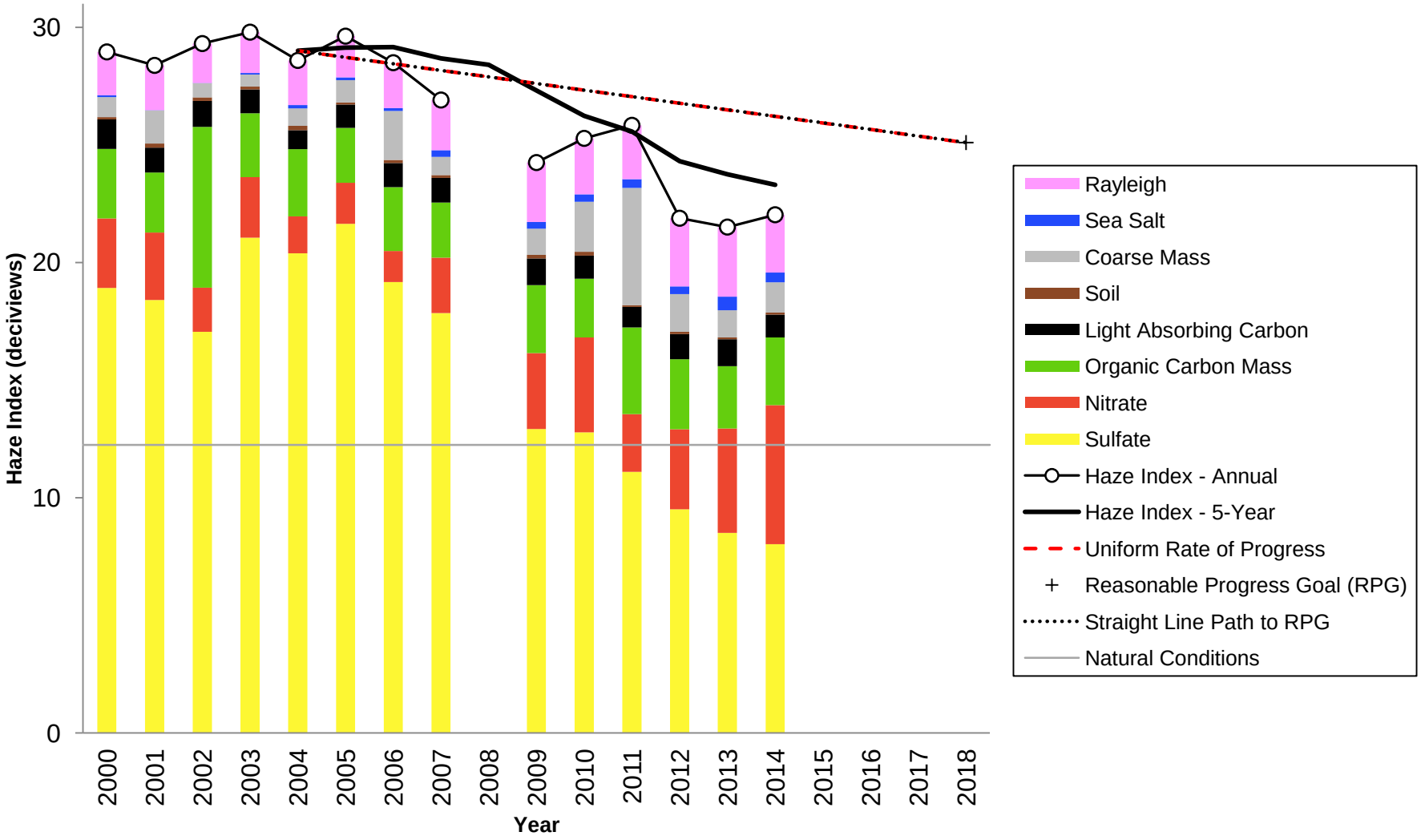
# MANE-VU Technical Support Committee Update

**OTC/MANE-VU Stakeholders Meeting: September 10, 2015**
**Hall of the States, Washington, DC**

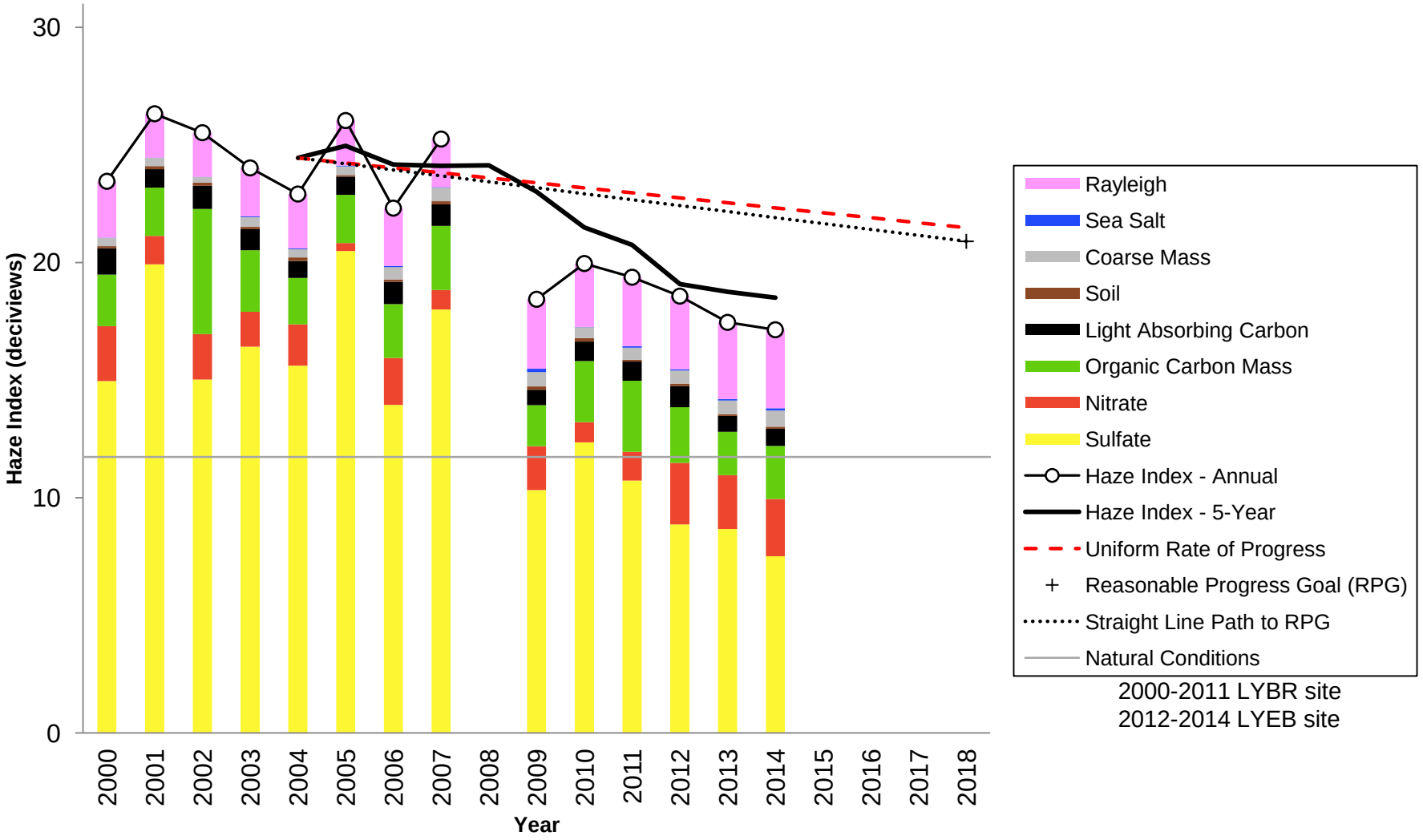
# Overview

1. Updated Visibility Trends
2. Inventory/Modeling
3. Four-Factor Analysis
4. Contribution Analysis
5. CHP Workgroup

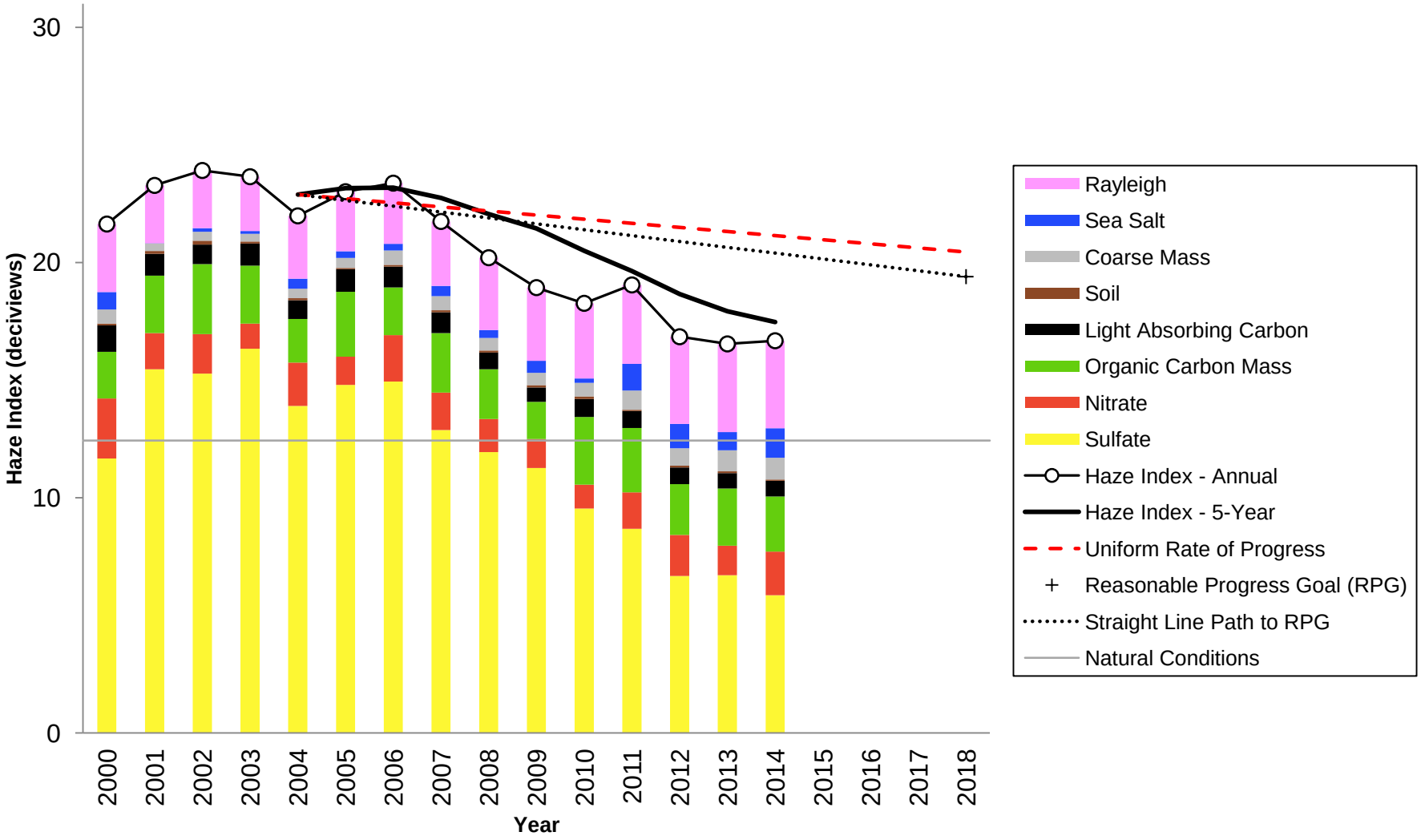
# Visibility Trends in Brigantine, NJ (Worst 20%)



