NOx RECLAIM
Working Group Meeting

July 31, 2014

Agenda

- Welcome & Introductions
- General BARCT Methodology
  - Refinery Sector
    - Coke Calciner
    - Sulfur Recovery/Tail Gas Incinerators
    - Refinery Boilers/Heaters
    - FCCU
    - Gas Turbines
  - Non-Refinery Sector
    - Sodium Silicate Furnace
    - Container Glass Furnaces
    - Metal Heat Treating Furnaces
    - Update on Cement Kilns
    - ICEs
    - Gas Turbines
- Amount of Shave Determination
- RTC Reduction Calculation Methodology
- Shaving Methodology
- Market Protection Mechanisms
- Schedule/Next Meeting

Status

Category	Control Equipment Manufacturer Contacted	Preliminary Cost Effectiveness Analysis Completed
FCCU	X	X
Cement Kilns	X	X
Gas Turbines (Refinery and Non-Refinery)	X	X
Coke Calciner	X	X
Glass Furnaces	X	X
Metal Heat Treating Furnaces	X	X
SRU/Tail Gas	X	X
ICEs	X	X
Refinery Boilers/Heaters	X	X
Non-Refinery Boilers/Heaters	X	X

Overall BARCT Methodology

- Technical Feasibility
- Cost Effectiveness
  - Incremental Cost Effectiveness beyond 2000/2005 BARCT
  - Based on 2011 activity

Refinery Sector Preliminary Analysis Coke Calciner

Proposed BARCT for Coke Calciner

- Control Technologies:
  - Scrubber with LoTOx
  - UltraCat
- Proposed BARCT: 2 ppmv
- Implementation: 2017 to 2020 and may consider synchronizing with refinery's turnaround schedule

Development of Present Worth Value

Manufacturer's Information

- LoTOx estimated by BELCO of Dupont
  - Total Installed Costs (TIC) = $6.25 M
  - Annual Operating Costs (AOC) = $544,300
  - PWV with 1.5 contingency factor = TIC + (15.62*AOC) = $22.13 M
- Ultra-Cat estimated by Tri-Mer
  - Total Installed Costs (TIC) = $12.74 M for NOx, SOx, PM Control
  - Annual Operating Costs (AOC) = $1.13 M
  - Filter Replacement = $215,000 every 5 years
  - PWV = $50.61 M
- Equipment Life = 25 years
- Interest Rate = 4%

Proposed Incremental Cost Effectiveness

- Estimation Process
  - 2011 NOx emissions at 64.95 ppmv = 0.5 tpd
  - 2011 NOx emissions at 2005 BARCT of 30 ppmv = 0.25 tpd
  - 2011 NOx emissions at 2014 BARCT of 2 ppmv = 0.02 tpd
  - Incremental NOx emission reductions = 0.23 tpd
  - LoTOx: $22.13 M/(0.23*365*25) = $10 K per ton NOx
  - UltraCat: $50.61 M /((0.23 tpd NOx +0.28 tpd SOx)*365*25) = $11 K per ton
- Range for Cost Effectiveness for Coke Calciner
  - $10 K - $11 K per ton (DCF Method)
  - $17 K - $18 K per ton (LCF Method)

Refinery Sector
Preliminary Analysis
Refinery SRU/TG Incinerators

Proposed BARCT for SRU/TG Incinerators

- Control Technologies:
  - SCR technology with Johnson Matthey, Haldor Topsoe, Mitsubishi-Cormetech, and others
  - Scrubber technology with LoTOx or KnowNOx

    LoTOx technology uses Ozone (O3) to convert non-soluble NO into soluble components NO2, N2O5 and HNO3 while KnowNOx technology uses Chlorine Dioxide (ClO2)
- Proposed BARCT: 2 ppmv
- Implementation: 2017 to 2020 and may consider synchronizing with refinery turnaround

