EMISSIONS INVENTORY PREPARATION IN MANE VU

Regional Modeling Conference
April 30, 2012
Chicago, Illinois
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Senior Engineer, MARAMA

TOPICS

1. MARAMA Inventories
   - What have we learned about the process?
   - What data is available?

2. Emissions Inventory Analysis
   - What are expected changes in emissions 2007 to 2020?
   - How much would OTC strategies reduce emissions?
   - Plans for trends analysis report for MANE-VU

3. On-Road Mobile - MOVES

4. ERTAC – EGU Forecast
   - How will it work? When will results be available?
   - What issues remain?

5. Plans for using inventory data in future modeling
   - What's available? What makes sense to use?
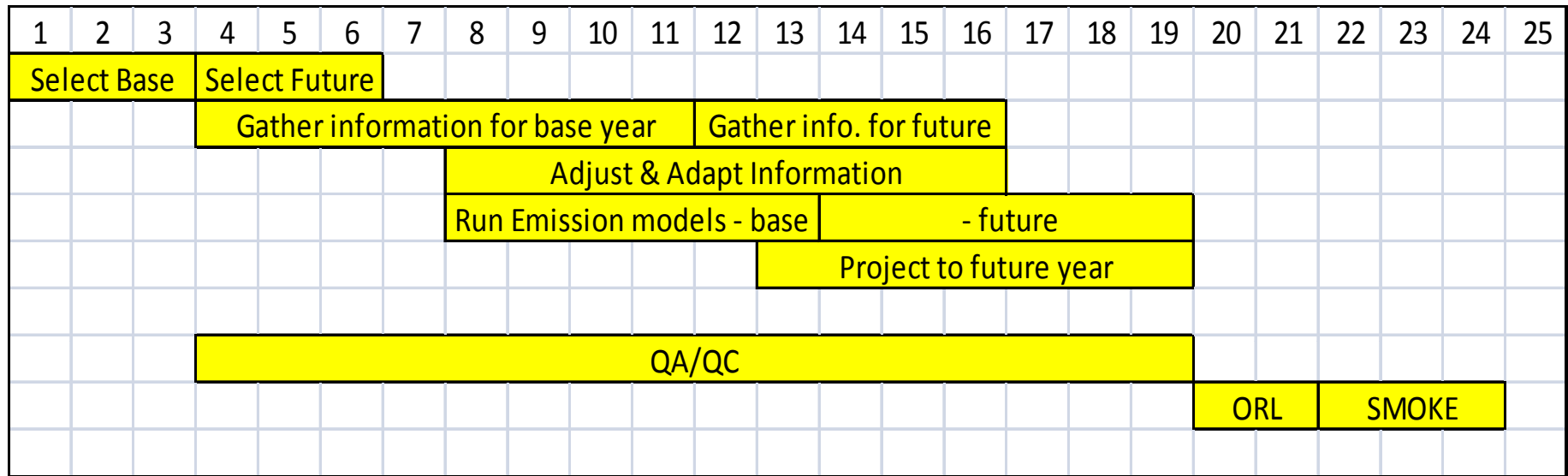   - What will be considered to be SIP quality?

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MANE VU INVENTORY AND MODELING DOMAIN

Eastern Modeling Domain (12km grid)
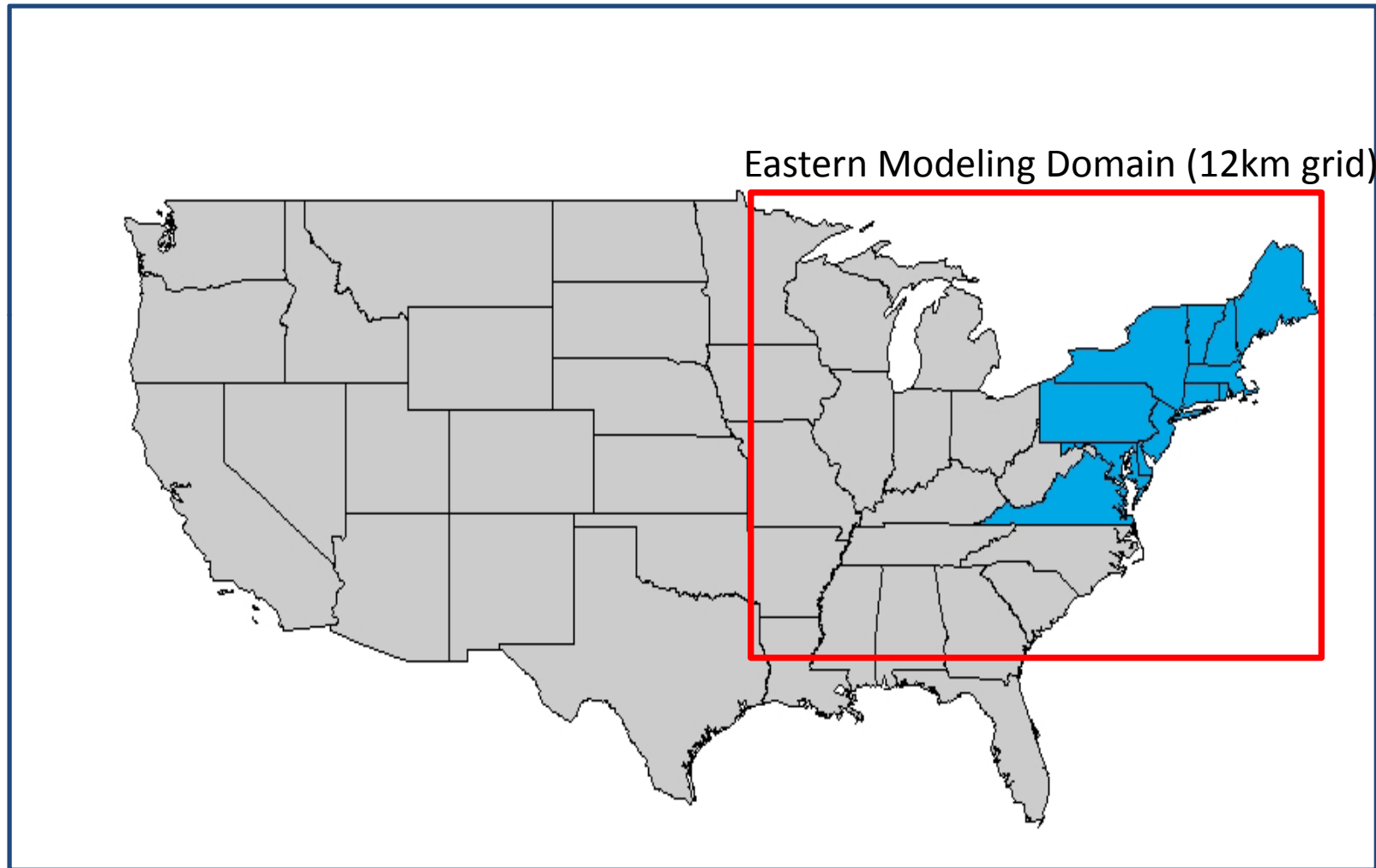
RPO National Domain (36km Grid)

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Preparing a regional modeling inventory

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |

Select Base

Select Future

Gather information for base year

Gather info. for future

Adjust & Adapt Information

Run Emission models - base

- future

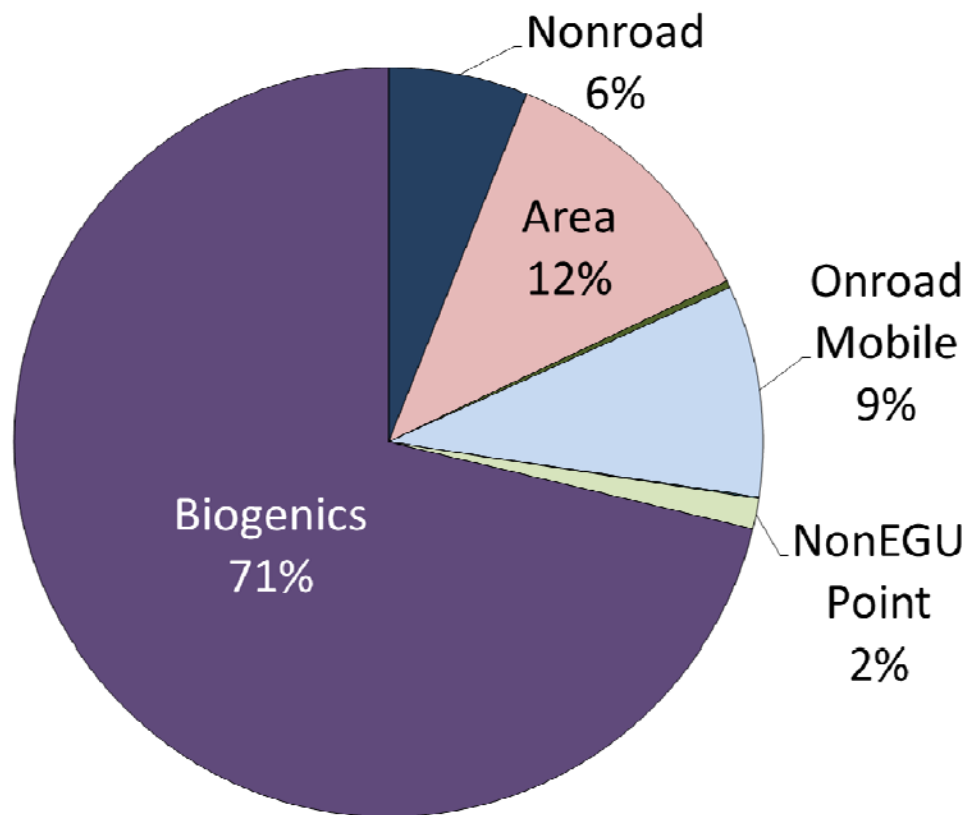Project to future year

QA/QC

ORL

SMOKE

PLUS OR MINUS 6 MONTHS - DEPENDS ON :

1. Collaboration by a lot of people...what are their priorities?

2. Timing of EPA guidance

3. SIP quality or preliminary analysis?

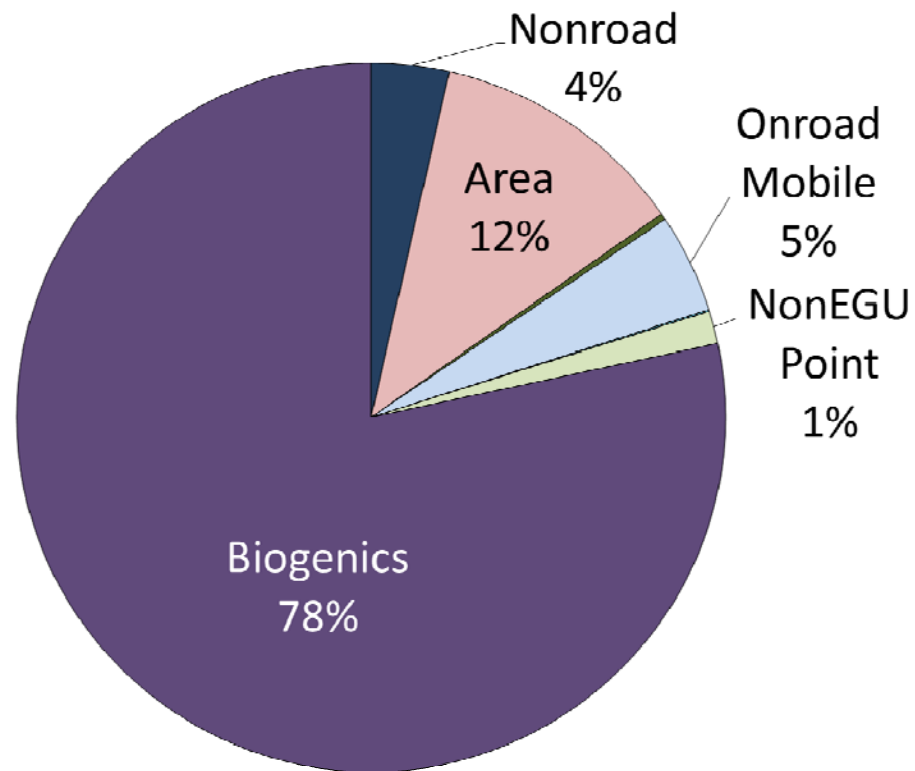4. Time is spent reworking due to errors or change in direction.

