EMISSIONS INVENTORY UPDATE

Susan Wierman, Patrick Davis, Julie McDill
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OTC Committee Meeting
March 16, 2011

TOPICS

- Current Data
- Upcoming Work
- Where to find the inventories

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INVENTORY BASICS

- **Modeling inventory years**:
  - 2007, 2017, and 2020 (dropped 2013)
  - Limited analysis of 2025
- **Geographic Coverage:**
  - Ozone Transport Region + All of VA
- **Pollutants:**
  - CO, NH_3, NO_X, PM_{10}, $PM_{2.5}$, SO_2 & VOC.

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THANKS FOR YOUR HELP

- Stakeholder comments
- State QA of data and maps
- EPA partnership

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A LOOK AT EMISSIONS & TRENDS

- Mobile Sources dominate the 2007 regional NOx inventory.
  - For some counties, Marine sources are the largest NO_X category.
- Area and Nonroad NO_X emissions are projected to decline from 2007 through 2020,
  - Substantial reductions in some states.
  - VOC emissions from nonroad sources are also projected to decrease.
- These reductions are due to control measures already in place and fleet turnover.

2007 EMISSIONS OTC+VA REGION
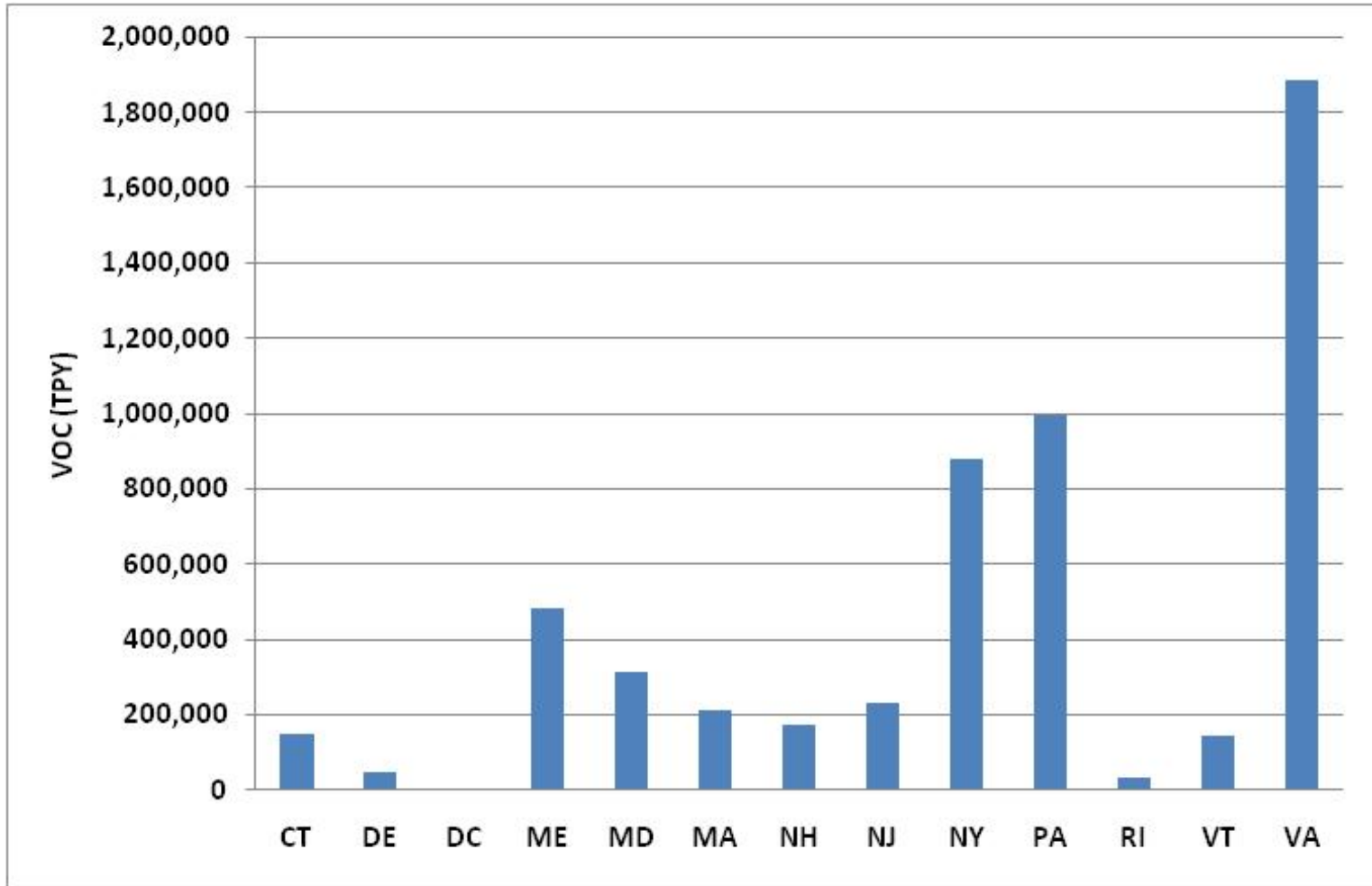
NO$_X$ 3.2 MILLION TPY

VOC 7.7 MILLION TPY
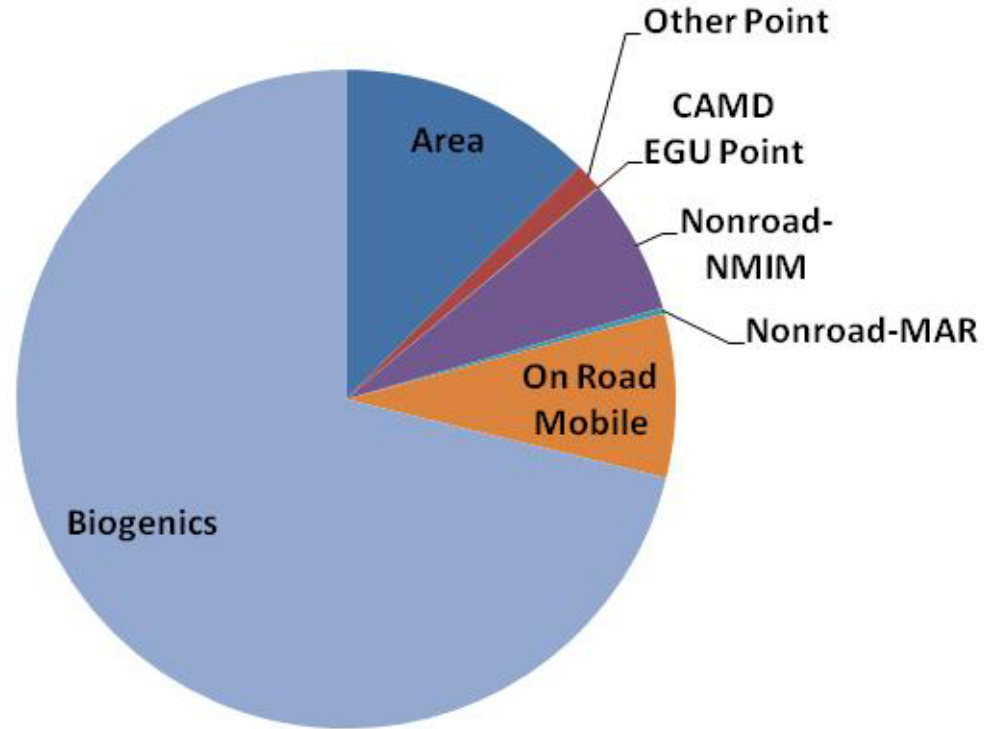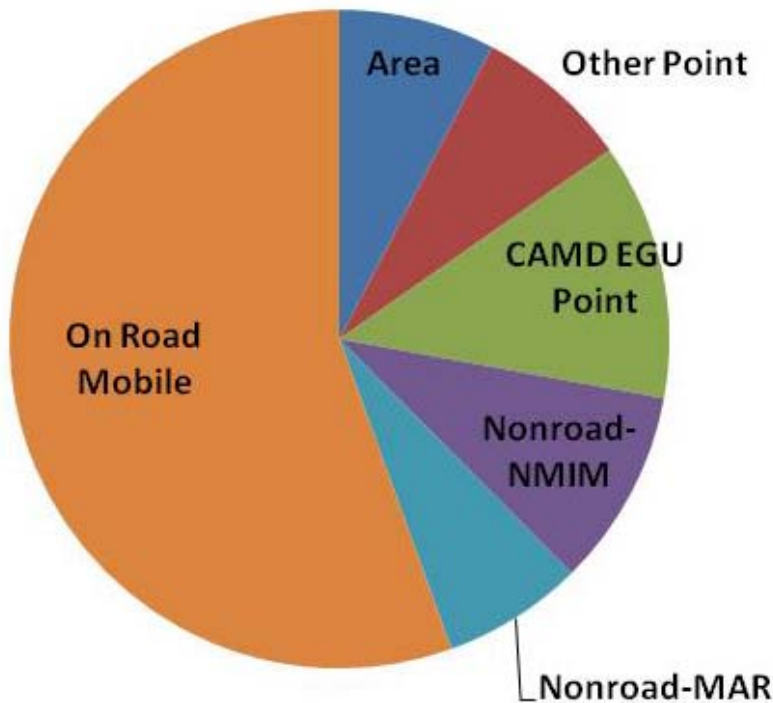
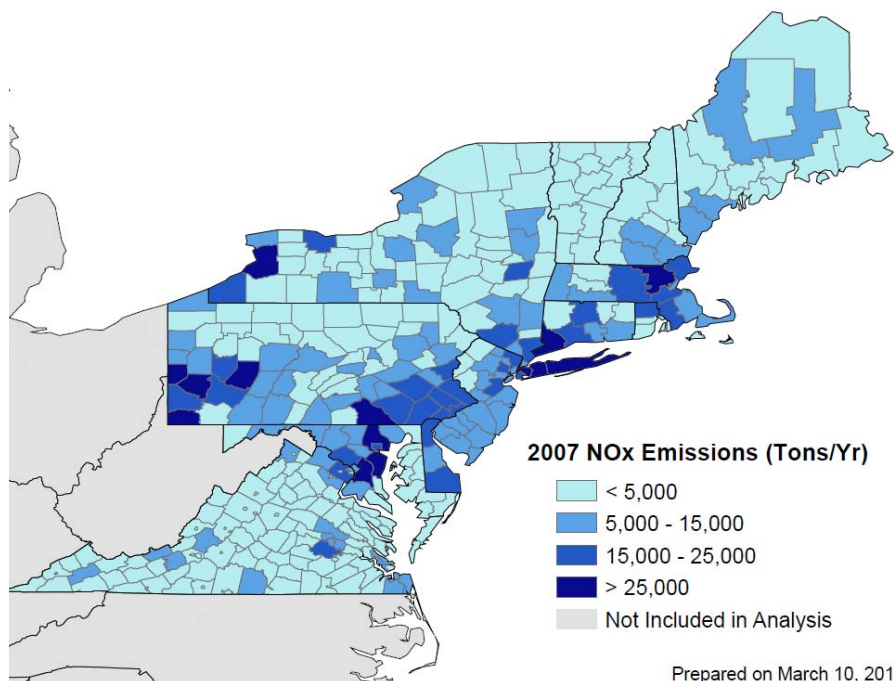**Mobile emissions are draft and subject to change (2007 NYDEC proxy)**
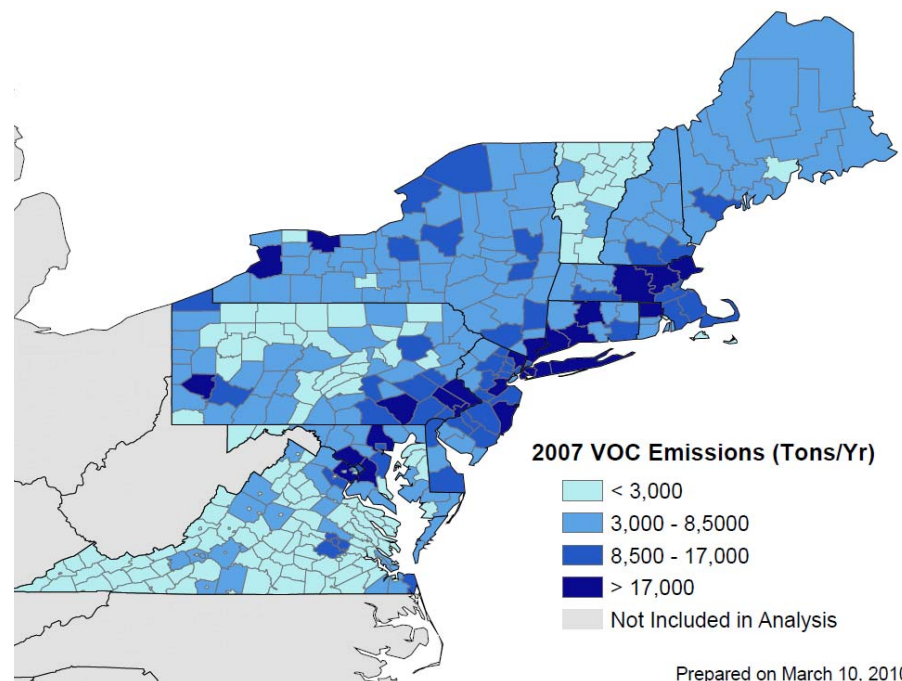
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BIOGENIC EMISSIONS

