OTC / MANE-VU Committees Meeting

April 17, 2018

Francis Steitz, NJ
Chair
Stationary and Area Sources Committee





OZONE TRANSPORT COMMISSION

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Stationary & Area Sources Committee

Agenda

2018 SAS Charges – Progress & Products from:

- Largest Contributors Workgroup
- Control Measures Subgroup
- Consumer Products Workgroup

2018 SAS Charges

Charge: …perform technical analyses to help OTC states pursue legally supportable cost-effective strategies to achieve reductions of ozone-forming pollutants and satisfy CAA requirements.

Calculate & document emissions reductions inside & outside of the OTR for the recommended SAS GN SIP strategies as formalized in the GN SIP Resolution for use in photochemical modeling & develop recommendations for additional strategies for consideration.

GN SIP Resolution

1. Optimize use of existing SCR or SNCR NOx control technology on coal-fired EGUs each day of ozone season – LC Workgroup
2. Install SCR or SNCR control technology on uncontrolled coal-fired EGUs & optimize use of such technology each day of the ozone season - LC Workgroup
3. Adopt OTC model rule for natural gas pipeline compressor prime movers – CM Workgroup

Largest Contributors Workgroup

Deliverables:

Quantification of NOx Reductions

1. From optimizing the use of existing SCR or SNCR NOx control technology on coal-fired EGUs each day of OS – *has been included in OTC Modeling Committee's 2023 CAMx contribution modeling analysis*

2. From installing & optimizing the use of SCR or SNCR control technology on uncontrolled coal-fired EGUs - *Ran ERTAC EGU tool with hourly control rates: 0.064 (SCR) & 0.125 (SNCR) lb NOx/MMBtu → post-process the results*

Cost Calculations

GN SIP Resolution #2: Emissions reduction from installing & optimizing control technologies on uncontrolled coal-fired EGUs

State	Sum of 2023 OS NOx (tons) Base Optimized	GN SIP Resolution #2	OS NOx Reduction (tons)
CT	277.39	232.04	45.35
DE	955.38	955.38	0.00
MA	378.20	378.20	0.00
MD	3,980.38	3,980.38	0.00
ME	110.61	110.61	0.00
NH	352.95	445.82	-92.87
NJ	1,969.02	1,969.02	0.00
NY	6,193.01	6,016.49	176.52
PA	17,096.81	16,682.15	414.67
RI	142.59	142.59	0.00
VT	0.00	0.00	0.00
MANE-VU Total	**31,456.33**	**30,912.67**	**543.66**
LADCO Total	**74,115.70**	**56,229.49**	**17,886.21**
SESARM Total	**106,962.25**	**84,436.25**	**4,755.59**

IL, IN, MI, MN, OH, WI

AL, FL, GA, KY, MS, NC, SC, TN, VA

Results from Eastern Regional Technical Advisory Committee (ERTAC) Run – ready for modeling

Largest Contributor Workgroup

Estimated SCR & SNCR Retrofit Control Costs - Sargent & Lundy Method:

Reduction Technology	Est. Ozone Season Total NOx Reduction (tons)	Est. Ozone Season Total NOx Reduction (%)	Overall Annualized Capital Cost ($/ton NOx removed)	Range of Unit-Specific NOx Control Cost ($/ton NOx removed)	No. of Units with Cost Effectiveness Below $10,000/ton
SNCR	23,653	22	4,011	3,608 - 11,896,287	57
SCR	68,020	63	20,486	7,594 – 9,745, 272	6

2017 Ozone Season CAMD/AMPD data for CSAPRU & OTC states:

- All data & estimates are ozone season based, not annual
- Analysis of retrofit costs for coal-fuel EGUs without SCR or SNCR in 2017
- Costs are in 2012 dollars
- Annualized capital costs include only capital cost components, no O&M costs
- Range of unit-specific ozone season cost includes both capital & O&M costs
- Assumptions:

	Limit (lbs NOx/MM Btu)	**Per Unit Control Efficiency**
SNCR	0.125	30%
SCR	0.064	90%

2023 Annual vs 2017 Ozone Season SCR costs – A Rough Comparison

$$\$8273.40/\text{ton} \; x \frac{6{,}231 \;\text{ann. hr}}{3{,}424 \;\text{OS hr}} \; x \frac{5{,}734{,}885 \;\text{ann. heat input}}{3{,}310{,}643 \;\text{OS heat input}} \; x \frac{0.245 \;\text{lb/mmBtu 2023 inlet NOx}}{0.171 \;\text{lb/mmBtu 2017 inlet NOx}}$$

- $37,285/ton compared to $30,430/ton OS cost using Sargent & Lundy method.
- Unit analyzed: 190.4 MW coal-fueled Gorgas Unit #9 in Alabama
- Comparison shows that assumed operating hours, heat input, and inlet NOx concentration are critical inputs irrespective of the control cost analysis method used
- Input Assumptions Really Matter!
- Averaging Time (Annual vs Ozone Season vs Daily) Really Matters!