VOC
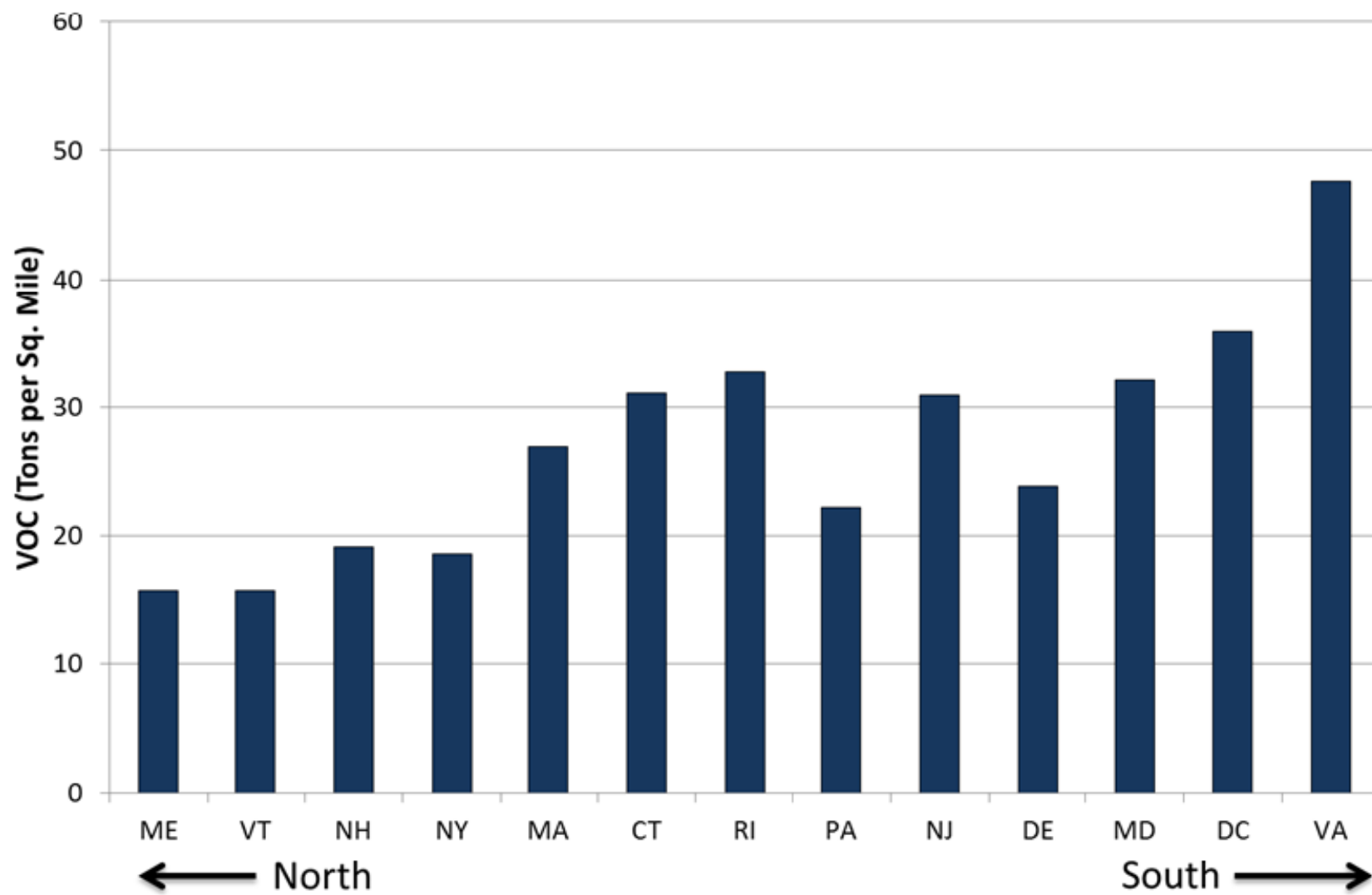## MARAMA V3
MANE VU + VA

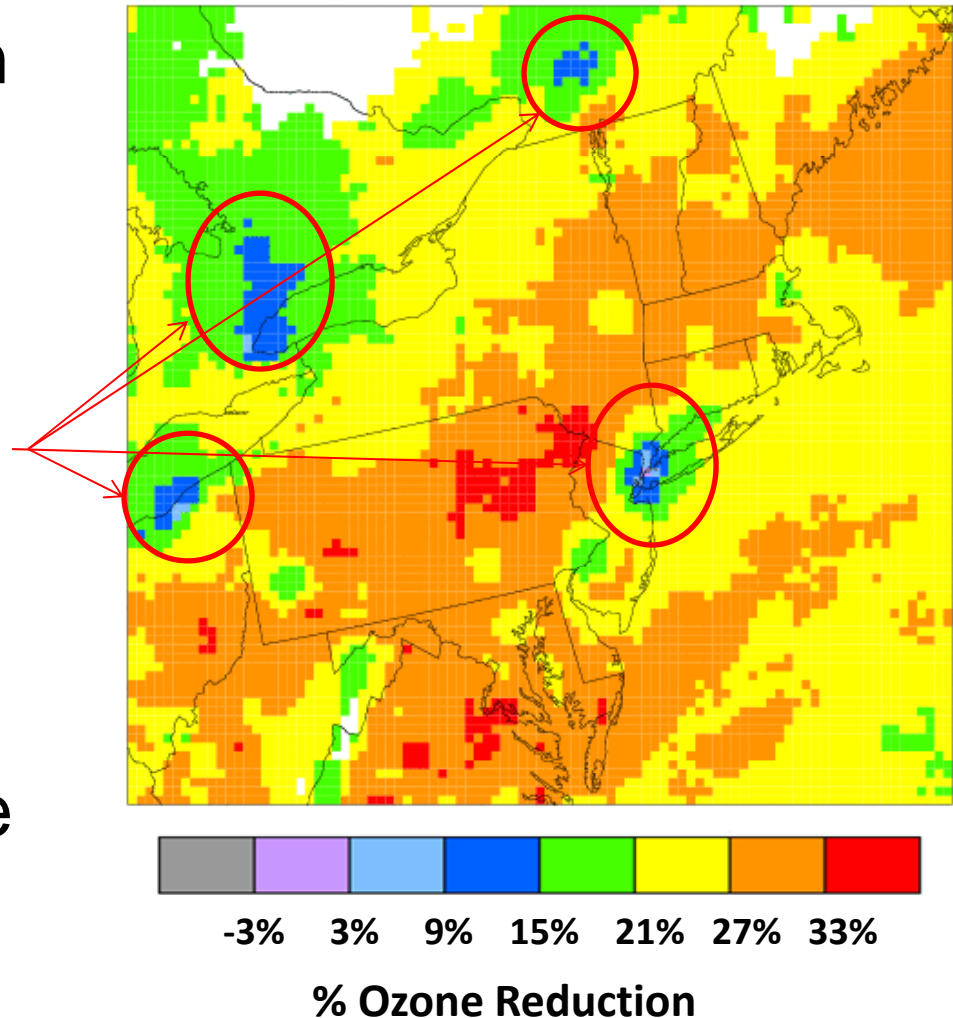**2007**

Total: 7,788,014 TPY

2020

Total: 7,083,668 TPY

Overall VOC reduction
2007 to 2020 expected to be 9%
Anthropogenic reduction 31%
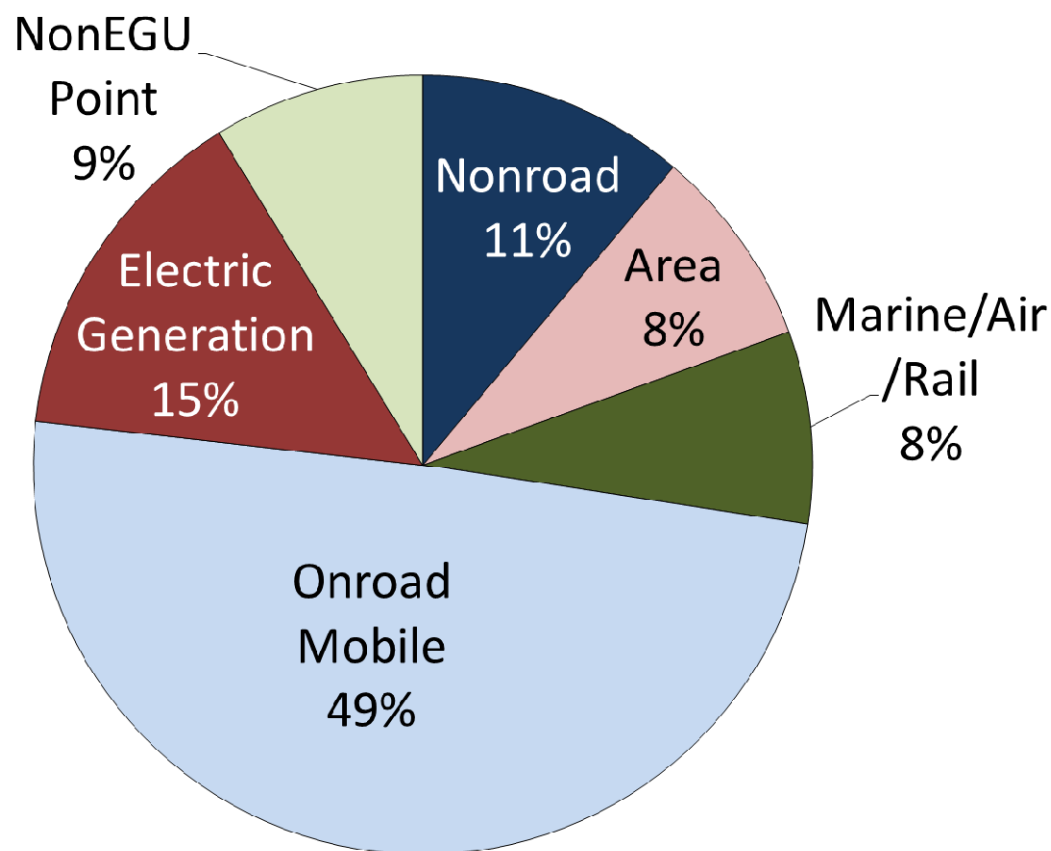
VOC Biogenic Production
Spatial Analysis

VOC Impact on Urban Cores?