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SPATIAL DISTRIBUTION OF EMISSIONS

2007 NO$_X$

2007 VOC

2007 NOx Emissions (Tons/Yr)
- < 5,000
- 5,000 - 15,000
- 15,000 - 25,000
- > 25,000
- Not Included in Analysis

Prepared on March 10, 2010

2007 VOC Emissions (Tons/Yr)
- < 3,000
- 3,000 - 8,5000
- 8,500 - 17,000
- > 17,000
- Not Included in Analysis
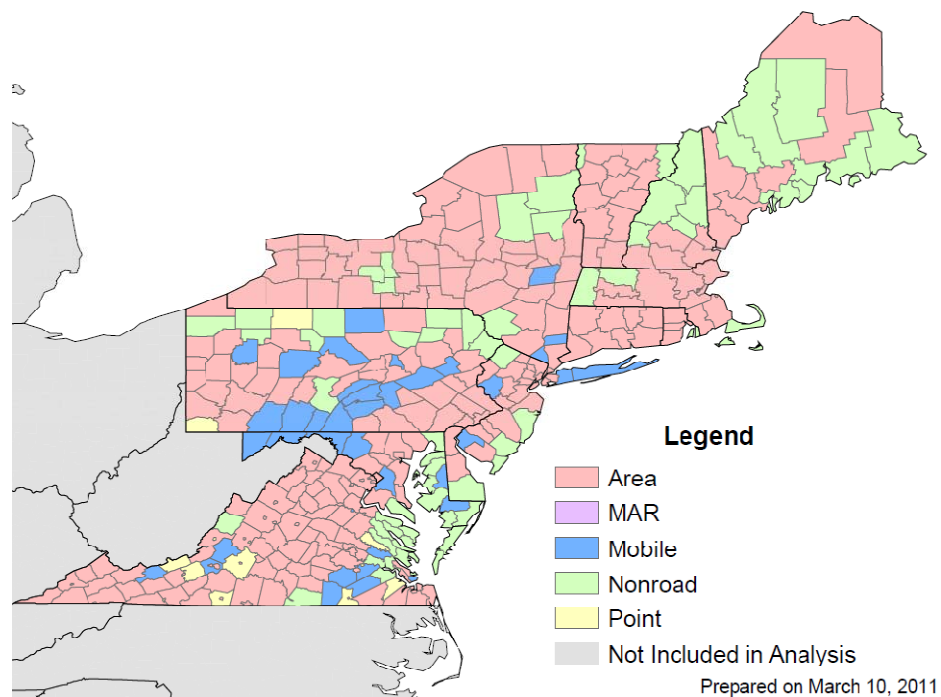
Prepared on March 10, 2010

