PROPOSED AMENDED RULES 1147, 1100, & PROPOSED RULE 1147.1 WORKING GROUP MEETING #5

FEBRUARY 11, 2020

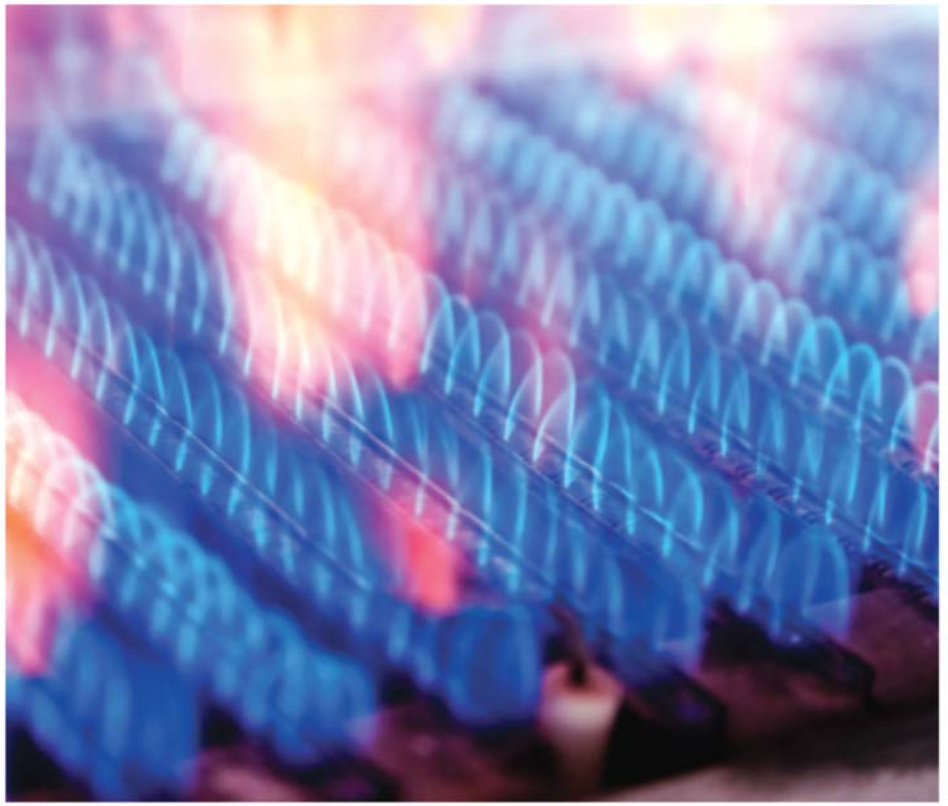
SOUTH COAST AQMD

DIAMOND BAR, CA

Call-in Number: 866-705-2554
Passcode: 298901

AGENDA

- Summary of Previous Working Group Meeting
- BARCT Analysis
  - Other Regulatory Requirements
  - Assessment of Pollution Control Technologies
  - Initial BARCT Emission Limit
- Next Steps



PREVIOUS WORKING GROUP RECAP

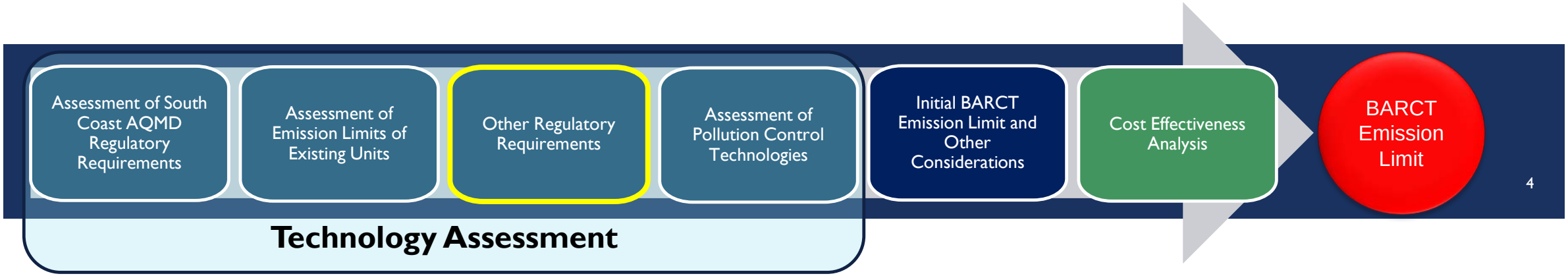
Working Group #4

- Presented results of Rule 1147 Equipment Survey results
- Analysis on source test results for all Rule 1147 categories* and Micro-turbines
- Observed data from all category suggests that equipment size does not impact NOx concentration potential

***Analysis excludes equipment from PR 1147.2 and 1147.3 universe**

Other Regulatory Requirements

RULES FROM OTHER AGENCIES



RULES FROM OTHER AGENCIES
CALIFORNIA

Other Regulatory Requirements

Ventura County Air Pollution Control District (VCAPCD)

- **Rule 74.34 – Misc Sources**
  - Applicability: > 5 MMBtu/hr
  - Limit: 30 to 80 ppm depending on application and process temperature
  - O^2 Correction: 3%

Sacramento Metropolitan Air Quality Management District (SMAQMD)

- **Rule 419 – Misc. Sources**
  - Applicability: > 2 MMBtu/hr located at major sources / >5 MMBtu/hr located at other sources
  - Limit: Between 30 to 60 ppm depending on application and process temperature
  - O^2 Correction: 3%

