

**OTC / MANE-VU Spring Meeting  
Baltimore, MD June 7, 2018**

**Francis Steitz, NJ  
Chair  
Stationary and Area Sources Committee**



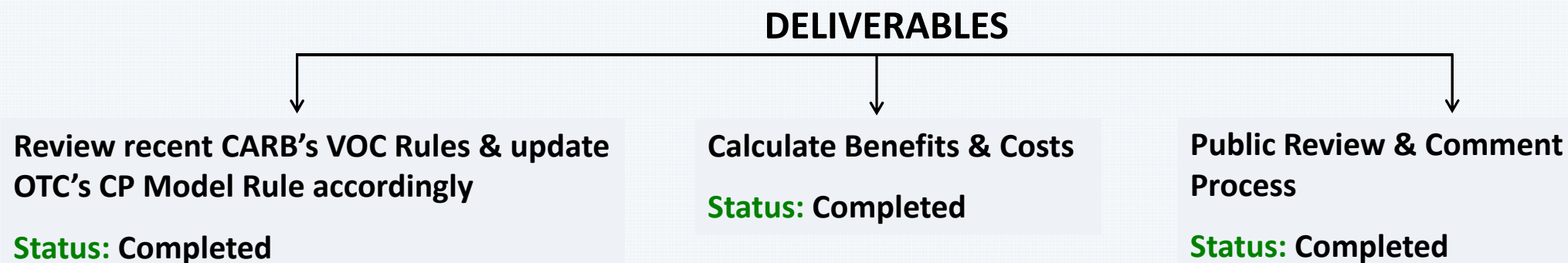
**OZONE TRANSPORT COMMISSION**

# Stationary & Area Sources Committee

2018 SAS Charges – Products & Progress from:

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

# Standing Charge: Update existing OTC Model Rule on Consumer Products based on CARB Rule 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 14 new product categories, revised (more stringent) VOC limits for ~20 existing product categories, & revised definition language
- Includes limits in CA with an effective date of January 1, 2017 or earlier in CA
- Does not include limits with future effective dates in CA or reactivity-based limits
- Includes provision for optional (defined/unlimited) sell-through period

# Phase V Consumer Products Model Rule – Benefits & Costs

**BENEFITS** \* Reductions based on CARB’s at the time of proposal in CA, adjusted for population

| Total Emission Reductions in the OTR  | Categories with Highest Reductions |
|---------------------------------------|------------------------------------|
| 29 tons per day VOC*                  | General Purpose Cleaners           |
| 7% of Consumer Products VOC Inventory | Air Fresheners                     |
| 3% of Area Source VOC Inventory       | Lubricants                         |
|                                       | General Purpose Degreasers         |

**COSTS** Total Average Cost Effectiveness for Categories: \$5,613/ton or \$2.81/lb VOC reduced  
(conservative estimates based on CARB’s at the time of proposal in CA; include one time R&D and reformulation costs)

| Categories with Highest Cost per Ton of VOC Reduced | Categories with Highest Annualized Costs | Categories with Lowest Cost per Ton of VOC Reduced |
|---|--|--|
| Spot Removers                                       | Personal Fragrances                      | Fabric Softeners                                   |
| Sealant or Caulking Compounds                       | Sealant or Caulking Compounds            | Metal Polishes or Cleansers                        |
| Glass Cleaners, aerosol                             | Lubricants                               | Glass Cleaners, nonaerosol                         |
| Personal Fragrances                                 | Spot Removers                            | Air Fresheners                                     |

# Phase V Consumer Products Model Rule – Public Comment

| Stakeholder Comment   | Resolution  |
|---|---|
| Remove optional 3 year sell through period: excessive burden on industry to conduct a recall for no environmental benefit | Leave in the Rule as optional for states to choose  |
| Concerns with inconsistency in Northeast: differences in adoption of previous OTC model rules                             | Continue with update and finalize   |
| Lubricants: don't include specialty lubricants because they are mostly for industrial use                                 | Compliant products exist, leave Rule consistent with CARB                                     |
| Sealants: create specialty category for a particular sealant needed for application in extreme weather conditions         | Compliant products exist, leave Rule consistent with CARB                                     |
| Artist's Solvent: change exemption from 1 liter to 1 gallon, waste of packaging   | Leave Rule consistent with CARB due to toxicity level concerns                                |
| Windshield Wiper Fluids: could have freezing issues, safety concerns  | Do not propose CARB limit; make Rule consistent with previous OTC Model Rule and Federal rule |

**Charge completed - Model Rule will be Posted on OTC Website**

# 2018 SAS Charge

**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 NO<sub>x</sub> control technology on coal-fired EGUs each day of ozone season – **Largest Contributors Workgroup**
2. Install SCR or SNCR control technology on uncontrolled coal-fired EGUs & optimize use of such technology each day of the ozone season - **Largest Contributors Workgroup**
3. Adopt OTC model rule for natural gas pipeline compressor prime movers – **Control Measures Workgroup**