- Modeling focused on regional NOx reductions

- Ozone reductions less in dense urban cores, such as NYC

- May examine the impact of VOC reductions to explore the effect of VOC control in urban core
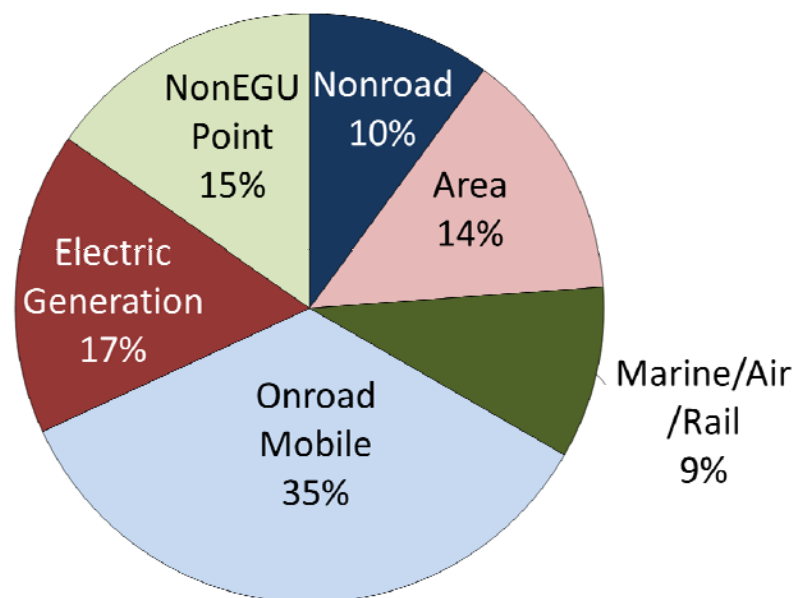

-3% 3% 9% 15% 21% 27% 33%

% Ozone Reduction

NOx
MARAMA V3
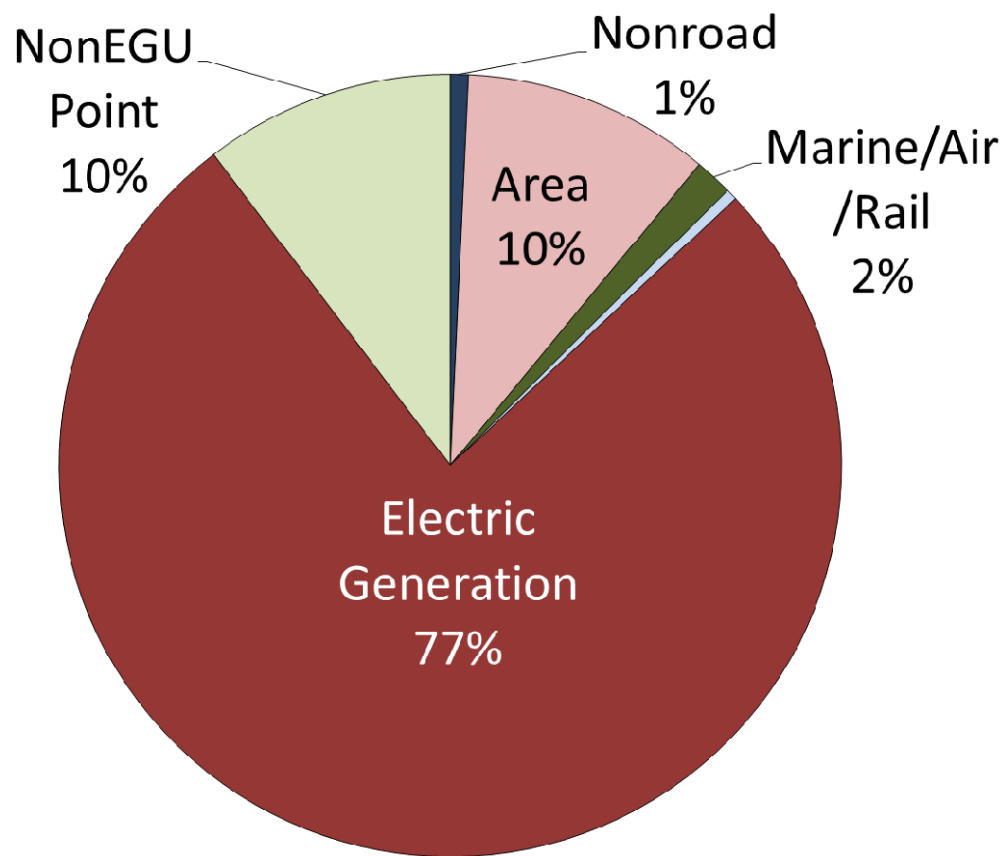MANE VU + VA

2007
Total: 2,745,211 TPY

2020
Total: 1,550,418 TPY

Overall NOX reduction from 2007 to 2020 expected to be 44%

SO$_2$
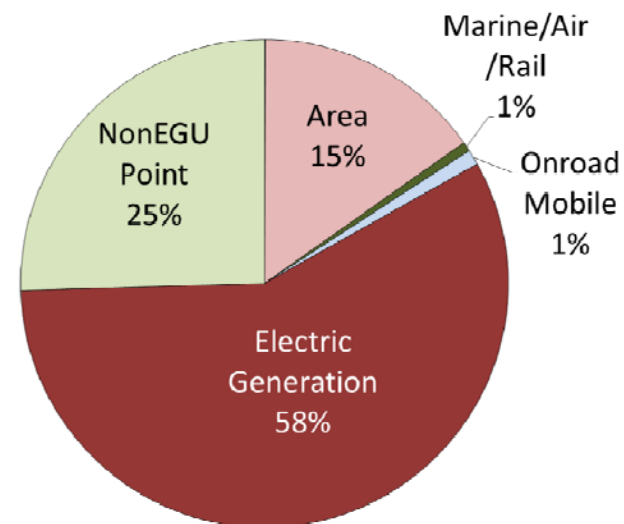MARAMA V3
MANE VU + VA

2007
Total: 2,240,548 TPY

2020
Total: 863,858 TPY

Overall SO2 reduction from 2007 to 2020 expected to be 61%

PM2.5
MARAMA V3
MANE VU + VA

2007 Nonroad 6%, NonEGU Point 9%, Electric Generation 10%, Onroad Mobile 10%, Marine/Air/Rail 2%, Area 63%
Total: 483,688 TPY
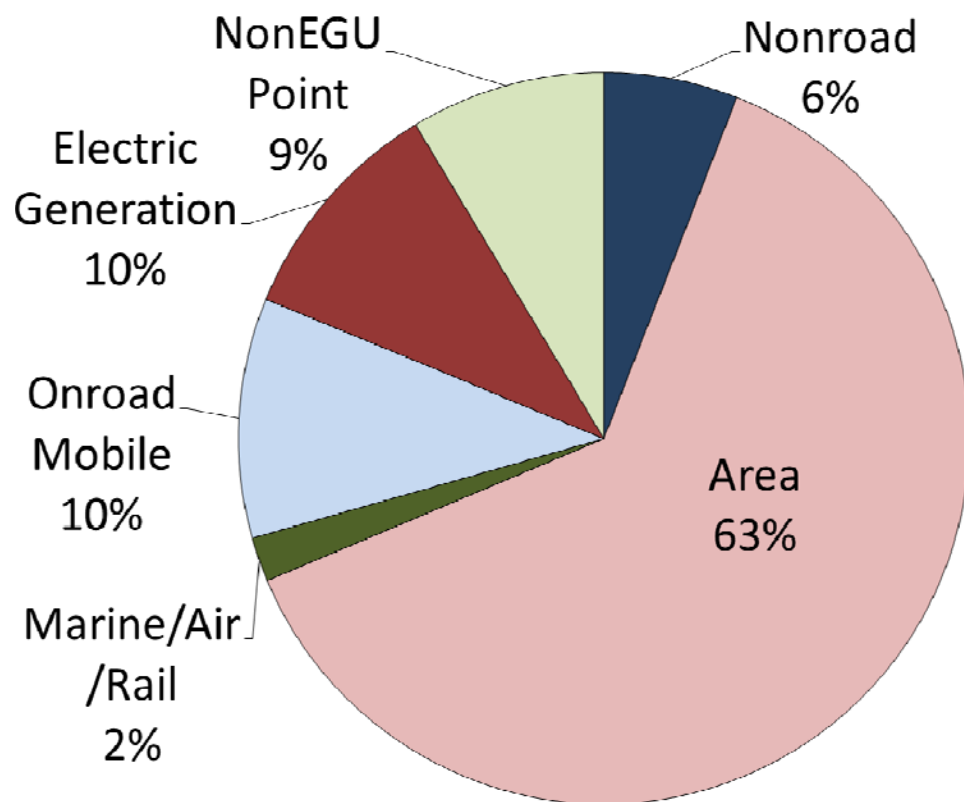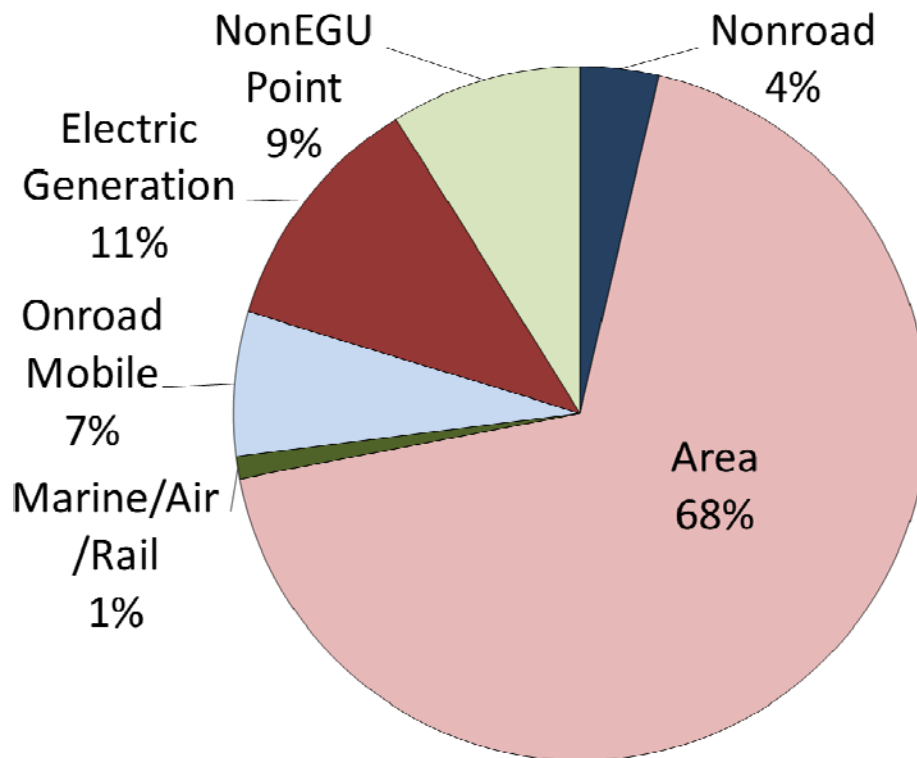
2020 Nonroad 4%, NonEGU Point 9%, Electric Generation 11%, Onroad Mobile 7%, Marine/Air/Rail 1%, Area 68%
Total: 454,142 TPY