San Joaquin Valley Air Pollution Control District (SJVAPCD)*

- **Rule 4309 – Dryers, Dehydrators, and Ovens**
  - Applicability: > 5 MMBtu/Hr
  - Limit: 3.5 to 4.3 ppm depending on process (corrected to 19% O^2)
  - O^2 Correction: 19% (if measured O^2 is <19%) / Measured O^2 if measured O^2 is >19%

**Rule does not mention process temperatures*

RULES FROM OTHER AGENCIES
CALIFORNIA (CONTINUED)

Other Regulatory Requirements

Great Basin Unified Air Pollution Control District (GBUAPCD)*

- **Regulation 404-B – Oxides of Nitrogen**
  - Applicability: Fuel Burning Equipment
  - Limit: 125 ppm (Natural Gas) / 225 ppm (Liquid or Solid Fuel)
  - O^2 Correction: 3%

Bay Area Air Quality Management District (BAAQMD)*

- **Regulation 9, Rule 3 – Nitrogen Oxides from Heat Transfer Operations**
  - Applicability: Heat Transfer Operations
  - Limit (New): 125 ppm (Gaseous Fuel) / 225 ppm (Liquid Fuel)
  - Limit: (Existing): 175 ppm (Gaseous Fuel) / 300 ppm (Liquid Fuel)
  - O^2 Correction: None

San Diego Air Pollution Control District (SDAPCD)*

- **Rule 68 – Fuel-Burning Equipment, Oxides of Nitrogen**
  - Applicability: Non-vehicular, fuel burning equipment ≥50 MMBtu/hr
  - Limit: 125 ppm (Gaseous Fuel) / 225 ppm (Liquid or Solid Fuel)
  - O^2 Correction: 3%

**Rule does not mention process temperatures*

RULES FROM OTHER AGENCIES
UNITED STATES

Other Regulatory Requirements

New Jersey Department of Environmental Protection – New Jersey Administrative Code*

- **Title 7, Chapter 27, Subchapter 19– Oxides of Nitrogen**
  - Applicability: Stationary Combustion Equipment (Size varies for equipment type)
  - Limit: None applicable for Rule 1147 equipment
  - O2 Correction: N/A

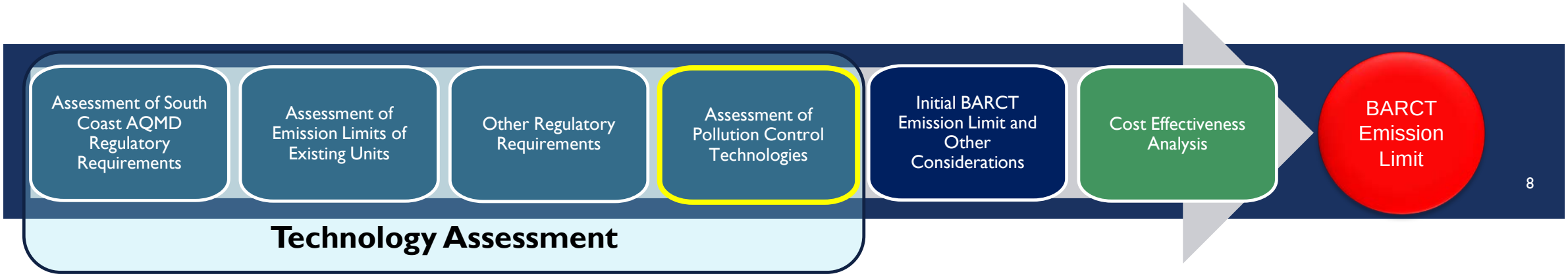
New York State Department of Environmental Conservation*

- **Chapter III, Subchapter A, Part 227-Stationary Combustion Installations**
  - Applicability: Stationary Combustion Equipment (Size varies for equipment type)
  - Limit: 3 lb/hour NOx
  - O2 Correction: N/A

**Rule does not mention process temperatures*

Assessment of Pollution Control Technologies

ASSESSMENT OF EMISSION CONTROL TECHNOLOGY



ASSESSMENT OF EMISSION CONTROL TECHNOLOGY
BACKGROUND

Assessment of Pollution Control Technologies

- Technology assessments are conducted to assess current NOx control technologies available for equipment categories subject to Proposed Amended Rule 1147
  - Assessment will also consider opportunities for potential reductions
- NOx pollution control technologies are separated into two control categories:

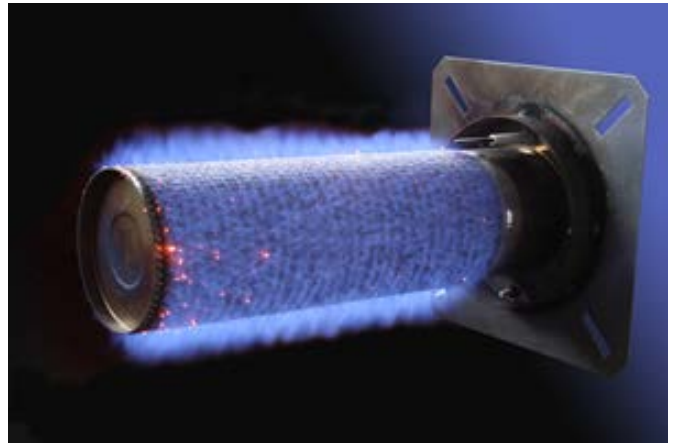
Combustion	Post-Combustion
o Low NOx/Ultra-Low NOx Burners	o Selective Catalytic Reduction
o Flue Gas Recirculation	
o Flameless Thermal Oxidizers	

OVERVIEW OF POLLUTION CONTROL TECHNOLOGIES

Assessment of Pollution Control Technologies

Combustion Controls (Low-NOx/Ultra-Low NOx Burners)