# Visibility Trends in Lye Brook, VT (Worst 20%)



# Visibility Trends in Acadia NP, ME (Worst 20%)



# Inventories

- Regional Haze Inventories
  - 2011 MARAMA Alpha 2
  - 2018 MARAMA Alpha 2 w/2018 EPA mobile
  - 2028 MARAMA Alpha 2 w/2025 EPA mobile
- Status:
  - 2011 is complete
  - 2018 is complete
  - 2028
    - ERTAC EGU v2.3 is complete (may update to v2.4)
    - Draft EMF projections to 2028 are complete (review underway)
    - Need  2025 onroad/nonroad from EPA (expected October)

# Modeling 2011 vs IMPROVE data

- Compare 24-hour average particulate speciation at IMPROVE sites with CMAQ annual 2011 simulation
- $SO_4$, $NO_3$, EC, OC, SOIL, SALT, CM (coarse mass)
- Mass and aerosol extinction ($b_{ext}$)
- Reconstructed fine mass (RCFM) and particulate extinction based on “modified original” light extinction algorithms from the most recent IMPROVE annual report (Hand et al. 2011)

# "Modified original" IMPROVE light extinction

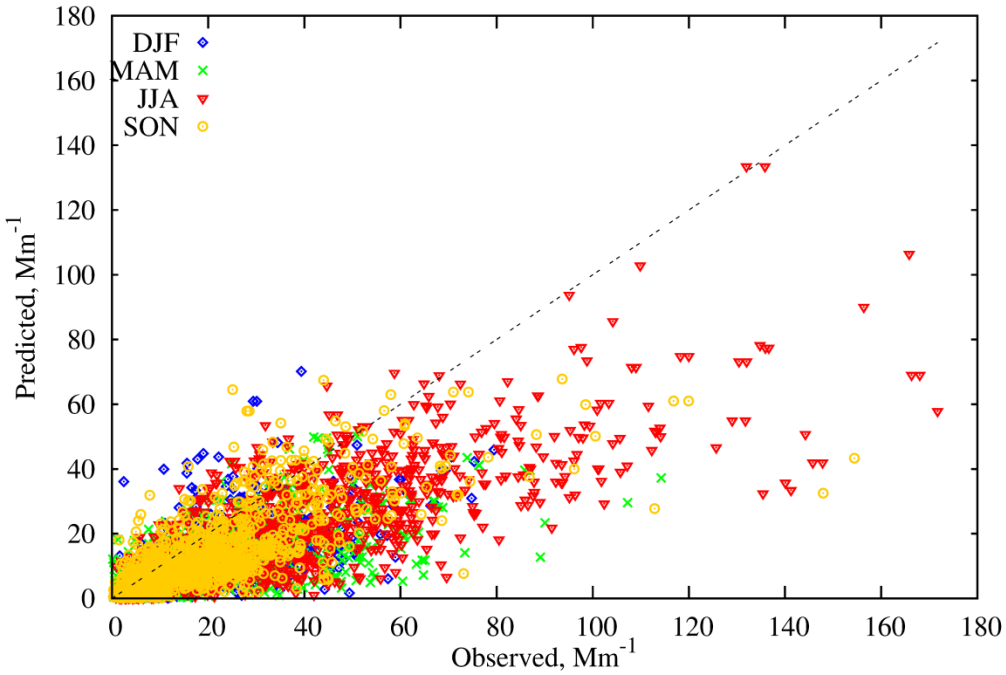
- ***RCFM***: ammonium sulfate + ammonium nitrate + light-absorbing carbon (LAC) + particulate organic matter (POM) + soil + sea salt

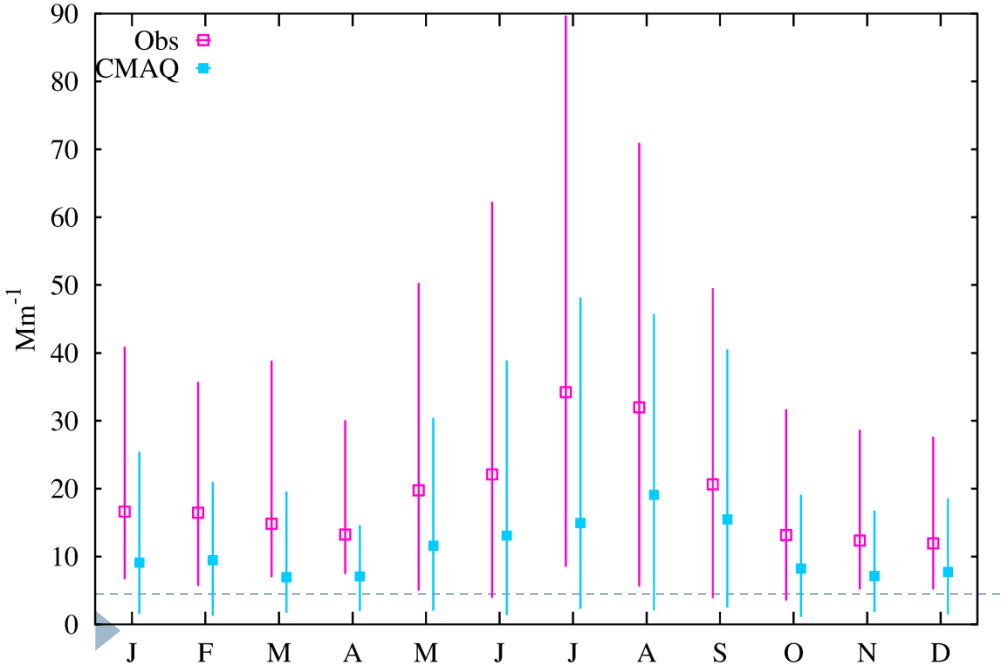
  = $1.375\times SO_4$ + $1.29\times NO_3$ + EC + $1.8\times OC$ + soil + $1.8\times Cl^-$

- $b_{ext}$: extinction due to ammonium sulfate + ammonium nitrate + light-absorbing carbon (LAC) + particulate organic matter (POM) + soil + sea salt + coarse mass (CM)

  = $1.375\times 3xf(RH)\times SO_4$ + $1.29\times 3xf(RH)\times NO_3$ + $10\times EC$ + $1.8\times 4\times OC$ + soil + $1.7\times f(RH)_{ss}\times 1.8\times Cl^-$ + $0.6\times CM$

f(RH) and $f(RH)_{ss}$ are site-specific growth factors for hygroscopic species $SO_4$, $NO_3$, and sea salt



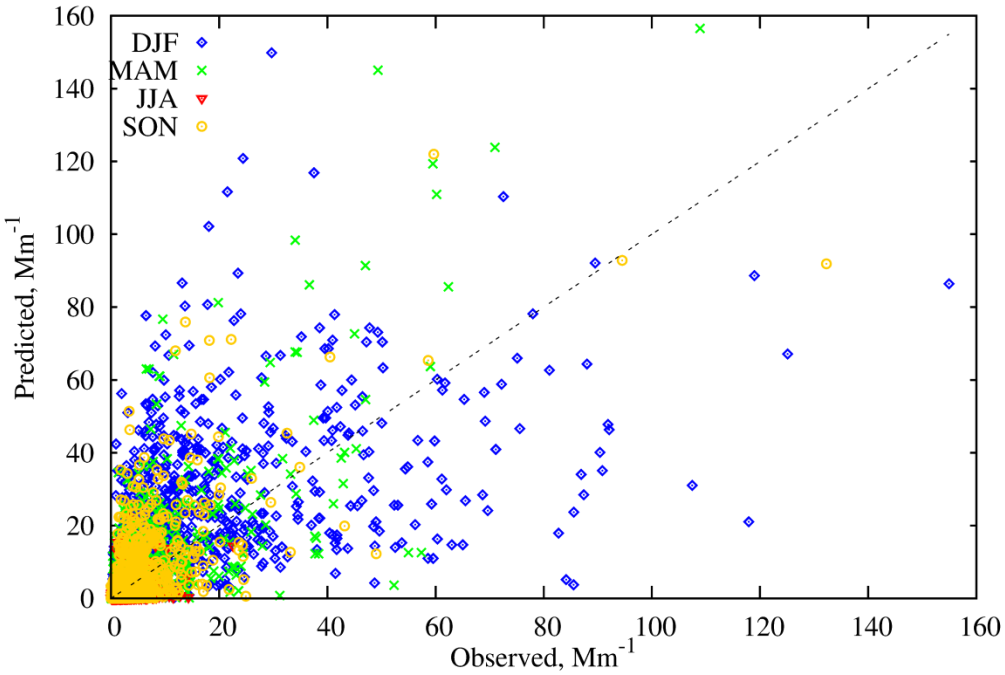



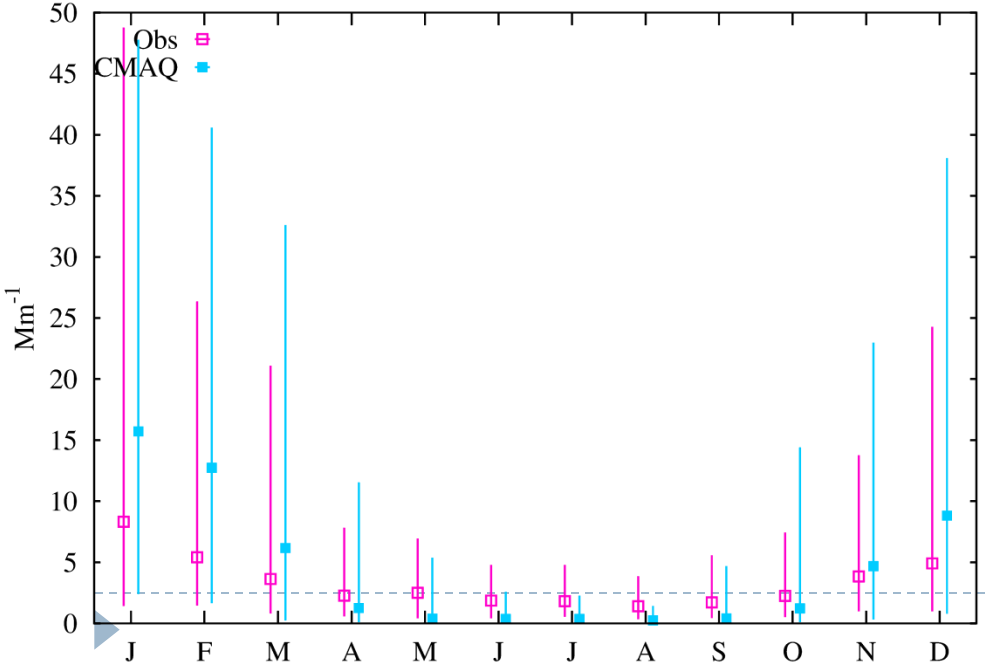

## Extinction due to ammonium sulfate

- Daily average observed vs predicted by season, all sites (top panel)
- Monthly median values with 10$^{th}$%-ile to 90$^{th}$%-ile ranges across all sites (bottom panel)
- Broken line is 1:1