Overall PM2.5 reduction from 2007 to 2020 expected to be 6%

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MOBILE MODEL CHANGE
MOVES VS MOBILE6
INVENTORY NOT BACKWARD COMPATIBLE

- **NOX Emissions Up 20-40% - Trucks**
- **VOC Emissions About the Same**
- **PM2.5 Emissions Double**
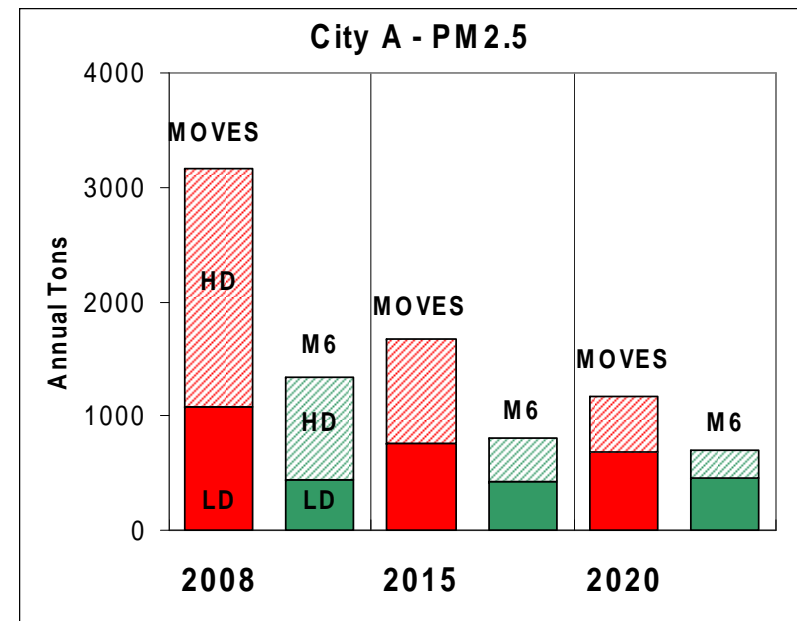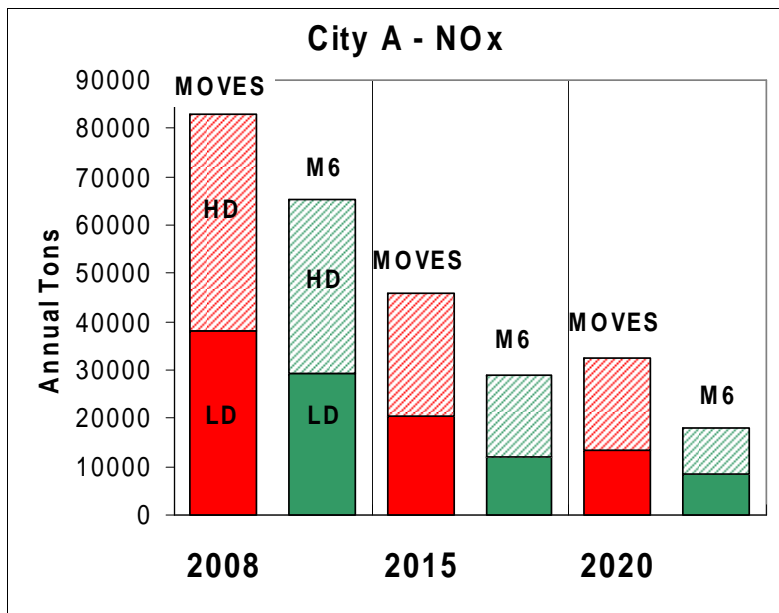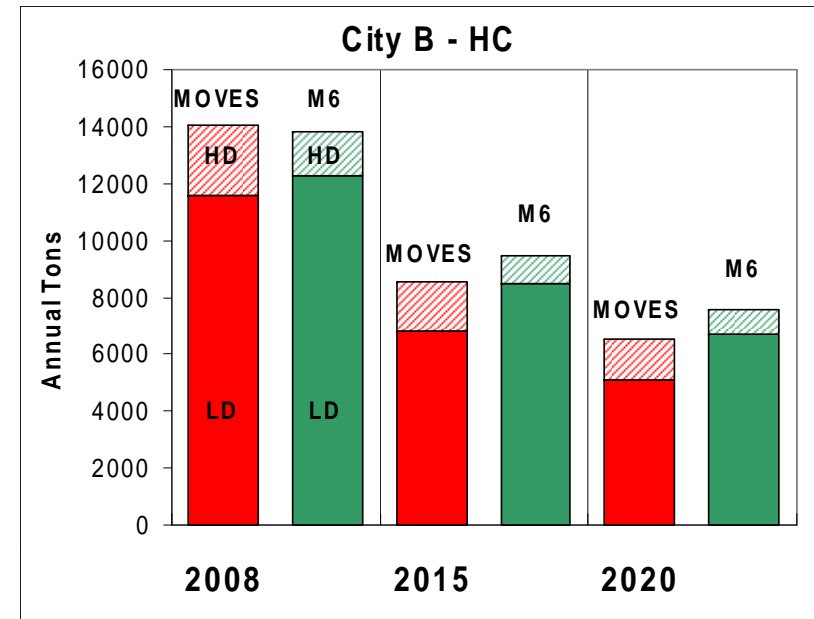
From: OTAQ presentation at 2009 EI Conf in Baltimore

MOVES Mobile Emissions 2007 Vs 2020
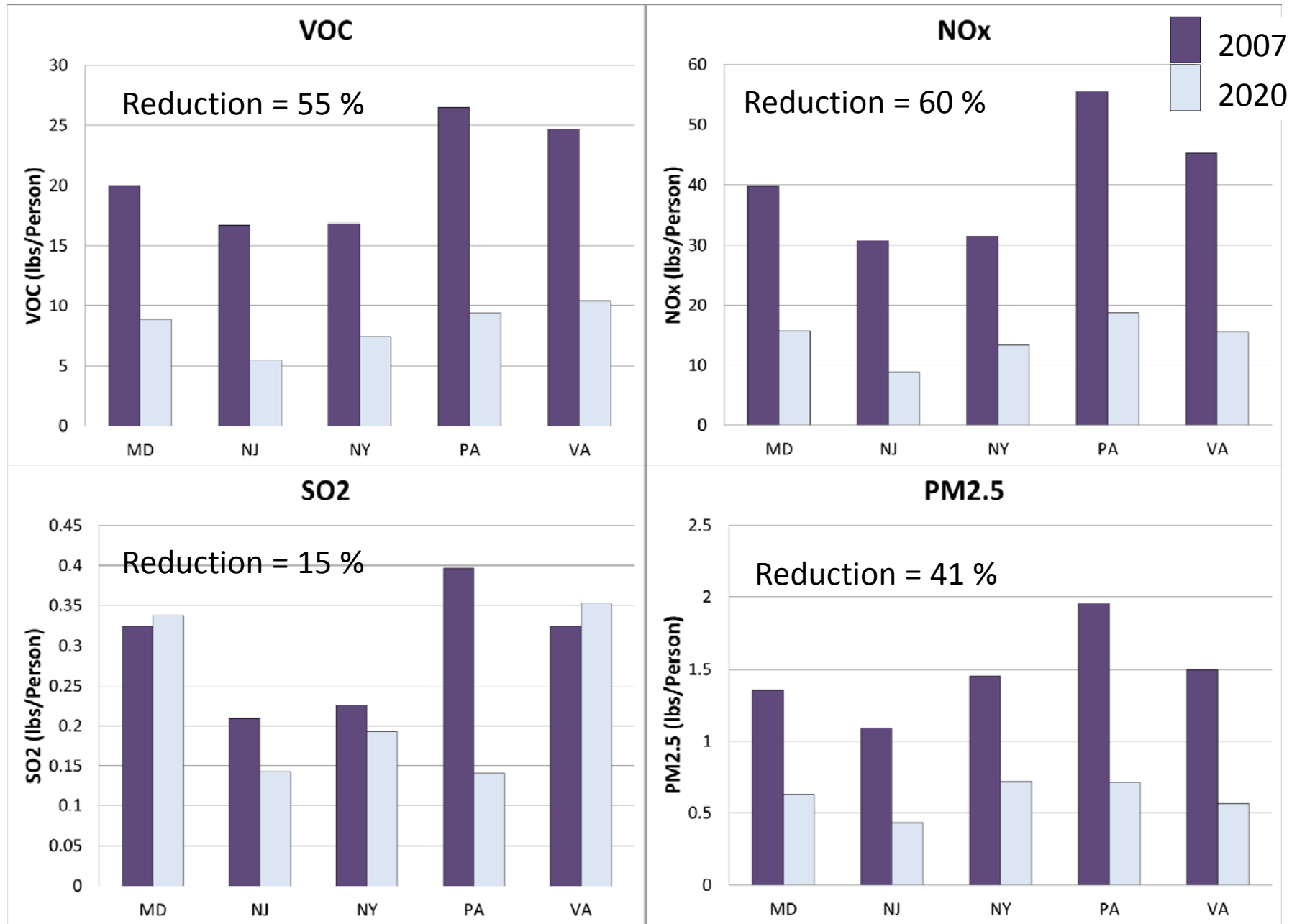
Onroad NOx Emissions - Spatial Distribution

2007

2020

Legend

— Interstate

NOx / County Area (Tons/[yr*sq mi])