- Various burner configurations and designs:
  - Lean premix
  - Flue gas recirculation
  - Fuel/air staging
  - Metal mesh burner head
  - Recuperative/regenerative
- Reduces thermal NOx formation
- Costs are generally lower than post combustion controls
- Most common form of control in the PAR 1147 Universe



OVERVIEW OF POLLUTION CONTROL TECHNOLOGIES

Assessment of Pollution Control Technologies

Combustion Controls (Low-NOx/Ultra-Low NOx Burners) – Cont'd

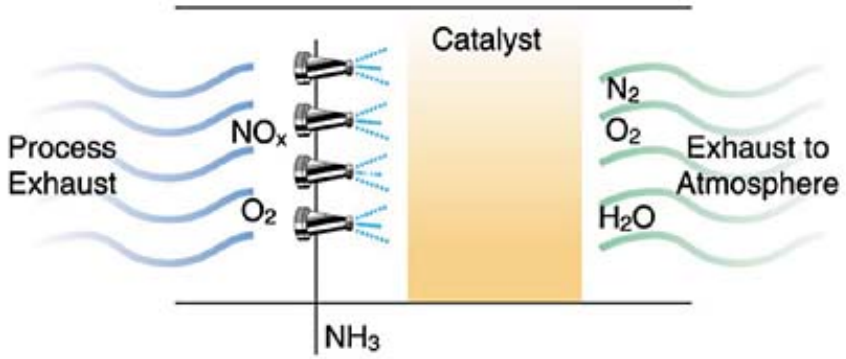
- Additional Considerations:
  - Multiple burner manufacturers provide emission guarantees to meet <30 ppm^ for both low and high temperature applications
    - Emissions guarantees are for multiple models for a wide range of applications
  - Source test data gathered from equipment impacted by PAR 1147 show low NOx burners are capable of achieving real world emissions of <20 ppm^ in some applications
  - Ultra-Low NOx burners available in boiler applications capable of achieving <5 ppm^ without the need of post combustion controls

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

OVERVIEW OF POLLUTION CONTROL TECHNOLOGIES

Assessment of Pollution Control Technologies

Post-Combustion Controls (Selective Catalytic Reduction)



$$4\ NO + 4\ NH_3 + O_2 \longrightarrow 4\ N_2 + 6\ H_2O$$

$$2\ NO_2 + 4\ NH_3 + O_2 \longrightarrow 3\ N_2 + 6\ H_2O$$

- NOx treatment at the exhaust with the use of reactant (ammonia/urea) and catalyst
  - Capable of >95% NOx reduction
  - Technology is scalable and used mostly in applications >10 MMBtu/hr
- Generally more costly than combustion controls via Low NOx/Ultra-Low NOx burners
  - Additional recurring costs includes electricity, catalyst, and reagent
- Some applications require exhaust pre-treatment prior to intake of SCR

OVERVIEW OF POLLUTION CONTROL TECHNOLOGIES

Assessment of Pollution Control Technologies

Post-Combustion Controls (Selective Catalytic Reduction) – Cont'd

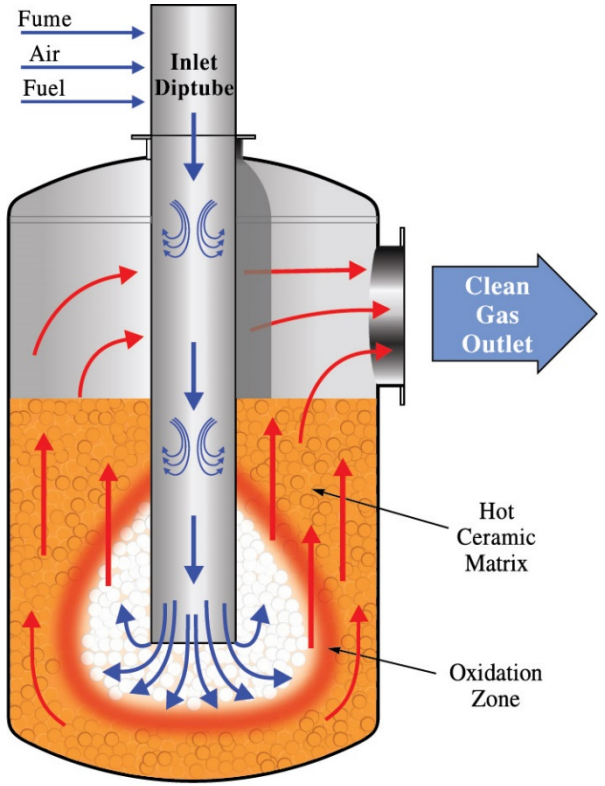
- Additional Considerations:
  - Upfront costs of SCR systems are generally more expensive than that of combustion control technologies
  - Additional monitoring will be required to keep SCR in optimal operation
    - Exhaust temperature and ammonia input
  - Introduction of ammonia/urea will cause unreacted ammonia to slip at the exhaust
    - Current South Coast AQMD BACT for ammonia slip is 5 ppm
  - No applications of SCR found for existing Rule 1147 equipment universe

OVERVIEW OF POLLUTION CONTROL TECHNOLOGIES

Assessment of Pollution Control Technologies

Post-Combustion Controls
Flameless Thermal Oxidizer Technology

- Utilizes natural gas burner paired with hot ceramic matrix
- Natural gas burner is only used to bring ceramic media to operating temperature (>1,500°F)
- Natural gas is injected directly into the ceramic matrix where combustion occurs
  - Heat released from oxidation process is absorbed back into ceramic media
  - Advertised to meet <2 ppm NOx and 99.99% destruction efficiency



