Proposed Amended Rule 1110.2

Emissions from Gaseous- and Liquid- fueled Engines and

Proposed Amended Rule 1100

Implementation Schedule for NOx Facilities

WORKING GROUP MEETING NO. 5

Date – May 30, 2019

South Coast AQMD Headquarters – Room GB

Agenda

- Review of Working Group Meeting #4
- Status of Rule Development
- Proposed Emission Limits
- Cost-Effectiveness
- Emission Impacts
- Proposed Rule Language
- Next Steps and Proposed Schedule

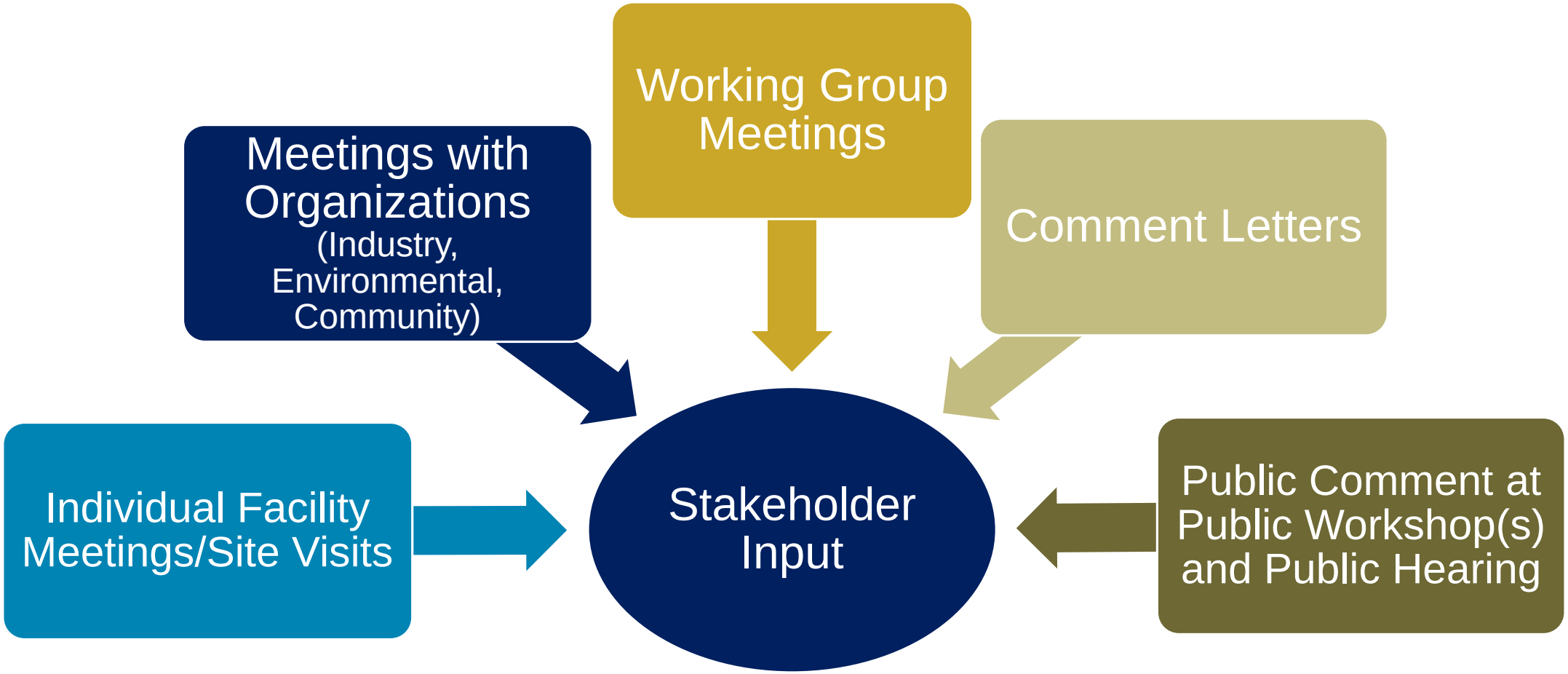
Summary of Working Group Meeting #4

Summary of Working Group Meeting #4

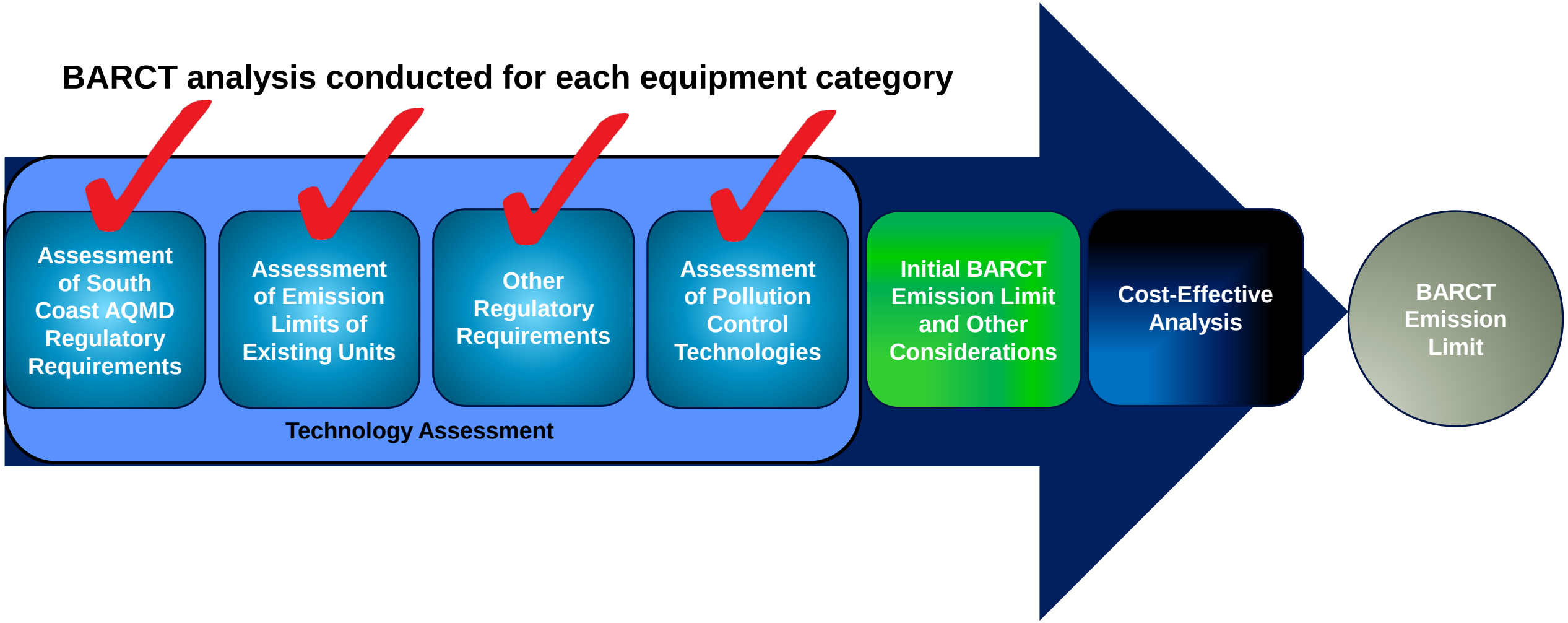
- Overview of current emissions control technology
- Presented initial emission limits for engines exiting RECLAIM
  - Harmonize Rule 1110.2 provisions with Rules 219 and 222 for radio transmission tower engines
- Estimated potential NOx reductions
- Introduced cost-effectiveness methodology
- Discussed initial rule language

Status of Rule Development

Rule Development Process



BARCT Assessment



Engine Categories

- 76 engines in the RECLAIM universe would be subject to Rule 1110.2
  - 68 would need to comply with the 11 ppm NOx limit
  - 8 portable engines subject to state Air Toxics Control Measure phase-out schedule (replacement with Tier IV final engines)

Lean Burn (2-stroke)	Lean Burn (4-stroke)	Rich Burn	Engines subject to ATCM
Count: 11	Count: 34	Count: 23	Count: 8
Engines meeting 11 ppmv[1] NOx: 0	Engines meeting 11 ppmv[1] NOx: 8	Engines meeting 11 ppmv[1] NOx: 13	Engines meeting 11 ppmv[1] NOx: 0

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Proposed Emissions Limits

Assessment of Pollution Control Technologies

- Staff evaluated available technologies for different engine types
  - Research literature
  - Vendor information
  - Current installations

- Two technologies identified to meet emissions standards
  - Lean-burn engines: Selective Catalytic Reduction (SCR)
  - Rich-burn engines: Non-Selective Catalytic Reduction (NSCR)