### Seasonal statistics

| | DJF | MAM | JJA | SON |
|---|---|---|---|---|
| MFB, % | -61.9 | -67.0 | -58.9 | -48.3 |
| MFE, % | 69.4 | 75.8 | 68.4 | 63.2 |
| MAGE, $Mm^{-1}$ | 8.52 | 10.46 | 16.31 | 8.45 |



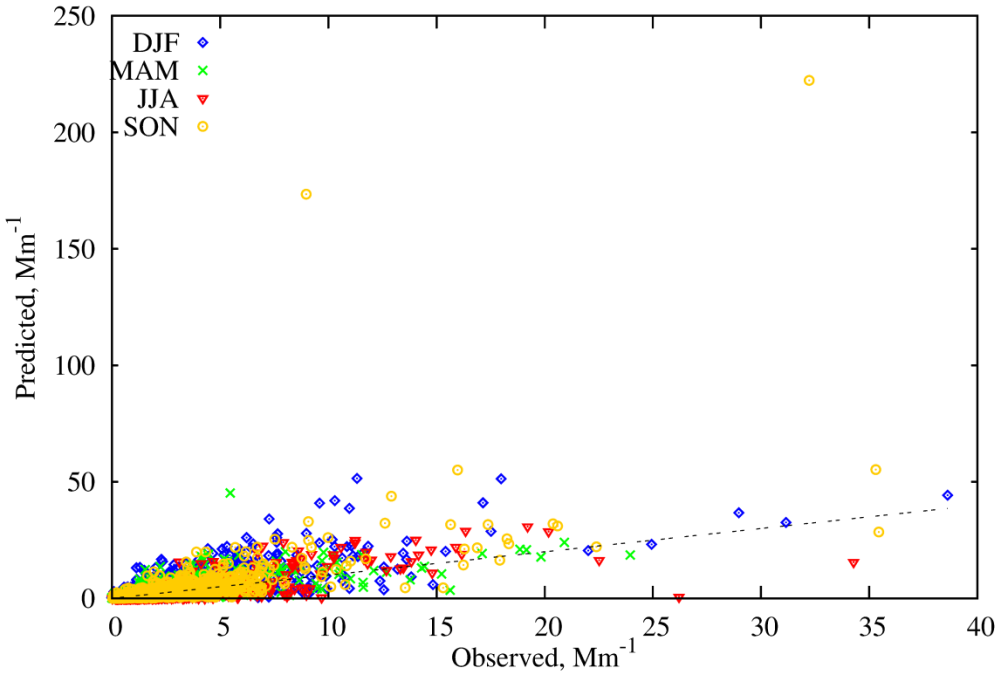



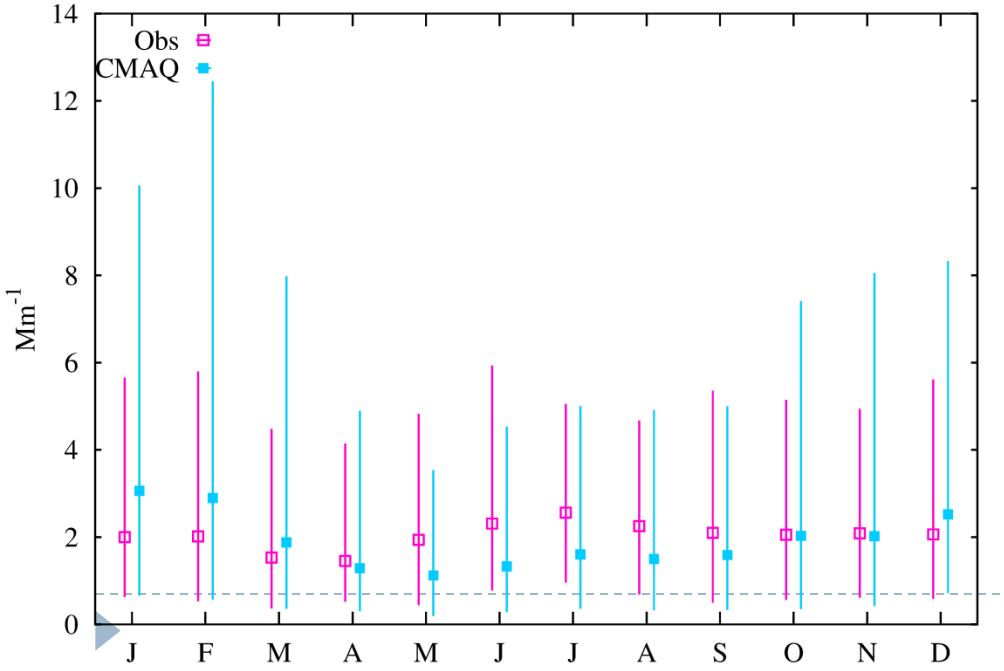

## Extinction due to ammonium nitrate

- Daily average observed vs predicted by season, all sites (top panel)
- Monthly median values with 10$^{th}$%-ile to 90$^{th}$%-ile ranges across all sites (bottom panel)
- Broken line is 1:1

### Seasonal statistics

| | DJF | MAM | JJA | SON |
|---|---|---|---|---|
| MFB, % | 34.0 | -40.9 | -111.7 | -41.1 |
| MFE, % | 84.4 | 101.7 | 128.7 | 100.1 |
| MAGE, μg/m$^3$ | 11.72 | 4.87 | 1.80 | 4.01 |



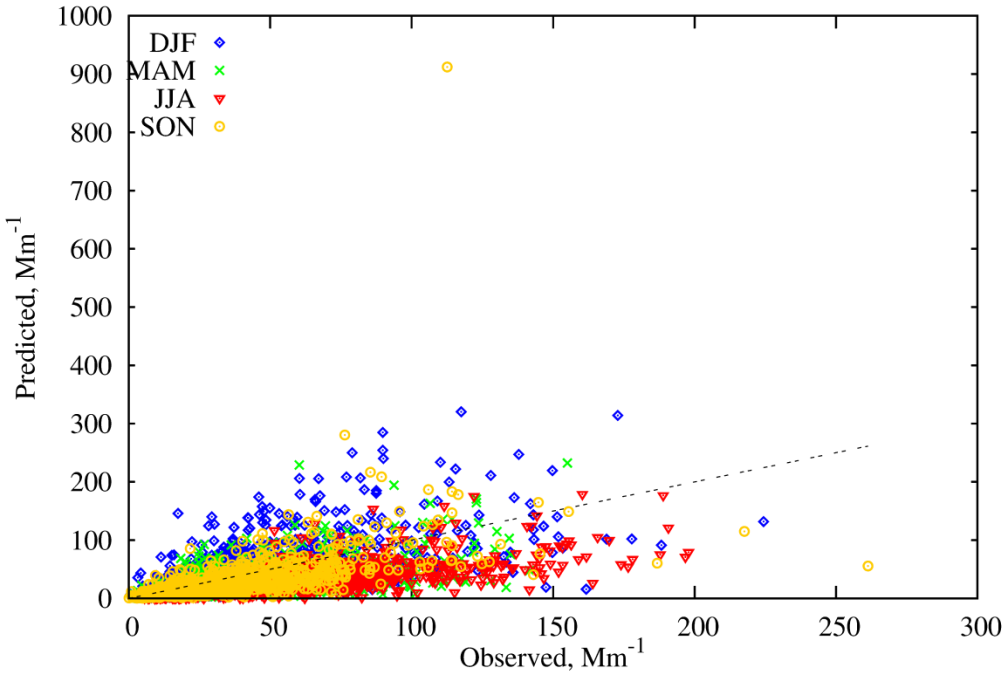



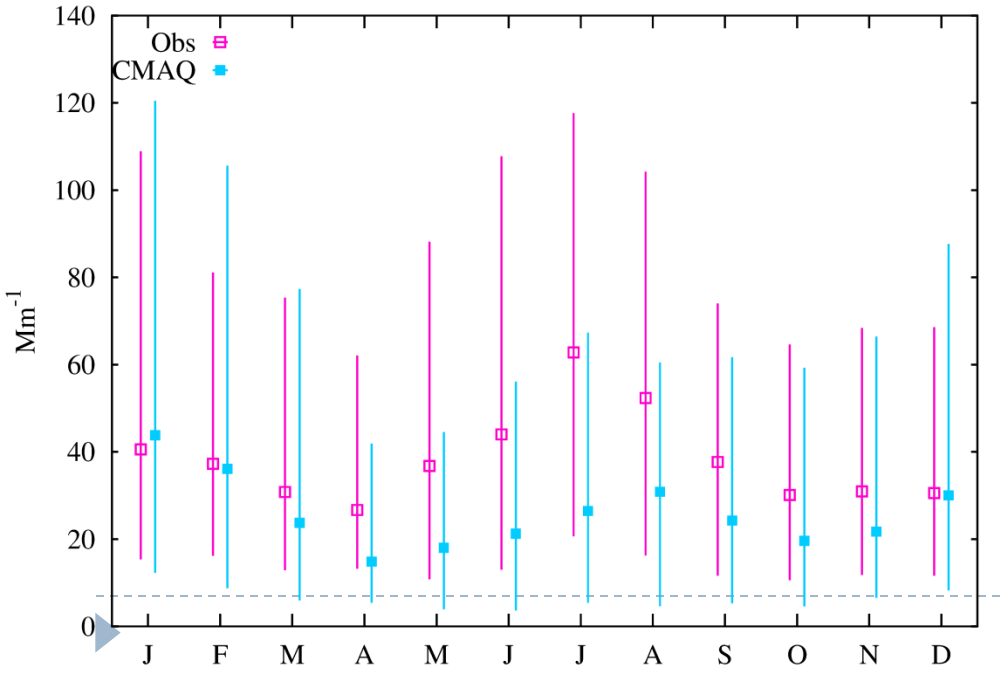

Extinction due to LAC

- Daily average observed vs predicted by season, all sites (top panel)
- Monthly median values with 10$^{th}$%-ile to 90$^{th}$%-ile ranges across all sites (bottom panel)
- Broken line is 1:1