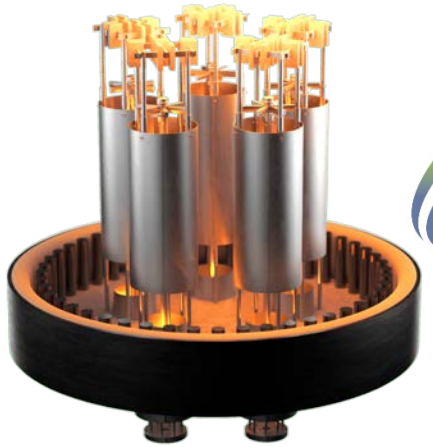
Only applicable to equipment category containing afterburners, thermal oxidizers, RTOs, and Oxidizers

OVERVIEW OF POLLUTION CONTROL TECHNOLOGIES

Assessment of Pollution Control Technologies

Prospective Transferable Technologies

- ClearSign Duplex™ Technology
  - <5 ppm^ achieved in practice using natural gas
- John Zink Hamworthy SOLEX
  - ~5 ppm^ demonstrated at test facility using natural gas
  - Designed for refinery applications



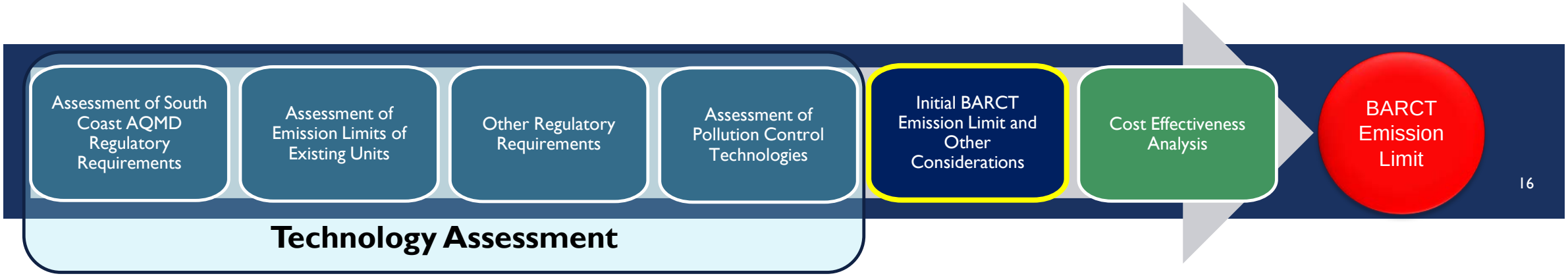
ClearSign

JOHN ZINK HAMWORTHY COMBUSTION®

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

Initial BARCT Emission Limit

INITIAL NO_X BARCT EMISSION LIMIT FOR RECLAIM AND NON-RECLAIM UNITS



Initial BARCT Emission Limit

INITIAL BARCT EMISSION LIMIT

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

BACKGROUND
OVEN/DRYER/HEATER/FURNACE/KILN/HEATED PROCESS TANK

Initial BARCT Emission Limit

RECLAIM Universe

- Consists of 191 pieces of permitted equipment
- Source test results were evaluated for 43 out of 191 units

Non-RECLAIM Universe

- Consists of 1,509 pieces of permitted equipment
- Source test results were evaluated for 173 out of 1,509 units

Large Sources (≥40 MMBtu/hr)

- Identified one unit from RECLAIM and RECLAIM universe rated ≥40 MMBtu/hr
- Unit is a Major Source in the RECLAIM universe and equipped with CEMS

CEMS ANALYSIS OF RECLAIM MAJOR SOURCE
OVEN/DRYER/HEATER/FURNACE/KILN/HEATED PROCESS TANK

Initial BARCT Emission Limit

Identified Major Source (RECLAIM)

- Heat Input: 84 MMBtu/hr*
- Operating Temperature: ≥1,200°F
- Total Emissions (2018 to 2019 CEMS data): 7.5 tons/year
- CEMS Lifetime NOx Maximum: 9.47 ppm

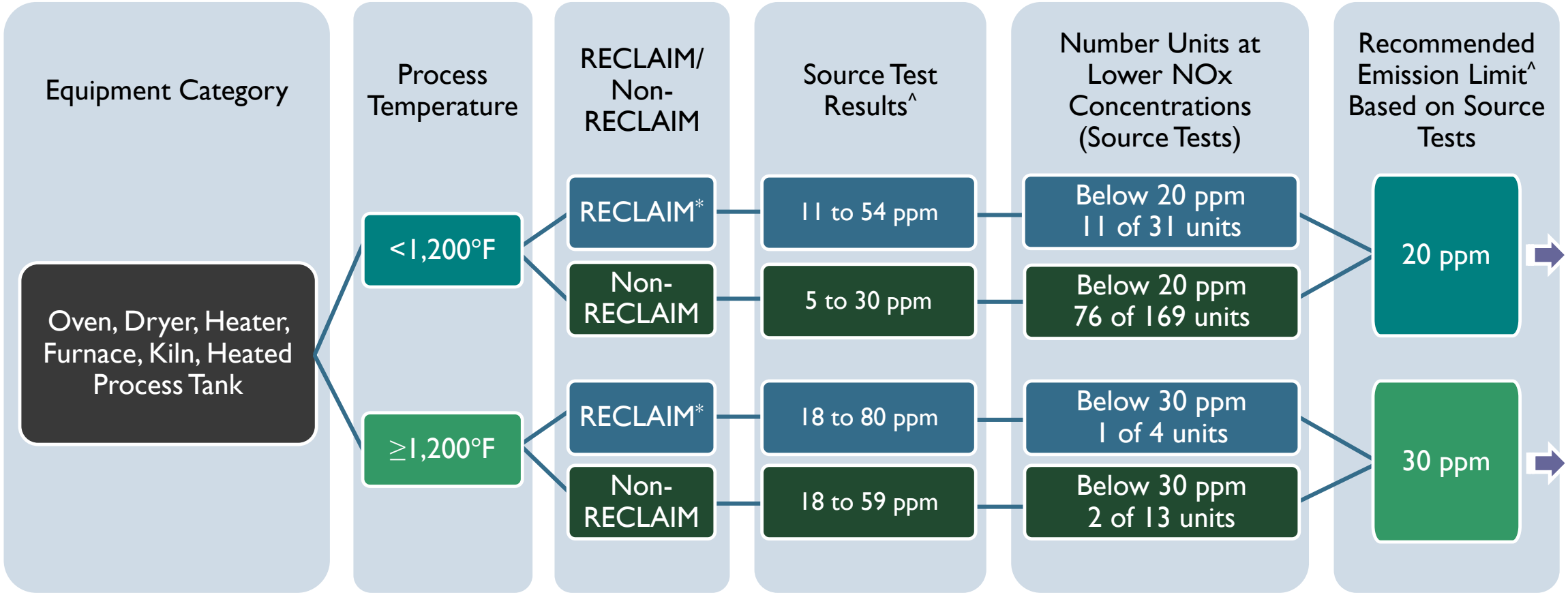
Unit does not have any post combustion controls