Proposed Rule 1110.2 Emissions Limits

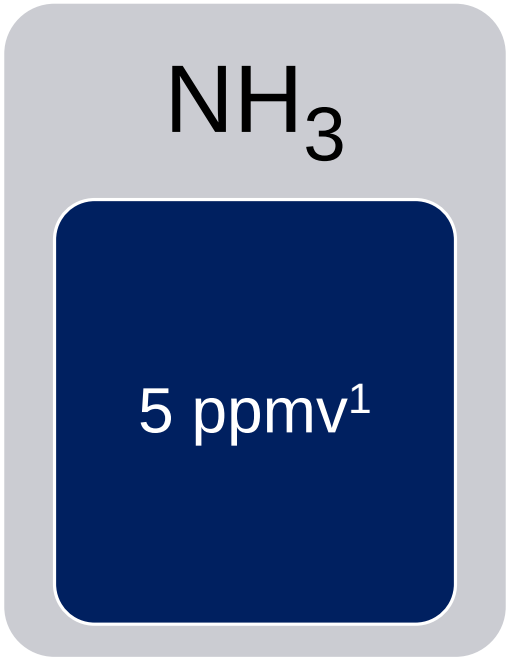
Based on technology assessment, recommending to maintain existing Rule 1110.2 emissions limits

NOx	VOC[3]	CO
11 ppmv[1]	30 ppmv[2]	250 ppmv[1]

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes
[2] Parts per million by volume, measured as carbon, corrected to 15% oxygen on a dry basis and averaged over the sampling time required by the test method
[3] Alternative VOC limits would still apply to engines that currently have them

Proposed Ammonia Emissions Limits

- Establish ammonia limit for new or modified engines with SCR at 5 ppmv[1]



[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Remote Transmission Towers

- Harmonize rule for remote transmission towers
  - Serves essential public safety function
  - No utility, electricity, or natural gas available within ½ mile radius
  - Engines rated less than 100 bhp
  - Fueled on #2 diesel, CNG, or LPG

Cost-effectiveness Analysis

Cost-effectiveness

- Cost-effectiveness is a cost-benefit analysis comparing relative costs and outcomes
- Measured in cost per ton of pollutant reduced
- Based on present worth value calculation
- Equipment cost data collected from facilities, vendors, and past rule evaluations
- Factors and assumption include:
  - Total Installed Cost
  - Annual Costs
  - Assumes a 4% interest rate
  - 25-year equipment life
  - Emission reductions

Cost-effectiveness

Present Worth Value & Cost-Effectiveness Calculations

- $PWV = TIC + PW_f \times AC$
- $CE = PWV / (ER \times 365 \times 25 \text{ years})$

PWV	=	Present Worth Value ($)
TIC	=	Total Installed Cost ($)
PW_f	=	Present Worth factor at 4% interest for 25 years is **15.622**
AC	=	Annual Cost ($)
CE	=	Cost-Effectiveness ($/ton)
ER	=	Emission Reduction (ton/yr)

Cost-effectiveness

Factors used in the calculation of NOx reductions

- SCR installation cost
- Catalyst cost
  - SCR
  - NSCR
- Total engine replacement
- Operations and maintenance costs
- CEMS – new and retrofit costs

Cost-effectiveness

Factors used in the calculation of NOx reduction potential

- Annual NOx emissions data taken from reported 2016 – 2017 RECLAIM data as baseline emissions
  - Except one facility: used 2014 data, due to non-operation
- Major Sources used recent source test data for baseline NOx concentration level
- Other sources used permitted values for baseline NOx concentration level
- Final NOx concentration level set at 11 ppmv[1]

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Cost-effectiveness for Lean-burn, 2-stroke Engines

Engine	bhp	Current NOx Limit (ppm[1])	Proposed Limit (ppm[1])	Estimated NOx Reduction (tpd)	CE ($/ton)
1	450	675	11	n/a	low use
2	450	675	11	n/a	low use
3	995	150	11	.004	70,067
4	995	150	11	.003	78,869
5	995	150	11	.003	75,953
6	2000	225	11	.024	15,637
7	2000	225	11	.012	32,241
8	2000	225	11	.025	15,192
9	3000	85	11	.003	102,676
10	3000	101	11	.004	83,572
11	3200	194	11	.025	12,185

- Engines 1 and 2 operate less than 500 hrs/year
- Cost Effectiveness for category: $27,240/ton

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Cost-effectiveness for Lean-burn, 4-stroke Engines

Engine	bhp	Current NOx Limit (ppm[1])	Proposed Limit (ppm[1])	Estimated NOx Reduction (tpd)	CE ($/ton)
1	131	208	11	n/a	low use
2	190	12	11	n/a	n/a
3	190	12	11	n/a	n/a
4	190	12	11	n/a	n/a
5	190	12	11	n/a	n/a
6	190	12	11	n/a	n/a
7	190	12	11	n/a	n/a
8	190	12	11	n/a	n/a
9	450	344	11	n/a	low use
10	853	450	11	0.004	replacement
11	853	450	11	0.005	replacement
12	853	450	11	0.002	replacement

- Engines 1 and 9 are operating less than 1000 hours per year.
- Engines 2 – 8 are permitted at 12 ppmv but are operating below 11 ppmv
- Engines 10 – 12 are in the process of replacement by source