# Charge: GN SIP NO<sub>x</sub> Control Strategies for Coal-Fired EGUs

## DELIVERABLES

### Quantify Emissions Reduction

**Status:** Modeling underway

Poorly Controlled EGUs: Optimize use of existing SCR / SNCR on each day of OS

OTC Modeling Committee → 2023 CAMx contribution modeling analysis

Uncontrolled EGUs: Install SCR / SNCR & optimize their use each day of ozone season

Ran ERTAC EGU tool with hourly control rates of 0.064 (SCR) & 0.125 (SNCR) lb NO<sub>x</sub>/MMBtu → Results post-processed → UMD's photochemical modeling nearing completion

### Calculate Control Costs

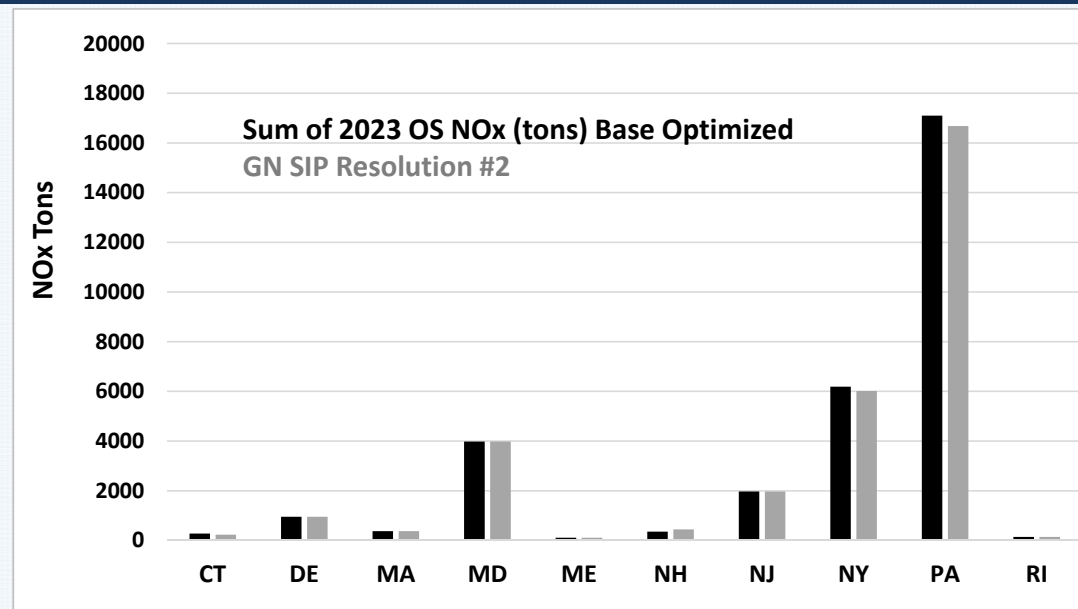
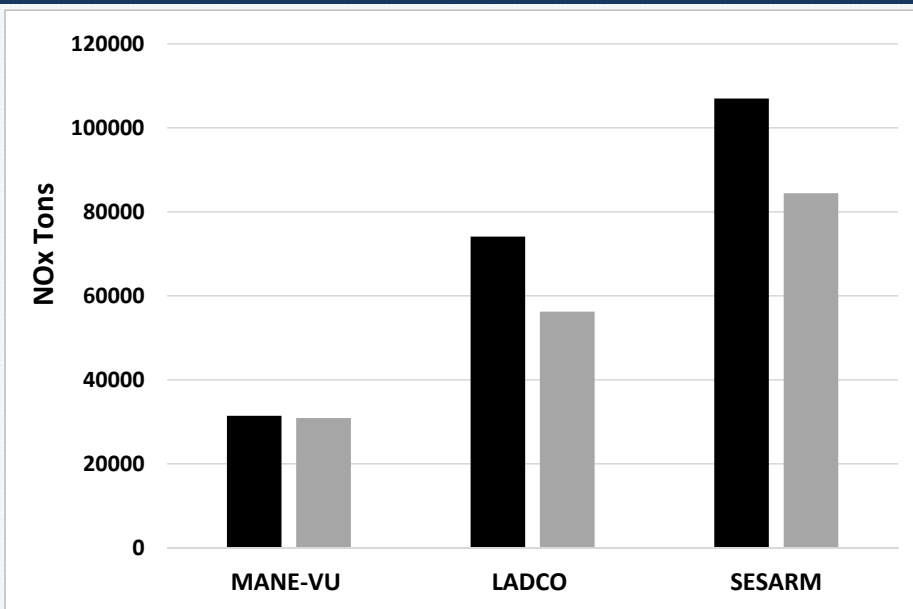
**Status:** Developing estimates