Top 25 NO_x Emitters with Controls - CSAPR States, 2017 Ozone Season

	State	Facility Name	Facility - Unit ID	Avg. NOx Rate (lb/MMBtu)	NO_x (tons)	SCR?	Best Observed Rate (lb/mmBTU)	Year	2017 Allocations
1	AR	White Bluff	6009-1	0.296	3,748				2,116
2	IN	Rockport	6166-MB2	0.203	3,421				1,858
3	AR	Independence	6641-2	0.245	3,009				2,017
4	OH	W H Zimmer Generating Station	6019-1	0.191	2,972	Yes	0.056	2006	1,325
5	WV	Fort Martin Power Station	3943-2	0.312	2,584				875
6	OH	Killen Station	6031-2	0.267	2,561	Yes	0.089	2005	719
7	IA	Walter Scott Jr. Energy Center	1082-3	0.221	2,499				1,517
8	KY	Paradise	1378-3	0.231	2,425	Yes	0.100	2005	1,303
9	TX	Limestone	298-LM2	0.185	2,373				1,329
10	LA	Ninemile Point	1403-5	0.276	2,037				994
11	WV	Fort Martin Power Station	3943-1	0.302	1,870				912
12	TX	Limestone	298-LM1	0.168	1,850				1,206
13	MI	Belle River	6034-2	0.221	1,825				926
14	IA	Louisa	6664-101	0.191	1,817				1,523
15	OH	Gen J M Gavin	8102-1	0.105	1,806	Yes	0.069	2004	1,517
16	OK	Muskogee	2952-6	0.269	1,778				624
17	WV	Mountaineer (1301)	6264-1	0.099	1,773	Yes	0.039	2007	1,979
18	TX	Martin Lake	6146-1	0.160	1,714				1,166
19	IN	IPL - Petersburg Generating Station	994-4	0.237	1,696				750
20	IN	Rockport	6166-MB1	0.176	1,673				1,823
21	AR	Independence	6641-1	0.240	1,671				1,840
22	TX	Martin Lake	6146-2	0.160	1,631				1,126
23	LA	Ninemile Point	1403-4	0.237	1,618				877
24	MI	Belle River	6034-1	0.197	1,608				875
25	TX	H W Pirkey Power Plant	7902-1	0.166	1,598				1,090

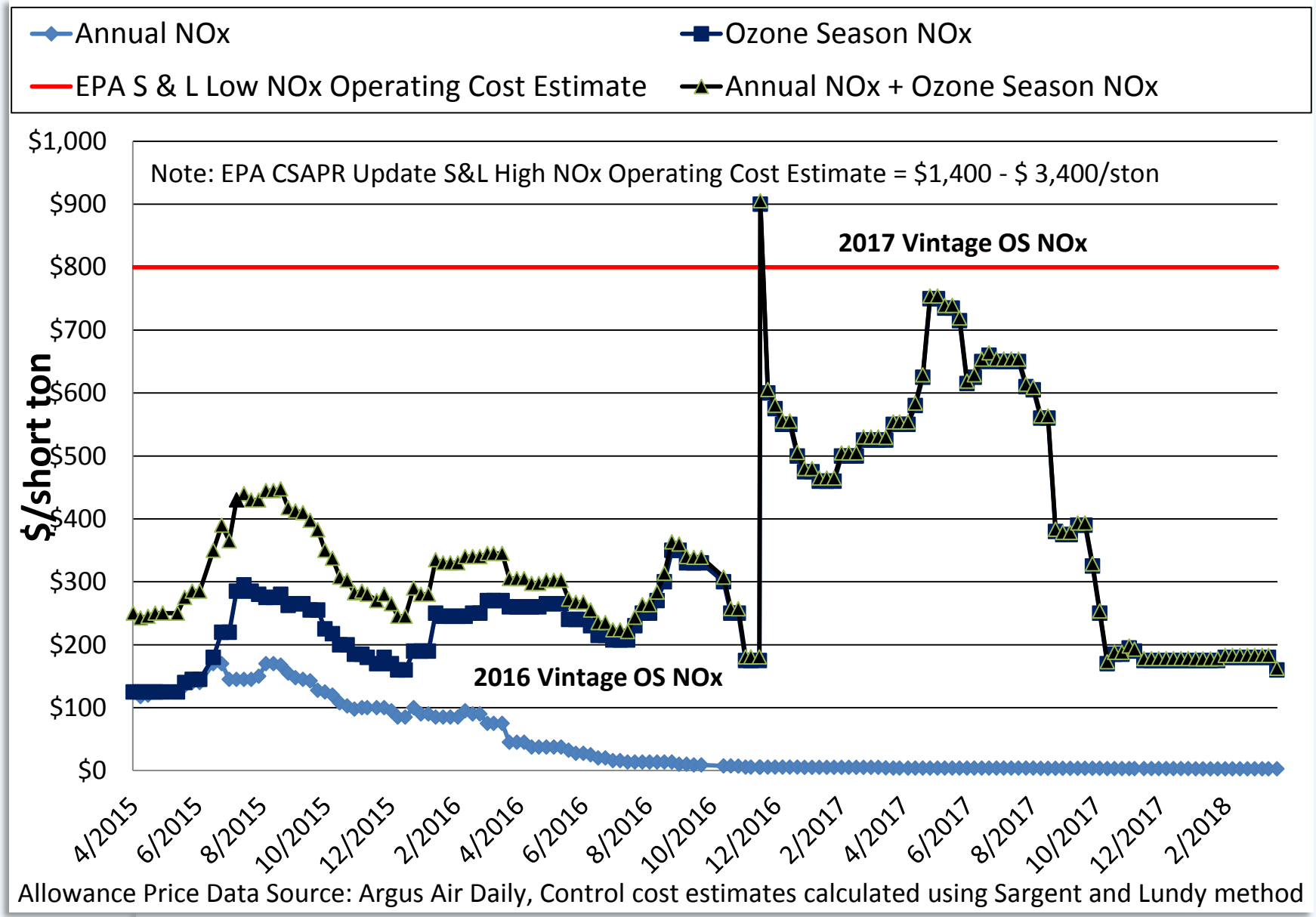
- 5 SCR units in Top 25 sub-optimal operation although Gavin & Mountaineer are still quite good.
- Others have LNB, OFA, etc. but no SNCR
- Rockport MB1 (#20) installed SCR as of 7/26/17, but still doing some testing & did not have a full season of use
- Overall there is tremendous fleet improvement over the past couple years.