Notes:
- All anthropogenic sectors included
- No biogenic sectors included
- Mobile emissions are draft and do not use MOVES

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TOP INVENTORY SECTOR BY COUNTY

2007 NOx

2007 VOC

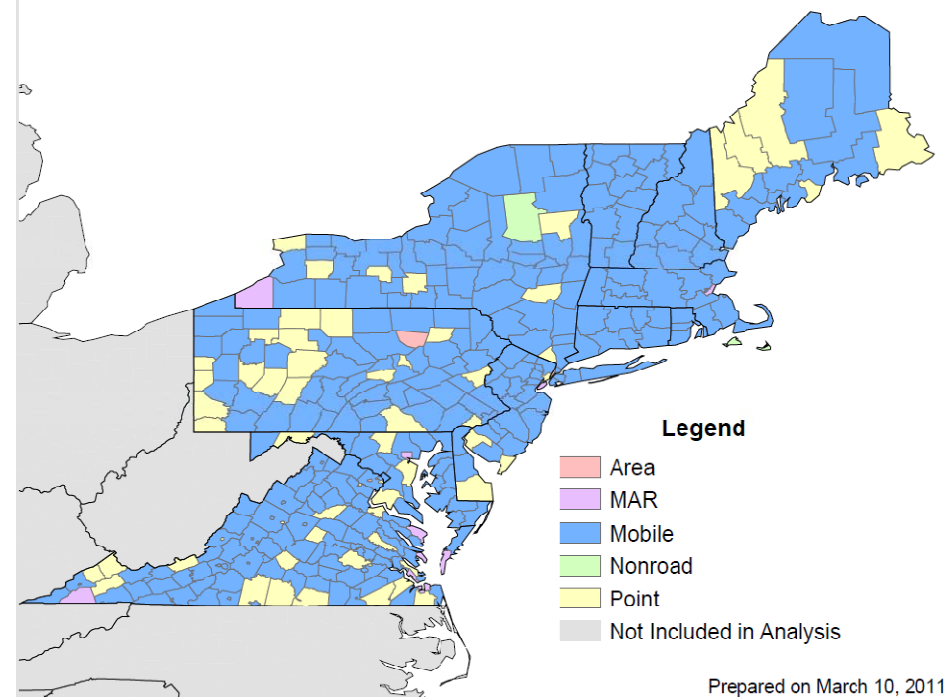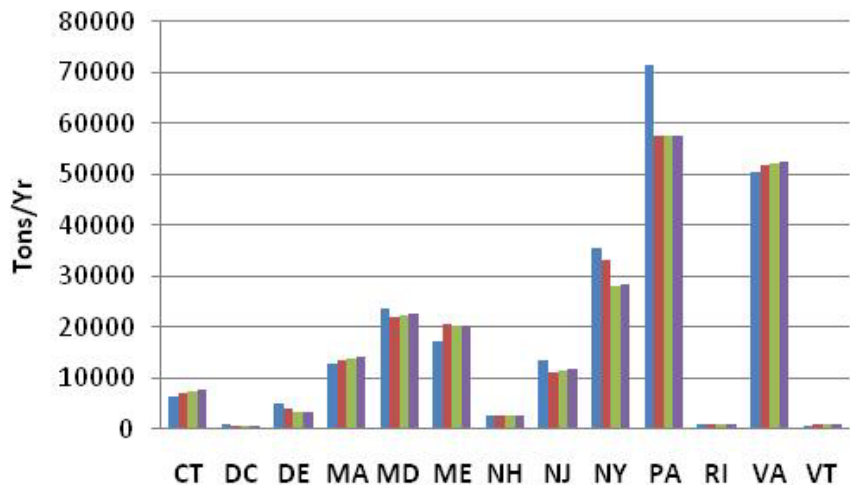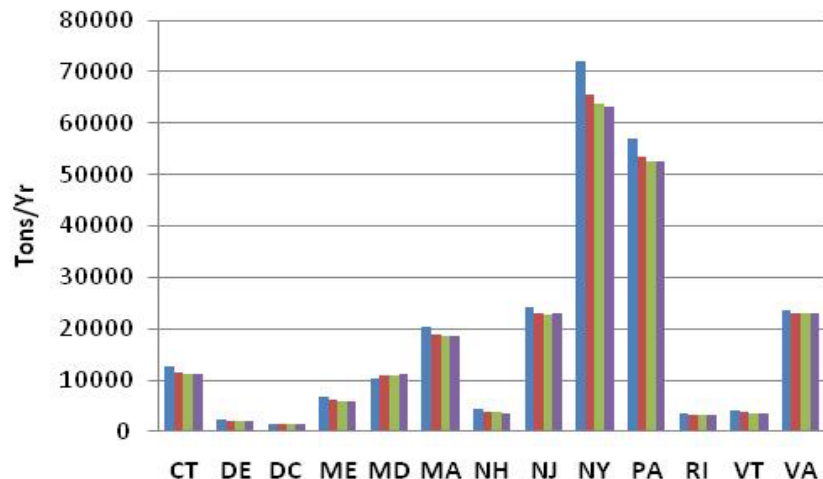**Notes:**
- All anthropogenic sectors included
- No biogenic sectors included
- Mobile emissions are draft and do not use MOVES