Estimates developed using Sargent and Lundy Method

### Document Process & Results

**Status:** In progress

# Uncontrolled Coal-Fired EGUs: Costs & Benefits from Implementing GN SIP Strategy



## Estimated SCR & SNCR Retrofit Control Costs for 2017 Ozone Season (OS) using Sargent & Lundy Method:

| Reduction Technology | Est. OS Total NOx Reduction (tons) | Overall Annualized Capital Cost (\$/ton NOx removed) | Range of Unit-Specific NOx Control Cost (\$/ton NOx removed) | # Units with Cost Effectiveness <\$10,000/ton |
|----------------------|------------------------------------|--|--|---|
| SNCR                 | 23,653                             | 4,011  | 3,608 - 11,896,287   | 57  |
| SCR                  | 68,020                             | 20,486   | 7,594 - 9,745,272  | 6   |

Notes: All data (from CAMD/AMPD for Cross-State Air Pollution Rule Update (CSAPRU) & OTC states) & estimates only for OS; Costs in 2012 dollars; Annualized capital costs include only capital components, no O&M costs; Unit-specific OS costs include both capital & O&M costs  
 Assumptions: Limit (lbs NOx/MM Btu): 0.125 (SNCR), 0.064 (SCR); Per Unit Control Efficiency 30% (SNCR), 90% (SCR)



# Top 25 NO<sub>x</sub> Emitters - CSAPR States, 2017 Ozone Season

|    | State | Facility Name                       | Facility - Unit ID | Avg. NO <sub>x</sub> Rate<br>(lb/MMBtu) | NO <sub>x</sub><br>(tons) | SCR? | Best Observed Rate<br>(lb/mmBTU) | Year | 2017<br>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               |

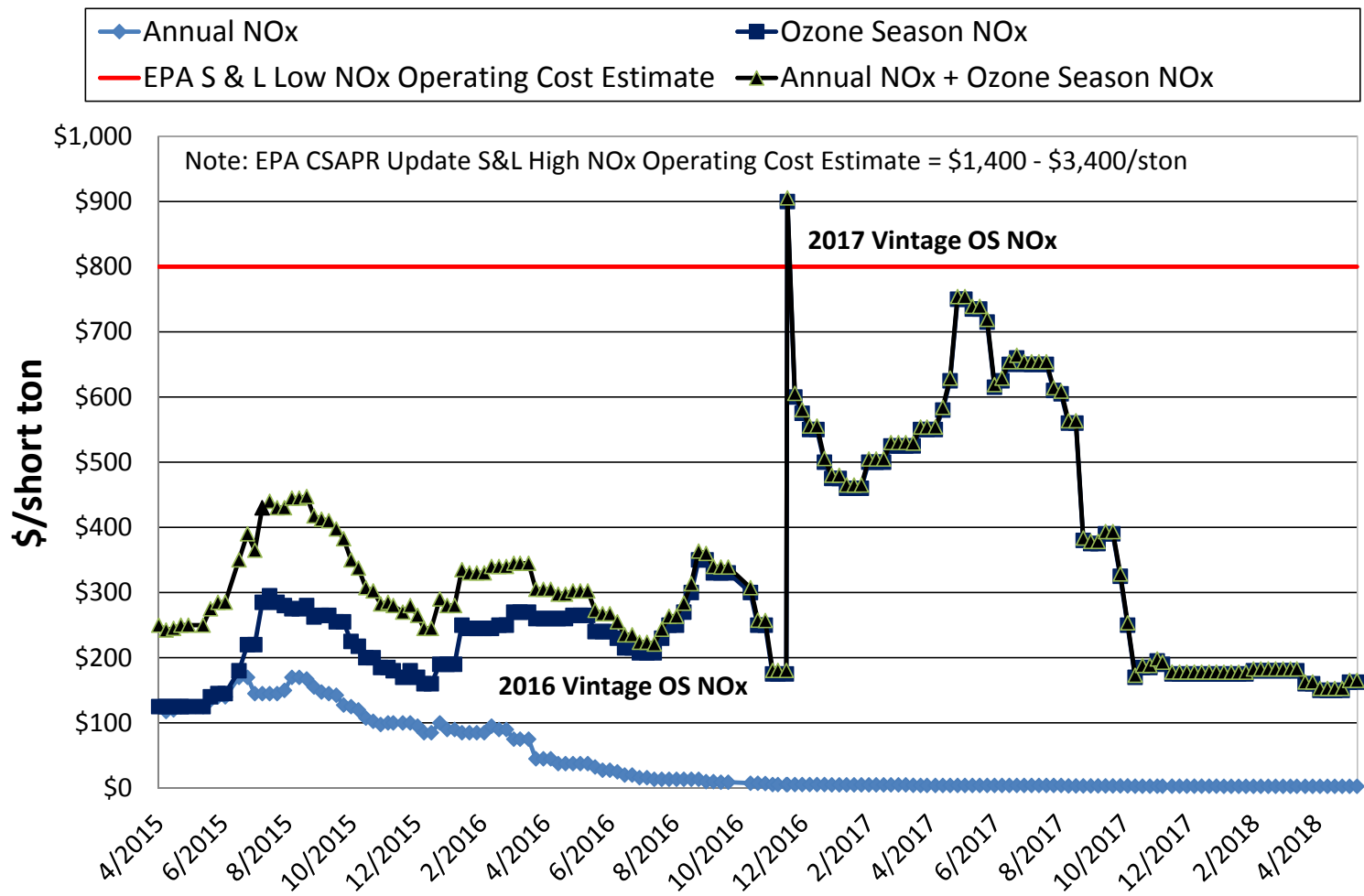
- 5 SCR units in Top 25 sub-optimal operation although Gavin & Mountaineer are still quite good.
- Others have LNB, OFA, etc. but no SNCR
- Rockport MB1 (#20) installed SCR as of 7/26/17, but still doing some testing & did not have a full season of use
- Overall there is tremendous fleet improvement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

