Coast AQMD Annual Emissions Reporting (AER) emission factor derived from either US EPA AP-42 or Ventura APCD: http://www3.aqmd.gov/webappl/help/newaer/index.html?external_combustion.htm

6

FURTHER ASSESSMENT OF SINGEING MACHINES

Initial BARCT Emission Limit

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)

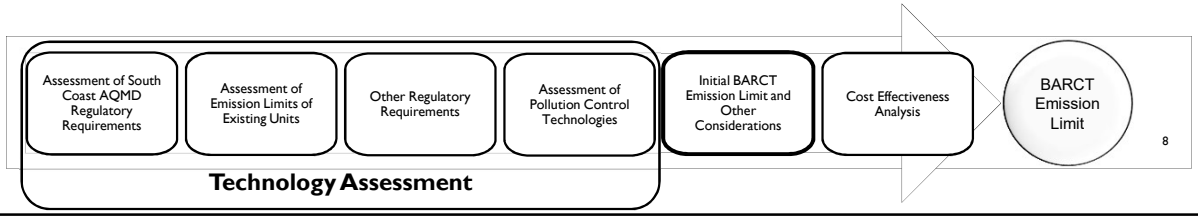
Further Assessment

- 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

7

Initial BARCT Emission Limit

FURTHER ASSESSMENT OF SINGEING MACHINES



8

FURTHER ASSESSMENT OF SINGEING MACHINES

Initial BARCT Emission Limit

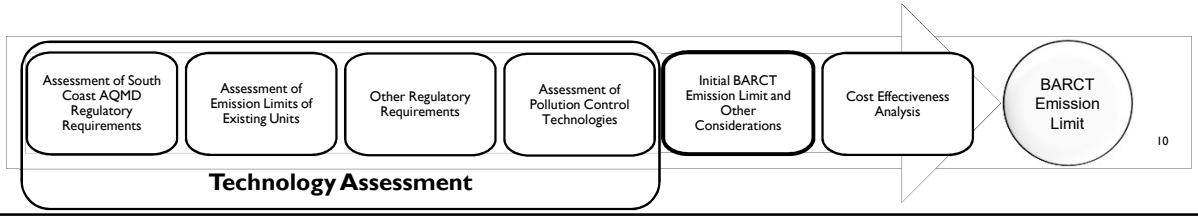
Operating Temp	Existing Units+^		Rule 1147 Limit^	Other Regulatory#	BARCT Technology Review^	Initial BARCT Limit^
	Source Test Results	Units Meeting Initial BARCT Limit				
<1,200° F	N/A	N/A	30 ppm	30 ppm^	30 ppm	30 ppm
		N/A				
	Unable to identify existing source test results		Applicable rule limit from existing Rule 1147	Applicable rule limit from SMAQMD[1]	Based on capabilities of existing Low NOx burner technology	Cost-Effectiveness Analysis is needed

+ Emissions data collected from source test results
^ NOx concentrations are corrected to 3% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency
[1] Sacramento Metropolitan AQMD Rule 419: http://www.airquality.org/ProgramCoordination/Documents/rule419.pdf

9 9

Initial BARCT Emission Limit

BARCT ANALYSIS
OVERVIEW



10

OVERVIEW OF INITIAL BARCT LIMITS PRESENTED AT PREVIOUS WORKING GROUP MEETING

Initial BARCT Emission Limit

Equipment Category	Operating Temperature	Equipment Size	Current Rule Limit^	Initial BARCT Limit^	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**
	≥1,200°F	All	60 ppm		

^ *NOx concentrations are corrected to 3% O_2 dry*

11

BARCT ANALYSIS
PROGRESS OF BARCT ANALYSIS

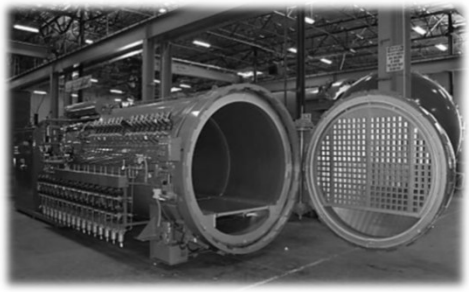
Initial BARCT Emission Limit

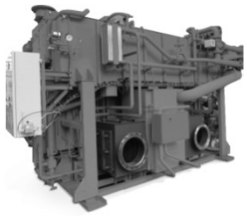
- ❑ Completed the technology assessment and presented initial BARCT limits for six equipment categories
- ❑ Based on stakeholder input, three additional equipment categories were identified:
  - ✓ Micro-turbines (Natural Gas and Diesel)
  - ✓ Absorption Chillers
  - ✓ Autoclaves
- ❑ Next Steps:
  - ➢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