- 0 - 10.00
- 10.01 - 20.00
- 20.01 - 50.00
- 50.01 - 100.0
- > 100

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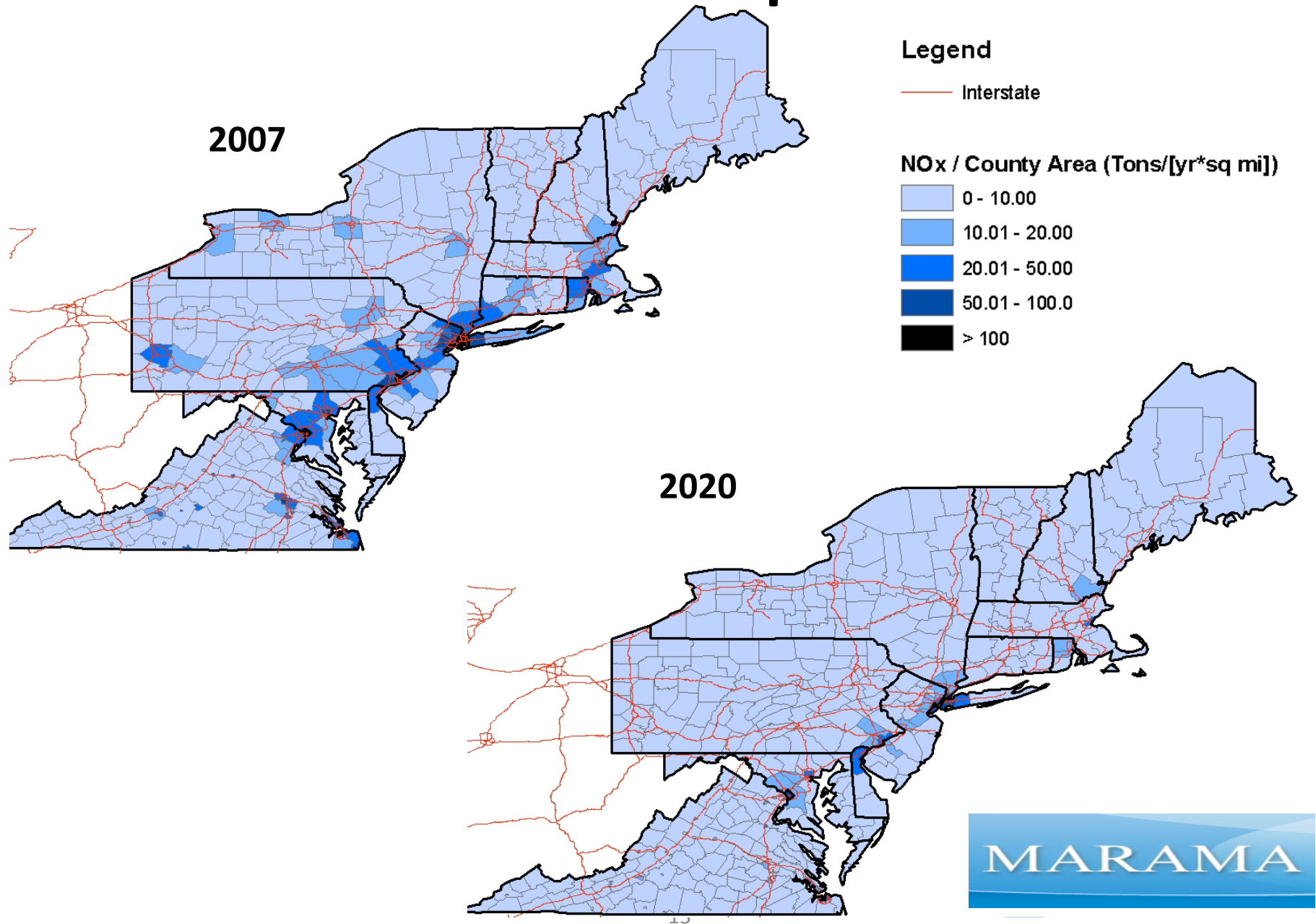
2007 NOx Regional Mobile Emissions
Area Normalized

Legend

— Interstate

Counties

NOx / County Area (Tons/[yr*sq mi])

0 - 10.00
10.01 - 20.00
20.01 - 50.00
50.01 - 100.0
> 100
New Jersey

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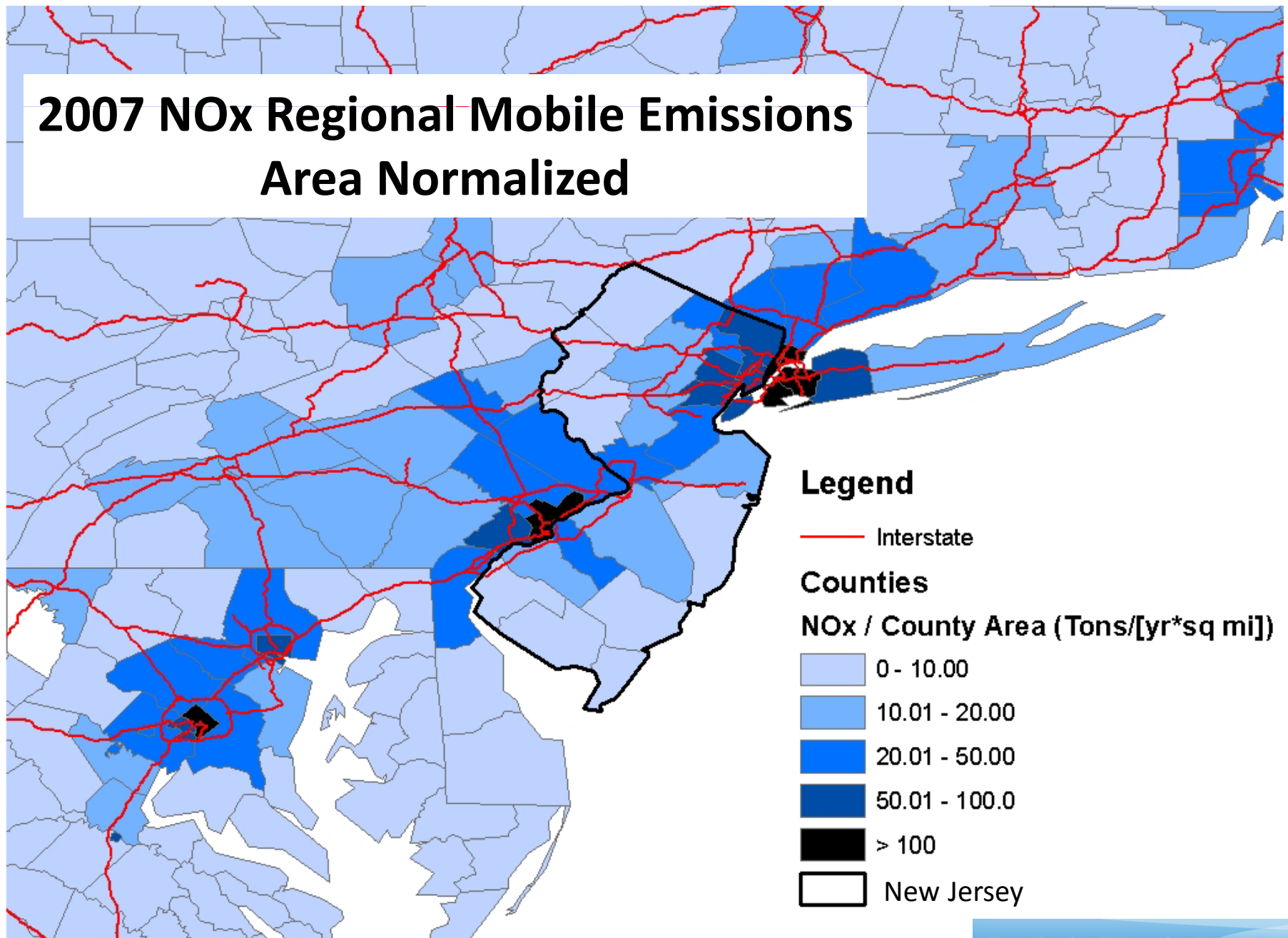
Shale gas emissions not in inventory

AEO2011
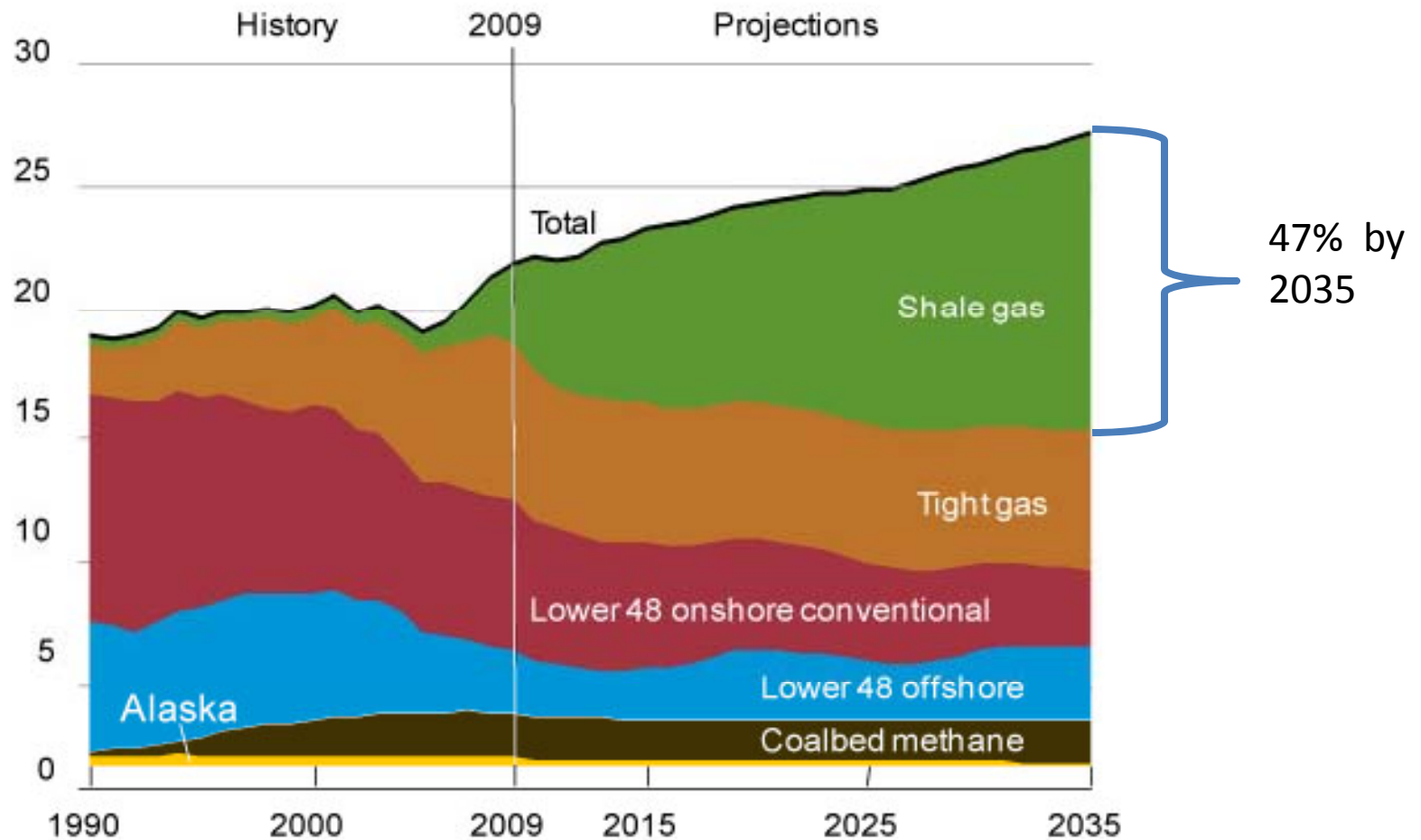
National Oil & Gas Committee

- **Grew out of a ERTAC/OAQPS Cooperative Venture**
- **Committee membership from states nationwide**
- **Gathered documents**
- **Surveyed states**
  - Only 8/26 states inventory Oil and Gas emissions
- **National Oil & Gas Calculation Tool**
  - Upstream oil and gas production sector
  - Pollutants: Criteria, HAPs, ammonia, and GHG
  - Oil and Gas production data – HPDI database
  - Emission Factors – state collected data from existing documents