Top 25 NO_x Emitters Without SCR - CSAPR States, 2017 Ozone Season

	State	Facility Name	Facility - Unit ID	Avg. NOx Rate (lb/MMBtu)	NO_x (tons)	SCR?	2017 Allocations
1	AR	White Bluff	6009-1	0.296	3,748	No	2,116
2	IN	Rockport	6166-MB2	0.203	3,421	No	1,858
3	AR	Independence	6641-2	0.245	3,009	No	2,017
4	WV	Fort Martin Power Station	3943-2	0.312	2,584	No	875
5	IA	Walter Scott Jr. Energy Center	1082-3	0.221	2,499	No	1,517
6	TX	Limestone	298-LM2	0.185	2,373	No	1,329
7	LA	Ninemile Point	1403-5	0.276	2,037	No	994
8	WV	Fort Martin Power Station	3943-1	0.302	1,870	No	912
9	TX	Limestone	298-LM1	0.168	1,850	No	1,206
10	MI	Belle River	6034-2	0.221	1,825	No	926
11	IA	Louisa	6664-101	0.191	1,817	No	1,523
12	OK	Muskogee	2952-6	0.269	1,778	No	624
13	TX	Martin Lake	6146-1	0.160	1,714	No	1,166
14	IN	IPL - Petersburg Generating Station	994-4	0.237	1,696	No	750
15	AR	Independence	6641-1	0.240	1,671	No	1,840
16	TX	Martin Lake	6146-2	0.160	1,631	No	1,126
17	LA	Ninemile Point	1403-4	0.237	1,618	No	877
18	MI	Belle River	6034-1	0.197	1,608	No	875
19	TX	H W Pirkey Power Plant	7902-1	0.166	1,598	No	1,090
20	TX	Oklaunion Power Station	127-1	0.246	1,572	No	918
21	TX	Monticello	6147-3	0.138	1,549	No	1,055
22	LA	Little Gypsy	1402-3	0.251	1,493	No	520
23	TX	Welsh Power Plant	6139-1	0.178	1,489	No	651
24	IA	Ottumwa	6254-1	0.138	1,469	No	1,361
25	MO	Sioux	2107-1	0.215	1,402	No	554

- 3 LA Units – NG
- 1 TX Unit – coal, SNCR
- all others have LNB, OFA, etc. but no PCC except for TX- Monticello.

CSAPR Allowance Prices (4/17/15 – 4/6/18)