Seasonal statistics

| | DJF | MAM | JJA | SON |
|---|---|---|---|---|
| MFB, % | 31.1 | -13.1 | -43.8 | -8.4 |
| MFE, % | 59.8 | 62.7 | 55.7 | 53.3 |
| MAGE, $Mm^{-1}$ | 2.38 | 1.37 | 1.40 | 1.78 |



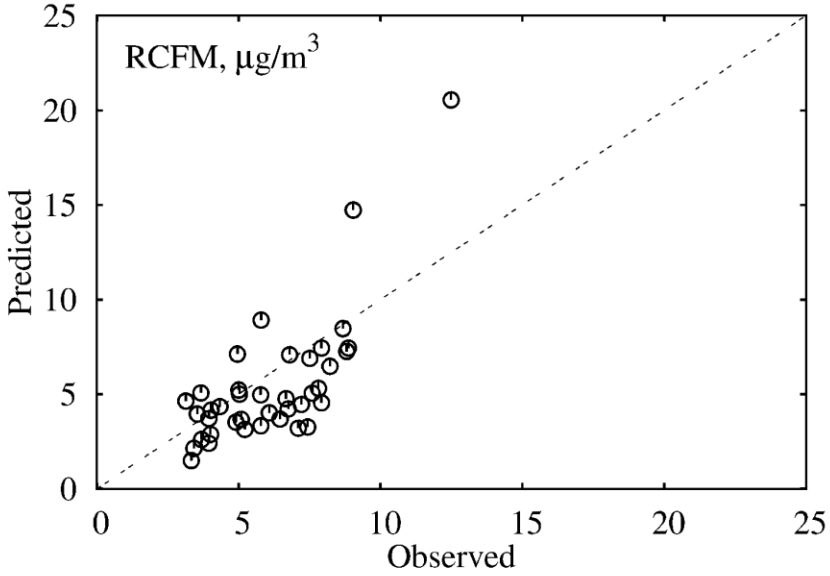



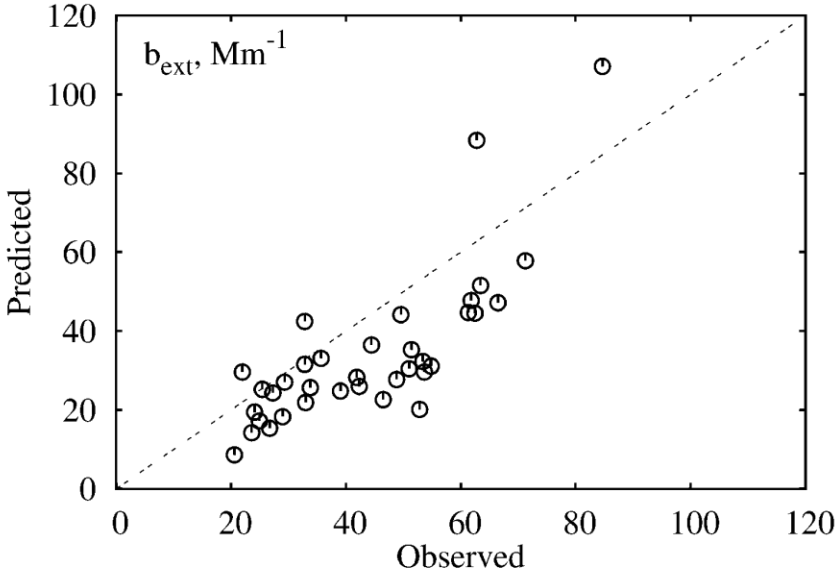

## Total aerosol extinction

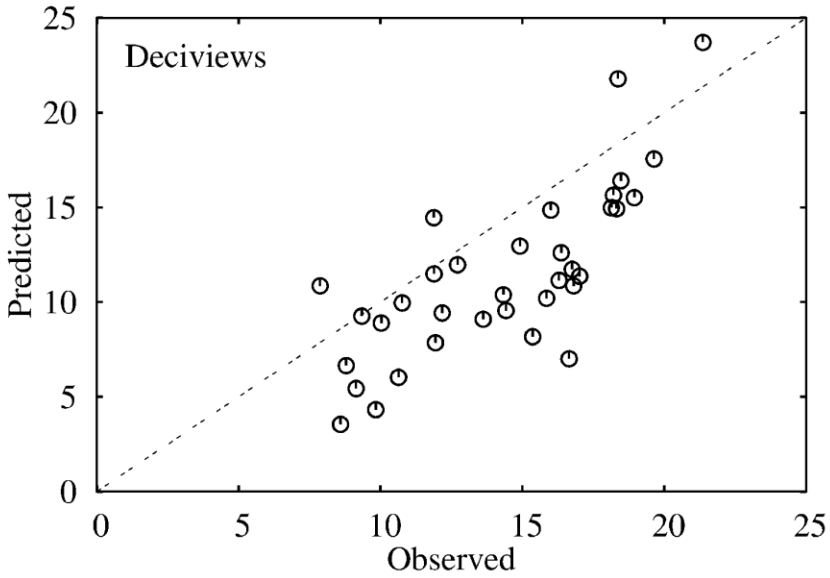
- Daily average observed vs predicted by season, all sites (top panel)
- Monthly median values with 10$^{th}$%-ile to 90$^{th}$%-ile ranges across all sites (bottom panel)
- Broken line is 1:1

### Seasonal statistics

| | DJF | MAM | JJA | SON |
|---|---|---|---|---|
| MFB, % | -2.1 | -48.8 | -71.4 | -37.3 |
| MFE, % | 49.7 | 64.3 | 74.2 | 54.8 |
| MAGE, $Mm^{-1}$ | 22.94 | 19.11 | 28.81 | 16.81 |




Annual average RCFM, $b_{ext}$, and deciviews at IMPROVE sites, 2011

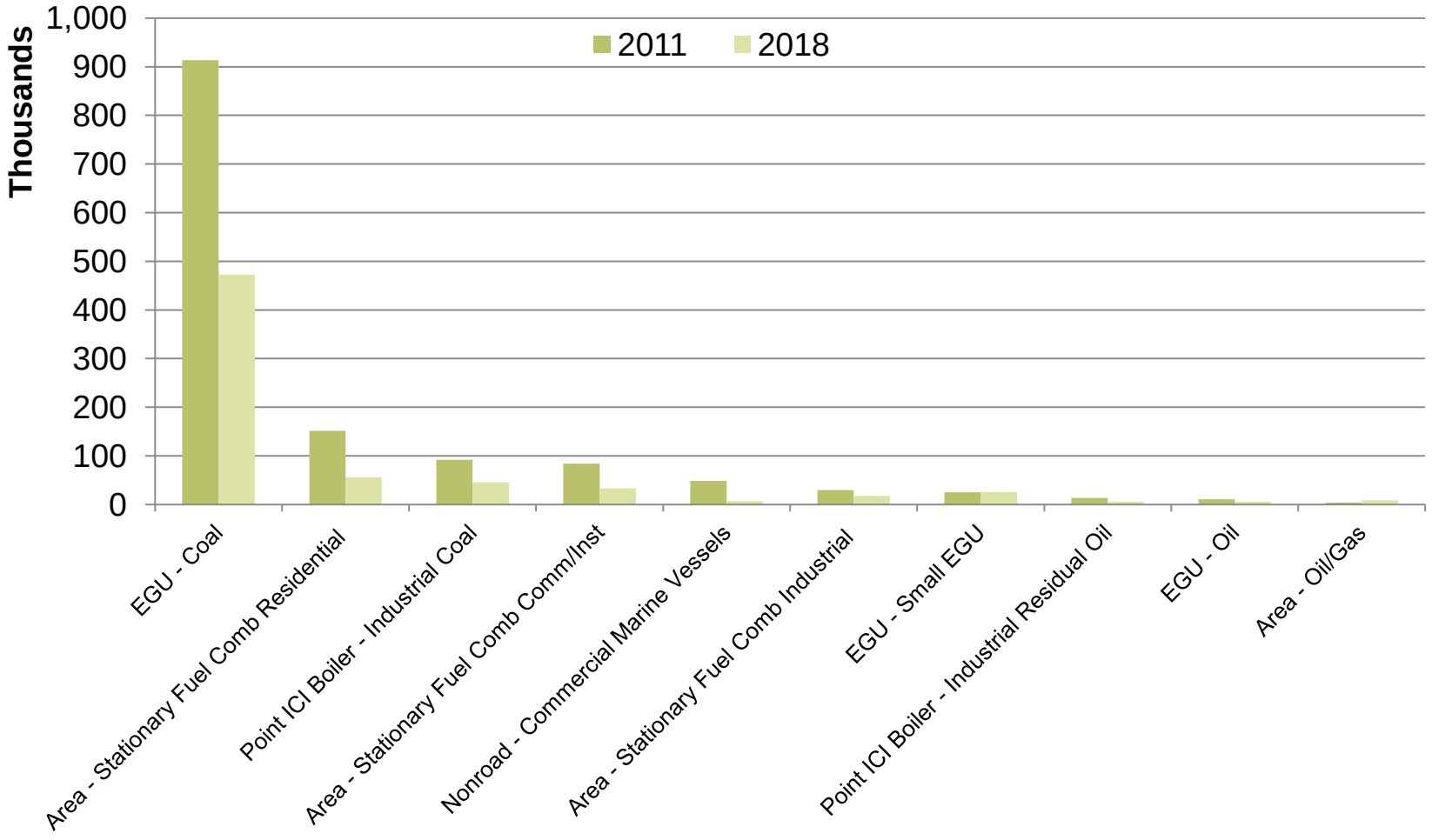
# Modeling Summary

- 2011 Base Case Modeling is complete
- Results adhere to the model performance guidelines outlined by EPA
- Next Steps:
  1. Complete 2028 draft projections
  2. Model 2028 base case using draft inventory
  3. Conduct review process of 2028 modeling

