



Proposed Rule (PR) 1147.2

NOx Reductions from Metal Melting and Heating Furnaces

Working Group Meeting #8

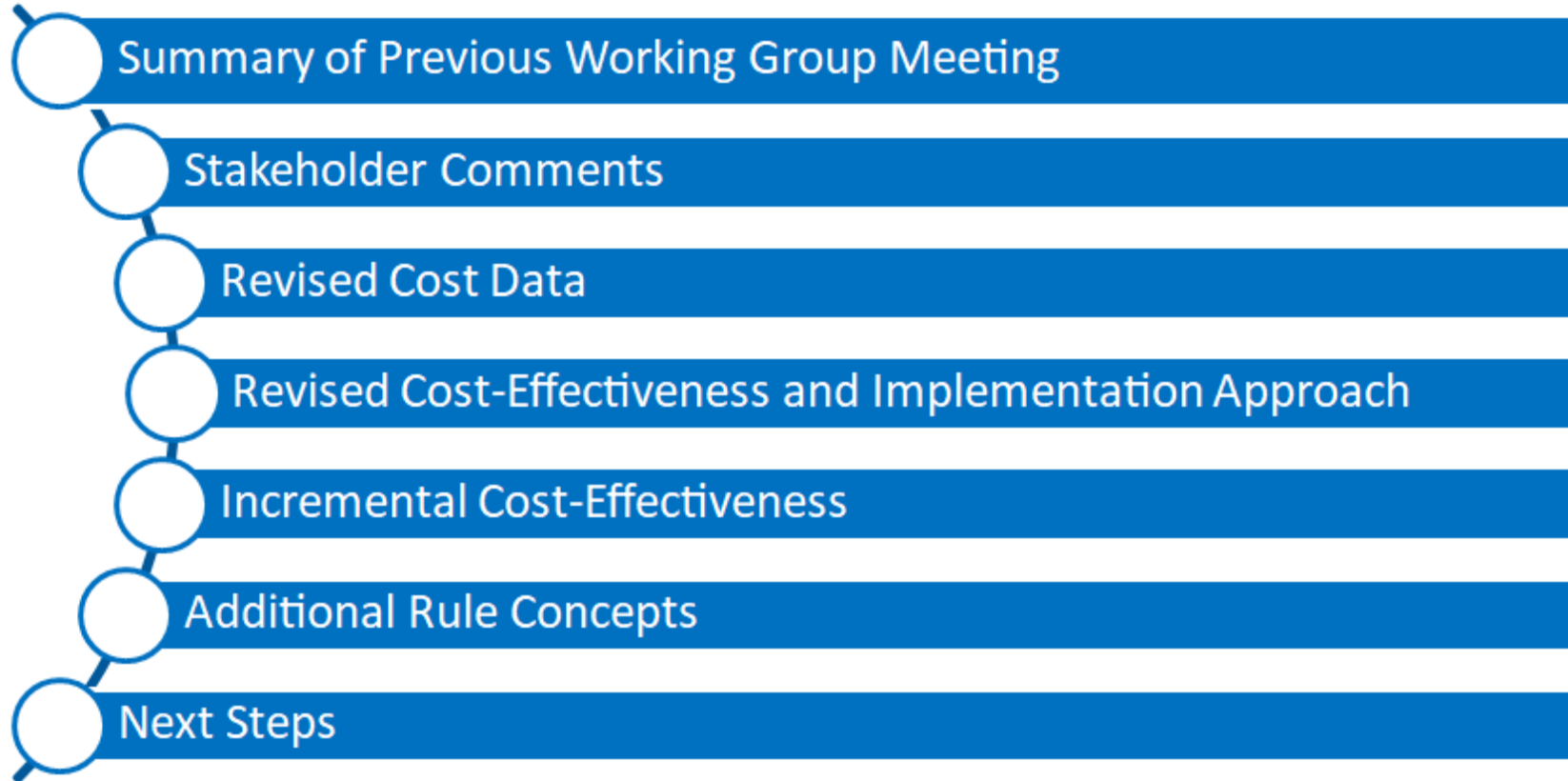
July 8, 2021

Zoom URL: <https://scaqmd.zoom.us/j/91810732436>

Dial-In: 1-669-900-6833

Meeting ID: 918 1073 2436

Agenda

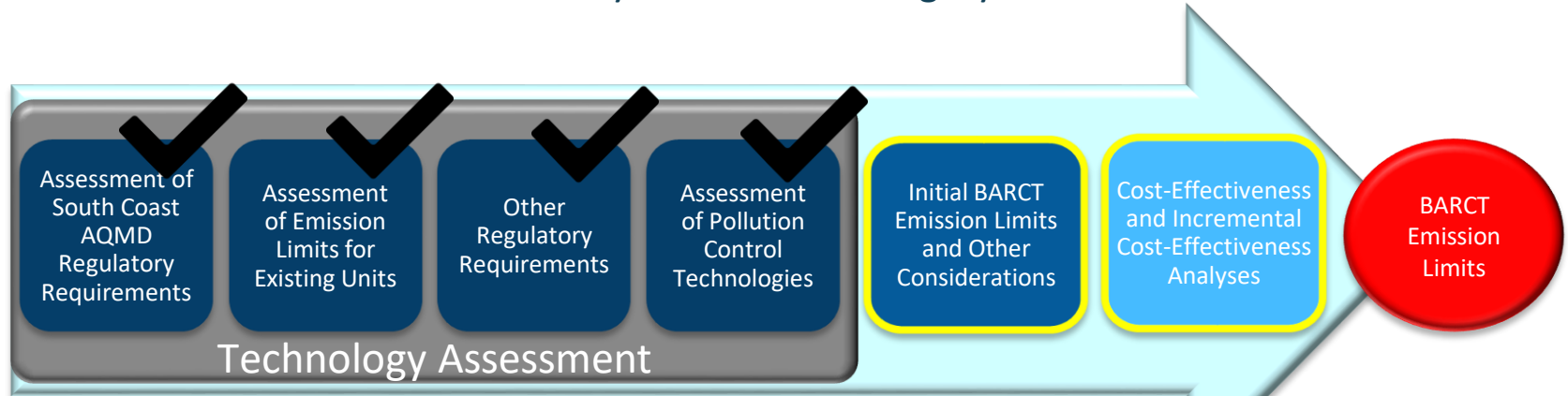




Summary of Previous Working Group Meeting