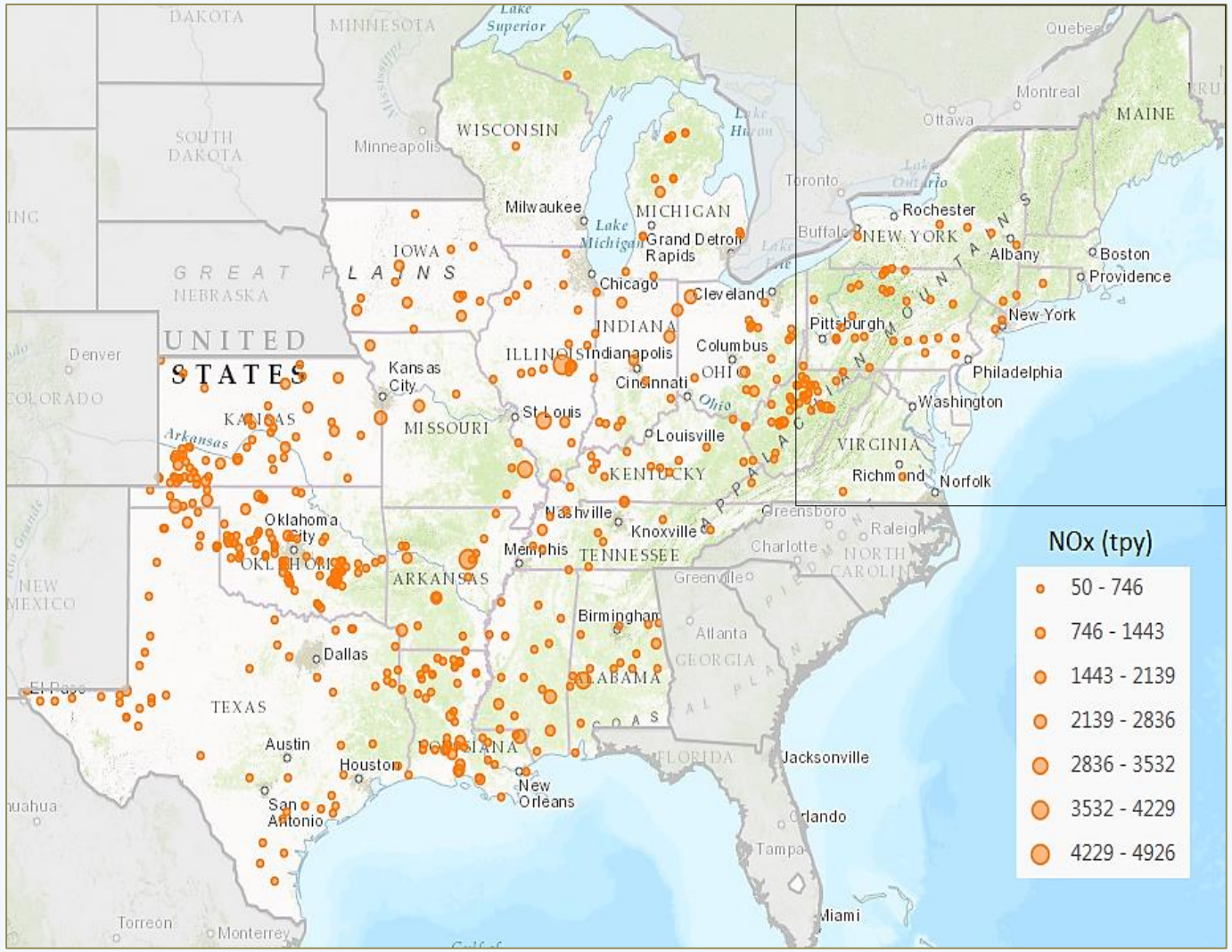


Allowance Price Data Source: Argus Air Daily, Control cost estimates calculated using Sargent and Lundy method

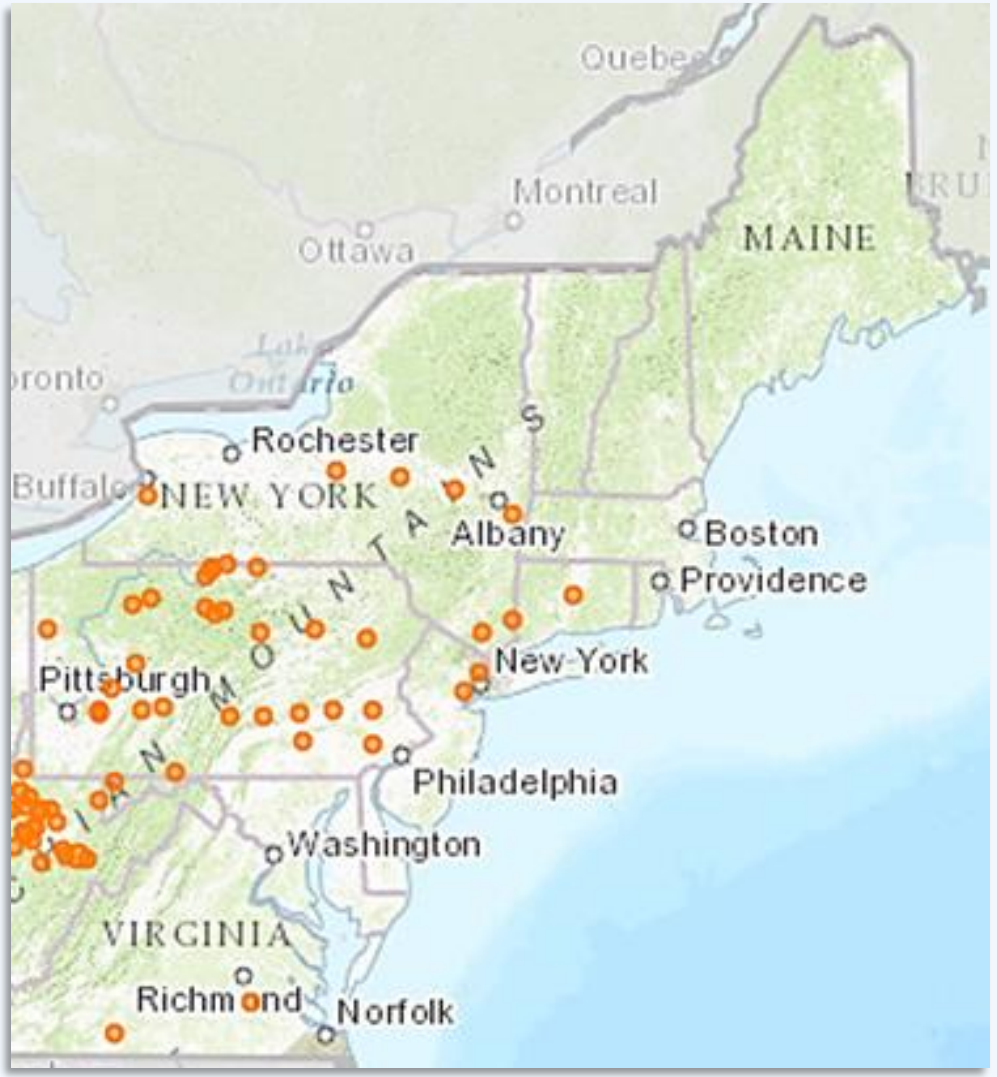
Still Cheaper to Buy Allowances than to Run Controls in most cases!

Control Measures Subgroup

Pipeline Transportation of Natural Gas



Facilities emitting ≥50 tpy NOx in CSAPR U & OTR States



Facilities in OTR States emit (50-746) tpy NOx

Control Measures Subgroup

Deliverables: Estimation of potential emissions reduction & costs of implementing limits in the 2017 OTC Model Rule on Natural Gas Pipeline Compressor Fuel-Fired Prime Movers

NOx Limits in the Model Rule:

Four-Stroke Rich Burn ICE	
Nameplate Rating in HP	**NOx Rate in g/BHP-hr (% Reduction)**
200 - 499	1.5 (90)
500 - 1999	1.5 (90)
≥2000	1.0 (95)

Four-Stroke Lean Burn ICE	
Nameplate Rating in HP	**NOx Rate in g/BHP-hr (% Reduction)**
200 - 499	1.5 (90)
500 - 1999	1.5 (90)
≥2000	1.5 (90)