ANNUAL NO$_X$ EMISSION TRENDS 2007 - 2020
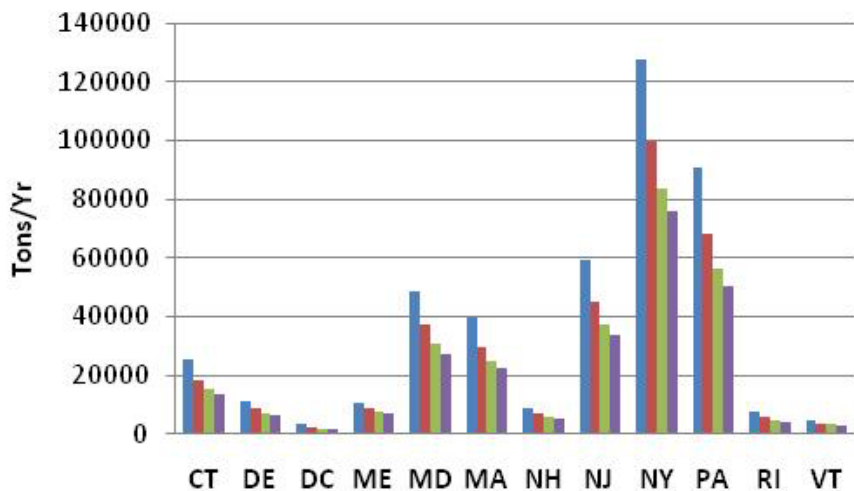
ANNUAL VOC EMISSION TRENDS
2007 - 2020
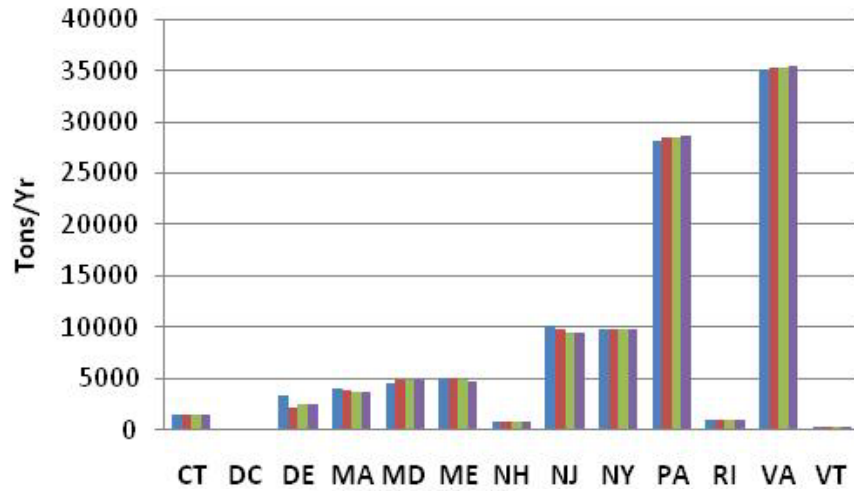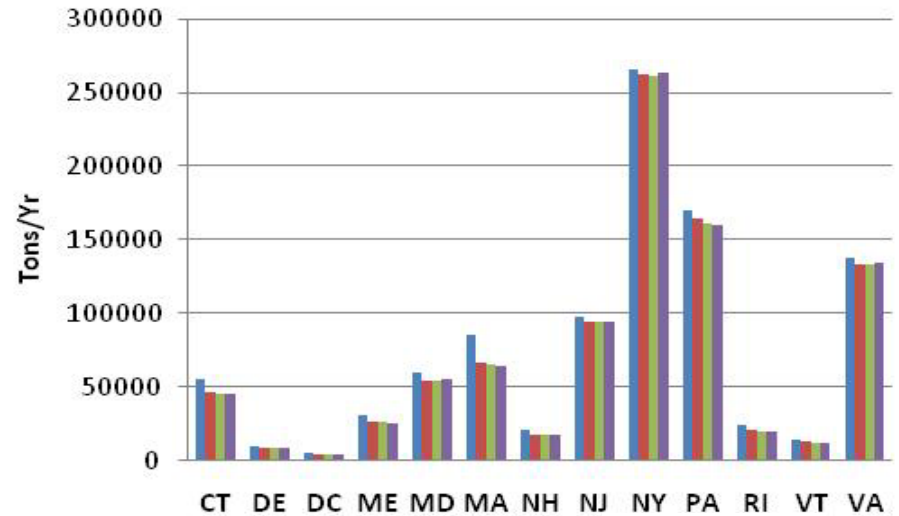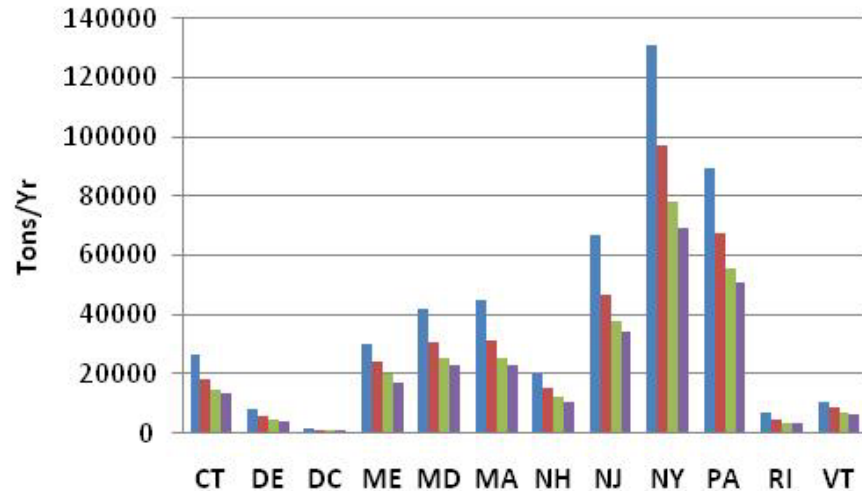
UPCOMING WORK