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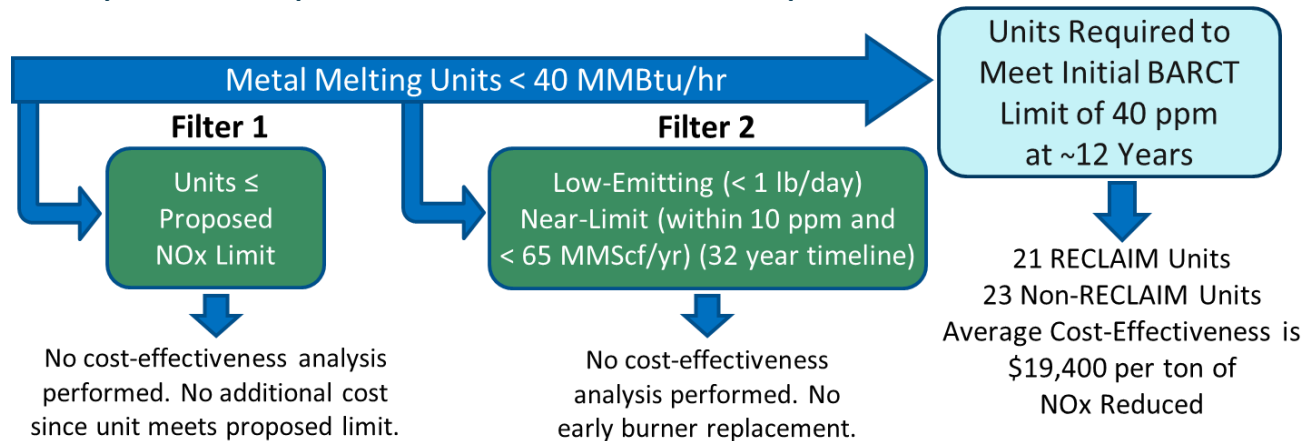
- Meeting focused on BARCT analysis for metal melting, metal heat treating, and metal heating and forging units
- Revised initial BARCT emission limits and recategorized metal heating as metal heat treating and metal heating and forging
- Conducted cost-effectiveness analyses for each category to establish BARCT emission limits