Development of Present Worth Value

SCR Manufacturers' Information

- Process data of SRU/TG incinerators at three refineries were provided to SCR manufacturers
- Vendors' estimates are close
- Use the highest estimates
  - Total Installed Costs = $1.4 M
  - Annual Operating Costs = $123 K
  - Catalyst replacement: $507 every 5 years
  - PWV with 1.5 Contingency Factor* = $6.95 M
- Equipment Life = 25 years
- Interest Rate = 4%

*The total installed cost is multiplied by the contingency factor

Development of Present Worth Value Data

LoTOx and KnowNOx Manufacturers' Information

- Process data of SRU/TG incinerators were provided to MECS and KnowNOx
- Costs information estimated by MECS of DuPont
  - Total Installed Costs = $4.9 M - $5.7 M for LoTOx only
  - Annual Operating Costs = $49 K - $99 K
  - PWV with 1.5 Contingency Factor = $8.5 M – $10.7 M
- Cost information estimated by KnowNOx
  - Total Installed Costs = $1.4 M – $1.44 M for KnowNOx only
  - Annual Operating Costs = $108 K - $199 K
- Use the higher estimates from MECS

Proposed Incremental Cost Effectiveness

- 10 out of 17 SRU/TG units are cost effective
  - DCF cost-effectiveness threshold of <$50,000 per ton (LCF threshold ~$80,000 per ton)
- Total Emission Reductions = 0.35 tpd
- Cost Effectiveness
  - $15 K - $21 K per ton (DCF Method)
  - $25 K - $36 K per ton (LCF Method)

Refinery Sector
Preliminary Analysis
Refinery Boilers/Heaters

Proposed BARCT for Boilers/Heaters

- Control Technologies:
  - SCR Technology: Johnson Matthey, Haldor Topsoe, Mitsubishi-Cormetech, and others
  - Other Technology: Great Southern Flameless Heater, ClearSign Duplex Burner, LoTOx, Cheng Low NOx
- Proposed BARCT
  - 2 ppmv for > 40 mmbtu/hr boilers/heaters
  - No new BARCT for smaller units
- Implementation
  - 2017 to 2020 and may consider synchronizing with refinery's turnaround schedule

Development of Present Worth Values

SCR – Refinery's Data from Survey

- Achieved In Practice 1.6 ppmv – 3.5 ppmv
  - 14 heaters 13 mmbtu/hr – 653 mmbtu/hr
  - 7 SCRs with 3 SCRs shared between several heaters
  - Installation period from 1992 to 2008
- Equipment costs, installation costs, and annual operating costs provided by refineries
  - PWV = TIC + (15.62 x AOC)
  - From the overall results, average PWV = 1.052 TIC
- Equipment Life = 25 years
- Interest Rate = 4%

Development of Present Worth Values

SCR – Refinery Consultants' Study

- Based on a study provided by a refinery:
  - 18 heaters rating: 24 mmbtu/hr - 352 mmbtu/hr
  - Several heaters have dual stack
  - Existing NOx level: 30 ppmv - 85 ppmv
  - Designed NOx level: 2 ppmv - 5 ppmv
- Total Installed Costs (TIC) provided by a consultant to the refinery
- PWV = 1.052 * TIC

  where 1.052 is from refinery survey

Development of Present Worth Values

SCR – Manufacturers' Information

- Costs provided by 3 SCR manufacturers for 100 – 350 mmbtu/hr heaters
- All 3 manufacturers confirm that SCR for 2 ppmv NOx costs 5% - 10% more than SCR for 5 ppmv NOx
- Catalyst replacement frequency varies from 3 years to 7 years depending on manufacturers
- Ammonia slip at 5 ppmv and amount of 19% aqueous ammonia usage varies depending on manufacturers