12

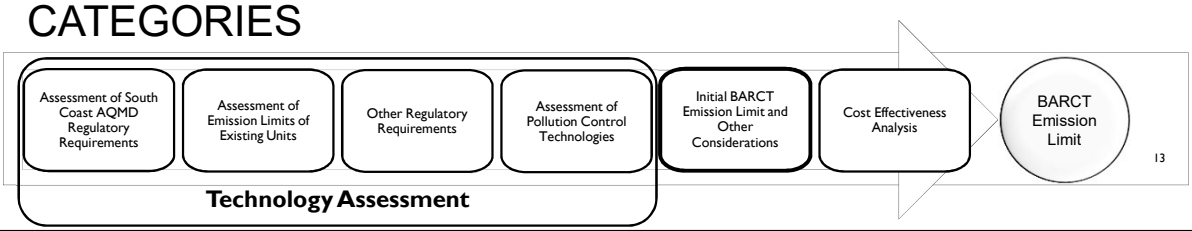
^ *NOx concentrations are corrected to 3% O_2 dry*

Initial BARCT Emission Limit





FURTHER EVALUATION OF NEWLY IDENTIFIED CATEGORIES



13

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^	Initial BARCT Limit^
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

14

^ *NOx concentrations are corrected to 3% O_2 dry*
* *NOx concentrations are corrected to 15% O_2 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^
  - 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^
    - Unable to identify source test for non-RECLAIM unit

15

^ *NOx concentrations are corrected to 3% O_2 dry*

INITIAL BARCT NOX LIMIT
ABSORPTION CHILLERS

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		Rule 1147 Limit^	Other Regulatory#	BARCT Technology Review^	Initial BARCT Limit^
	Source Test Results	Units Meeting Initial BARCT Limit				
<1,200° F	4 to 10 ppm	3 of 3 RECLAIM No Source Test for Non-RECLAIM	30 ppm	30 ppm^	20 ppm	20 ppm
			Applicable rule limit from existing Rule 1147	Applicable rule limit from SMAQMD[1]	Based on existing equipment permit limits and burner technology	No further action required for identified units

16

+ *Emissions data collected from source test results*
^ *NOx concentrations are corrected to 3% O_2 dry*
# *Oxygen corrections for NOx concentrations vary depending on regulatory agency*
[1] *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 ≥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

17

* *NOx concentrations are corrected to 15% O_2 dry*

INITIAL BARCT NOX LIMIT
MICRO-TURBINES (NATURAL GAS)

Initial BARCT Emission Limit

Fuel Type	Existing Units+*		Rule 1147 Limit^	Other Regulatory*	BARCT Technology Review*	Initial BARCT Limit*
	Source Test Results	Units Meeting Initial BARCT Limit				
Natural Gas	3 to 6 ppm	6 of 6 RECLAIM 11 of 11 Non-RECLAIM	N/A	43 ppm* (~54.4 lb/mmscf)	9 ppm	9 ppm

Unable to identify existing rule requirements from South Coast AQMD

South Coast AQMD AER Reporting Factor[2]

Based on turbine technologies from OEM guarantees

Cost-Effectiveness Analysis is needed

+ *Emissions data collected from source test results*
^ *NOx concentrations are corrected to 15% O_2 dry*
# *Oxygen corrections for NOx concentrations vary depending on regulatory agency*
[2]*South Coast AQMD Annual Emissions Reporting (AER) emission factor derived from either US EPA AP-42 or Ventura APCD:* http://www3.aqmd.gov/webappl/help/newaer/index.html?internal_combustion.htm

18
18

INITIAL BARCT NOX LIMIT
MICRO-TURBINES (DIESEL)

Initial BARCT Emission Limit

Fuel Type	Existing Units+*		Rule 1147 Limit^	Other Regulatory*	BARCT Technology Review*	Initial BARCT Limit*
	Source Test Results	Units Meeting Initial BARCT Limit				
Diesel	65 to 68 ppm	3 of 3 RECLAIM	40 ppm	880 ppm^ (~469 LB/MGal)	77 ppm	40 to 77 ppm