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ERTAC EGU Growth

- **Eastern Regional Technical Advisory Committee**
- **Collaboration:**
  - NE, Mid-Atlantic, SE, and Lake Michigan area states;
  - Industry; and
  - Multi-jurisdictional organizations
- **Goal: Methodology to Create EGU FY Emission Inventories**
  - Conservative predictions of activity
  - Transparent
  - Inexpensive
  - Relies on base year activity data
  - Flexible

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What You Can Expect….

- **Provides growth estimates for**
  - CAMD reporting units
  - Coal, oil, natural gas
- **Regional boundaries delineate NYC**
  - Flexibility in growth rates
  - No unit retirements w/o state input
- **Future year hourly temporal profiles for**
  - NOx, SO2, activity data
  - New units that didn't operate in the base year

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Progress So Far ….

- **Development:**
  - Methodology created, documentation crafted
  - Preprocessor running on Linux and Windows platforms (GA, VA, MARAMA, IN, NJ, OTC)
  - Working out bugs – Adjusting methodology as needed; limited resources

- **Estimating Growth in Generation:**
  - Growth rates and regions defined
  - Updating with current AEO; working to update growth rates table and crosswalk

- **Input File Development:**
  - 2007 unit file and known future controls file reviewed by states
  - Further state input required

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Timeline
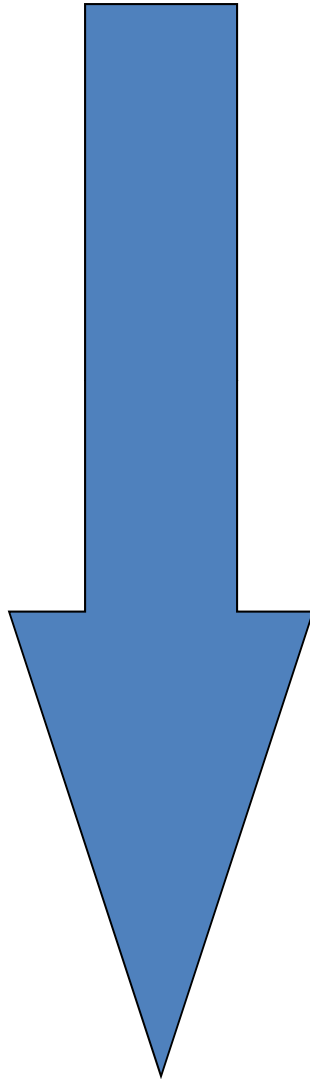
- January, 2012
  - Preprocessor debugging
  - Preprocessing of databases
- February & March, 2012
  - Main processor debugging
  - Initial multi-state test runs
- April & May, 2012
  - Update growth factors
  - Documentation updates
  - Northeast state review of unit & controls data
- June, 2012
  - State/MJO runs of input files – Northeast
  - Results post processing

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How does the algorithm work? Inputs

- **Starting Point: BY CAMD activity data**
  - Gross load hourly data, unit fuel, unit type, location
  - Units categorized by type, fuel, region

- **States provide known new units, controls, retirements, fuel switches, etc**

- **Energy Information Agency annual energy growth factors**

- **NERC peak growth factors**

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How does the algorithm work? Processing

- Project growth by region: peak and nonpeak

- Adjust growth to account for unit retirements, new units, fuel switches

- Allocate growth on an hourly basis to units by region and type

- Check system integrity: Does enough generation exist to satisfy future needs?

- Check policy: Will units meet program caps?

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A conceptual example.....

Combined Cycle, Annual GF=1.02, Peak GF=1.10
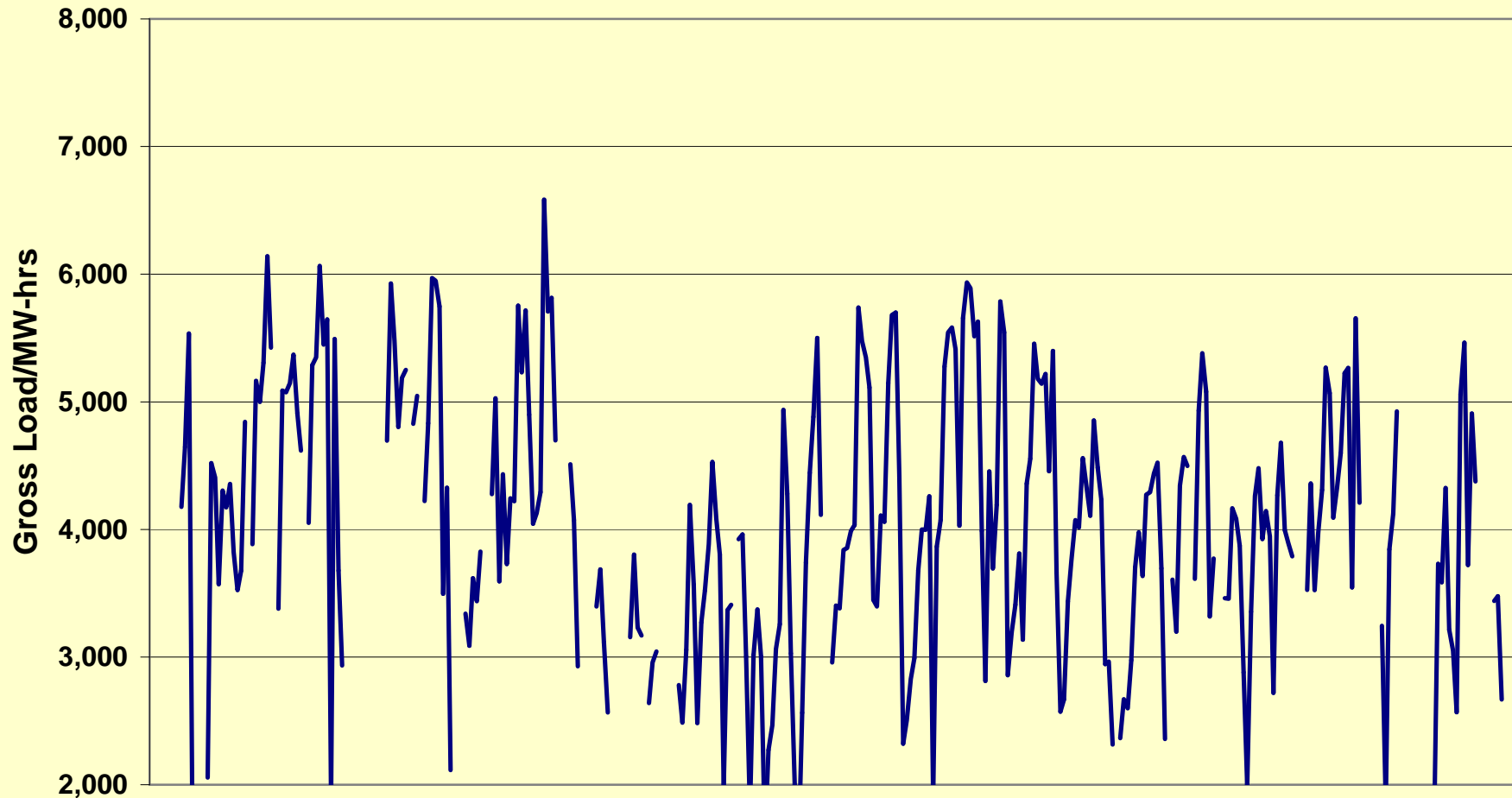
BY activity ~ 1.15 million MW-hrs   **Days of the Year**   *DRAFT-Do Not Quote or Cite*

—— Base Year

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A conceptual example.....