➢ Will conduct cost-effectiveness for potential further reductions

**Total heat input consists of twelve 7 MMBtu/hr burners*

SUMMARY OF SOURCE TEST ASSESSMENT
OVEN/DRYER/HEATER/FURNACE/KILN/HEATED PROCESS TANK

Initial BARCT Emission Limit



^*NOx concentrations are corrected to 3% O_2 dry*
**Excludes RECLAIM Major Source*

INITIAL BARCT NOX LIMIT (WORKING GROUP #5)
OVEN, DRYER, HEATER, FURNACE, KILN, AND HEATED PROCESS TANK

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		South Coast AQMD Limit^	Other Regulatory#	Technology Assessment*^		Initial BARCT NOx Limit*^	
	ST Recommended Limit	Units Meeting Recommendation			≥40 MMBtu/hr	<40 MMBtu/hr	≥40 MMBtu/hr	<40 MMBtu/hr
<1,200° F	20 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	30 ppm	1 of 4 RECLAIM 2 of 13 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])

Cost-Effectiveness Analysis is needed

+ *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*

Initial BARCT Emission Limit

INITIAL BARCT EMISSION LIMIT

Afterburner, Thermal Oxidizer, RTO, and Oxidizer

BACKGROUND
AFTERBURNER, THERMAL OXIDIZER, RTO, AND OXIDIZER

Initial BARCT Emission Limit

RECLAIM Universe

- Consists of 80 pieces of permitted equipment
- Source test results were evaluated for 15 out of 80 units

Non-RECLAIM Universe

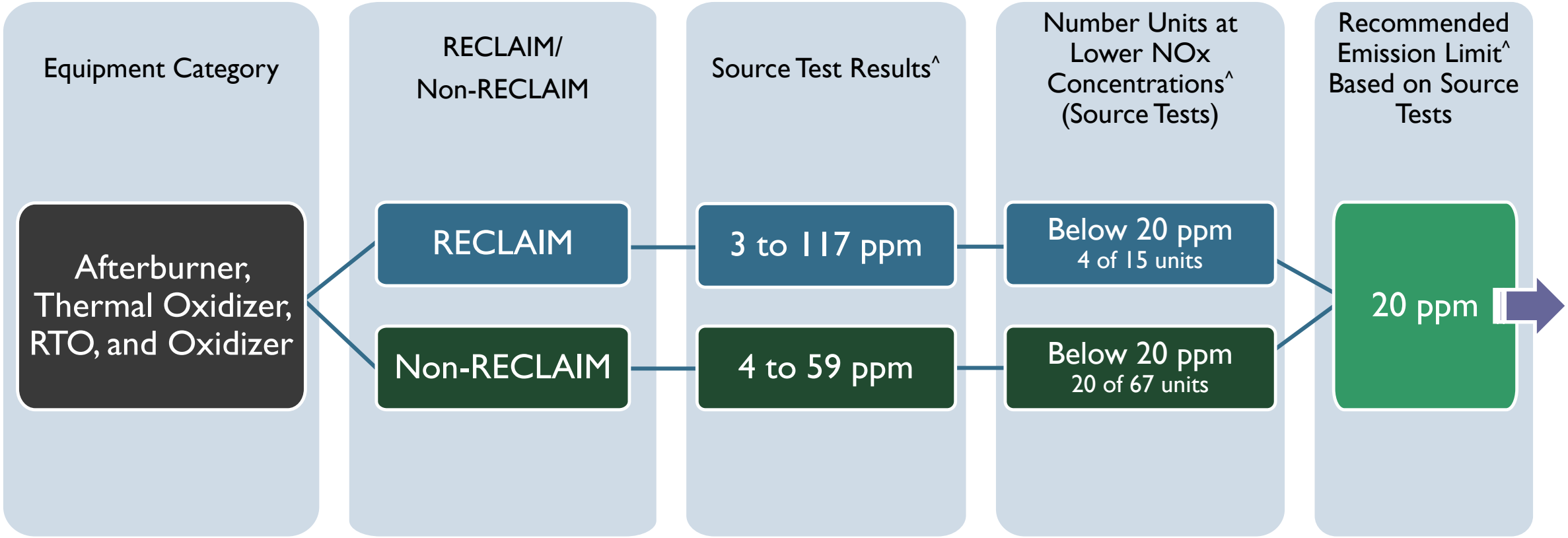
- Consists of 267 pieces of permitted equipment
- Source test results were evaluated for 67 out of 267 units