- MOVES
- ERTAC
- Marcellus Shale

ON ROAD MOBILE SOURCE EMISSIONS

- MOVES is being run in "look up table" mode

- MOVES creates emissions factors for various road & vehicle types, and temperatures

- The SMOKE-MOVES interface prepares emissions files for CMAQ

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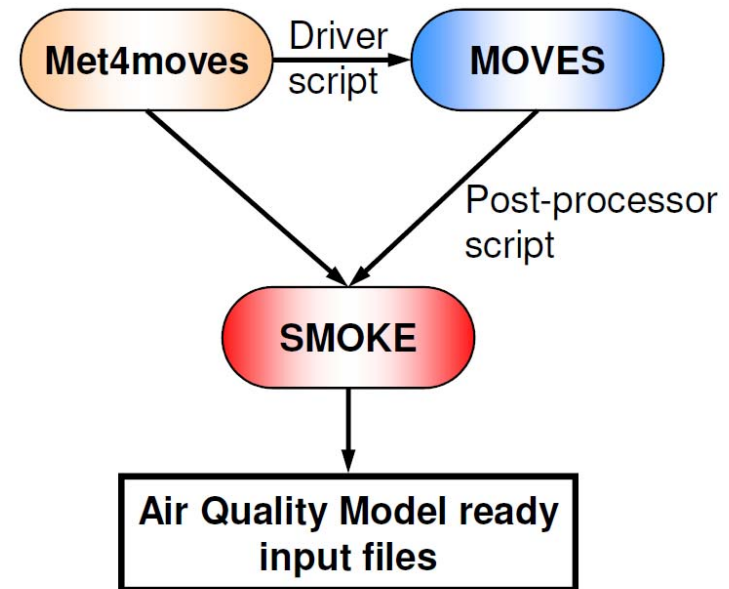
MOVES SET UP

- Inputs from OTC states obtained & reviewed for
  - 2007
  - 2013
  - 2017
  - 2020
- Also gathering inputs for 2025
- Representative counties identified

- MOVES runs for 2007 completed by
  - Pennsylvania
  - Virginia
  - New York
  - NESCAUM for rest of OTC
- SMOKE-MOVES runs for 2007 underway by
  - New York
  - Virginia
  - NESCAUM

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ERTAC EGU FORECASTING

FUTURE EGU EMISSIONS: ERTAC EGU GROWTH

- Eastern Regional Technical Advisory Committee
- Collaboration:
  - NE, Mid-Atlantic, SE, MW, Contributions from Texas and other western states.
  - Industry; and
  - Multi-Jurisdictional Organizations (MJOs)
- GOAL: Develop methodology to estimate EGU future year emissions
  - Follow up to ERTAC workgroup that reviewed temporalization techniques

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WHAT ERTAC WILL DO?

- Estimates EGU out 20 years
- Transparent
- Reproducible
- Anyone can make changes and re-run
  - To make changes to control strategy
  - Change in base & projection years
  - Does not require computing power beyond a desktop
- Peak hour growth included
- Alternative to IPM
  - Incorporates latest and best data from states, industry and ISOs
- States own this product – as good as the data states provide
- Evaluation of strategies for the CAMD EGU fleet

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ERTAC STRUCTURE
SUBCOMMITTEES AND CO-CHAIRS

- *Implementation* - Mark Janssen LADCO, Doris McLeod VA
  - Develop method to allocate growth among existing and new units.
- *Growth Factor* - Bob Lopez, WI & Laura Crowder, WV
  - Develop region & fuel specific growth rates for peak and off-peak
- *Data Tracking* - Wendy Jacobs, CT
  - Improve default data to reflect state specific data (allocation order, controls, plant characteristics)
- *Renewables and Conservation Program* - Danny Wong, NJ
  & Laura Boothe, NC
  - Identify generation type-specific growth rates for energy efficiency programs and renewable energy.