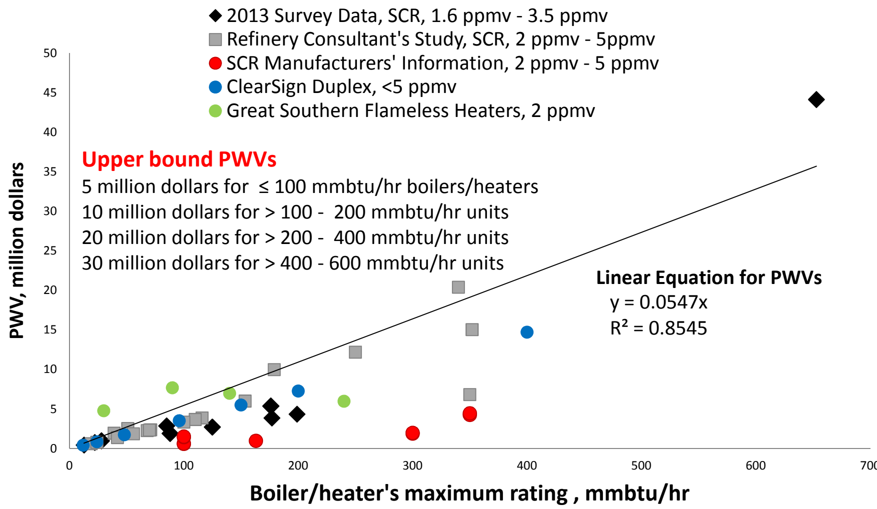
Development of Present Worth Values
Great Southern Flameless Heaters

- Achieved In Practice: 10 mmbtu/hr new crude heater in Coffeyville Kansas, 1 year in operation at 4-8 ppmv flameless mode firing
- Preheat combustion air in combination with proprietary flameless nozzle grouping (FNG) to create flameless combustion, eliminate hot spots and reduce NOx emissions.
- Stack-up module units up to 240 mmbtu/hr

Development of Present Worth Values
ClearSign DUPLEX Burners

- Bench tested 1 mmbtu/hr firetube boiler to less than 5 ppmv NOx
- DUPLEX porous flame holder downstream of conventional burner to create uniform heat distribution, decrease flame length, eliminate hot spot, and reduce NOx emissions.
- Feasible to retrofit in existing applications
- Costs provided highly conservative and adjustable to market demand

Present Worth Values of Controls for Refinery Boilers/Heaters



Proposed Incremental Cost Effectiveness

- Total 212 units = 23 boilers + 189 heaters
- 103 units are cost effective, 109 not cost effective
  - DCF cost-effectiveness threshold of <$50,000 per ton (LCF threshold ~$80,000 per ton)
- Total Emission Reductions = 1.05 tpd
- Average Incremental Cost Effectiveness
  - $27 K/ton (DCF Method) and $44 K/ton (LCF Method) based on SCR technology using upper bound PWVs

Refinery Sector

Review for FCCUs

(Summary from January 22, 2014 WGM)

and Gas Turbines

(Summary from March 18, 2014 WGM)

Proposed BARCT for FCCUs

(Summary from January 22, 2014 WGM)

- 2 ppmv NOx
- Control Technology
  - SCR
  - LoTOx
  - NOx Reducing Additives in combination with SCR or LoTOx
- Implementation Schedule
  - 2017 to 2020
  - May Consider Synchronization with Refinery's Turnaround Schedule

Proposed BARCT Cost Effectiveness @ 2 ppmv

Incremental Cost Effectiveness with SCR or LoTOx

(Summary from January 22, 2014 WGM)

Equipment	2005 BARCT Level	Incremental PWV ($M)	Incremental Emission Reduction from 2005 BARCT Level (tpd)	CE for 2014 BARCT ($/ton)
	(a)	(b)	(c)	(d)
FCCUs with SCR	85% reduction	13	0.43	3,444
FCCUs with LoTOx	85% reduction	- 14	0.43	- 3,521

(a) 2005 BARCT level from Table 3 of Rule 2002

(b) Incremental difference in costs of control equipment for 85% reduction and control equipment for 2 ppmv