# 4-Factor Inventory Overview

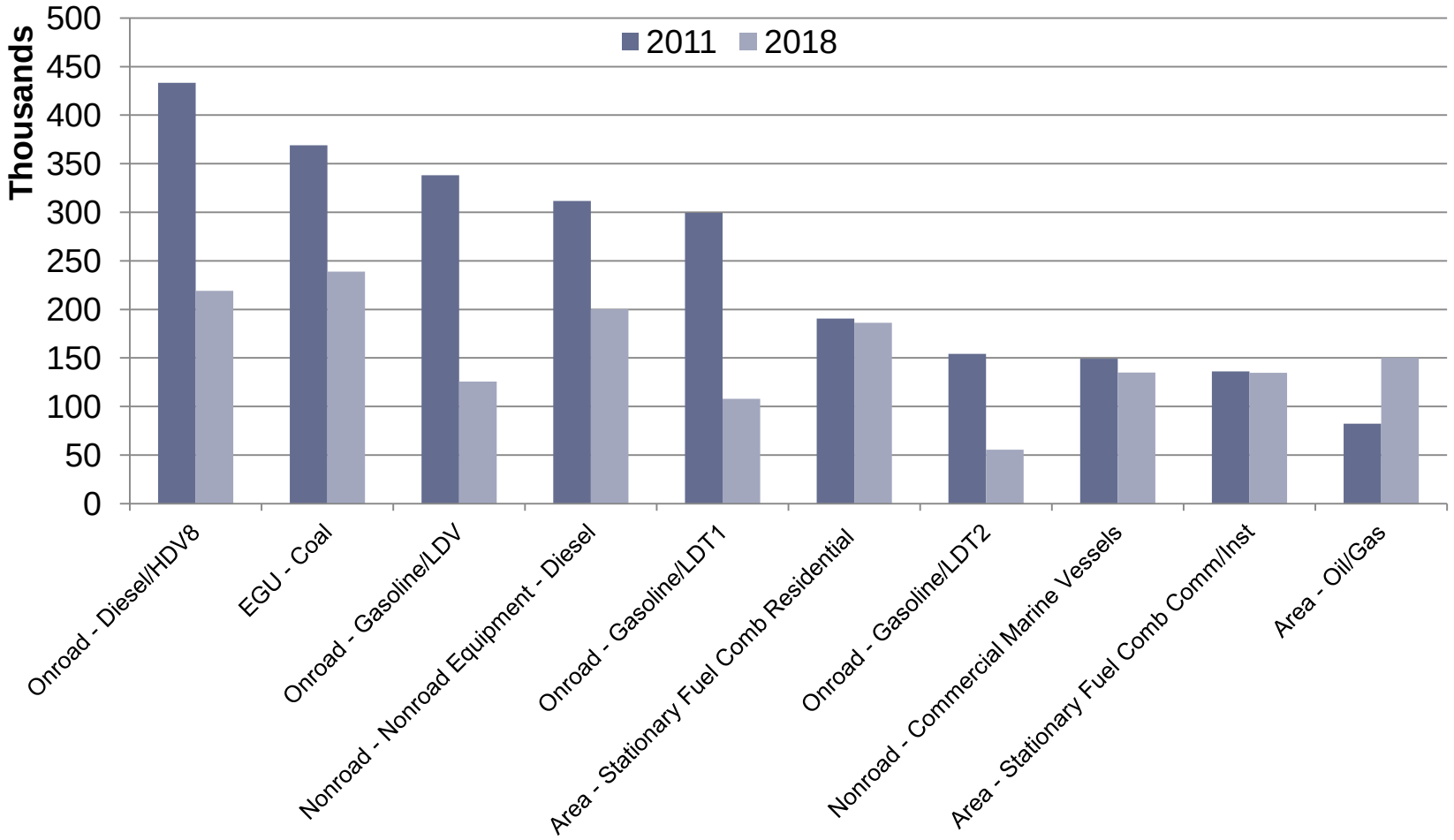
- Examined 2011 and 2018 Inventories
- Used
  - Onroad Mobile: EPA v1
  - ERTAC EGU: v2.3
  - Other Sectors: MARAMA Alpha 2
- Examined emission totals in MANE-VU
- Will be used to influence which sectors get examined in the 4-Factor Analysis

# 4-Factor Inventory: MANE- VU $SO_2$ (Annual Tons)




Top 10 Categories Ordered by 2011 Emissions

# 4-Factor Inventory: MANE-VU $NO_X$ (Annual Tons)




Top 10 Categories Ordered by 2011 Emissions

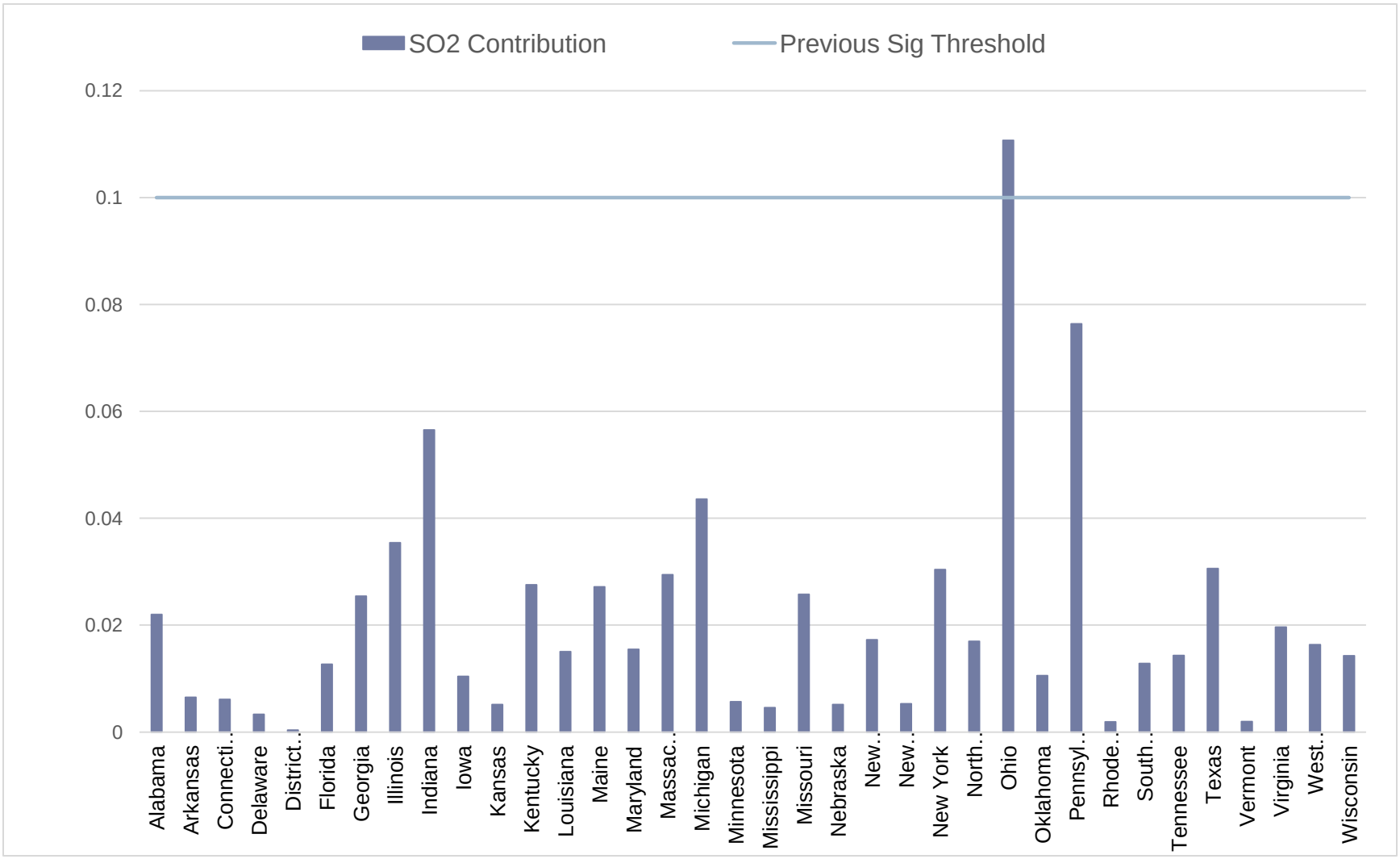
# 4-Factor Next Steps

- Cost factor analysis on inventory sectors
- Documentation

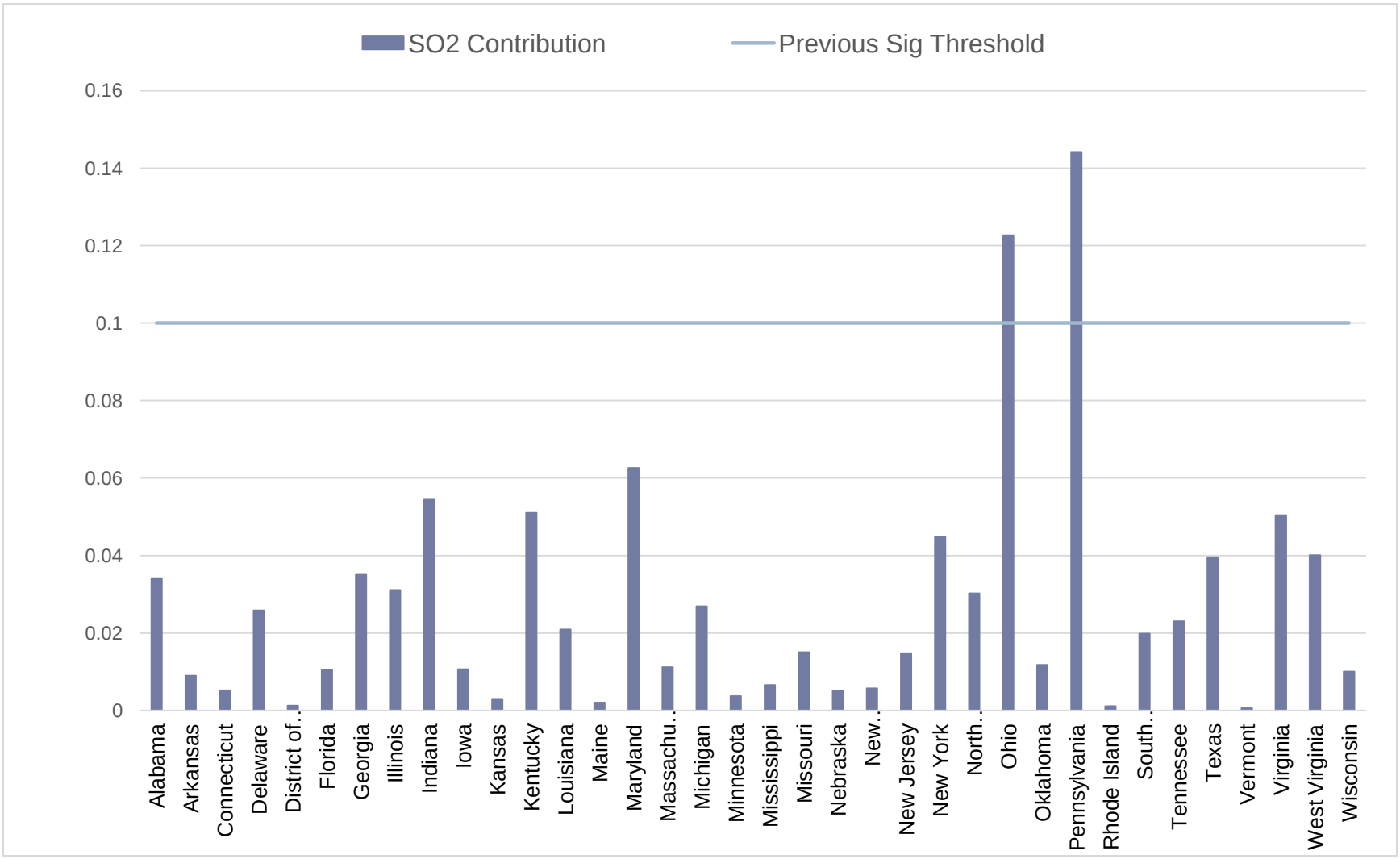
# Adjusted Q/d

- Paper is available on otcair.org under meetings. Accepting comments until October 9, 2015
- Workgroup conducted a Q/d analysis, adjusted by a meteorological factor for Class I sites
- Used the 2011 MARAMA alpha 2 emission inventory
- Relied on similar methodologies to the NESCAUM reports that looked at the 2002 & 2007 inventories
- Intended to inform the consultation process