# Top 25 NO<sub>x</sub> Emitters Without SCR - CSAPR States, 2017 Ozone Season

|    | State | Facility Name                       | Facility - Unit ID | Avg. NO <sub>x</sub> Rate (lb/MMBtu) | NO <sub>x</sub> (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    | Oklunion 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 – 5/25/18)



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

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

# Charge: GN SIP NOx Control Strategy for NG Pipeline Compressor Prime Movers \*

## DELIVERABLES

### Quantify Emissions Reduction

**Status:** Still parsing inventory

Extract point & nonpoint emissions in 2023 Gamma inventory of Eastern Modeling Domain minus partial states

↓  
Match permit data for individual facilities with inventory data

↓  
Compare Model Rule limits with permitted limits

↓  
Address data gaps (e.g. design capacity missing for many units → difficult to apply model rule limits)

↓  
Develop EMF control packet to simulate NOx reductions from Model Rule limits)

↓  
Perform GN SIP air quality modeling (2011 platform with 2023 future year projection)

### Calculate Control Costs

**Status:** Developing estimates

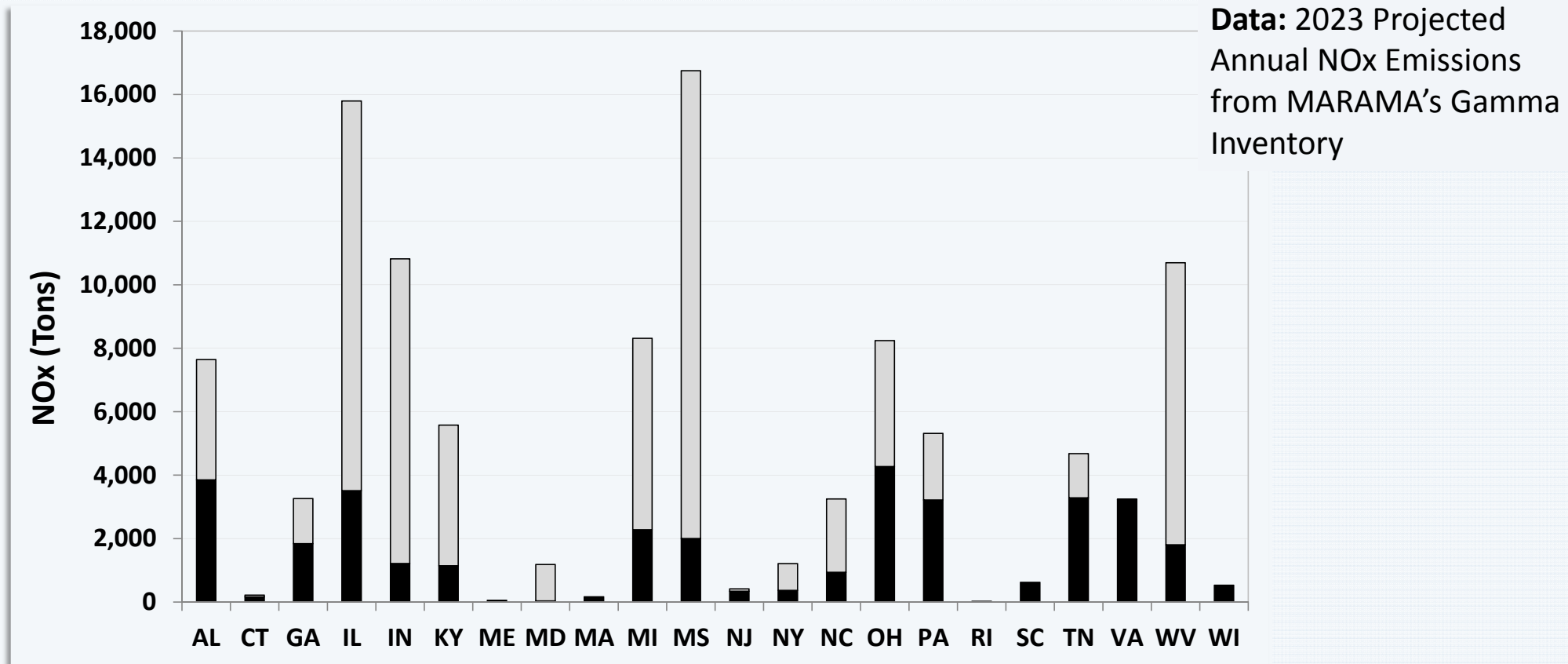
Reviewing “Mojave Desert AQMD IC Engine NOx RACT Staff Paper” & cost information from other states