Additional Considerations

- Flameless thermal oxidizers will be further evaluated in cost-effectiveness analysis
- BACT for this equipment category is 30 ppm

SUMMARY OF SOURCE TEST ASSESSMENT
AFTERBURNER, THERMAL OXIDIZER, RTO, AND OXIDIZER

Initial BARCT Emission Limit



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

INITIAL BARCT NOX LIMIT (WORKING GROUP #5)
AFTERBURNER, THERMAL OXIDIZER, RTO, AND OXIDIZER

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
	ST Recommended Limit	Units Meeting Recommendation				
<1,200° F	20 ppm	4 of 15 RECLAIM	60 ppm (30 ppm BACT)	125 to 175 ppm	30 ppm (via LNB[1])	20 ppm (via LNB[1])
≥1,200° F		20 of 67 Non-RECLAIM				

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] *Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations*

Initial BARCT Emission Limit

INITIAL BARCT EMISSION LIMIT

Evaporator, Fryer, Heated Process Tank, and Parts Washer

BACKGROUND
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Initial BARCT Emission Limit

RECLAIM Universe

- Consists of 15 pieces of permitted equipment
- Source test results were evaluated for 1 out of 15 units

Non-RECLAIM Universe

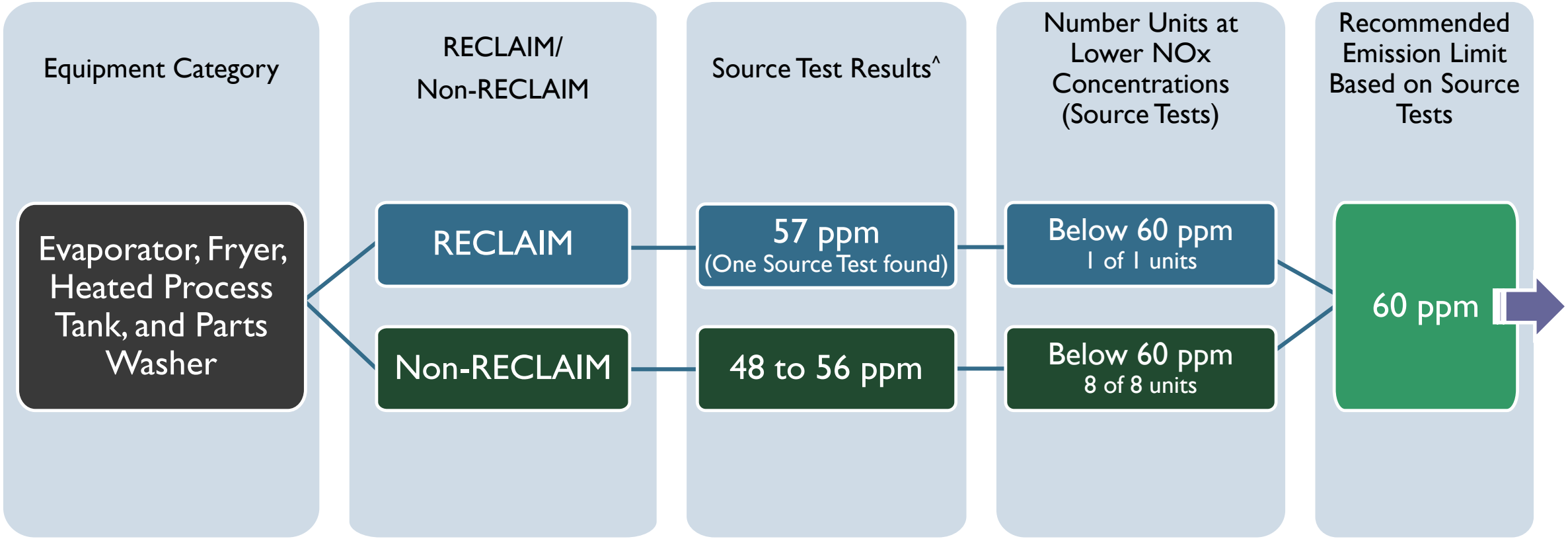
- Consists of 55 pieces of permitted equipment
- Source test results were evaluated for 8 out of 55 units

Additional Considerations

- Retrofit options available for parts washers utilizing immersion tube burners
- Equipment vented to a control device such as Afterburners and RTOs are excluded from this analysis
- Limited number of source tests were available due to current Rule 1147 compliance schedule and the popularity of alternate heating methods in this application space (i.e. hot oil heaters, electric)

SUMMARY OF SOURCE TEST ASSESSMENT
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Initial BARCT Emission Limit



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

INITIAL BARCT NOX LIMIT (WORKING GROUP #5)
EVAPORATOR, FRYER, HEATED PROCESS TANK, AND PARTS WASHER

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
	ST Recommended Limit	Units Meeting Recommendation				
<1,200° F	60 ppm	1 of 1 RECLAIM	60 ppm	125 to 175 ppm	30 ppm (via LNB[1])	30 ppm (via LNB[1])
≥1,200° F		8 of 8 Non-RECLAIM				

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] *Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations*

Initial BARCT Emission Limit

INITIAL BARCT EMISSION LIMIT

Burn-off Furnace, Burnout Oven, Incinerator, Crematory with or without Integrated Afterburner

BACKGROUND

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Initial BARCT Emission Limit

RECLAIM Universe

- Consists of 12 pieces of permitted equipment
- All RECLAIM equipment are using default emission factor of 130 lb/mmscf
- Unable to obtain source test results from RECLAIM equipment