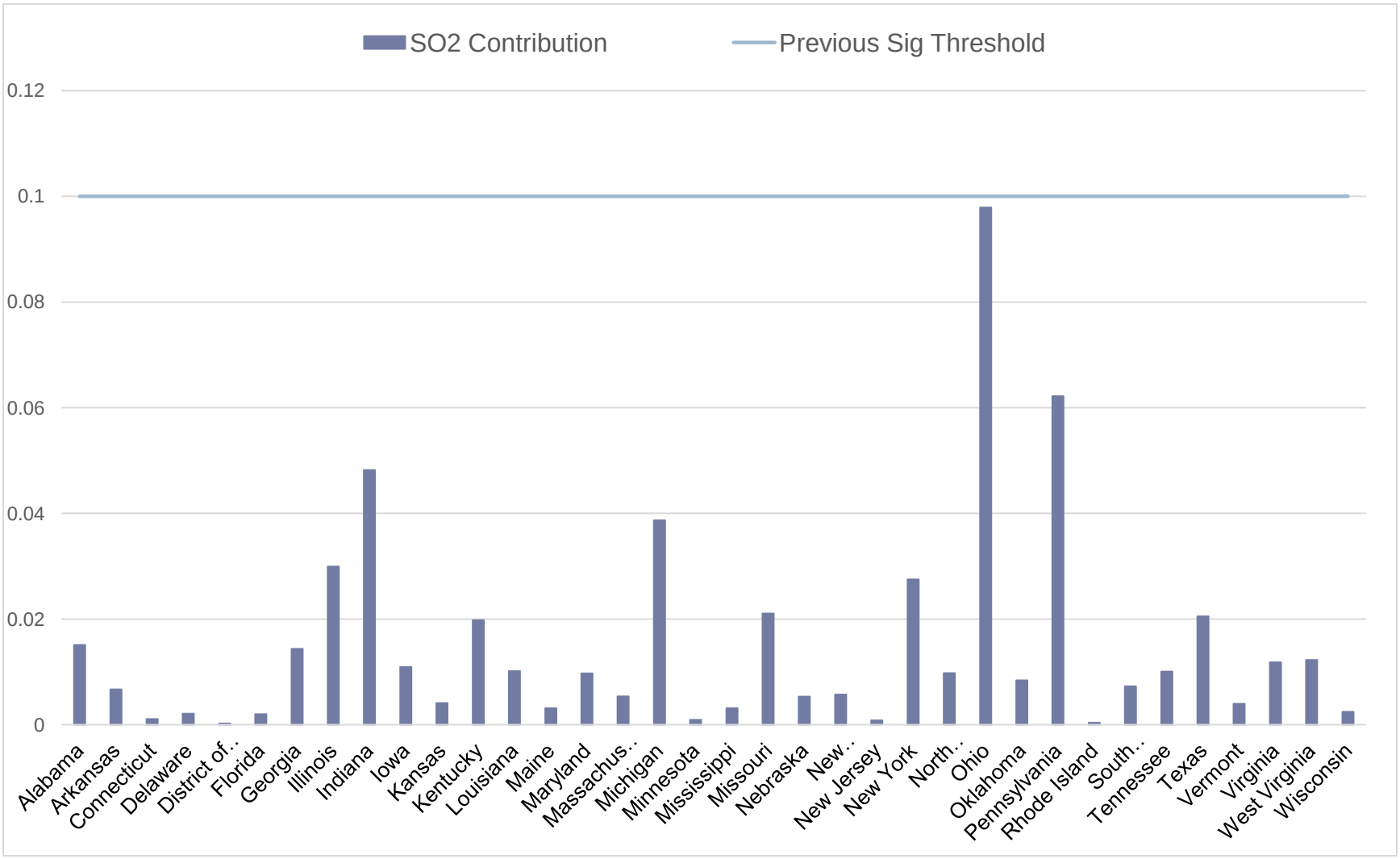
# Acadia $SO_2$ Q/d



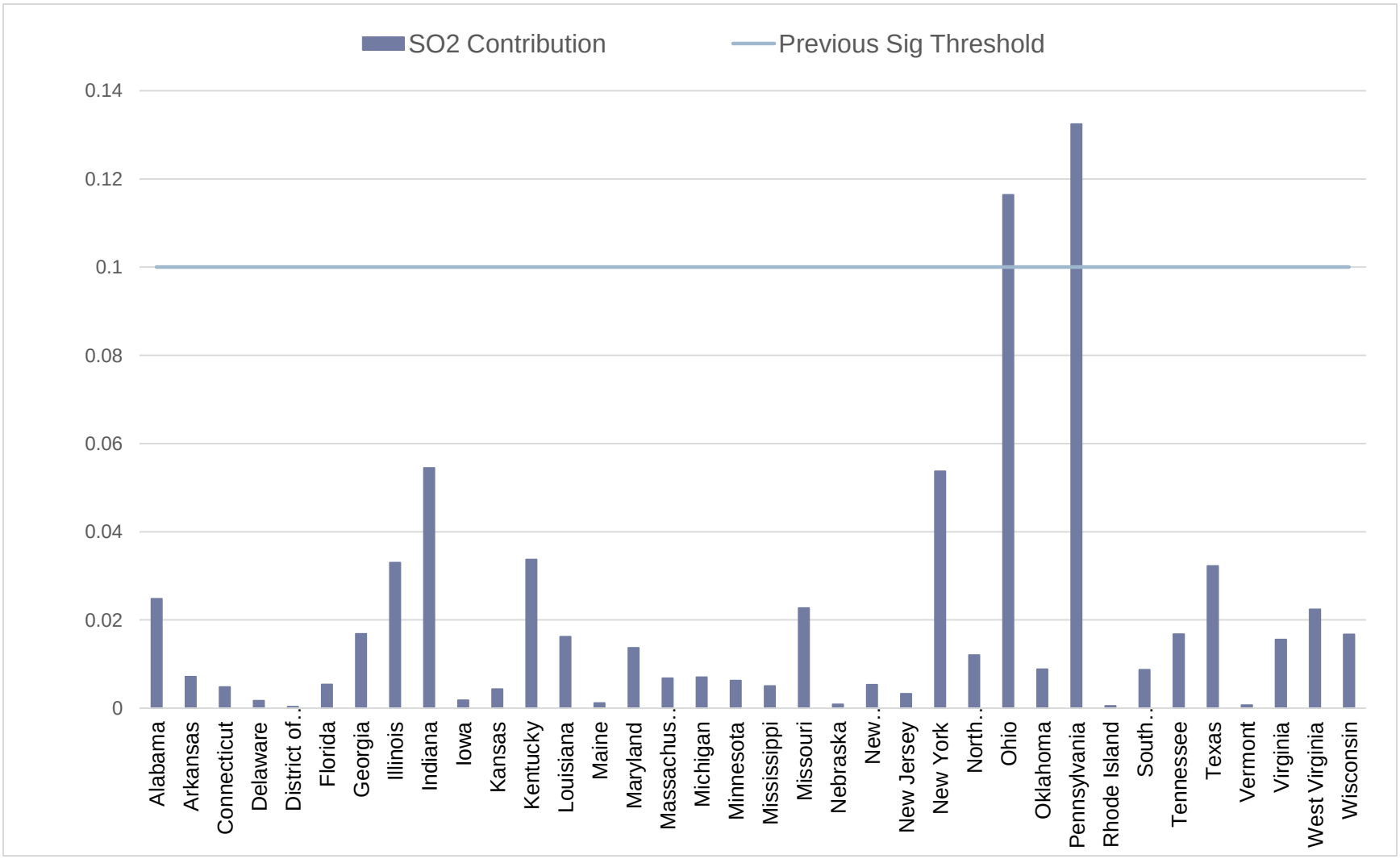
# Brigantine $SO_2$ Q/d



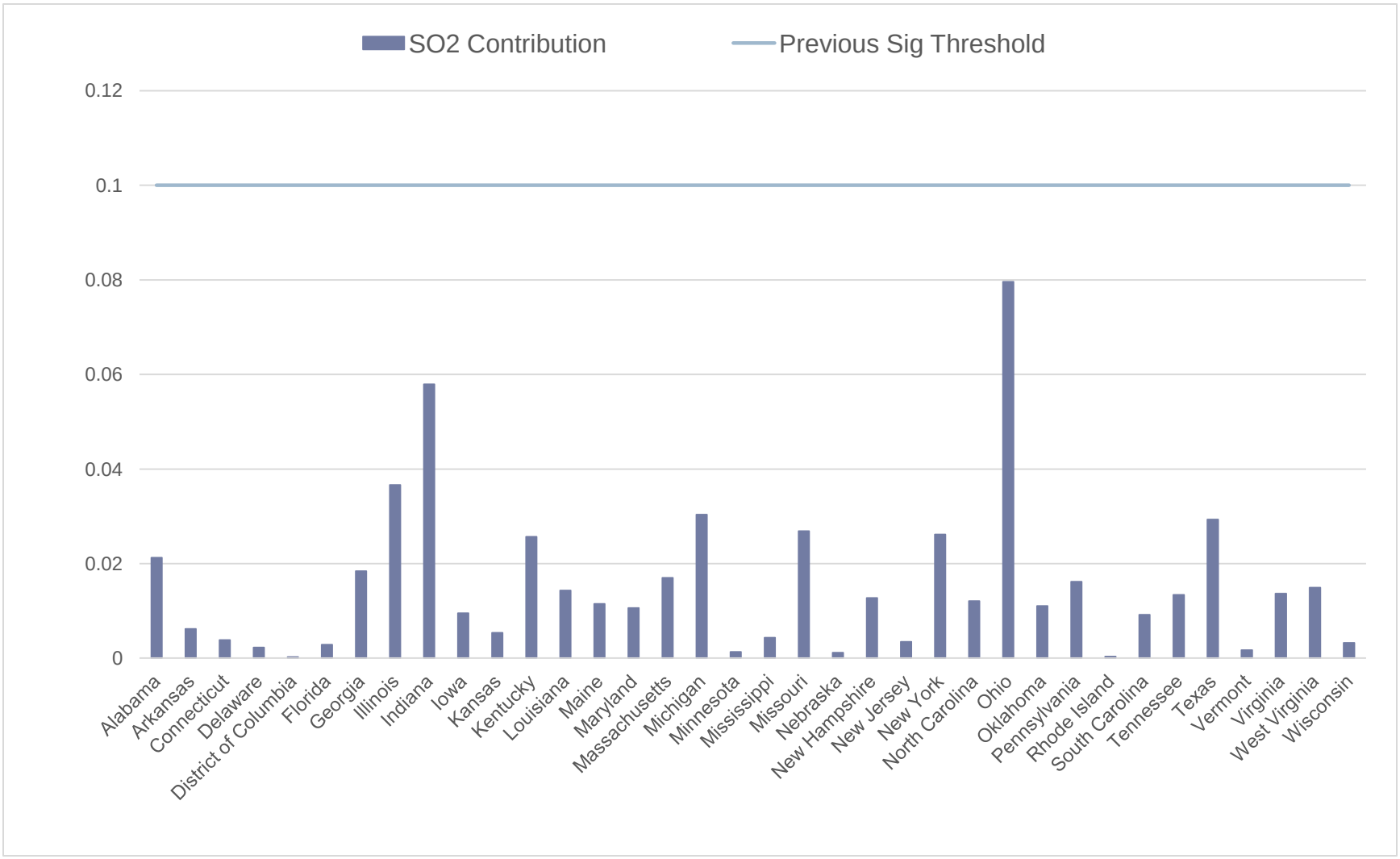
# Great Gulf $SO_2$ Q/d



# Lye Brook $SO_2$ Q/d



# Moosehorn $SO_2$ Q/d



# Regional Haze SIP Planning Schedule

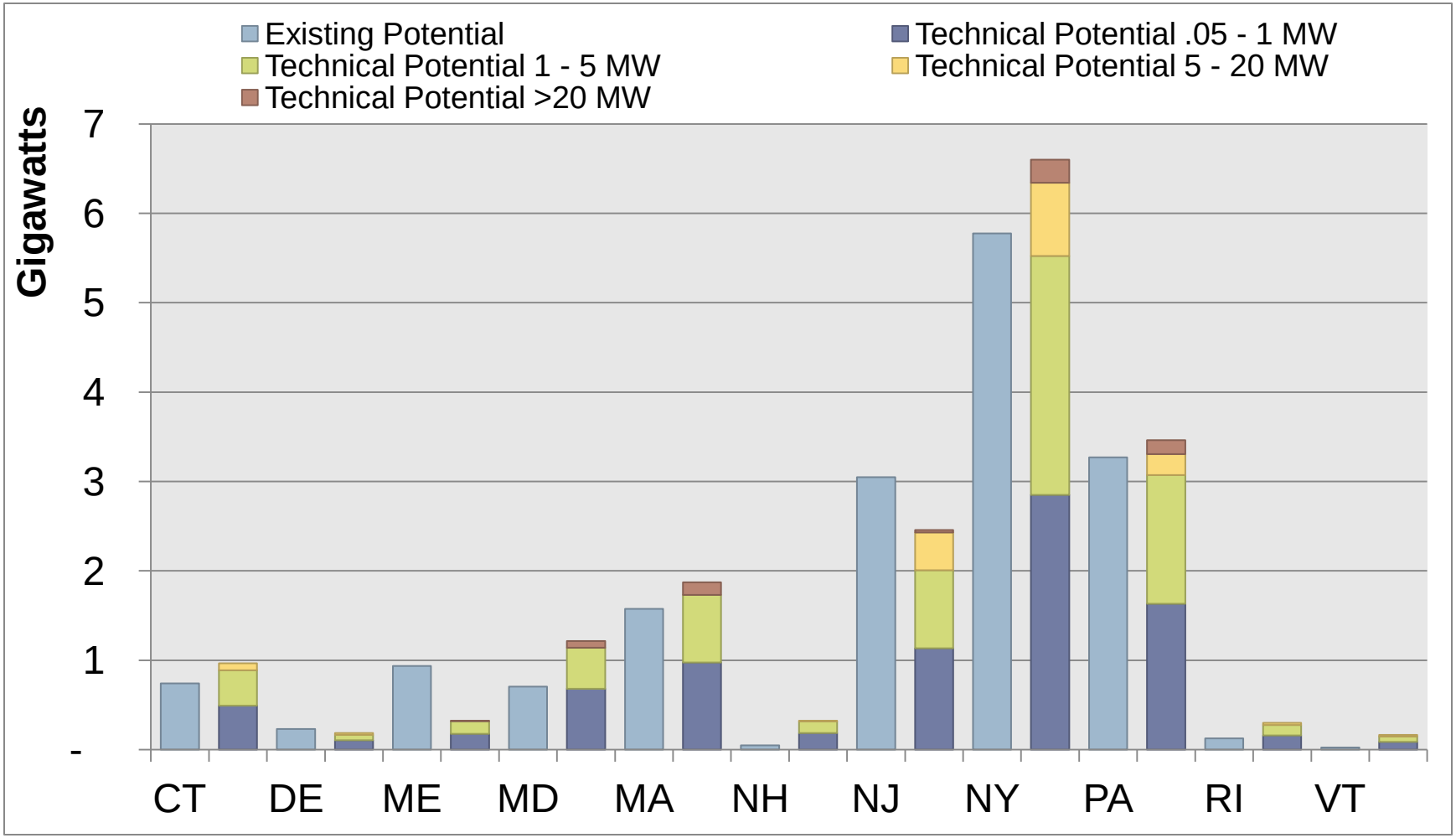
| Regional Activity | Steps | Timeframe |
|---|---|---|
| **Training** | Training | Complete |
| **IMPROVE Data Analysis** | Decisions on Methods | Complete |
| | 2014 Data Availability | Available |
| | Calculations and QA | Fall of 2015 |
| **Inventory Development** | 2028 ERTAC EGU | Complete |
| | 2011 EPA Modeling Inventory | Complete |
| | 2028 EMF Projections of 2018 | Fall 2015 |
| **Photo Chemical Modeling** | 2011 Met Modeling | Complete |
| | 2011 Base Case Modeling | Complete |
| | 2028 Base Case Modeling | Fall 2015 |
| | 2028 Control Modeling | Fall 2016 |
| **Contribution Assessment** | Draft Q/d | Complete |