### Document Process & Results

**Status:** In progress

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

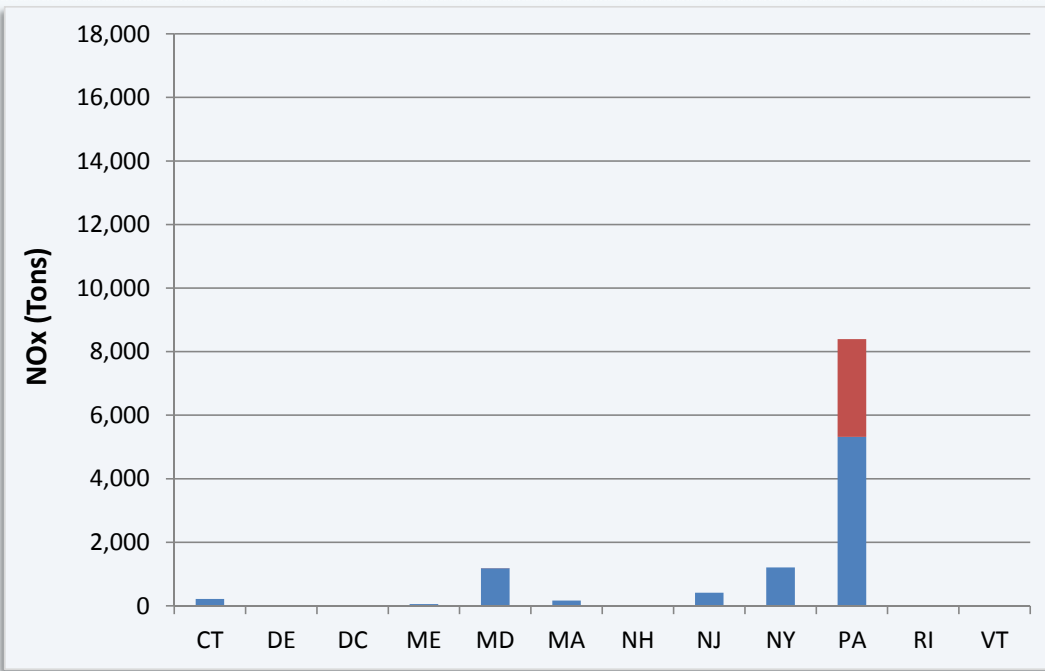
# NOx Emissions from NG Pipeline Compressor Prime Movers (Point)



■ Matched = emissions from units where a corresponding permit limit (or default value, e.g. based on AP-42) was available to compare with applicable model rule limit with confidence

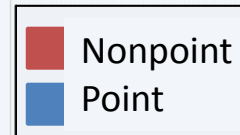
■ Unmatched = emissions where permit data has not been collected/is not available & a direct comparison cannot be made