Applicable rule limit from existing Rule 1147

South Coast AQMD AER Reporting Factor[2]

Based on existing equipment permit limits and 300 hour/yr

Cost-Effectiveness Analysis is needed

+ Emissions data collected from source test results
^ NOx concentrations are corrected to 15% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency
[2]South Coast AQMD Annual Emissions Reporting (AER) emission factor derived from either US EPA AP-42 or Ventura APCD: http://www3.aqmd.gov/webappl/help/newaer/index.html?internal_combustion.htm

19
19

FURTHER EVALUATION
AUTOCLAVES

Initial BARCT Emission Limit

- Autoclaves are currently subject to the same Rule 1147 category as ovens and furnaces with rule limit of 30 ppm^ NOx
- Staff identified autoclaves as a new equipment category due to utilization of pressure vessel
- Identified 10 permitted autoclaves in RECLAIM and none in non-RECLAIM
  - Two autoclaves with permit limits of 30 ppm^ NOx with source test results
    - Source test results show between 25 to 29 ppm
    - One new installation and one retrofit; both around 24 MMBtu/hr
  - Remaining autoclaves are reporting under RECLAIM default of 130 lb/mmscf NOx

^ NOx concentrations are corrected to 3% O_2 dry

20

INITIAL BARCT NOX LIMIT
AUTOCLAVES

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		Rule 1147 Limit^	Other Regulatory#	BARCT Technology Review^	Initial BARCT Limit^
	Source Test Results	Units Meeting Initial BARCT Limit				
<1,200° F	24 to 29 ppm	2 of 2 RECLAIM	30 ppm	30 to 175 ppm (Oven Limit)	30 ppm	30 ppm

Applicable rule limit from existing Rule 1147

Applicable rule limits from various Air Districts

Based on existing equipment permit limits and burner technology

Cost-Effectiveness Analysis is needed

+ Emissions data collected from source test results
^ NOx concentrations are corrected to 3% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency

21
21

OVERVIEW OF INITIAL BARCT LIMITS
NEWLY IDENTIFIED CATEGORIES

Initial BARCT Emission Limit

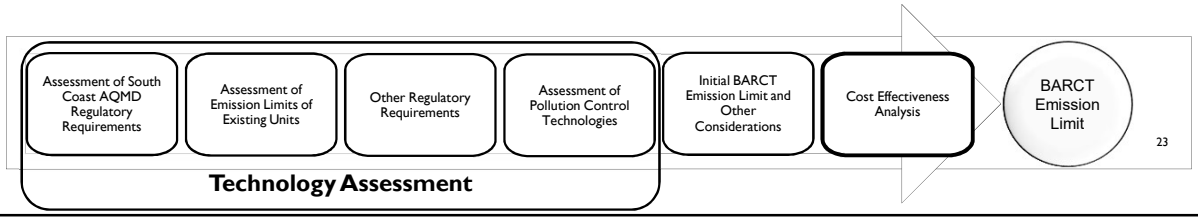
Equipment Category	Operating Temperature	Equipment Size	Current Rule Limit^	Initial BARCT Limit^	Cost-Effectiveness Analysis
Absorption Chillers	All	All	30 ppm	20 ppm	**Pending**
Micro-Turbines (Natural Gas)	All	All	N/A	9 ppm*	**Pending**
Micro-Turbines (Diesel)	All	All	40 ppm	40 to 77 ppm*	**Pending**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

^ NOx concentrations are corrected to 3% O_2 dry
** NOx concentrations are corrected to 15% O_2 dry*

22

Cost-Effectiveness Analysis

COST-EFFECTIVENESS ANALYSIS: METHODOLOGY AND ASSUMPTIONS



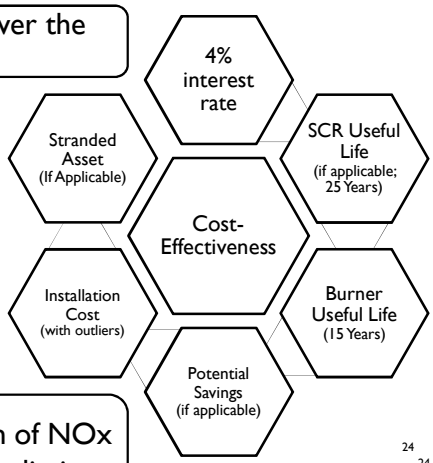
23

Cost-Effectiveness Analysis

OVERVIEW OF COST-EFFECTIVENESS

Cost-Effectiveness is the cost (capital and annual costs) over the emission reductions for the life of the equipment