(c) Incremental emission reductions = Emissions @ 2005 BARCT – Emissions @ 2ppmv

(d) CE = (b)/(c*365*25) for DCF method. For LCF, CE = $5,700 -$5,900 per ton

Proposed BARCT for Gas Turbines

(Summary from March 18, 2014 WGM)

- 2 ppmv NOx
- SCR with as applicable
  - Dry Low NOx (DLN) / Dry Low Emissions (DLE)
  - Cheng Low NOx (CLN)
- Implementation Schedule
  - 2017 to 2020
  - May Consider Synchronization with Refinery's Turnaround Schedule

Proposed BARCT Cost Effectiveness @ 2 ppmv

Incremental Cost Effectiveness with SCR (Summary from March 18, 2014 WGM)

Unit Rating Profile (MW)	**2000/2005 BARCT Level** (lbs/mmscft)	**PWV** ($M)	**Emission Reduction from 2000/2005 BARCT** (tpd)	**CE for 2014 BARCT** ($/ton)
(a)	(b)	(c)	(e)	(f)
59	62.27	15.7	0.210	8,210
46	62.27	12.6	0.310	4,472
30	62.27	8.9	0.200	4,851
23	62.27	7.2	0.140	5,631
83	62.27	4.8 (d)	0.600	870
No Turbines/Duct Burners = 21 No of Cogen Units = 12		**Total PWV = $97.68 M**	**Total Reductions = 4.14 tpd**	**Average CE = 2,692 $/ton (g)**

(a) All gas turbines and all SCRs at the refineries were installed ≥ 25 years ago
(b) 2000/2005 BARCT Level from Table 1 of Rule 2002
(c) PWV = (0.2372 x MW) + 1.7376
(d) Costs for additional SCR catalysts to get from 10 ppmv to 2 ppmv
(e) Emission Reduction = Emissions @ 2000/2005 BARCT Level – Emissions @ 2 ppmv
where Emissions @ 2000-2005 BARCT Level = 2011 Fuel Gas Usage (mmscft/yr) x 62.27 (lb/mmscft)
Emissions @ 2 ppmv = 2011 Emissions x (2 ppmv / 2011 NOx Level in ppmv)
(f) CE = PWV/Emission reductions from 2000-2005 BARCT = (c)/(e x 365 x 25)
(g) CE (DCF Method) = $2692 per ton. CE (LCF Method) = $4500 per ton for 25 years life and 4% interest rate

Non-Refinery Sector Preliminary Analysis

Cost Analysis for Sodium Silicate Furnace

- Year 2000 BARCT level: 6.4 lb/ton glass pulled
- No new BARCT level in 2005
- Proposed BARCT level
  – 80% Reduction (~1.2 lb/ton glass pulled)
- Proposed control technology
  – Selective Catalytic Reduction (SCR)
  – Ultra-Cat Ceramic Filters

Cost Analysis for Sodium Silicate Furnace

- SCR and Ultra-Cat manufacturer equipment costs used for Total Installed Costs (TIC)
- Annual Costs (AC) include ammonia consumption and catalyst replacement
- Present Worth Value (PWV) assumes a 4% interest rate and a 25-year equipment life

Cost Analysis for Sodium Silicate Furnace

- PWV = TIC* + (15.62 x AC)
- Emission Reductions (ER) for this category
  - 0.09 tons per day
- Cost Effectiveness = PWV / (ER x 365 days x 25 years)
- Cost Effectiveness Range
  - DCF range: $3,500 - $5,700 / ton
  - LCF range: $5,600 - $9,100 / ton

*Applied a contingency factor between 0.4 and 0.6 depending on the vendor

Cost Analysis for Container Glass Melting Furnaces

- Year 2000 BARCT level: 1.2 lb/ton glass pulled
- No new BARCT level in 2005
- Proposed BARCT level
  - 80% Reduction (~0.2 lb/ton glass pulled)
- Proposed control technology
  - Selective Catalytic Reduction (SCR)
  - Ultra-Cat Ceramic Filters with dry scrubbing