Combined Cycle, Annual GF=1.02, Peak GF=1.10

BY activity ~ 1.15 million MW-hrs

FY activity ~ 1.19 million MW-hrs

Days of the Year

DRAFT-Do Not Quote

— Base Year — Future Year

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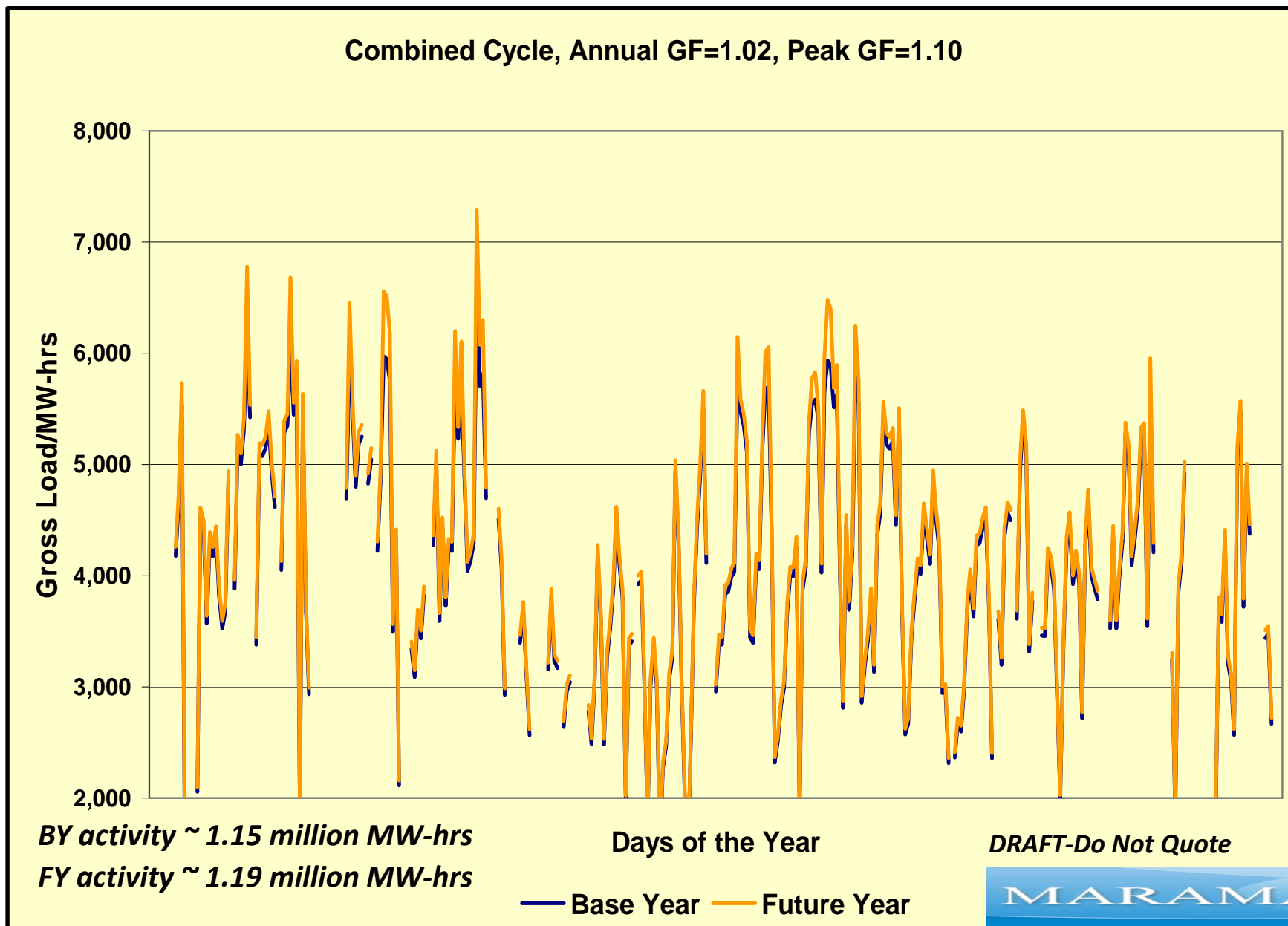
EXAMPLE DRAFT ERTAC OUTPUT

NO$_X$

TPY

Overall reduction: 5%

SO$_2$

TPY

Overall reduction 62%

Heat Input

mmBTU/yr

Overall increase 3%

■ Sum of BY-HI(mmBTU/yr)   ■ Sum of FY-HI(mmBTU/yr)

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EXAMPLE STATE OUTPUT

EGU Base & 2017 projection (AEO2010)

Three Units get NOX emission reduction (control?) (542-10,11,12)
Many units operated in future, but not base, so cannot be compared.

DRAFT-Do Not Quote or Cite
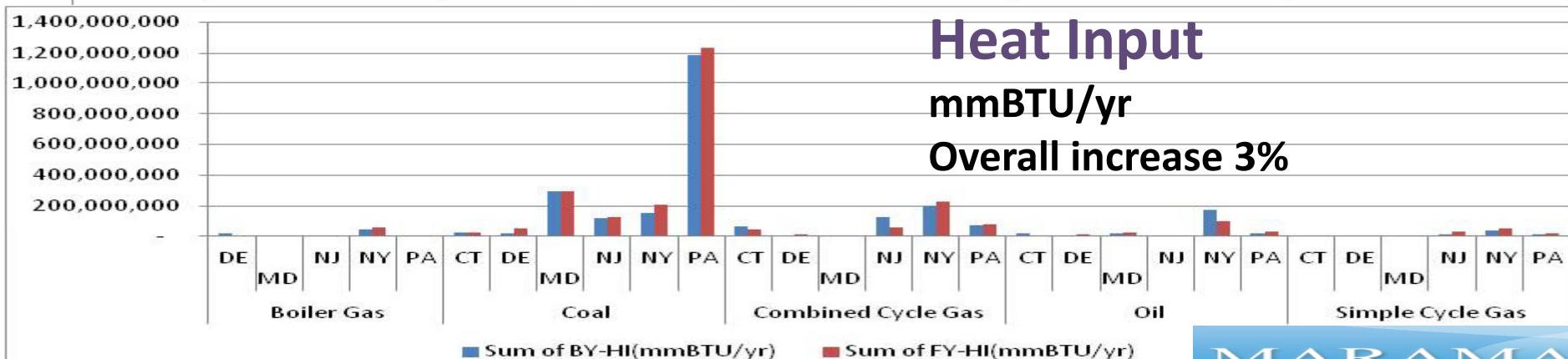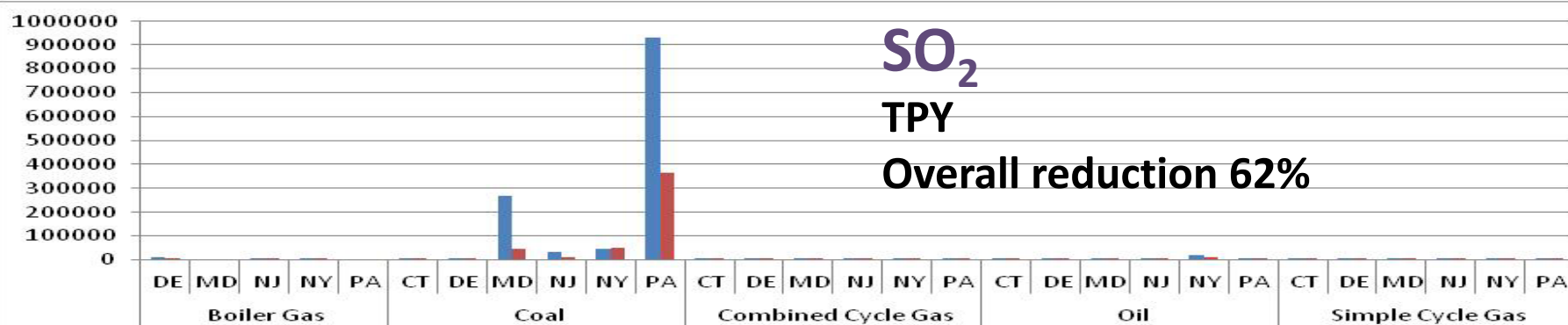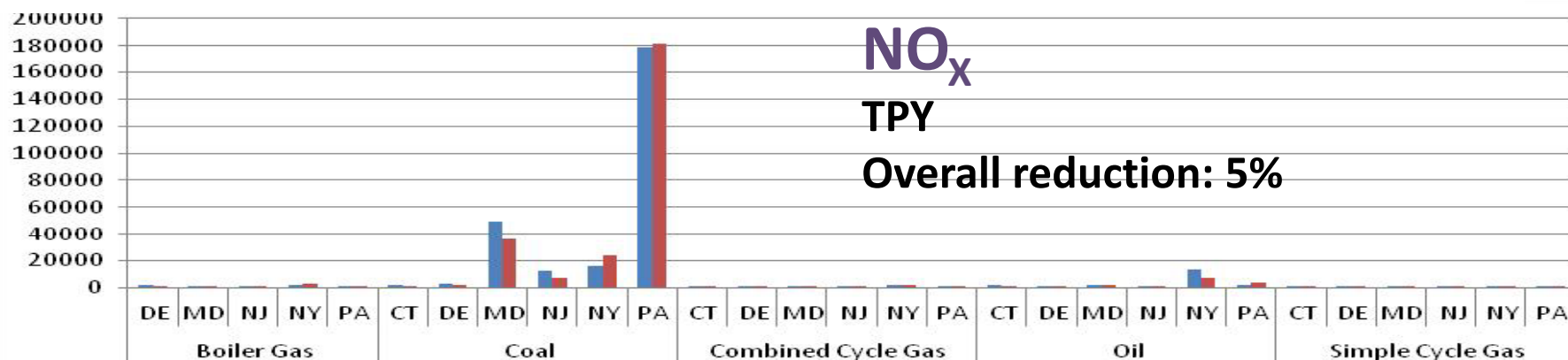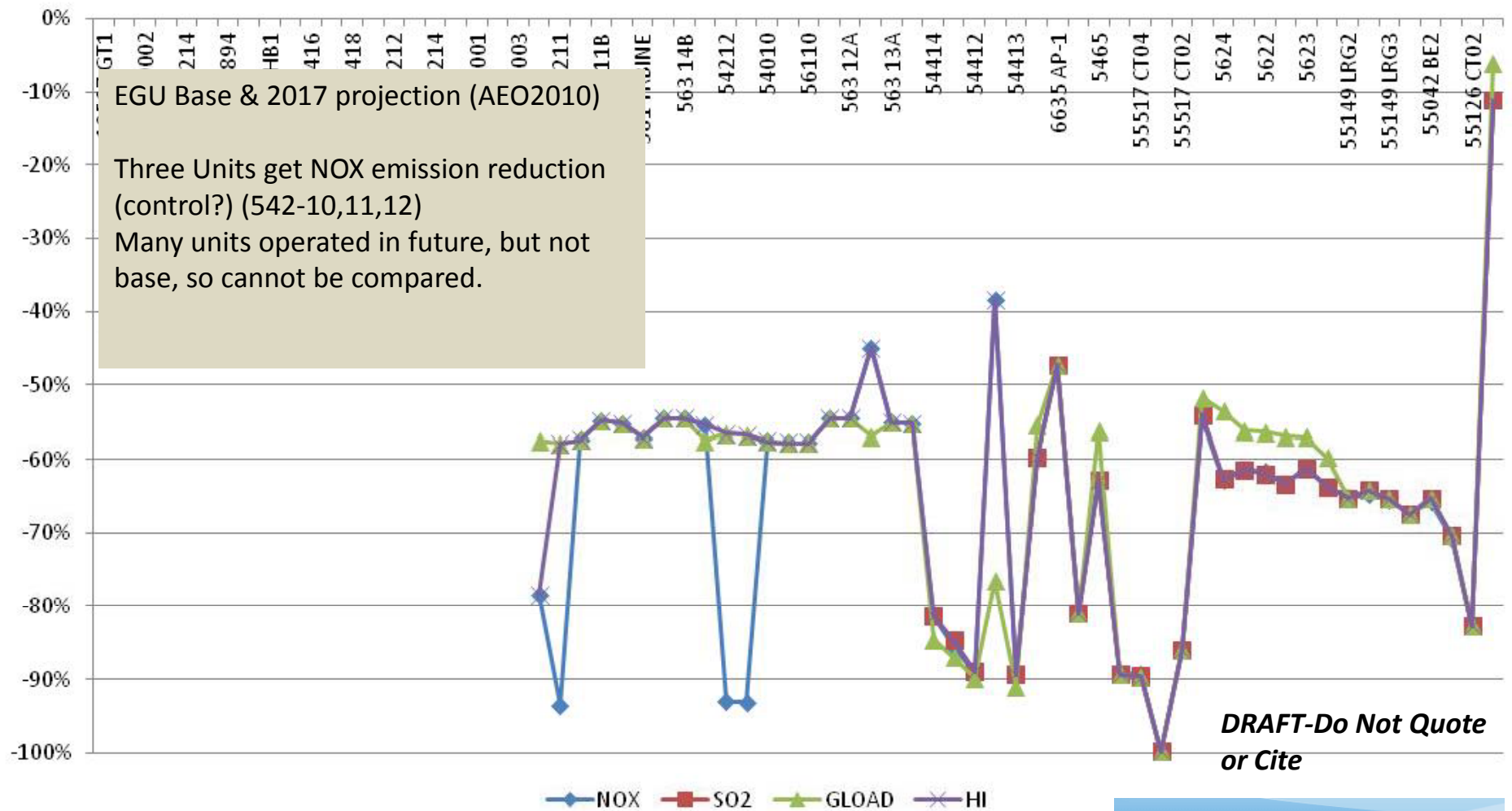
Unit Level Percent Reduction Plot

Outstanding EGU Forecasting Issues

- Open source code: How to keep up to date?