# NOx Emissions from NG Pipeline Compressor Prime Movers

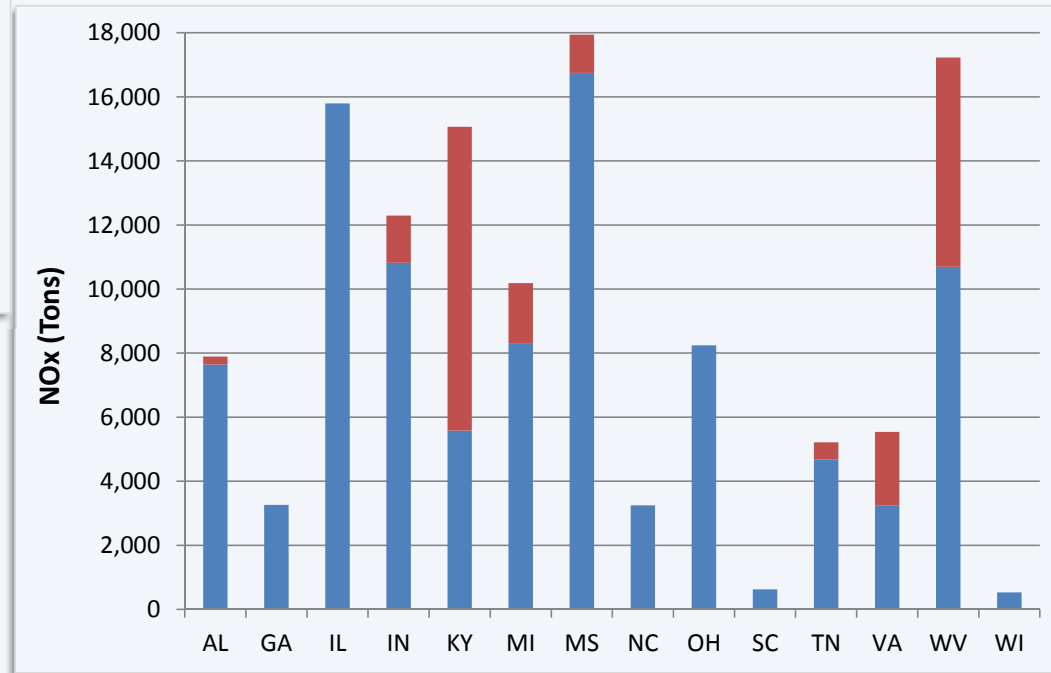


**Data:** 2023 Projected Annual NOx Emissions from MARAMA's Gamma Inventory

MANE-VU States



Other Modeling Domain States (except partial states)



# OTC Model Rule on Natural Gas Pipeline Compressor Fuel-Fired Prime Movers

## Four-Stroke Rich Burn ICE

| Nameplate Rating in HP | NOx Rate in g/BHP-hr<br>(% 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<br>(% 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<br>(% Reduction) |
|------------------------|---------------------------------------|
| 200 - 499              | 2.0 (80)                              |
| 500 - 1999             | 1.5 (80)                              |
| ≥2000                  | 1.5 (90)                              |

## Combustion Turbines

| Nameplate Rating in HP<br>(MW) | NOx Rate in ppmvd @ 15% O <sub>2</sub><br>(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)  |

# Addendum to 2018 SAS Charge

OTC SAS Committee to perform technical analysis of potential strategies identified below to assist OTC states in developing cost-effective strategies to reduce ozone-forming pollutants as required by the CAA:

- Information from the separate analyses recently conducted by CT, DE, MD, ME, and NJ
- Data needed to perform episodic modeling run(s) on the impact of 2017 daily NO<sub>x</sub> emissions from EGUs that report to EPA's Clean Air Markets Division and are located in the CSAPR U and the OTC states.
- Evaluation of a new cost effectiveness metric based on the ratio of the Daily Emissions Reduction (tons/day) to the Annualized Cost (in million \$).

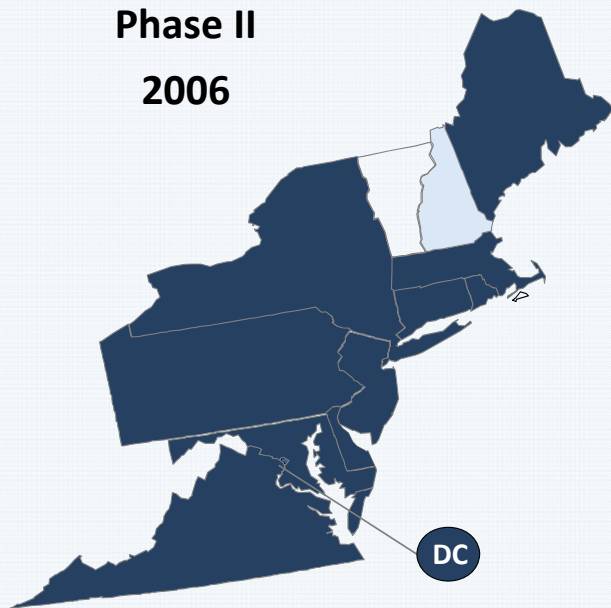
The analysis must be completed and presented to the Air Directors by the 2018 Fall OTC Air Directors' Meeting.



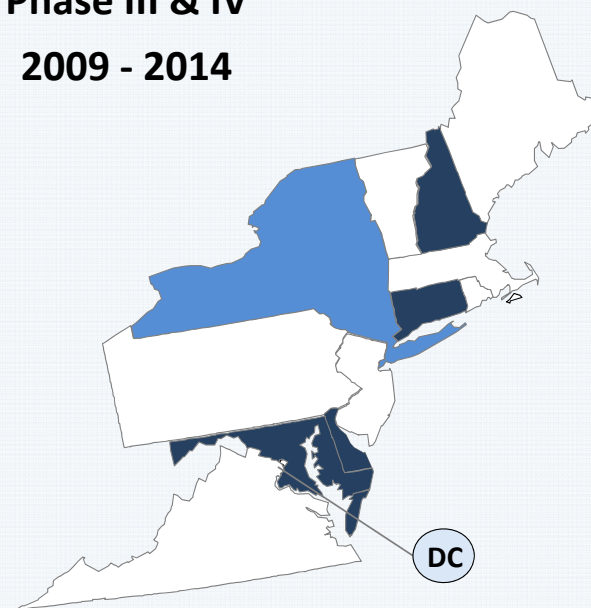
# BONUS SLIDES

# Adoption of OTC Model Rules on Consumer Products (As of Jan. 2018)

Phase II  
2006



Phase III & IV  
2009 - 2014



- Adopted / Similar Rule
- To be adopted soon
- Under review / development

# Phase V Consumer Products Model Rule - Product Categories

## New

- Astringent/Toner
- Anti-seize Lubricant
- Cutting or Tapping Oil
- Gear, Chain or Wire Lubricant
- 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