Cost Analysis for Container Glass Melting Furnaces

- Multiple control options analyzed
  - Vendor 1: Dry scrubbing and ceramic filter system installed after the furnaces, replacing the dry scrubber and ESP. NOx, SOx, and PM removal.
  - Vendor 2: SCR system installed post ESP, NOx removal only.
    - Option 1: single chamber
    - Option 2: three chambers
  - Vendor 3: SCR system installed post ESP using costs provided by facility per EPA cost manual, NOx removal only.
    - Option 1: two chambers
    - Option 2: three chambers

Cost Analysis for Container Glass Melting Furnaces

- Present Worth Value (PWV) assumes a 4% interest rate and a 25-year equipment life
- PWV = TIC* + (15.62 x AC)
- Emission Reductions (ER) for this category
  - 0.24 tons per day
- Cost Effectiveness = PWV / (ER x 365 days x 25 years)
- Cost Effectiveness Range
  - DCF range: $1,900 - $8,900 / ton
  - LCF range: $3,000 - $14,200 / ton

*Applied a contingency factor between 0.4 and 1.5 depending on the vendor

Cost Analysis for Metal Heat Treating Furnaces (>150 MMBTU/hr)

- BARCT level in 2005: 0.055 lb/MMBTU (45 ppm @3%O_2)
- Proposed BARCT level: 80% Reduction (0.011 lb/MMBTU or 9 ppm @3%O_2)
- Proposed control technology
  - Selective Catalytic Reduction (SCR)

Cost Analysis for Metal Heat Treating Furnaces (>150 MMBTU/hr)

- SCR equipment and achieved-in-practice installation costs used for Total Installed Costs (TIC)
- Annual Costs (AC) include ammonia consumption and catalyst replacement
- Present Worth Value (PWV) assumes a 4% interest rate and a 25-year equipment life

Cost Analysis for Metal Heat Treating Furnaces (>150 MMBTU/hr)

- PWV = TIC* + (15.62 x AC)
- Emission Reductions (ER) for this category
  - 0.35 tons per day
- Cost Effectiveness = PWV / (ER x 365 days x 25 years)
- Cost Effectiveness Range
  - DCF range: $3,000 - $3,800 / ton
  - LCF range: $4,800 - $6,000 / ton

*Applied a contingency factor between 0.6 and 2 depending on the vendor

7/31/2014 NOx RECLAIM 37

Updated Cost Analysis for Cement Kilns

- Multiple control options analyzed
  - Vendor 1: SCR system installed between waste heat boiler and baghouse. NOx removal only.
  - Vendor 2: Dry scrubbing and ceramic filter system installed after the waste heat boiler and replacing the baghouse. NOx, SOx, and PM removal.
  - Vendor 3: Wet gas scrubber and SCR system with heat exchanger installed after the waste heat boiler and replacing the baghouse. NOx, SOx, and PM removal.
- Cost Effectiveness Range
  - DCF range: $2,900 - $9,100 / ton
  - LCF range: $4,600 - $14,600 / ton

7/31/2014 NOx RECLAIM 38

Non Refinery Boilers >40 MMBTU/hr

- BARCT level evaluated: 2 ppm @3%O_2
- Achievement of emission level not cost effective for the units analyzed in the top 38 facilities (> $70K per ton)
  - 1 boiler potentially may be cost effective

Non-Refinery Sector

Review for ICEs

(Summary from January 22, 2014 WGM)

and Gas Turbines

(Summary from March 18, 2014 WGM)

ICEs (Non-OCS, SI-Lean Burn)

(Summary from January 22, 2014 WGM)

- No new BARCT level in 2005
- Proposed BARCT level: 11 ppm @15% O_2
- Proposed control technology: Selective Catalytic Reduction (SCR)
- Emission Reductions (ER) for this category
  - 0.84 tons per day
- Cost Effectiveness Range
  - DCF range: $4,400 - $7,300 / ton
  - LCF Range: $7,200 - $12,000 / ton