- Cost-effectiveness is expressed in a dollar per ton of pollutant reduced
- Two major cost elements
  - Capital costs
  - Annual costs
- Emission reductions are based on current emission levels (baseline) compared to the Initial BARCT emission limit



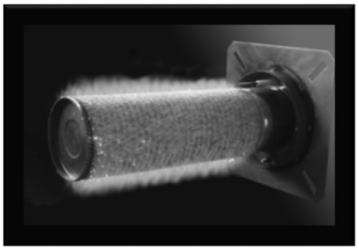
Staff uses the 2016 AQMP cost-effectiveness of $50,000/ton of NOx reduced as guidance for establishing the BARCT emission limit

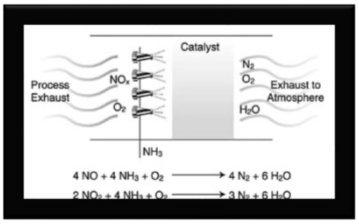
24
24

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-NOx Burners
  - Selective Catalytic Reduction





25

LOW-NO_X BURNER COST ASSUMPTIONS

Cost-Effectiveness Analysis

Burner Replacement (Low-NOx)

- 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 NOx burners

26

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

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[1] and the 2018 Rule 1146 Staff Report[2]
- 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

27

[1]EPA SCR Cost Manual- https://www3.epa.gov/ttn/ecas/docs/SCRCostManualchapter7thEdition_2016.pdf
[2]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

28

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

CAPITAL AND ANNUAL OPERATING COSTS

Cost-Effectiveness Analysis

Capital Costs
(One-Time Expenses)

- Equipment costs
- Installation costs
- Permit application fee
- Initial Source Test

Annual Operating Costs
(Increased Recurring Expenses)

- Labor & Maintenance
- Increased fuel
- Increased electricity
- Recurring source tests
- Catalyst (SCR Only)
- Reagent (SCR Only)
- Monitoring, Reporting, and Recordkeeping (SCR Only)

29

COST-EFFECTIVENESS CALCULATIONS

Cost-Effectiveness Analysis

Discounted Cash Flow (DCF) Method

ULNB Cost Calculations

Cost-Effectiveness =

$$\frac{\textit{Capital Costs} + (\textit{Increased Annual Operating Costs} * \textit{Equipment Life})}{\textit{Emissions Reduced Over Equipment Life}}$$

SCR Cost Calculations

Cost-Effectiveness (SCR) =

$$\frac{\textit{Capital Costs} * (\textit{Capital Recovery Factor}) + \textit{Annual Operating Costs}}{\textit{Emissions Reduced Per Year}}$$

Capital Recovery Factor for annualizing equipment cost = $\frac{i*(1+i)^n}{(1+i)^n-1}$

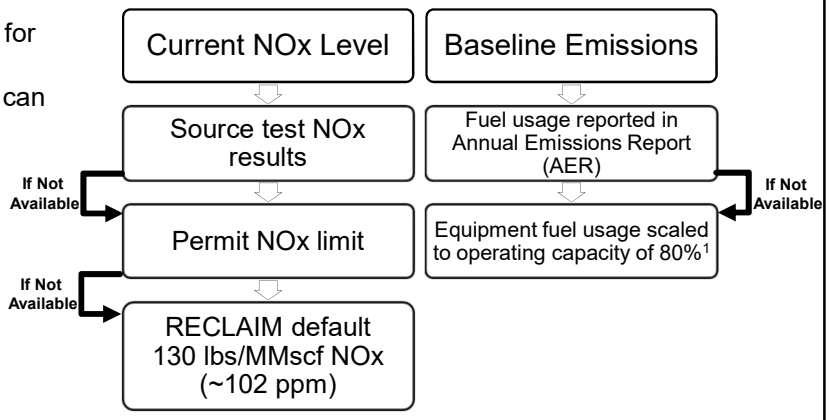
- **i = nominal interest rate**
- **n = equipment useful life**