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METHODOLGY OVERVIEW

- Base Year CEM data as a starting point

- Hours ordered by region from peak days down

- Growth factors determined by region and fuel

- Allocate growth to all units

- Check for over capacity and create "Excess Generation Pool" (EGP)
  - Physical capacity (hourly, annual)
  - Regulatory capacity

- Assign EGP to units based on allocation order

GROWTH FACTORS

- ERTAC Regions defined
  - considered CAMD, EIA, and NERC regions
- Annual average growth forecasts based on AEO2011
  - Growth factors specific to primary fuel type (coal, oil, gas)
- Regional Peak Demand
  - based on difference between official NERC peak and EIA annual demand
- Peak factors applied to hours with the highest loading rate in the base year
  - Annual growth adjusted to match AEO total.

NEW UNIT TREATMENT

When future year power demands cannot be met with existing units.

- State input
- Federal form data
- New units needed for each fuel created based on reasonable default unit sizes
- New units will be "located" at an existing facility ("grown in place")
- Emission rates for new units set at 90th percentile cleanest of CAMD data
- Reporting function to allow states to review and corroborate or adjust data

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ASSIGNMENT OF CONTROLS

If caps cannot be met with existing known controls.

- Based on state input
- If additional controls are needed to meet regulatory caps:
  - Age factored into determination of control
  - Controlled units not retrofitted further
  - Controls applied to uncontrolled units in the dispatch order until caps are met
  - For SO_2, control type not specified, only controlled emission rates
  - For NO_X, control type limited to SCR and SNCR, depending on size, configuration, and age
- Reporting function to allow states to review and update control applications
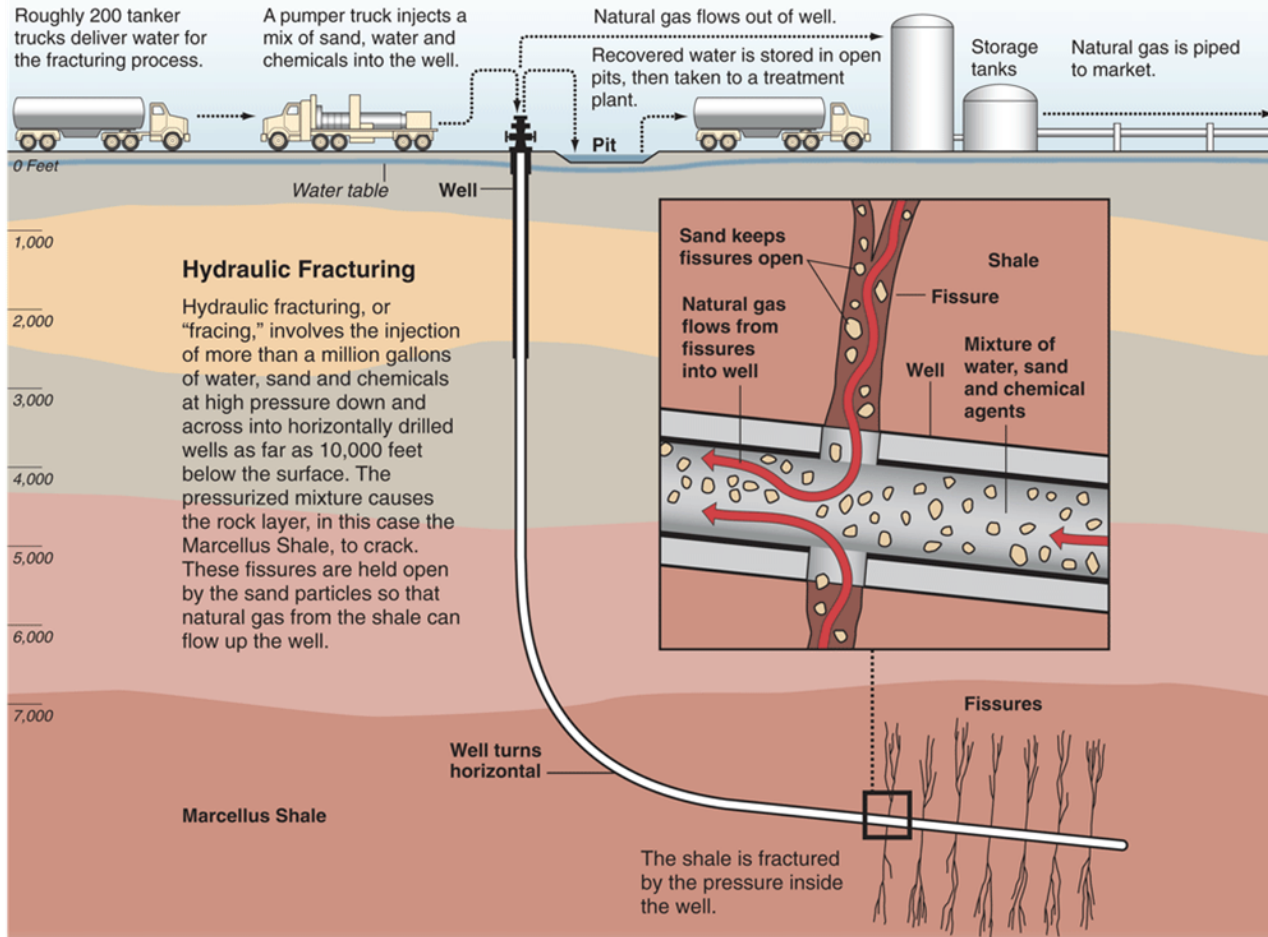
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![MARAMA - Mid-Atlantic Regional Air Management Association, Inc.]