| | Final | Spring 2016 |
| **RPGS/4 Factor Analysis** | Inventory Analysis of Sectors | Complete |
| | Cost Analysis | ?? |
| | 167 Stack Review | Spring 2016 |
| **Consultation** | | |

# CHP Workgroup

- Accepting comments until October 9, 2015
- CHP, or cogeneration, is are systems that produce both heat and electricity
- Efficiencies:
  - Typical separated system: 45%
  - CHP: 80%
- Installations can increase local emissions of $NO_X$ and $SO_X$, but do lead to reductions offsite through decreased electricity production
- Transmission losses are also decreased since electricity is now produced closer to user

# Existing/Technical CHP Potential in MANE-VU

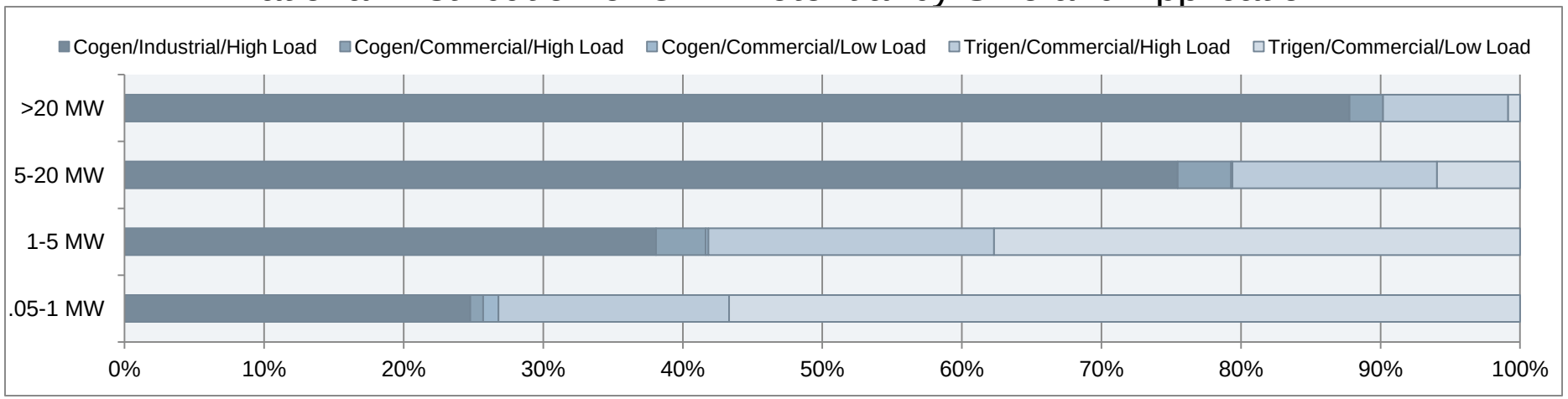
Based on report from ICF on national CHP Applications



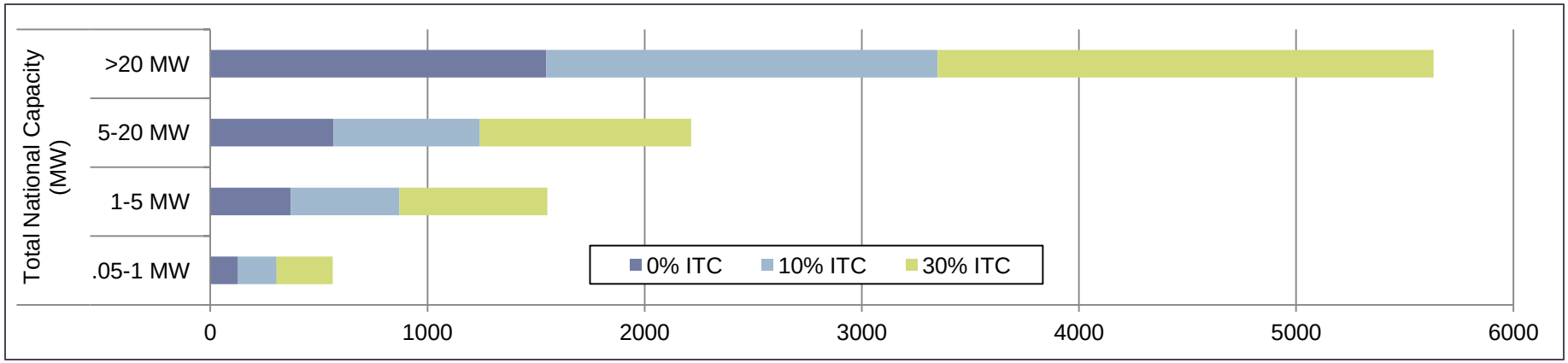

[1] ICF International. "Effect of a 30 Percent Investment Tax Credit on the Economic Market Potential for Combined Heat and Power." October 2010. Accessed October 29, 2014.