*Adjustment to emission reductions and cost effectiveness made to reflect incremental reductions from the Tier 1 emission level

Gas Turbines (Non-OCS, Non-Power Plant)

(Summary from March 18, 2014 WGM)

- Tier-1 Level 2000 (0.06 lb/mmBtu)
- Proposed BARCT level: 2 ppm @15% O_2
- Proposed Control technology: Selective Catalytic Reduction (SCR)
- Emission Reductions (ER) for this category
  - 1.07 tons per day
- Cost Effectiveness Range
  - DCF range: $4,700 - $36,000 / ton
  - LCF range: $7,500 - $57,500 / ton

*Adjustment to emission reductions and cost effectiveness made to reflect incremental reductions from the Tier 1 emission level

Amount of Shave Determination

Refinery Sector

	Total No of Units	2011 Emissions (tpd)	2000/2005 BARCT	2011 Emissions at 2000/2005 BARCT (tpd)	2014 BARCT	2011 Emissions at 2014 BARCT (tpd)	Emission Reductions Beyond 2005 BARCT (tpd)	2023 Emissions at 2014 BARCT (tpd)
FCCUs/CO Boilers	8	1.08	85% control	0.60	2 ppmv	0.17	0.43	0.17
Turbines/Duct Burners	21	1.33	62.27 lbs/mmcft	4.86	2 ppmv	0.72	4.14	0.72
Coke Calciner	2	0.55	30 ppmv	0.25	2 ppmv	0.02	0.23	0.02
Sulfur Recovery Units/Tail Gas Incinerators	17	0.43	7 - 55 ppmv	0.43	2 ppmv 95% control	0.08	0.35	0.08
Boilers/Heaters > 110 mmbtu/hr	73	4.88	5 ppmv	0.82	2 ppmv	0.35	0.47	0.35
Boilers/Heaters 40-110 mmbtu/hr	69	2.00	25 ppmv	0.97	2 ppmv	0.39	0.58	0.39
Boliers/Heaters 20-40 mmbtu/hr	52	0.45	9 ppmv	0.10	-	0.10	0.00	0.10
Boilers/Heaters <20 mmbtu/hr	18	0.06	12 ppmv	0.02	-	0.02	0.00	0.02
Others (Major & Large Sources)	5	0.11		0.10	-	0.10	0.00	0.10
Process Units		0.6		0.6	-	0.6	0.00	0.6
Total	**265**	**11.5**		**8.76**		**2.56**	**6.20**	**2.56**