- 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
- Insect Repellent Aerosol
- Multi-purpose Lubricants
- Metal Polish or Cleanser
- Odor Remover/Eliminator
- Penetrant
- Sealant or Caulking Compound
- Spot Remover

**Not in CARB:** Automotive Windshield Cleaner @ 35% VOC

## Provisions:

- Defined Sell-through Period vs Unlimited Sell-through
- Optional prohibition for MeCl/Perc/TCE in Brake Cleaner

# Uncontrolled Coal-Fired EGUs: NOx Reduction from Implementing GN SIP Strategy

| 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                    |
| <b>MANE-VU Total</b> | <b>31,456.33</b>                         | <b>30,912.67</b>     | <b>543.66</b>           |
| <b>LADCO Total</b>   | <b>74,115.70</b>                         | <b>56,229.49</b>     | <b>17,886.21</b>        |
| <b>SESARM Total</b>  | <b>106,962.25</b>                        | <b>84,436.25</b>     | <b>4,755.59</b>         |

Results from Eastern Regional Technical Advisory Committee (ERTAC) Run – now being used in modeling

IL, IN, MI, MN, OH, WI

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

## 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                |
| <b>LADCO Total</b> | <b>74,115.70</b>                         | <b>56,229.49</b>     | <b>17,886.21</b>        |

| 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                  |
| <b>SESARM Total</b> | <b>106,962.25</b>                        | <b>84,436.25</b>     | <b>4,755.59</b>         |

# Uncontrolled Coal-Fired EGUs: Costs & Benefits from Implementing GN SIP Strategy

## Estimated SCR & SNCR Retrofit Control Costs for 2017 Ozone Season (OS) using Sargent & Lundy Method:

| Reduction Technology | Est. OS Total NOx Reduction (tons) | Est. OS 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 <\$10,000/ton |
|----------------------|------------------------------------|---------------------------------|--|--|--|
| <b>SNCR</b>          | <b>23,653</b>                      | <b>22</b>                       | <b>4,011</b>   | <b>3,608 - 11,896,287</b>                                    | <b>57</b>  |
| <b>SCR</b>           | <b>68,020</b>                      | <b>63</b>                       | <b>20,486</b>  | <b>7,594 – 9,745, 272</b>                                    | <b>6</b>   |

- All data (from CAMD/AMPD for CSAPRU & OTC states) & estimates only for OS
- Costs in 2012 dollars
- Annualized capital costs include only capital components, no O&M costs
- Unit-specific OS costs include both capital & O&M costs
- Assumptions:

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

CSAPRU = Cross-State Air Pollution Rule Update

# 2018 SAS Charges

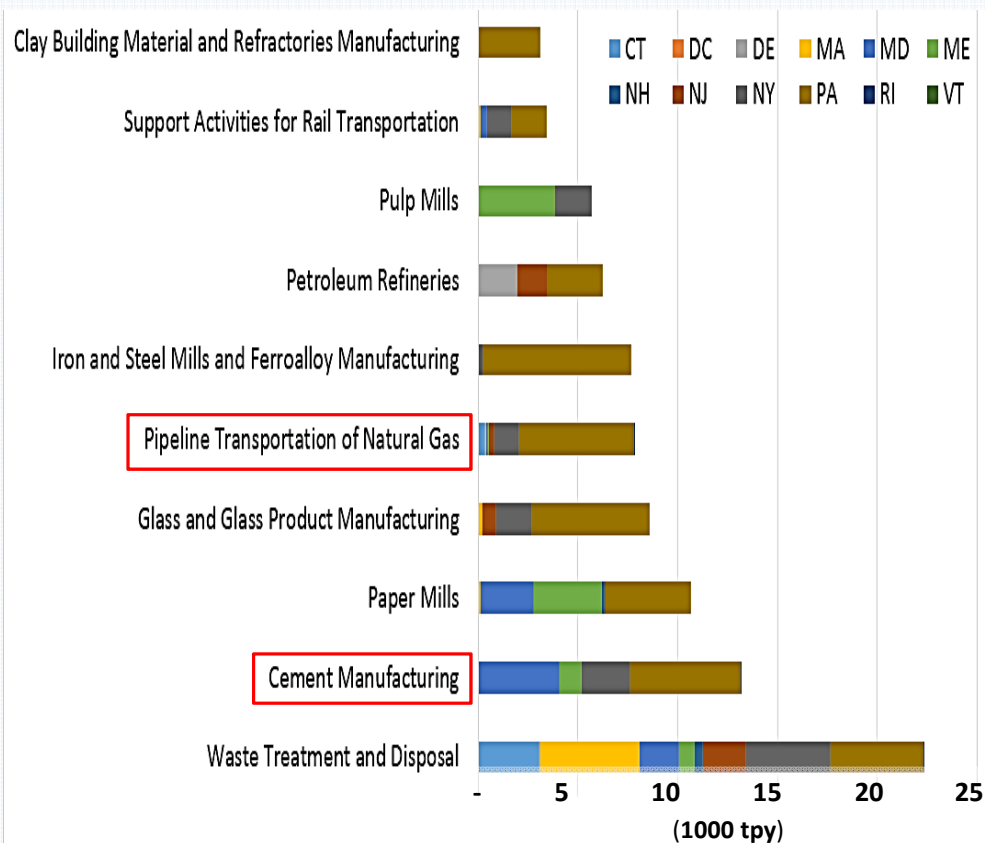
**Charge:** ...perform technical analyses to help OTC states pursue legally supportable cost-effective strategies to achieve reductions of ozone-forming pollutants and satisfy CAA requirements.