30

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



31

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

EMISSION REDUCTION CALCULATION METHODOLOGY

Cost-Effectiveness Analysis

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

32

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

COST-EFFECTIVENESS APPROACH

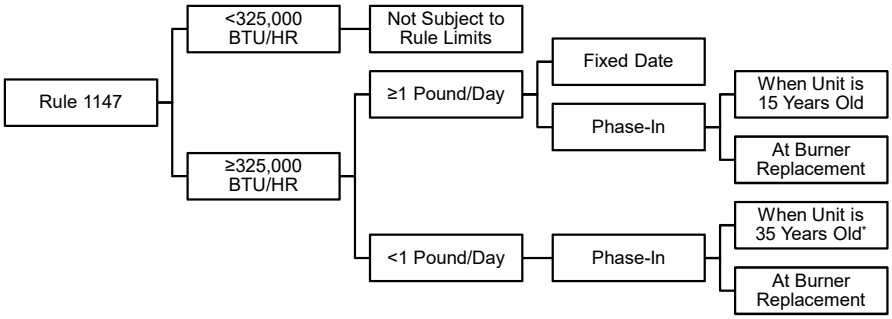
Cost-Effectiveness Analysis

- 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

33

EXISTING RULE 1147 COMPLIANCE PATHWAY

Cost-Effectiveness Analysis



- 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

34

**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*

PROPOSED COMPLIANCE PATHWAYS

Cost-Effectiveness Analysis

	Fixed-Date Approach Compliance by specific date(s)	Phase-in Approach (≥1 lb NOx/Day) Compliance at burner replacement	Phase-in Approach (<1 lb NOx/Day) Compliance at burner replacement
Compliance Schedule	Demonstrate compliance by **specific date**	When Burner is replaced OR ≥15 years old*	When Burner is replaced OR ≥35 years old*
Additional Costs	New equipment costs with installation & permitting Increased costs associated with operation & maintenance	No additional cost	No additional cost

35

**Compliance schedule per current Rule 1147 requirements http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1147.pdf*

COST-EFFECTIVENESS ANALYSIS STAFF METHODOLOGY

Cost-Effectiveness Analysis

Identify Current NOx Levels

↓

Bottom-Up Cost-Effectiveness Analysis

↓

Sensitivity Analysis (Remove Outliers)

↓

Identify Compliance Pathway (Remaining Units)

↓

Implementation Schedule (RECLAIM and Non-RECLAIM)

36

Cost-Effectiveness Analysis

COST-EFFECTIVENESS ANALYSIS

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

37

SUMMARY OF INITIAL BARCT LIMIT

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

Cost-Effectiveness Analysis

Operating Temp	Existing Units+^		Rule 1147 Limit^	Other Regulatory#	Technology Assessment*^		Initial BARCT NOx Limit*^	
	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 76 of 169 Non-RECLAIM	30 ppm	30 to 175 ppm	5 ppm (via SCR*)	30 ppm (via LNB[1])	5 ppm (via SCR*)	20 ppm (via LNB[1])
≥1,200° F	10 to 80 ppm	1 of 8 RECLAIM 3 of 4 Non-RECLAIM	60 ppm	30 to 175 ppm	5 ppm (via SCR*)	30 ppm (via LNB[1])	5 ppm (via SCR*)	30 ppm (via LNB[1])

+ Emissions data collected from source test results
** Staff assumption of 95% efficiency for SCR reductions from default emission factor of 130 lb/mmscf (~102 ppm)*
^ NOx concentrations are corrected to 3% O_2 dry
 # Oxygen corrections for NOx concentrations vary depending on regulatory agency
[1] 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

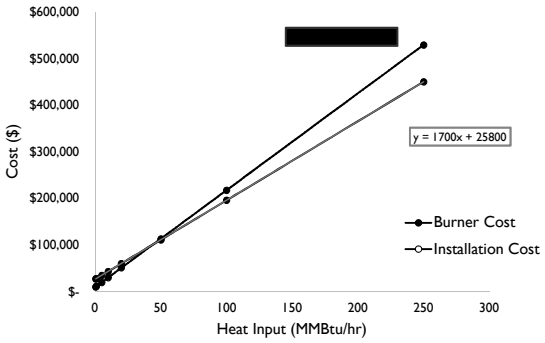
38

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

Burner and Installation Costs

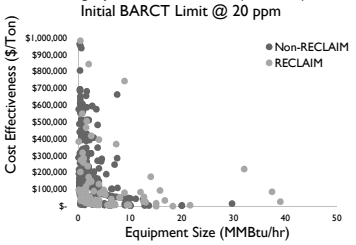


39

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

Cost-Effectiveness Analysis

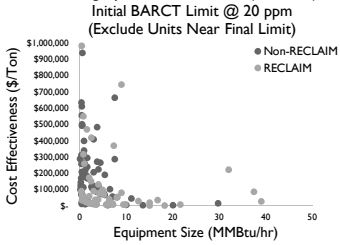
Category Cost-Effectiveness (<1,200°F)*
Initial BARCT Limit @ 20 ppm