DRAFT - NON-REFINERY SECTOR & PRELIMINARY ASSESSMENT IN TOP 38 FACILITIES

POWER PLANTS*	# of Units	2011 Emissions (tpd)	2000/2005 BARCT	2011 Emissions at 2000/2005 BARCT (tpd)	2014 BARCT	2011 Emissions at 2014 BARCT (tpd)	Emission Reductions Beyond 2005 BARCT (tpd)	Growth Factor	2023 Emissions at 2014 BARCT (tpd)
Boilers	16	0.44	7 ppm	0.85	No new BARCT	0.85	0	1.146	0.97
Turbines/Duct Burners	21	0.83	No new level	1.50	No new BARCT	1.50	0	1.146	1.72
ICEs	6	0.18	No new level	0.22	No new BARCT	0.22	0	1.146	0.25
TOTAL	**43**	**1.45**		**2.57**		**2.57**	**0**		**2.95**
NON-POWER PLANTS									
Boilers	16	0.08	9-12 ppm	0.07	No new BARCT	0.07	0	0.96	0.07
Heaters	3	0.01	60 ppm	0.01	No new BARCT	0.01	0	0.93	0.01
Furnaces >150 MMBTU/hr	2	0.49	45 ppm	0.49	9 ppm	0.14	0.35	0.93	0.13
Furnaces	10	0.31	45 ppm	0.31	No new BARCT	0.31	0	0.93	0.29
Glass Melting Furnaces	2	0.30	1.2 lb/ton	0.30	80% Reduction	0.06	0.24	1.18	0.07
Sodium Silicate Furnace	1	0.11	6.4 lb/ton	0.11	80% Reduction	0.02	0.09	1.21	0.02
Gas Turbines (non-OCS)	14	1.43	61.45 lb/mmcf	1.24	2 ppm	0.17	1.07	1.10	0.19
Gas Turbines (OCS)	6	0.49	61.45 lb/mmcf	0.12	No new BARCT	0.12	0	1.46	0.18
ICEs (non-OCS)	25	0.35	217.36 lb/mmcf	1.05	11 ppm	0.21	0.84	1.03	0.22
ICEs (OCS)	6	0.03	217.36 lb/mmcf	0.11	No new BARCT	0.11	0	1.46	0.16
*Cement Kilns***	*2*	*1.61*	*2.73 lb/ton*	*1.61*	*0.5 lb/ton*	*0.29*	*1.32*	*0.9*	*0.26*
TOTAL	**87**	**3.60**		**3.81**		**1.22**	**2.59**		**1.33**
TOTAL PP and NON-PP	**130**	**5.05**		**6.38**		**3.79**	**2.59**		**4.27**
Other Sources* **		**3.46**		**3.46**		**3.46**	**0**		**4.5**
TOTAL NON-REFINERY		**8.51**		**9.84**		**7.25**	**2.59**		**8.77**

*Power Plants in the top 37. This analysis will extend to all the power plants since the OTC repowers will apply to some of the units outside the top 37.

**CPCC's emissions and emission reductions have NOT been included in the totals, this facility did not have any emissions in CY2011. CY2008 emissions were used to calculate the BARCT reductions.

***Includes Non-Refinery Process Units in the Top 37 facilities and all other sources outside the Top 37.

Potential Adjustments to Account for Emissions

- Power Plants due to SONGS shutdown
- Shutdown Facilities Prior to 2011
- New Facilities After 2011

RTC Reduction Calculation Method

Calculation Method

- Remaining Emissions in 2023
  = (Refinery + Non-Refinery Remaining Emissions + Potential Adjustment) x Growth Factor
- RTC Reductions
  = Current RTC Holdings (26.5 tons) – (Remaining Emissions x 10% adjustment factor)
- Sample Calculation
  Remaining = 2.56 + 8.77 + *1** = 12.33 tons
  RTC Reductions = 26.5 – (12.33 x 1.1)= 12.94 tons

**For illustration purposes*

Implementation Period

- 2016 = 2 tpd
- 2017-2020 to phase in BARCT
- Some refinery sources may be given an implementation schedule beyond 2020 to accommodate facility turnaround

Shaving Methodology Options

Shaving Methodology

- Across the board with off-ramp
  - Similar off-ramp criteria as in Rule 2002(i) – RTC Redemption Exemption
- Weighted to industry categories with high reduction potential and sufficient RTC holdings
- Others?

Market Protection Mechanisms

Design Features for Market Protection

- 10% compliance margin applied to remaining emissions
- Assign a portion of shave to be non-tradable/non-usable
- RTC price threshold by which reductions would become usable, but non-tradable ($15K per ton)

Design Features for Market Protection

- Price floor (recommended by environmental groups)
- SCAQMD set-aside account for NSR holding requirements (proposed concept)
- Program review if RTC > $15K per ton
- Cross-cycle trading

Next Steps

- Complete emission adjustment analysis (August)
- Stakeholder review of BARCT determination (August – November)
- Third party consultants to review BARCT determination (August – November)
  - Refinery $75K
  - Non-Refinery $50K
- Prepare CEQA & Socioeconomic reports and public review (4th quarter)
- Rule adoption: 1st quarter 2015

Contact

Refineries
Minh Pham, P.E.
mpham@aqmd.gov
(909) 396 - 2613

Non-Refineries
Kevin Orellana
korellana@aqmd.gov
(909) 396 - 3492