Non-RECLAIM Universe

- Consists of 315 pieces of permitted equipment
- Observed some permitted equipment has different emission limits for primary and secondary chambers (30 and 60 ppm respectively)
- Source test results were evaluated for 68 out of 315 units

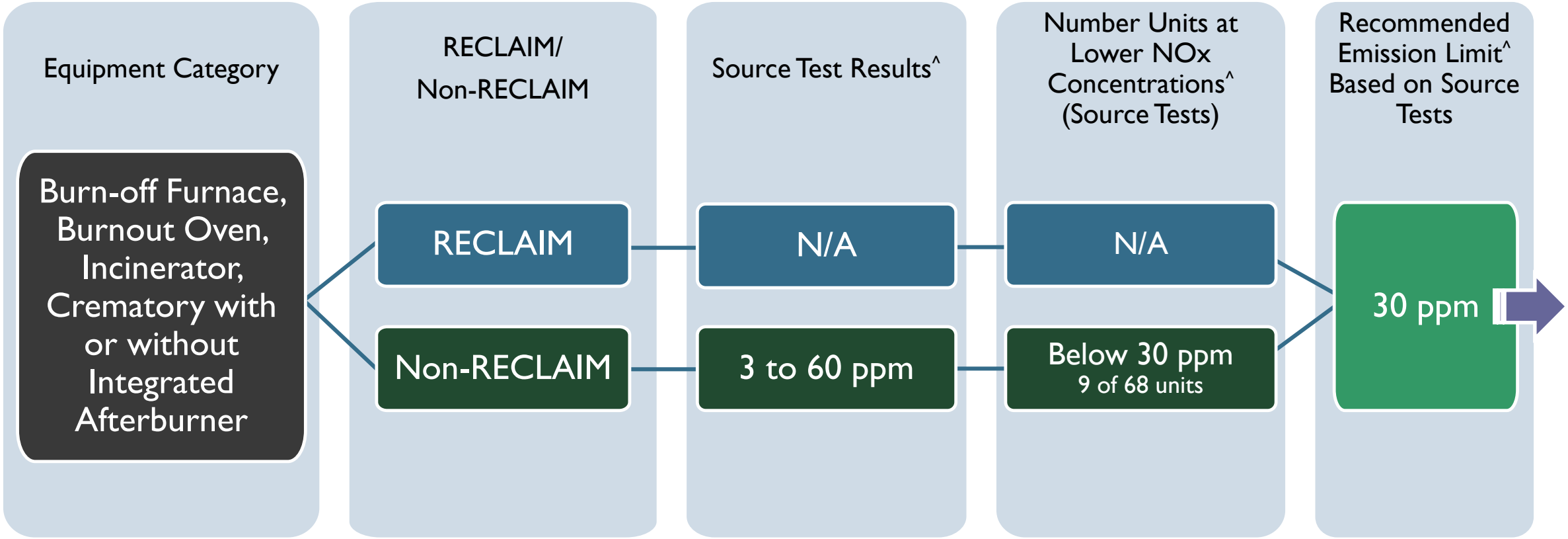
Additional Considerations

- Due to lack of source tests in RECLAIM, technology assessment will be done using only Non-RECLAIM equipment and data
- Multiple burner setups will be considered in cost-effectiveness analysis

SUMMARY OF SOURCE TEST ASSESSMENT

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Initial BARCT Emission Limit



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

INITIAL BARCT NOX LIMIT (WORKING GROUP #5)

BURN-OFF FURNACE, BURNOUT OVEN, INCINERATOR, CREMATORY WITH OR WITHOUT INTEGRATED AFTERBURNER

Initial BARCT Emission Limit

Operating Temp	Existing Units+^		South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
	ST Recommended Limit	Units Meeting Recommendation				
<1,200° F	30 ppm	0 of 0 RECLAIM	30 ppm (primary) 60 ppm (secondary)	125 to 175 ppm	30 ppm (via LNB[1])	30 ppm (via LNB[1])
≥1,200° F		9 of 68 Non-RECLAIM				

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

Initial BARCT Emission Limit

INITIAL BARCT EMISSION LIMIT

Tenter Frame, Fabric or Carpet Dryer

BACKGROUND
TENTER FRAME, FABRIC OR CARPET DRYER

Initial BARCT Emission Limit

RECLAIM Universe

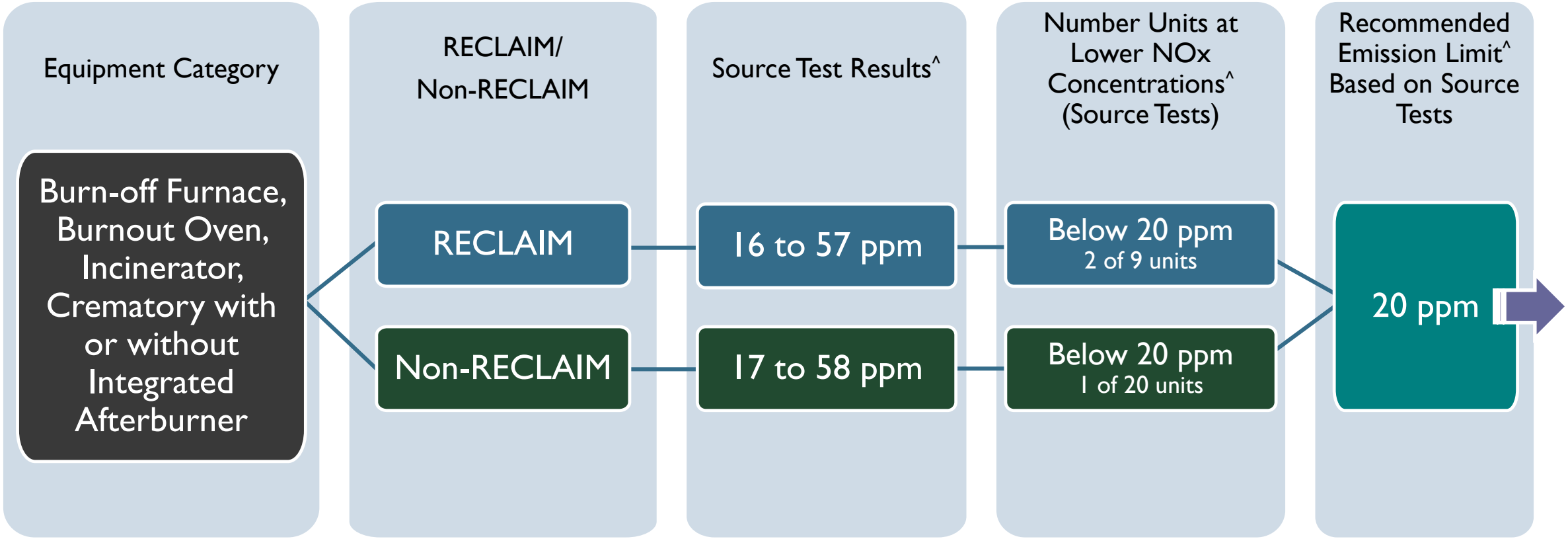
- Consists of 25 pieces of permitted equipment
- Source test results were evaluated for 9 out of 25 units