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

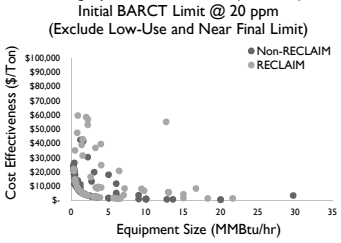
Category Cost-Effectiveness (<1,200°F)*
Initial BARCT Limit @ 20 ppm
(Exclude Units Near Final Limit)



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

Category Cost-Effectiveness (<1,200°F)*
Initial BARCT Limit @ 20 ppm
(Exclude Low-Use and Near Final Limit)



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

40

PROPOSED NO_X 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
<1,200° F	Source Tested or Permit Limit ≤20 ppm	107	✓		
	Source Tested or Permit Limit ≤30 ppm and >20 ppm	322		✓	
	Low-Use (<1 LB NOx/Day)	75		✓	
	Remaining Units	204			✓

Average Cost-Effectiveness: $12,635/Ton

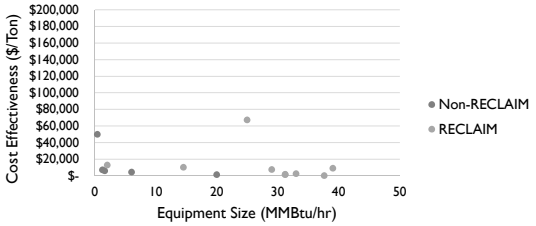
41

*Excludes equipment rated ≥40 MMBtu/hr

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

Cost-Effectiveness Analysis

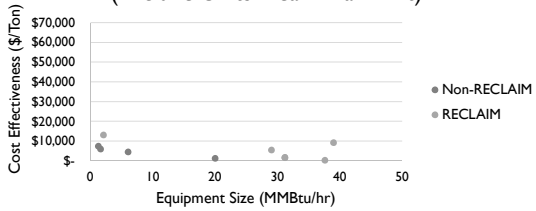
Category Cost-Effectiveness (≥1,200°F)*
Initial BARCT Limit @ 30 ppm



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

Category Cost-Effectiveness (≥1,200°F)*
Initial BARCT Limit @ 30 ppm
(Exclude Units Near Final Limit)



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

42

* Excludes equipment rated ≥ 40 MMBtu/hr

PROPOSED NO_X 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
≥1,200° F	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

43

*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 NOx Emission*		Proposed BARCT	Cost-Effectiveness ($/Ton)
				Lbs/Yr	Tons/Yr		
Kiln (Major Source)	84 MMBtu/hr	≥1,200° F	9.47 ppm (CEMS Max)	14,980	7.49	5 ppm (via SCR)	Pending
Furnace^ (Large Source)	50 MMBtu/hr	<1,200° F	130 lbs/mmscf	679	0.34	5 ppm (via SCR)	

*Annual NOx emissions obtained from 2018 to 2019 RECLAIM Audit
^Unit does not see continuous operation

Additional cost assessment is required

44

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

Cost-Effectiveness Analysis

Equipment Category	Operating Temperature	Equipment Size	Rule 1147 Limit^	Initial BARCT Limit^	Proposed BARCT Limit^
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	**20 ppm (Via LNB[1])**
	≥1,200°F	≥40 MMBtu/hr	60 ppm	5 ppm	**Pending**
		<40 MMBtu/hr	60 ppm	30 ppm	**30 ppm (Via LNB[1])**

^ *NOx concentrations are corrected to 3% O_2 dry*
[1] *Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations*

45

NEXT STEPS

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

46

CONTACTS

General RECLAIM Questions	Proposed Amended Rules 1147, 1100 and Proposed Rule 1147.1	Proposed Amended Rule 1147, 1100 and Proposed Rule 1147.2	Proposed Amended Rule 1147, 1100 and Proposed Rule 1147.3
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47