Calculate & document emissions reductions inside & outside of the OTR for the recommended SAS GN SIP strategies:

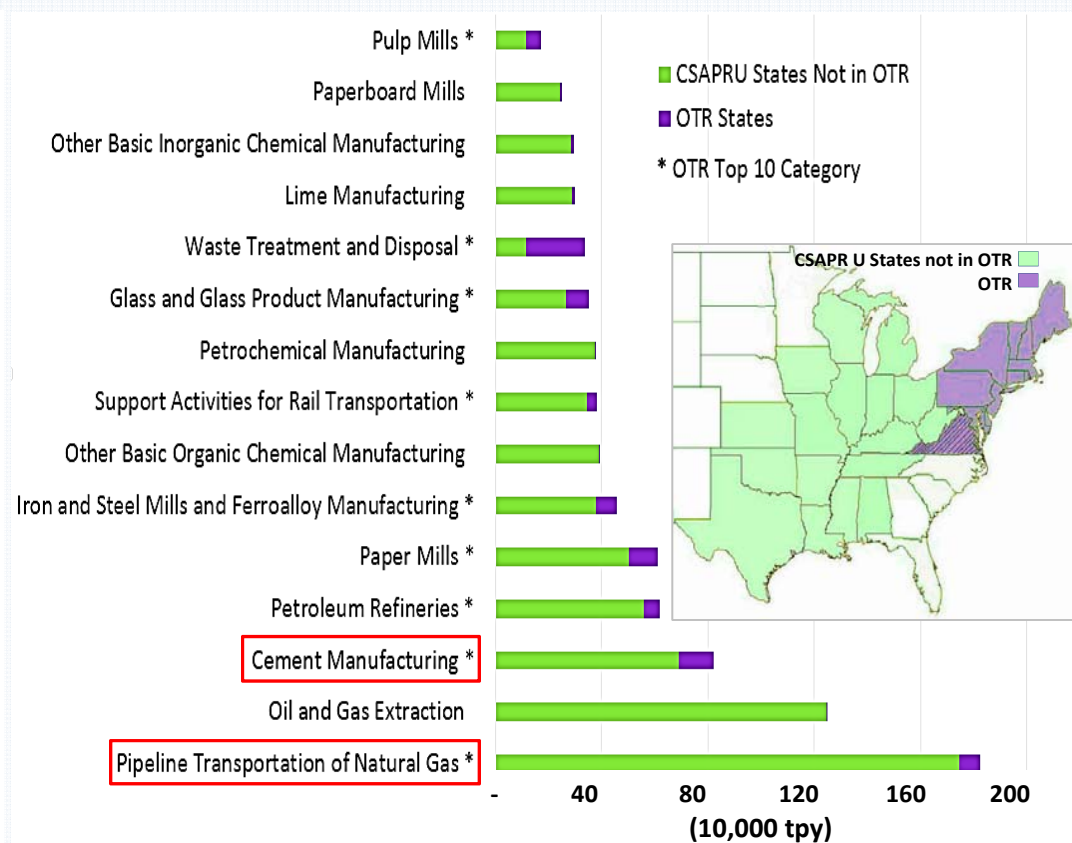
| GN SIP Strategies  | Deliverables                 |                         |                            |
|--|------------------------------|-------------------------|----------------------------|
|  | Quantify Emissions Reduction | Calculate Control Costs | Document Process & Results |
| Coal-fired EGUs: <ul style="list-style-type: none"> <li>• <u>Poorly controlled</u>: Optimize use of existing SCR / SNCR NOx control technology each day of ozone season</li> <li>• <u>Uncontrolled</u>: Install SCR / SNCR control technology &amp; optimize their use each day of ozone season</li> </ul> | Modeling underway – UMD/MDE  | Completed               | In Progress                |
| NG Pipeline Compressor Prime Movers  | In Progress                  | In Progress             | In Progress                |

# 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