***BARCT analysis is conducted for each equipment category and fuel type**

Cost-Effectiveness Analysis for Initial BARCT Limit of 40 PPM* (Metal Melting)

- Cost-effectiveness for metal melting is estimated to be \$19,400 per ton of NOx reduced to meet a NOx limit of 40 ppm
- Near-limit provision provided for units with a permit limit that is > 40 and ≤ 50 ppm



**Proposed NOx BARCT limit for metal melting units
< 40 MMBtu/hr with cold-air burners is 40 ppm @ 3% O2
Proposed maximum near-limit for this category is 50 ppm @ 3% O2**

* All ppm values in this presentation are corrected to 3% O2, dry, unless otherwise noted

Cost-Effectiveness Analysis for Initial BARCT Limit of 30/40 PPM (Heat Treating and Heating/Forging)

- Metal heating category split into metal heat treating and metal heating/forging categories
- Cost-effectiveness for metal heat treating and metal heating/forging showed that retrofits are cost-effective to meet a 30 ppm limit (units $\leq 1,200$ °F) and a 40 ppm limit (units $> 1,200$ °F) based on initial information
 - Staff requested stakeholder input – see Stakeholder Comments
- Near-limit provision provided for units with a permit limit within 10 ppm above the emission limit



Stakeholder Comments

Stakeholder Comments

Comment

- Above 1,200 °F certain furnaces have different heating schemes and burner firing methodologies

Response

- Temperature cutoffs have been revised to 1,200 °F for both the metal heat treating and the metal heating/forging categories

Comment

- Radiant-tube burners may have difficulty meeting 30 and 40 ppm limits because of burner flame characteristics different from other burner types

Response

- Radiant-tube burners – Identified on 7 of the 384 metal heat treating and metal heating/forging units; insufficient data available to support a separate category

Stakeholder Comments

Comment

- Some units operate both below and above the temperature cutoff

Response

- Units with multiple limits will be required to meet the higher limit
-

Comment

- Impact to facilities with a large number of units required to submit permit applications by July 1, 2021

Response

- First permit application deadline moved to July 1, 2022
- Staff is proposing a staggered schedule for facilities with multiple units which will be discussed later in this presentation
- Operators will be required to meet the NOx limit 12 months after the permit to construct is issued

Stakeholder Comments

Comment

- AMS 2750 uniformity testing costs should be included

Response

- Incorporated uniformity testing cost information into the current cost calculations

Comment

- Source testing can be a burden for a large number of units or those facilities with small units

Response

- Maintained a similar source testing schedule required under the RECLAIM program
- Maintained the Rule 1147 exemption for units $\leq 325,000$ Btu/hr
- Source testing is a critical requirement to verify the equipment is meeting the NOx limit and is required



Revised Cost Data

Revised Cost Data

Since the previous working group meeting, staff has received additional information on burner costs and retrofits:

- Staff met with 11 facilities and received 9 burner retrofit quotes
 - 1 of 9 quotes was for metal melting (burner equipment only)
 - 8 of 9 quotes were for heat treating and heating/forging retrofits – higher costs than previous staff estimates
- Received technical information from four vendors and one generalized burner retrofit quote
- Cost-effectiveness re-assessed for metal melting and heating treating and heating/forging retrofits based on the revised cost data

Impact of Revised Cost Data for Metal Melting Retrofits

- Revised cost data did not change the previous cost formula used to estimate the cost-effectiveness
- No changes to the proposed NOx limit and near-limit provision for metal melting units (permit limit > 40 and ≤ 50 ppm)