Non-RECLAIM Universe

- Consists of 37 pieces of permitted equipment
- Units installed during or prior to 2008 were subject to a higher permit limit of 60 ppm
- Source test results were evaluated for 20 out of 37 units

SUMMARY OF SOURCE TEST ASSESSMENT
TENTER FRAME, FABRIC OR CARPET DRYER

Initial BARCT Emission Limit



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

INITIAL BARCT NOX LIMIT (WORKING GROUP #5)
TENTER FRAME, FABRIC OR CARPET DRYER

Initial BARCT Emission Limit

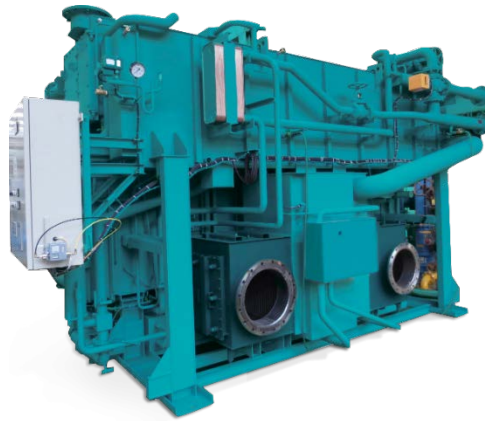
Operating Temp	Existing Units+^		South Coast AQMD Limit^	Other Regulatory#	Technology Assessment^	Initial BARCT NOx Limit^
	ST Recommended Limit	Units Meeting Recommendation				
<1,200° F	20 ppm	2 of 9 RECLAIM	30 ppm	30 to 175 ppm	30 ppm (via LNB[1])	20 ppm (via LNB[1])
≥1,200° F		1 of 20 Non-RECLAIM				

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] *Low NOx Burner (LNB) technology assessment is based off of vendor guarantees. Source test results analyzed demonstrate burners can achieve lower concentrations*

Initial BARCT Emission Limit

ADDITIONAL MISC. CATEGORIES



ADDITIONAL MISC. CATEGORIES

Initial BARCT Emission Limit

Absorption Chillers

Initial BARCT NOx Limit^: 10 ppm

- BACT for these equipment is 20 ppm
- No units found in Non-RECLAIM universe
- 3 active units in RECLAIM permitted to 20 ppm
  - All units source tested to demonstrate <10 ppm
- Unable to locate active units in Non-RECLAIM
- Cost-Effectiveness Analysis is needed

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

ADDITIONAL MISC. CATEGORIES

Initial BARCT Emission Limit

Micro-turbines (Natural Gas and Liquid Fuel)

Initial BARCT NOx Limit^:
9 ppm (NG)

Pending (Diesel)

- Diesel units are permitted to 77 ppm permit limit
  - Pending additional assessment
- Natural gas units are permitted to 9 ppm permit limit
  - Permit limit is backed by manufacturer guarantee
  - All units source tested to below 6 ppm
- Cost-Effectiveness Analysis is needed

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

ADDITIONAL MISC. CATEGORIES

Initial BARCT Emission Limit

Autoclaves

Initial BARCT NOx Limit^: Pending

- One RECLAIM unit source tested to demonstrate 28 ppm
- New units are capable of meeting 30 ppm
- Retrofit is feasible, but costs vary depending on pressure vessel
- Requires further assessment with cost-effectiveness analysis

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

ADDITIONAL MISC. CATEGORIES

Initial BARCT Emission Limit

Singeing Machines

Initial BARCT NOx Limit^: Pending

- RECLAIM Equipment
  - Two units reporting under RECLAIM default emission factor of 130 lb/mmscf
- Requires further assessment with cost-effectiveness analysis

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

ADDITIONAL MISC. CATEGORIES

Initial BARCT Emission Limit

Hot Pot/Diesel Tar Pot

Initial BARCT NOx Limit^: Not Applicable

- RECLAIM Equipment
- Determined to be process heaters applicable to Rule 1146.2

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

NEXT STEPS

- Continue to schedule emissions screenings and site visits with applicable facilities
- Calculate emissions reductions and conduct cost effectiveness analysis
- Next Working Group Meeting – April 2020

CONTACTS

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Proposed Amended Rules 1147, 1100 and Proposed Rule 1147.1

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