# Existing/Technical CHP Potential in MANE-VU

## National Distribution of CHP Potential by Size and Application




## National Distribution of CHP Potential by Economic Scenario

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# CHP Potential Scenarios

- Looked at six scenarios
  1. All technical potential
  2. Only systems less than 5MW
  3. Only systems 5MW and greater
  4. 30% ITC
  5. 10% ITC
  6. 0% ITC

# Methodology: Onsite

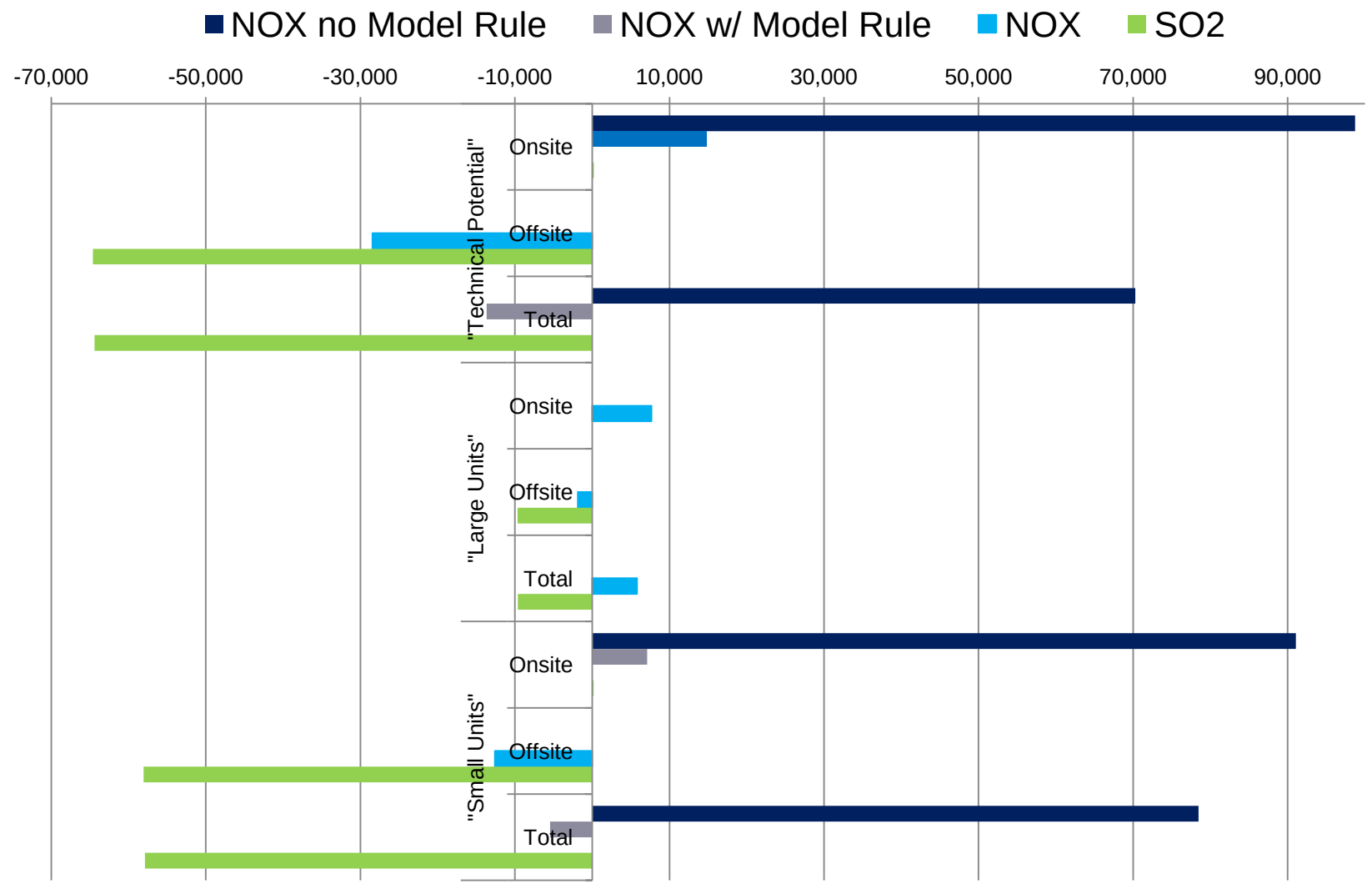
- Estimated distribution of unit sizes for each state's technical potential
- Calculated emission increases due to replacements
- Emission Rates Used:
  - $SO_X$: NY CHP Study
  - $NO_X$:

| Unit Size | DE | NJ | Other States | |
|---|---|---|---|---|
| | | | Case 1 | Case 2 |
| <5 MW | State Reg. | State Reg. | RICE NESHAP | OTC Stationary Generator M.R. |
| 5 - 20 MW | Average of 1. OTC Additional $NO_X$ Control Measures M.R. 2. Combustion Turbine NSPS | | | |
| > 20 MW | Combustion Turbine NSPS | | | |

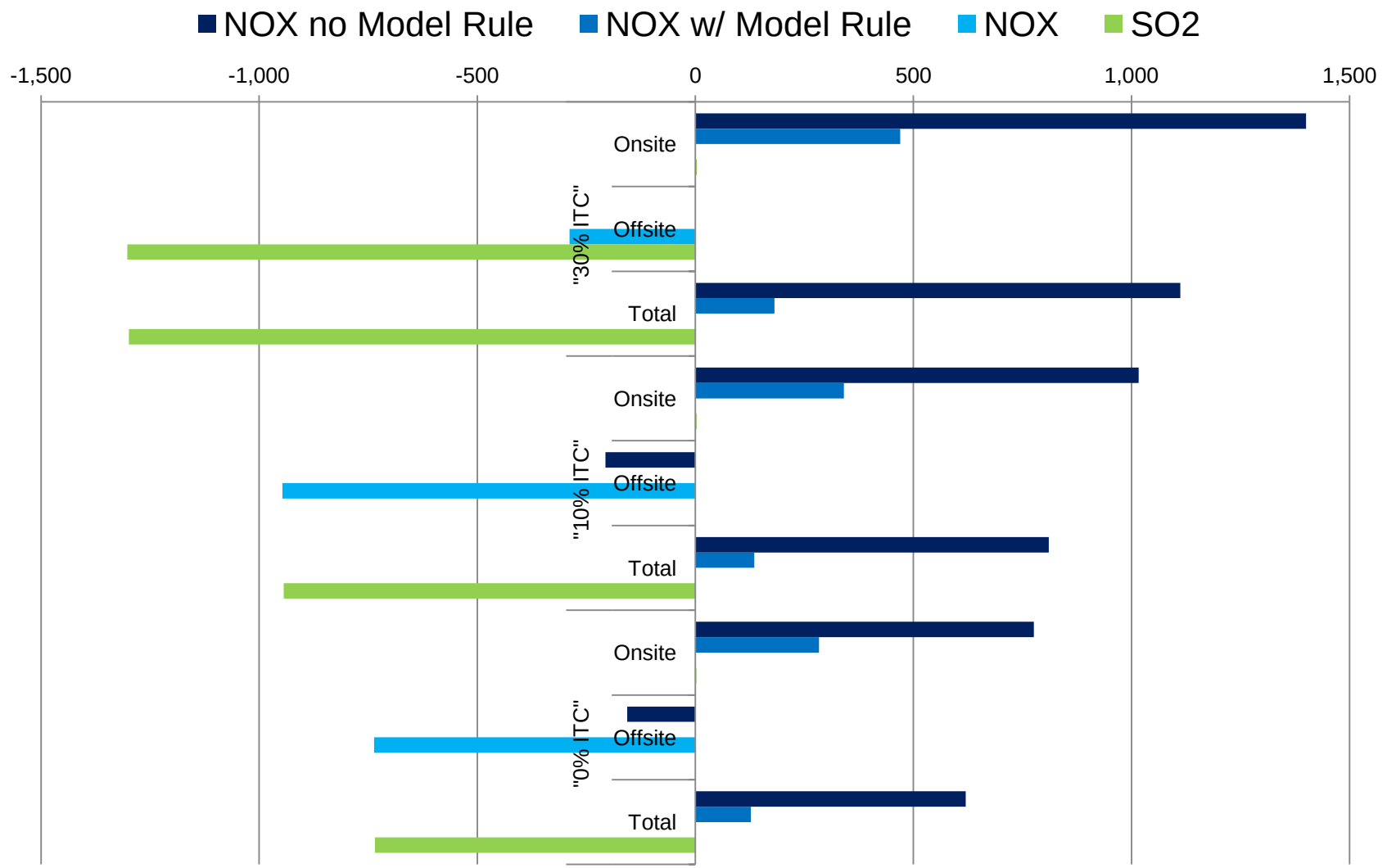
# Methodology: Offsite

- Used ERTAC EGU
- CHP systems were aggregated together as “virtual” new power plants
- Assumptions:
  - Systems would replace generation in the NERC regions:
    - New England for CT,  MA, NH, and VT
    - NY Upstate, NY City, and  NY Long Island for NY
    - Reliability First Corporation East for DC, DE, MD, NJ, and PA
  - Transmission loss is average in Eastern Interconnection
  - CHP systems would replace coal generations, except in NY City and NY Long Island where it would be combine cycle

# Emission Changes of CHP Installations in MANE-VU



# Emission Changes of CHP Installations in MANE-VU



# CHP Summary and Next Steps

- Results
  - CHP installations beneficial for $SO_2$ reductions
  - OTC model rule must be implemented for CHP installations to be beneficial for $NO_X$ reductions
  - Small scale increases in CHP installations result minor $NO_X$ increases
- Next Steps
  - Accepting comments until October 9, 2015 (Paper is available on otcair.org under meetings)
  - Finalize draft of current paper
  - Consider using a more advanced tool such as EPA's AVERT to better focus on marginal EGUs in the region rather than marginal units of one fuel type

# Questions?