Category	Emission Limit	Submit Permit Application*†	Cost-Effectiveness (\$/ton)
Metal Melting	40 ppm	All Units: On or before July 1 after the burner turns 12 years old Near-Limit Units: On or before July 1 after the burner turns 32 years old	\$23,700 [^]

* Staggered schedule provided for facilities with multiple impacted units in 2022

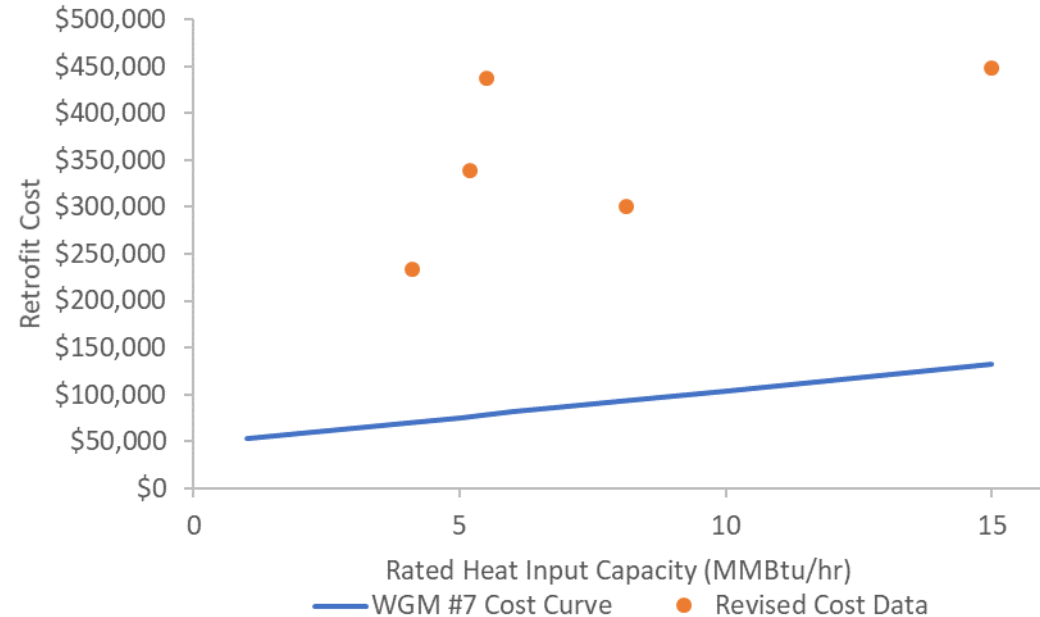
† Units with burners that already exceeded the burner age threshold must submit permit applications by July 1, 2022

[^] Updated to remove gas usage criteria, include size applicability, and merge cold-air and regenerative burner sub-categories

Impact of Revised Cost Data for Metal Heat Treating and Heating/Forging Retrofits

- Revised cost data for metal heat treating and heating and forging was substantially higher than initial cost estimates
- Increased costs primarily attributed to installation of auxiliary control equipment needed to achieve NOx limits below 40 ppm

Cost Basis Comparison



Discussion of Additional Costs for Retrofitting Heat Treating and Heating/Forging Units

- Stakeholder data for heat treating and heating/forging units identified additional retrofit costs to achieve a 30 ppm (units $\leq 1,200$ °F) or 40 ppm (units $> 1,200$ °F) limit when the burner reaches 15 years of age
- Additional costs beyond just the burner costs (\$10,000 to \$110,000 depending on size) included:
 - Fuel and air delivery systems, electrical panels, upgraded control systems, and installation of these components
 - Compliance with AMS 2750 (temperature uniformity) requirements which adds additional complexity to retrofitting units in these equipment categories
- The additional costs estimate was \$230,000 to \$300,000 per retrofit and increased the original costs estimate by more than 200%