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Cost-effectiveness for Lean-burn, 4-stroke Engines

Engine	bhp	Current NOx Limit (ppm[1])	Proposed Limit (ppm[1])	Estimated NOx Reduction (tpd)	CE ($/ton)
13	853	450	11	0.002	replacement
14	853	450	11	0.001	replacement
15	853	450	11	0.000	replacement
16	881	36	11	0.005	52,895
17	881	36	11	0.005	46,643
18	1468	11	11	0.000	compliant
19	2000	37	11	0.007	42,763
20	2000	21	11	0.003	102,431
21	2000	40	11	0.009	30,902
22	2000	53	11	0.008	33,767
23	2000	31	11	0.006	49,324
24	3043	50	11	0.001	38,767

- Engines 13 – 15 are in the process of replacement by source

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Cost-effectiveness for Lean-burn, 4-stroke Engines

Engine	bhp	Current NOx Limit (ppm[1])	Proposed Limit (ppm[1])	Estimated NOx Reduction (tpd)	CE ($/ton)
25	3043	50	11	0.002	33,391
26	3043	50	11	0.001	70,885
27	3043	50	11	0.002	29,421
28	3043	50	11	0.001	36,747
29	3043	50	11	0.002	33,437
30	5500	90	11	0.029	17,394
31	5500	71	11	0.012	42,394
32	5500	93	11	0.025	20,001
33	5500	91	11	0.025	20,087
34	5500	78	11	0.021	23,284

- Cost Effectiveness for category: $28,957/ton

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Estimated NOx Reduction for Rich-burn Engines

Engine	bhp	Current NOx Limit (ppm[1])	Proposed Limit (ppm[1])	Estimated NOx Reduction (tpd)	CE ($/ton)
1	147	4	compliant		
2	147	4	compliant		
3	189	4	compliant		
4	189	4	compliant		
5	268	10	compliant		
6	268	10	compliant		
7	268	10	compliant		
8	385	4	compliant		
9	738	20	11	0.000	50,965
10	738	20	11	0.000	69,930
11	790	11	compliant		
12	790	11	compliant		

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Estimated NOx Reduction for Rich-burn Engines

Engine	bhp	Current NOx Limit (ppm[1])	Proposed Limit (ppm[1])	Estimated NOx Reduction (tpd)	CE ($/ton)
13	818	20	11	0.001	45,273
14	818	20	11	0.001	31,168
15	818	20	11	0.001	32,477
16	818	20	11	0.001	35,682
17	818	20	11	0.001	44,633
18	818	20	11	0.001	44,690
19	818	20	11	0.001	62,907
20	830	11	compliant		
21	845	28	11	0.003	8,601
22	1150	7	compliant		
23	2000	6	compliant		

- CE high in several cases due to additional CEMS requirement
- Cost Effectiveness for category: $33,019/ton

[1] Parts per million by volume, corrected to 15% oxygen on a dry basis and averaged over 15 minutes

Emission Impacts

Summary of Potential NOx Reductions

- Estimated NOx emission reductions for engines exiting RECLAIM

Engine Category	Emissions Reductions (tpd)	CE ($/ton)
Lean burn, 2-stroke	0.110	27,240
Lean burn, 4-stroke	0.176	28,957
Rich burn	0.009	33,019
Total	0.295	28,647

Proposed Rule Language

Proposed Rule Language

- Establish 11ppm NOx emissions limit for engines at RECLAIM facilities
- Clarify provisions referring to RECLAIM facilities
- Harmonize rule with Rule 222-RT equipment
- Implementation schedule to be contained in Rule 1100 – Compliance schedule for NOx facilities
  - Proposed deadline of December 31, 2023 for most engines

Continuing Issues

Issues that we continue to work on

- Clarify monitoring requirements for equipment exiting RECLAIM
- Consideration for averaging time and VOC limit flexibility for engines with certain unique situations
- Examine source testing requirements for outer continental shelf crane engines

Stakeholder Input

- Welcome additional comments
- Available for site visits

Schedule

Next Steps and Proposed Rule Schedule

Contacts

Staff Contacts

Please contact the following South Coast AQMD staff members with any questions or comments

General RECLAIM

Susan Nakamura
Assistant Deputy Executive Officer
(909) 396-3105
snakamura@aqmd.gov

Michael Morris
Planning and Rules Manager
(909) 396-3282
mmorris@aqmd.gov

Proposed Amended Rule 1110.2

Kevin Orellana
Program Supervisor
(909) 396-3492
korellana@aqmd.gov

Rodolfo Chacon
Air Quality Specialist
(909) 396-2726
rchacon@aqmd.gov