Two-Stroke Lean Burn ICE	
Nameplate Rating in HP	**NOx Rate in g/BHP-hr (% Reduction)**
200 - 499	2.0 (80)
500 - 1999	1.5 (80)
≥2000	1.5 (90)

Combustion Turbines	
Nameplate Rating in HP (MW)	**NOx Rate in ppmvd @ 15% O_2 (lb/MWhr)**
≤2000 (1.5)	150.0 (6.0)
2000 - 4999 (1.5-3.7)	50.0 (2.0)
≥5000 (3.7)	25.0 (1.0)

Control Measures Subgroup

Process:

- Develop an Emissions Modeling Framework (EMF) control packet to simulate NOx reductions associated with the proposed 2017 OTC Model Rule
- Use control packet in OTC's GN SIP air quality modeling (2011 platform with 2023 future year projection)

Progress to-date:

- Drafted a Work Plan; Extracted relevant point & nonpoint emissions using EMF
- Selected inventory for analysis - *2023 Gamma Inventory, Eastern Modeling Domain omitting partial states (TX, LA, AR, MO) since only small portions of these states are in OTC modeling domain*
- Compared Model Rule limits with existing permitted limits where data is available
- Setting up EMF query based on SCC codes to identify these devices, to apply the NOx limits in OTC Model Rule
- Developing NOx control cost estimates using the "Mojave Desert AQMD IC Engine NOx RACT Staff Paper" as a reference

Control Measures Subgroup

- Preliminary analysis of point source NG compressor engines indicates significant potential reductions of NOx
- Preliminary analysis of non-point source NG compressor engines (e.g. rich & lean burn engines) indicates NOx reductions have been accounted for in 2023 base case modeling

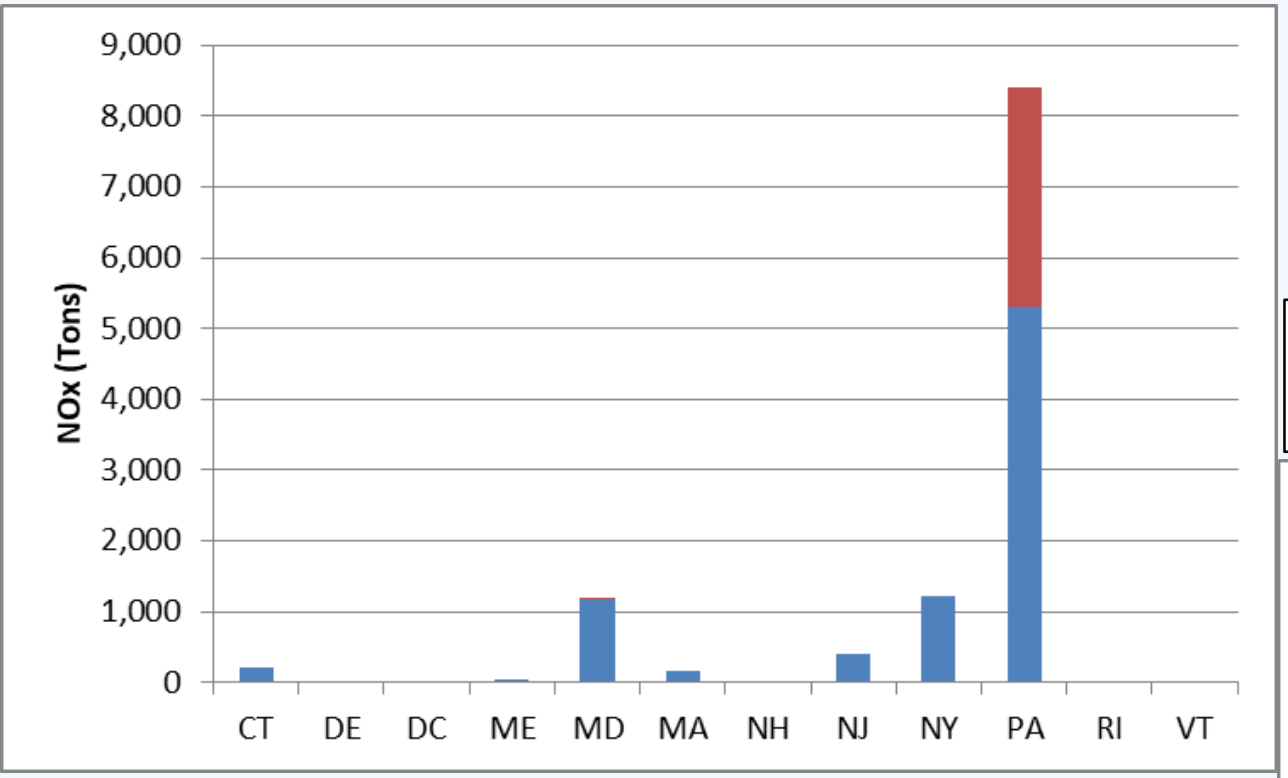
Ongoing Tasks and Challenges:

- Gathering more on-line permit data, very time-consuming
- Don’t want to apply controls to units with permit limits at or below Model Rule limits
- Many data gaps (e.g. design capacity is missing for many units, making it difficult to apply the appropriate model rule limit)

Next Steps:

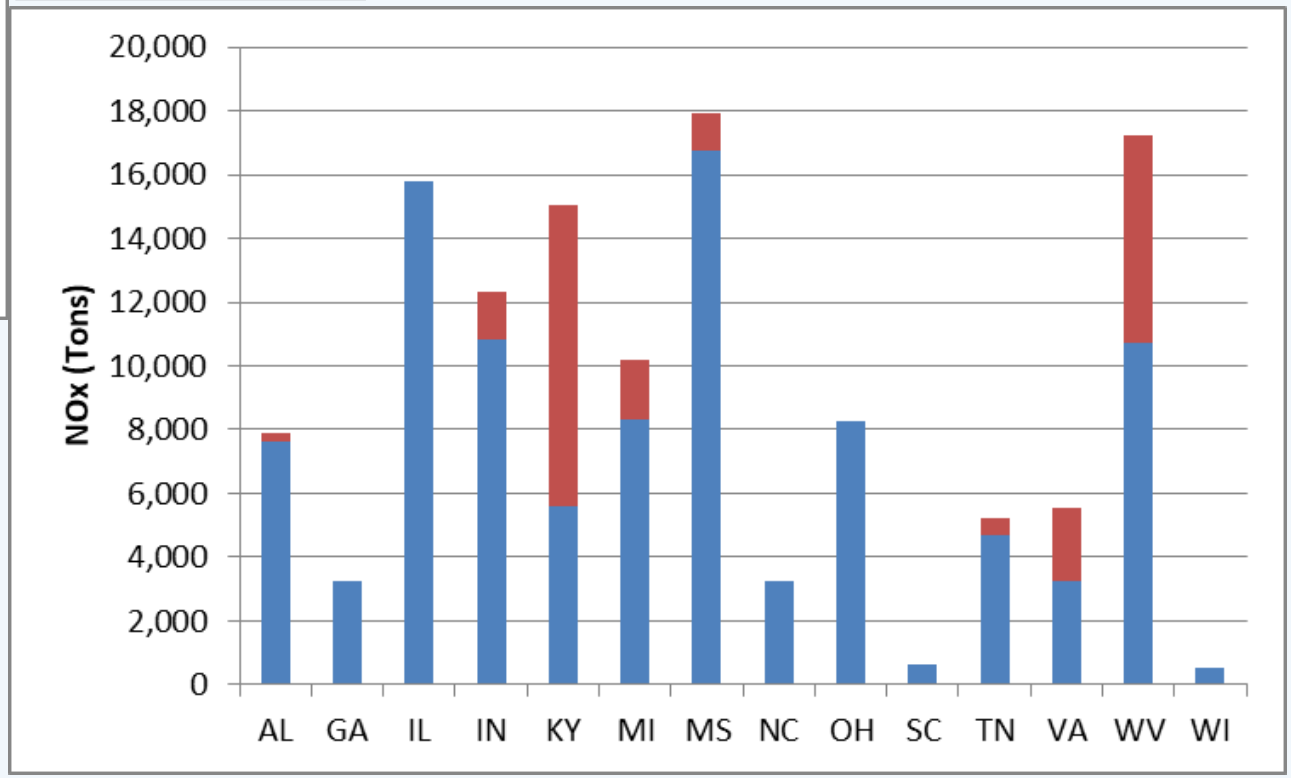
- Continue comparison with permit data
- Decide on the most appropriate way to apply limits/reductions to point and nonpoint sources
- Develop the EMF control packet itself
- Develop Documentation

NG Pipeline Compressor Stations NOx Emissions



MANE-VU States

Data: 2023 Projected NOx Emissions from MARAMA's gamma inventory



Other Modeling Domain States (except partial states)

Consumer Products Workgroup

Standing Charge: Evaluate and make recommendations to OTC member states of updates to any previously developed OTC model rule that is based on a CARB rule & shall update any such model rules to include any product categories or standards adopted by CARB.

OTC Model Rule for Consumer Products - Phase V - Summary of Proposed Updates:

- Based on latest CARB rule, amended as appropriate for the OTR, with the addition of new categories & more stringent VOC limits for existing categories & revised definition language;
- Includes limits in CA with an effective date of January 1, 2017 or earlier in CA;
- Will not include limits with future effective dates in CA or reactivity-based limits (lubricants at 10%);
- Includes insect repellent, personal fragrance & windshield washer fluid limits previously excluded;
- Includes an optional 3 year sell through limit for existing products that do not comply with VOC limits;
- Removes category/exemption for structural waterproof adhesives.

Consumer Products Model Rule - Phase V

New Product Categories, New VOC Limits, Revised Definitions

New Product Categories

- Astringent/Toner
- Fabric Softener
- Floor Maintenance Product
- Insect Repellent
- Motor Vehicle Wash
- Multi-purpose Solvent & Paint Thinner, Aerosol
- Personal Fragrance Product
- Pressurized Gas Duster
- Tire or Wheel Cleaner
- Windshield Water Repellent
- Dual Purpose Air Freshener/Disinfectant

Amended Product Categories

- Adhesives, Aerosol
- Air Freshener, Double Phase
- Automotive Windshield Washer Fluid
- Carpet/Upholstery Cleaners
- Dusting Aid
- Fabric Protectant
- Floor Polish or Wax
- Furniture Maintenance Product
- General Purpose Cleaner
- General Purpose Degreaser
- Glass Cleaner
- Heavy-duty Hand Cleaner or Soap
- Insecticide
- Lubricants (25%)
- Metal Polish or Cleanser
- Odor Remover/Eliminator
- Penetrant
- Sealant or Caulking Compound
- Spot Remover