Revised Cost- Effectiveness and Implementation Approach

Staff's Revised Approach for Metal Heat Treating and Heating/Forging

- Based on the revised cost data, the average cost-effectiveness to achieve 30 ppm and 40 ppm for metal heat treating and heating/forging is \$71,000 to \$101,000 per ton of NOx reduced
- Staff is proposing for these categories to achieve the most emission reductions possible while recognizing the high retrofit costs
- Staff is proposing two pathways:
 - **Path 1:** On or before July 1, 2022 meet 40 ppm ($\leq 1,200$ °F) and 50 ppm ($> 1,200$ °F)
 - **Path 2:** Submit permit application to meet 30 ppm ($\leq 1,200$ °F) and 40 ppm ($> 1,200$ °F) when the burner reaches 22 years old

Implementation Approach for Path 1: 40 ppm ($\leq 1,200$ °F) and 50 ppm ($> 1,200$ °F)

Path 1: On or before July 1, 2022 meet 40 ppm ($\leq 1,200$ °F) and 50 ppm ($> 1,200$ °F)

- Objective is to allow units that are currently meeting 40 ppm ($\leq 1,200$ °F) and 50 ppm ($> 1,200$ °F) NOx limits to accept a permit condition
- Provision is designed to capture units that are already meeting 40 ppm or 50 ppm
- Operators who qualify and opt for Path 1 will not be required to meet the lower NOx limits under Path 2
- Only available to units with burners < 22 years old as of July 1, 2022
- Units with burners ≥ 22 years old as of July 1, 2022 will need to meet the lower NOx limits under Path 2
- No additional costs for Path 1 since units are already meeting the proposed NOx limits of 40 ppm ($\leq 1,200$ °F) and 50 ppm ($> 1,200$ °F)

Implementation Approach for Path 2: 30 ppm ($\leq 1,200$ °F) and 40 ppm ($> 1,200$ °F) When Burner Reaches 22 Years Old

Path 2: Submit permit application to meet 30 ppm ($\leq 1,200$ °F) and 40 ppm ($> 1,200$ °F) when the burner reaches 22 years old

- Approach is designed to allow burners to reach their useful life (no additional costs for Path 2)
- Burner replacement would occur near 25 years (18 months for permit approval, 12 months to meet the limit after permit approval)
- Minimizes stranded assets for operators by allowing an extended implementation schedule
- Staggered schedule provided for facilities with multiple impacted units in 2022
- Units with burners that already exceed 22 years old must submit permit applications by July 1, 2022 to meet Path 2 emission limits

Emission Limits and Implementation Schedule – Heat Treating and Heating/Forging

Path 1: On or before July 1, 2022 meet 40 ppm ($\leq 1,200$ °F) and 50 ppm ($> 1,200$ °F)

Category	Emission Limit	Submit Permit Application
Heat Treating and Heating/Forging	Units $\leq 1,200$ °F: 40 ppm Units $>1,200$ °F: 50 ppm	On or before July 1, 2022 [^]

Path 2: Submit permit application to meet 30 ppm ($\leq 1,200$ °F) and 40 ppm ($> 1,200$ °F) when the burner reaches 22 years old

Category	Emission Limit	Submit Permit Application
Heat Treating and Heating/Forging	Units $\leq 1,200$ °F: 30 ppm Units $>1,200$ °F: 40 ppm	On or before July 1 after the burner turns 22 years old* [†]

[^] Units with burners ≥ 22 years old are not eligible for Path 1

* Staggered schedule provided for facilities with multiple impacted units in 2022

[†] Units with burners that already exceed the burner age threshold must submit permit applications by July 1, 2022

Cost-Effectiveness for Metal Heat Treating and Heating/Forging

Although the revised implementation approach removes the equipment-portion of the costs in the calculation for the cost-effectiveness for these categories, permitting and source testing costs are still accounted for:

- Permitting costs: based on Table 1A and Table Fee Rate-A in Rule 301¹
- Source testing costs: based on average of \$3,000 per each test performed over the lifetime of the burner (22 years)

¹ Rule 301: <http://www.aqmd.gov/docs/default-source/rule-book/reg-iii/rule-301-July-2019.pdf>

Cost-Effectiveness for Metal Heat Treating and Heating/Forging

Based on only permitting and source testing costs, each equipment category is shown to be cost-effective in complying with the emission limits