- Input file upkeep for variables, growth rates, unit and control/emissions information

- Developing and maintaining good user guide and design document

- Processes for comment/input into data files by industry/public

- User training

- Future improvements: funding and resources

- What data to use from other regions in near term

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Modeling Inventory Plan

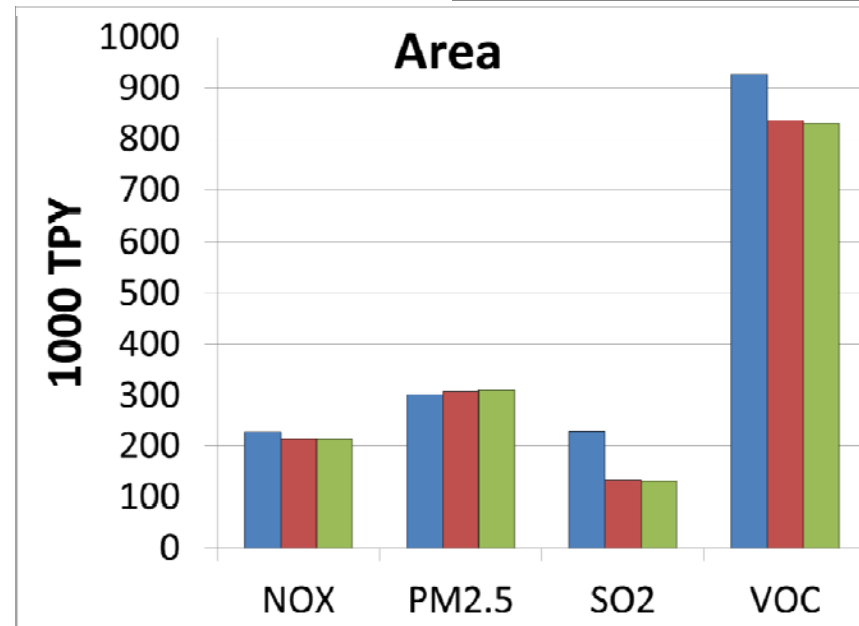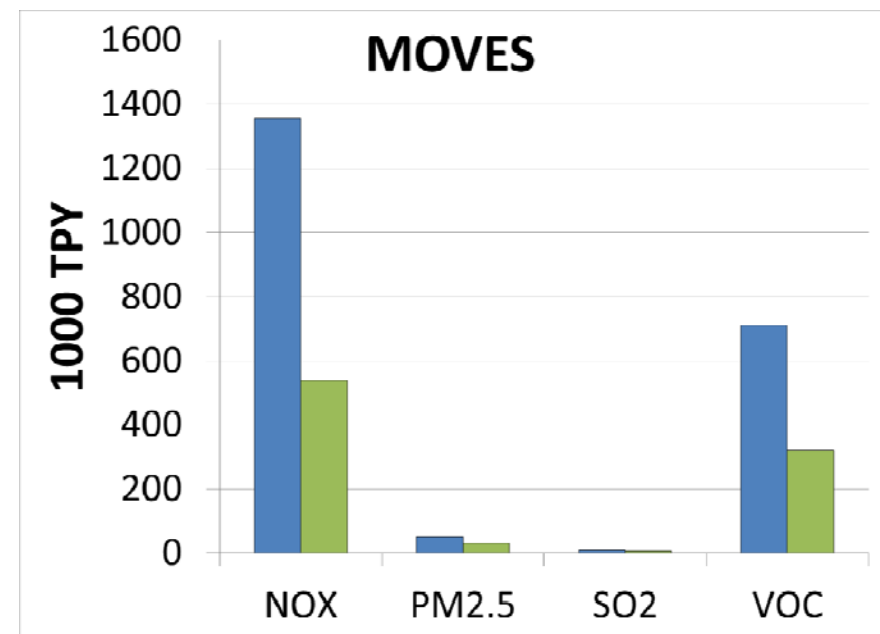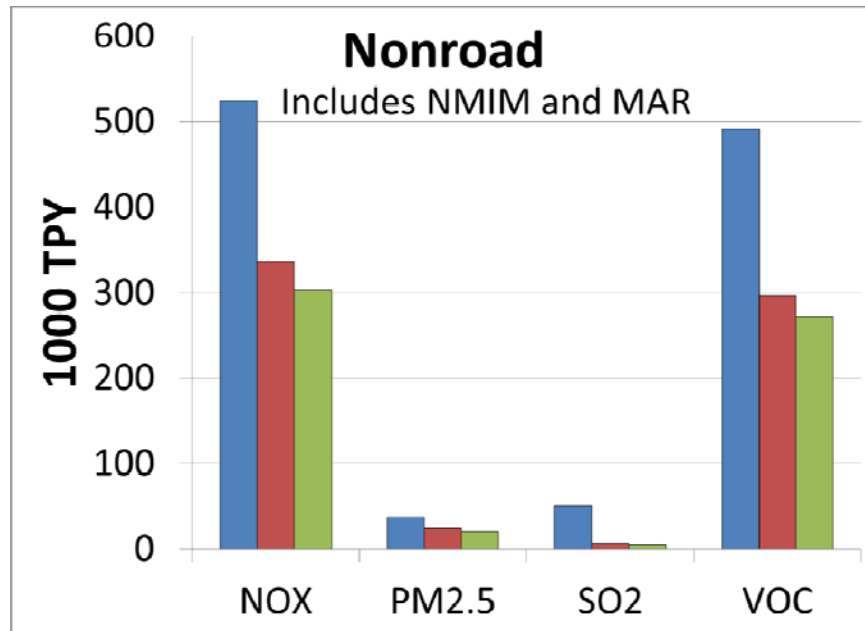|	2007					2020 Base Adjustments for NOX and VOC				
	OTR incl VA	LADCO	SEMAP excl VA	CENRAP	CANADA	OTR incl VA		Non-OTR excl VA		CANADA
	All Pollutants	All Pollutants	All Pollutants	All Pollutants	All Pollutants	NOX	VOC	NOX	VOC	All Pollutants
Mobile	MOVES 2007 Ver. 2	LADCO 2007	SEMAP 2007	EPA 2007 national MOVES inventory run, Gasoline PM emissions	OME 2005 (Canadian MOBILE6 Activity and	MARAMA 2020 Ver. 2		Proxy from 2007		OME 2005 (Canadian MOBILE6 Activity and Input Data)
								60%	55%	
EGU	MARAMA 2007 Ver. 3	LADCO 2007 (converted)	SEMAP 2007	NEI 2008 v2	OME 2005	Proxy from 2007		Proxy from 2007		OME 2005
						35%	Incr. 24%	35%	Incr. 24%	
Other Point	MARAMA 2007 Ver. 3	NEI 2008 v2	SEMAP 2007	NEI 2008 v2	OME 2005	MARAMA 2020 Ver. 3		Proxy from 2007		OME 2005
						Add 0%	Add 0%	1%	Incr. 2%	
Cat 3 Marine - Offshore	EPA CHIEF 2005 platform	EPA CHIEF 2005 platform	EPA CHIEF 2005 platform	NA	EPA CHIEF 2005 platform	EPA CHIEF 2020		EPA CHIEF 2020		EPA CHIEF 2020
						NA	NA	NA	NA	NA	NA
MAR	MARAMA 2007 Ver. 3	LADCO 2007	SEMAP 2007	NEI 2008 v2	OME 2005	MARAMA 2020 Ver. 3		Proxy from 2007		OME 2005
						Add 0%	Add 0%	33%	12%	
Nonroad	MARAMA 2007 Ver. 3	LADCO 2007	SEMAP 2007	NEI 2008 v2	OME 2005	MARAMA 2020 Ver. 3		Proxy from 2007		OME 2005
						Add 0%	Add 0%	49%	46%	
Area	MARAMA 2007 Ver. 3	LADCO 2007	SEMAP 2007	NEI 2008 v2	OME 2005	MARAMA 2020 Ver. 3		Proxy from 2007		OME 2005
						Add 0%	Add 0%	7%	10%	
Oil & gas	Not necessary	Not Necessary	Not Necessary	Not Necessary	Not necessary	Needed for SIP quality run	Needed for SIP quality run	Probably not Practical to estimate	Probably not Practical to estimate	NA
Anthropogenic Chlorine	EPA CHIEF 2005	EPA CHIEF 2005	EPA CHIEF 2005	EPA CHIEF 2005	N/A	EPA CHIEF 2005		EPA CHIEF 2005		N/A
Oceanic Chlorine	EPA CHIEF 2005	EPA CHIEF 2005	EPA CHIEF 2005	EPA CHIEF 2005	EPA CHIEF 2005	EPA CHIEF 2005		EPA CHIEF 2005		EPA CHIEF 2005
Biogenic	MEGAN	MEGAN	MEGAN	MEGAN	MEGAN	MEGAN		MEGAN		MEGAN

CONCLUSIONS

Inventory preparation – Long and costly process with much improvement made in recent years. Examples include MOVES model, and numerous ERTAC initiatives. The national Oil and Gas model will add an important missing component to the inventory. However, significant methodology improvements mean backward comparability difficult.

Mobile emissions –Emissions concentrated along highways and in cities. Expected to drop dramatically between 2007 and 2020 because of cleaner cars.

Coordination of Modeling Inventories improves super-regional modeling – Three regions (SE, NE, MW) all agreed to model 2007.   NE can use other regions base inventories and apply percentage reductions derived from our own future inventory to estimate future emissions outside our region.

INVENTORY TRENDS

INVENTORY TRENDS