Consumer Products Model Rule - Phase V

Product Categories

OUT	IN	NOT IN CARB
• Structural Waterproof Adhesive - and most likely CP candidate used for VOC • Multi-purpose Lubricant @ 10%	• Automotive Windshield Washer Fluid @ 25% • Multi-purpose Lubricant @ 25% • Insect Repellant Aerosol @ 65% • Personal Fragrance Product @ CARB VOC • Anti-seize Lubricant @ CARB VOC • Cutting or Tapping Oil @ CARB VOC • Gear, Chain or Wire Lubricant @ CARB VOC • Optional prohibition for MeCl/Perc/TCE in Brake Cleaner	• Automotive Windshield Cleaner @ 35%

Provisions: Defined Sell-through Period vs Unlimited Sell-through

Consumer Products Model Rule - Phase V

Benefits

Total Emission Reductions in the OTR:

- **29 tons per day VOC***
- 7 % of Consumer Products VOC Inventory
- 3 % of Area Source VOC Inventory

Categories with Highest Reductions:

- General Purpose Cleaners
- Air Fresheners
- Lubricants
- General Purpose Degreasers

* Reductions based on CARB estimates for CA, at the time of proposal in CA, adjusted using population.

Consumer Products Model Rule - Phase V

Costs

Total Average Cost Effectiveness for All Categories:

$5,613/ton* or $2.81/lb VOC reduced*

Categories with Highest Cost per Ton of VOC Reduced:

- Spot Removers
- Sealant or Caulking Compounds
- Glass Cleaners, aerosol
- Personal Fragrances

Categories with Highest Annualized Costs:

- Personal Fragrances
- Sealant or Caulking Compounds
- Lubricants
- Spot Removers

Categories with Lowest Cost per Ton of VOC Reduced:

- Fabric Softeners
- Metal Polishes or Cleansers
- Glass Cleaners, nonaerosol
- Air Fresheners

* Costs based on CARB estimates for CA, at the time of proposal in CA. Cost estimates are conservative as they include one time research and development and reformulation costs.

BONUS SLIDES

GN SIP Resolution #2: Emissions reduction from installing & optimizing control technologies on uncontrolled coal-fired EGUs

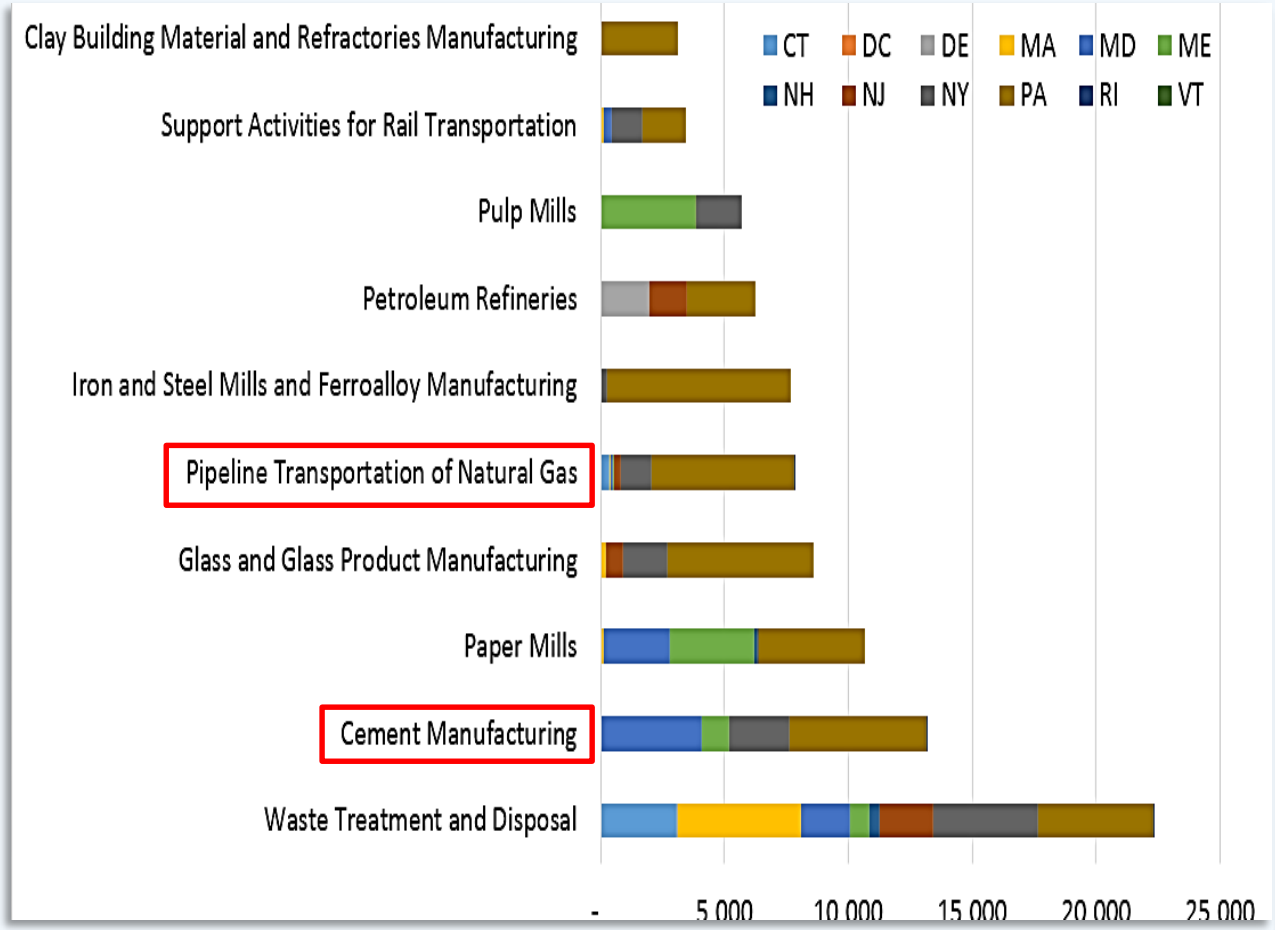
Results from ERTAC Run – ready for modeling