Category	Emission Limit	Submit Permit Application	Cost-Effectiveness (\$/ton)
Heat Treating	Path 1 $\leq 1,200$ °F: 30 ppm Path 2 $\leq 1,200$ °F: 40 ppm	Path 1: July 1, 2022 [^] Path 2: On or before July 1 after the burner turns 22 years old* [†]	\$6,400
Heat Treating	Path 1 $> 1,200$ °F: 40 ppm Path 2 $> 1,200$ °F: 50 ppm		\$8,400
Heating/Forging	Path 1 $\leq 1,200$ °F: 30 ppm Path 2 $\leq 1,200$ °F: 40 ppm		\$8,100
Heating/Forging	Path 1 $> 1,200$ °F: 40 ppm Path 2 $> 1,200$ °F: 50 ppm		\$6,400

[^] Units with burners ≥ 22 years old are not eligible for Path 1

* Staggered schedule provided for facilities with multiple impacted units in 2022

[†] Units with burners that already exceed the burner age threshold must submit permit applications by July 1, 2022

Emission Limits and Implementation Schedule – Units \geq 40 MMBtu/hr

- Units \geq 40 MMBtu/hr must submit permit applications on or before July 1, 2022
- Cost-effectiveness assumes these units must install post-combustion control technology (SCR) to achieve the emission limit
- Costs include equipment, reagent, catalyst, electricity, NOx feed-forward sensors, and CEMS equipment

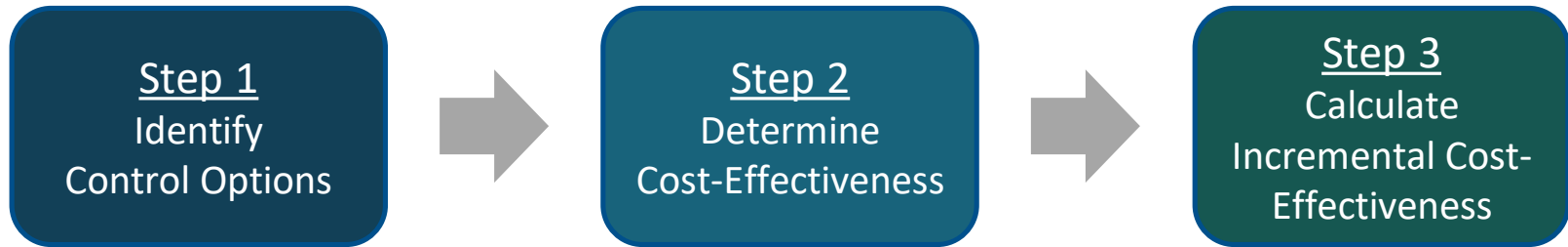
Category	Emission Limit	Submit Permit Application	Cost-Effectiveness (\$/ton)
All Units \geq 40 MMBtu/hr	15 ppm	On or before July 1, 2022	\$5,200



Incremental Cost-Effectiveness

Incremental Cost-Effectiveness

An incremental cost-effectiveness analysis was performed for each equipment category pursuant to California Health and Safety Code - HSC § 40920.6*



* HSC § 40920.6: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC§ionNum=40920.6

Step 1: Identify Control Options

- Based on the technology assessment discussed in previous Working Group Meetings staff determined:
- Units < 40 MMBtu/hr
 - Proposed NOx limits based on the technology assessment are based on low-NOx burners
 - Staff determined that a NOx limit based on SCR was not technologically feasible for units < 40 MMBtu/hr due to their size
- Units \geq 40 MMBtu/hr
 - There are two potential control options
 - Proposed NOx limit of 15 ppm based on SCR that can achieve the maximum emission reductions with a cost-effectiveness of \$5,200 per ton of NOx reduced
 - Proposed NOx limit of 30/40 ppm based on low-NOx burners
 - Technology assessment did consider a combination of SCR and regenerative low-NOx burners, however, for units with SCR the cost-effectiveness is > \$100,000 per ton
- Incremental cost-effectiveness only conducted for units \geq 40 MMBtu/hr since units < 40 MMBtu/hr had only one control option