State	Sum of 2023 OS NOx (tons) Base Optimized	GN SIP Resolution #2	OS NOx Reduction (tons)
IL	14,443.29	11,804.24	2,639.06
IN	18,503.31	14,521.31	3,982.00
MI	12,354.57	7,858.69	4,495.88
MN	6,592.19	4,158.46	2,433.73
OH	15,288.56	12,010.83	3,277.72
WI	6,933.79	5,875.97	1,057.82
LADCO Total	**74,115.70**	**56,229.49**	**17,886.21**

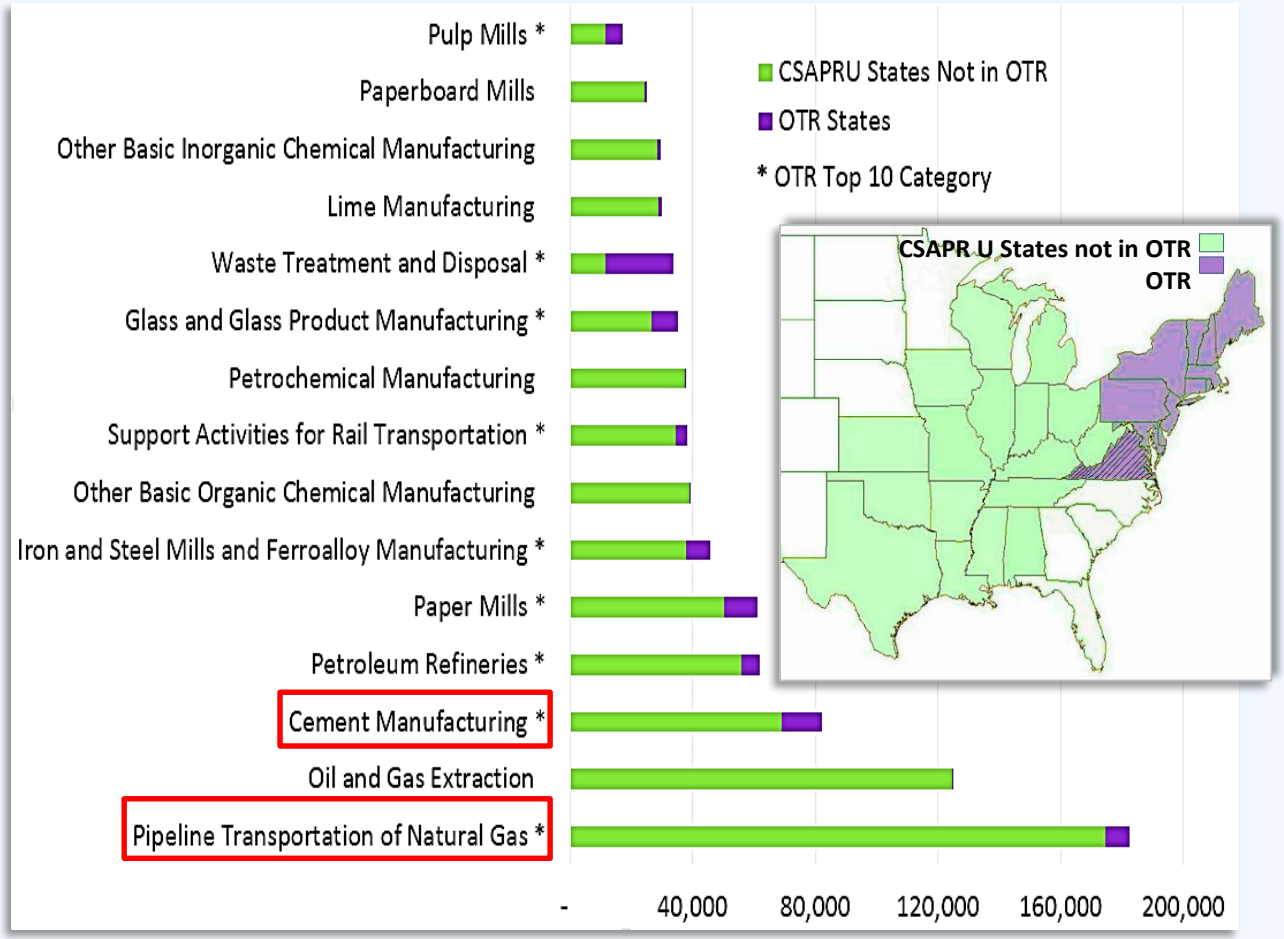
State	Sum of 2023 OS NOx (tons) Base Optimized	GN SIP Resolution #2	OS NOx Reduction (tons)
AL	7,373.60	6,888.63	484.97
FL	15,738.33	13,918.09	1,820.24
GA	9,831.84	9,403.68	428.16
KY	21,399.47	10,826.78	10,572.68
MS	9,077.48	5,097.75	3,979.73
NC	13,193.81	13,193.81	0.00
SC	4,428.52	4,428.52	0.00
TN	4,805.63	4,805.63	0.00
VA	5,320.50	4,835.87	484.62
SESARM Total	**106,962.25**	**84,436.25**	**4,755.59**

Top NOx Emitting Stationary Source Categories

Top 10 in OTR



Top 15 in CSAPR Update & OTR States



(Excluding EGUs, Airport LTO, & Sources from VA); Source: 2014 NEI v.1