Step 2: Determine Cost-Effectiveness

- Two control options identified for units with a heat input ≥ 40 MMBtu/hr:
 - 15 ppm using an SCR
 - 30 or 40 ppm using low NOx burners
- Of the four units ≥ 40 MMBtu/hr, two units are already equipped with SCR and meet the proposed 15 ppm NOx limit – no further analysis needed
- Cost-effectiveness evaluated for the proposed NOx limit that will provide the maximum reductions which is the proposed control option of 15 ppm
- Proposed NOx limit of 15 ppm is cost-effective and represents the maximum reductions for units ≥ 40 MMBtu/hr



Step 3: Calculate Incremental Cost-Effectiveness – PR 1147.2 Applicability

- Incremental cost-effectiveness is the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option¹

$$\text{Incremental Cost-Effectiveness} = \frac{(\$17.1\text{MM} - \$19.6\text{MM})}{(0.363 \text{ tons/day} - 0.292 \text{ tons/day}) * 365 \text{ days} * 25 \text{ years}} = \boxed{-\$3,900/\text{ton}}$$

- Incremental cost-effectiveness between 30/40 ppm and 15 ppm is -\$3,900
 - Cost of SCR is less than cost for replacement of regenerative burners with greater emission reductions
 - Burner cost to achieve 30/40 ppm is based on scaling a quote for regenerative burners of \$449,000 for a 15 MMBtu/hr furnace by heat input to determine burner cost for large units

Based on cost-effectiveness and incremental cost-effectiveness analysis, staff recommends a NOx limit of 15 ppm for units ≥ 40 MMBtu/hr

¹ Health and Safety Code §40920.6 (a)(3)

Summary of Proposed NOx Limits

Based on the cost-effectiveness and incremental cost-effectiveness analyses, the following table summarizes the proposed BARCT emission limits

Equipment Category	Equipment Sub-Category	NOx Limit	CO Limit
Metal Melting	< 40 MMBtu/hr	40 ppm	400 ppm
Metal Heat Treating, Metal Heating, and Metal Forging (Path 1)	< 40 MMBtu/hr and ≤ 1,200 °F	40 ppm	
	< 40 MMBtu/hr and > 1,200 °F	50 ppm	
Metal Heat Treating, Metal Heating, and Metal Forging (Path 2)	< 40 MMBtu/hr and ≤ 1,200 °F	30 ppm	
	< 40 MMBtu/hr and > 1,200 °F	40 ppm	
All Units ≥ 40 MMBtu/hr		15 ppm	



Additional Rule Concepts

Multiple Unit Implementation Schedule

- Staff recognizes that some facilities may have multiple units that will be required to submit permit applications by July 1, 2022
 - Units that meet the burner age criteria
 - Metal heat treating, heating, and forging units that opt to comply with Path 1 implementation schedule
- To address permitting and installation concerns, facilities with multiple impacted units may submit permit applications on a staggered implementation schedule[^]
- Of the total units at a facility required to submit permit applications by July 1, 2022, a minimum number of applications are required to be submitted in a given year based on a percentage of total heat input capacity of those units
- Units that are permanently shutdown can be used towards the facility's multiple unit implementation schedule quota

[^] Heat treating, heating, and forging units opting to comply with Path 1 implementation schedule are not eligible for the staggered implementation schedule

Multiple Unit Implementation Schedule (continued)

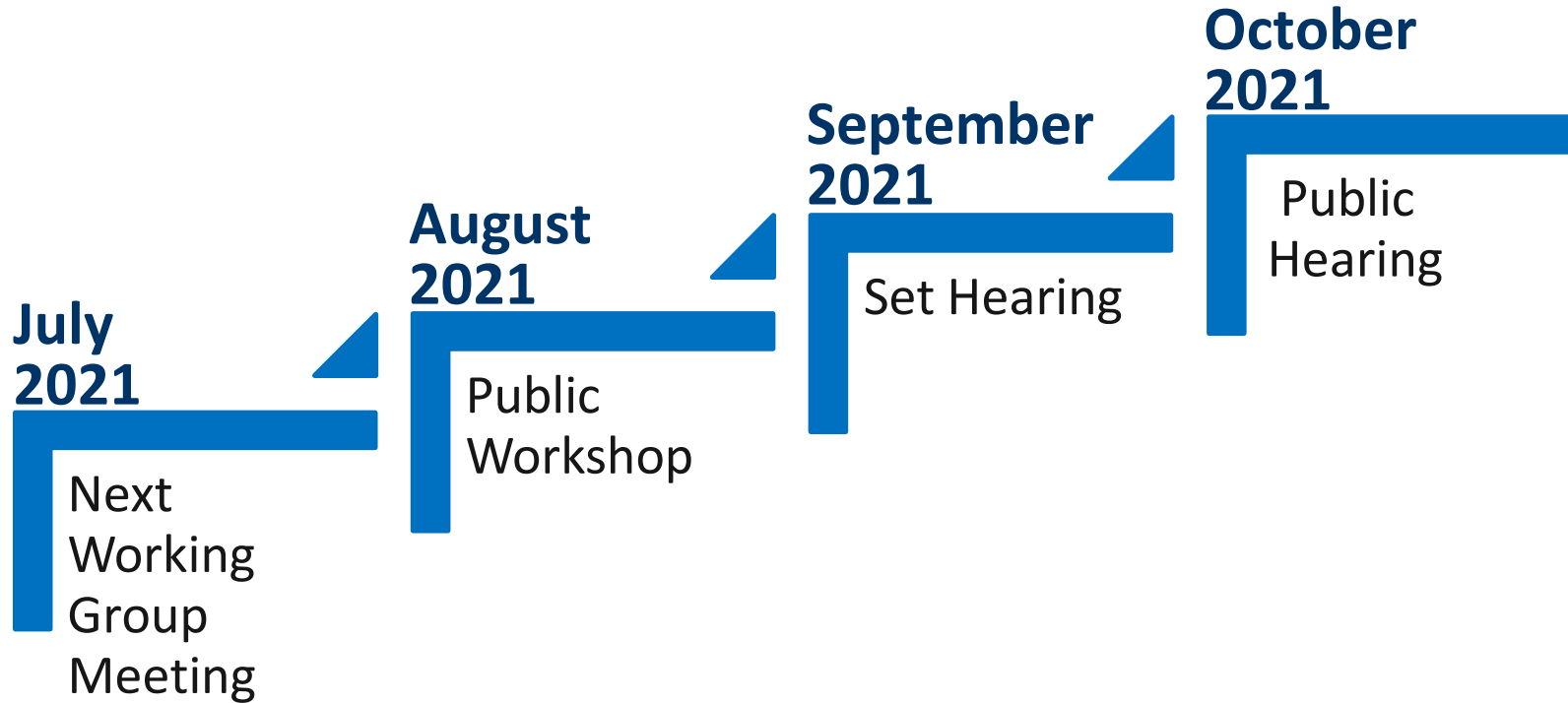
- Facilities with multiple impacted units may submit permit applications on a staggered schedule
- Permit submission quotas for each year dependent upon the number of units required to submit permit applications by July 1, 2022 and the total heat input capacity of those units
- A compliance plan to be submitted identifying which units are meeting the quota for each year based on units operating as of July 1, 2022

Permit Application Submission Deadline	5 – 9 Units (% of total heat input)	10 – 19 Units (% of total heat input)	20+ Units (% of total heat input)
July 1, 2022	50%	25%	10%
July 1, 2023	100%	50%	20%
July 1, 2024	Not Applicable	75%	30%
July 1, 2025		100%	40%
July 1, 2026		Not Applicable	50%
July 1, 2027			60%
July 1, 2028			70%
July 1, 2029			80%
July 1, 2030			90%
July 1, 2031		100%	



Next Steps

Next Steps



Contacts

PR 1147.2	PAR 1147	RECLAIM Questions	General Questions
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