MARCELLUS SHALE

MARCELLUS SHALE
HOW DOES IT WORK?

Roughly 200 tanker trucks deliver water for the fracturing process.

A pumper truck injects a mix of sand, water and chemicals into the well.

Natural gas flows out of well.

Recovered water is stored in open pits, then taken to a treatment plant.

Storage tanks

Natural gas is piped to market.

Pit

0 Feet

Water table   Well

1,000

Hydraulic Fracturing

Hydraulic fracturing, or "fracing," involves the injection of more than a million gallons of water, sand and chemicals at high pressure down and across into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer, in this case the Marcellus Shale, to crack. These fissures are held open by the sand particles so that natural gas from the shale can flow up the well.

2,000

3,000

4,000

5,000

6,000

7,000

Marcellus Shale

Well turns horizontal

The shale is fractured by the pressure inside the well.

Sand keeps fissures open

Natural gas flows from fissures into well

Shale

Fissure

Mixture of water, sand and chemical agents

Well

Fissures

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MARCELLUS SHALE
WHAT DOES IT LOOK LIKE?

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MARCELLUS SHALE WHERE IS IT?

Marcellus 516 TCF Current production rate=0.4 BCF

Barnett Shale 360 TCF Current production rate=923 BCF
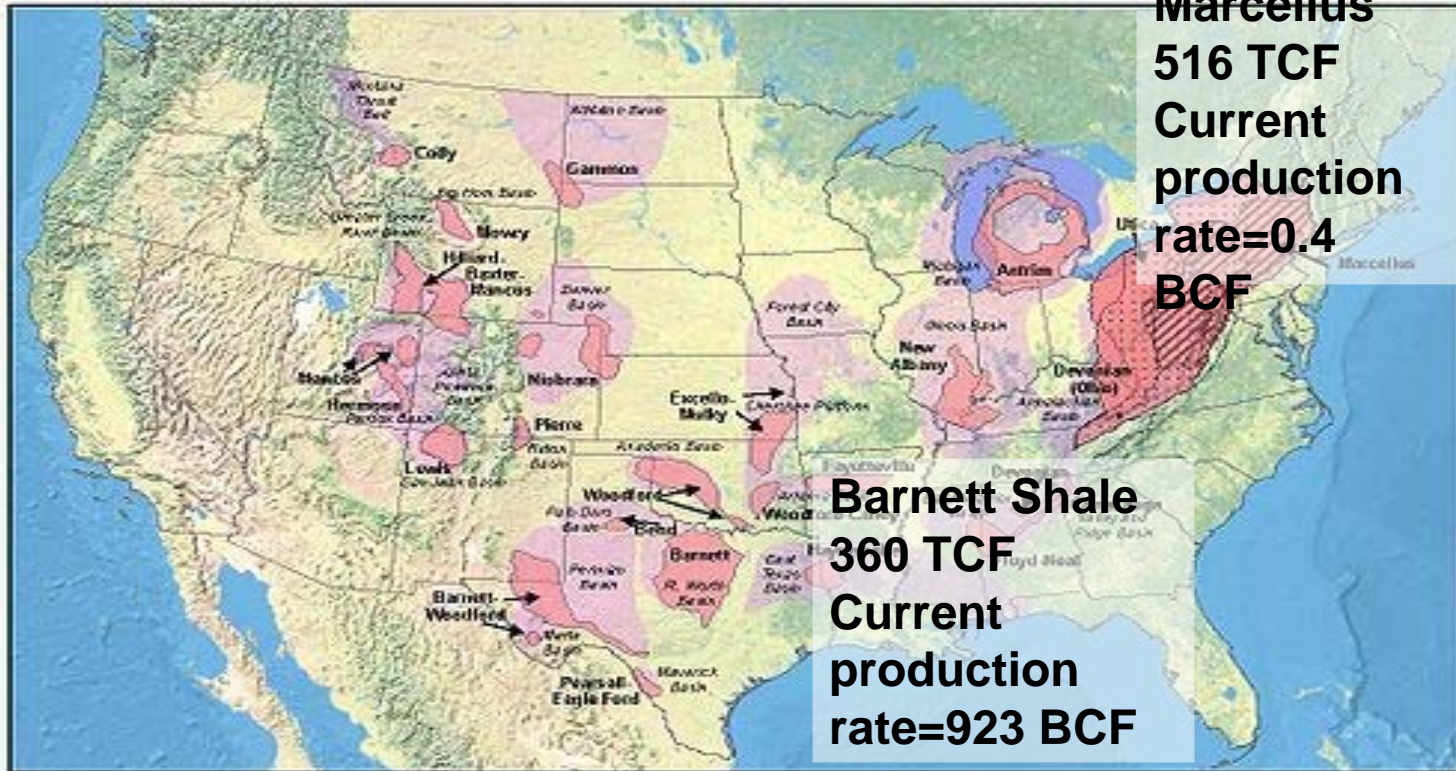
United States Shale Gas Plays

www.eia.doe.gov
Energy Information Administration
Office of Oil and Gas

Shale Gas Plays
Basins

Stacked Appalachian Plays
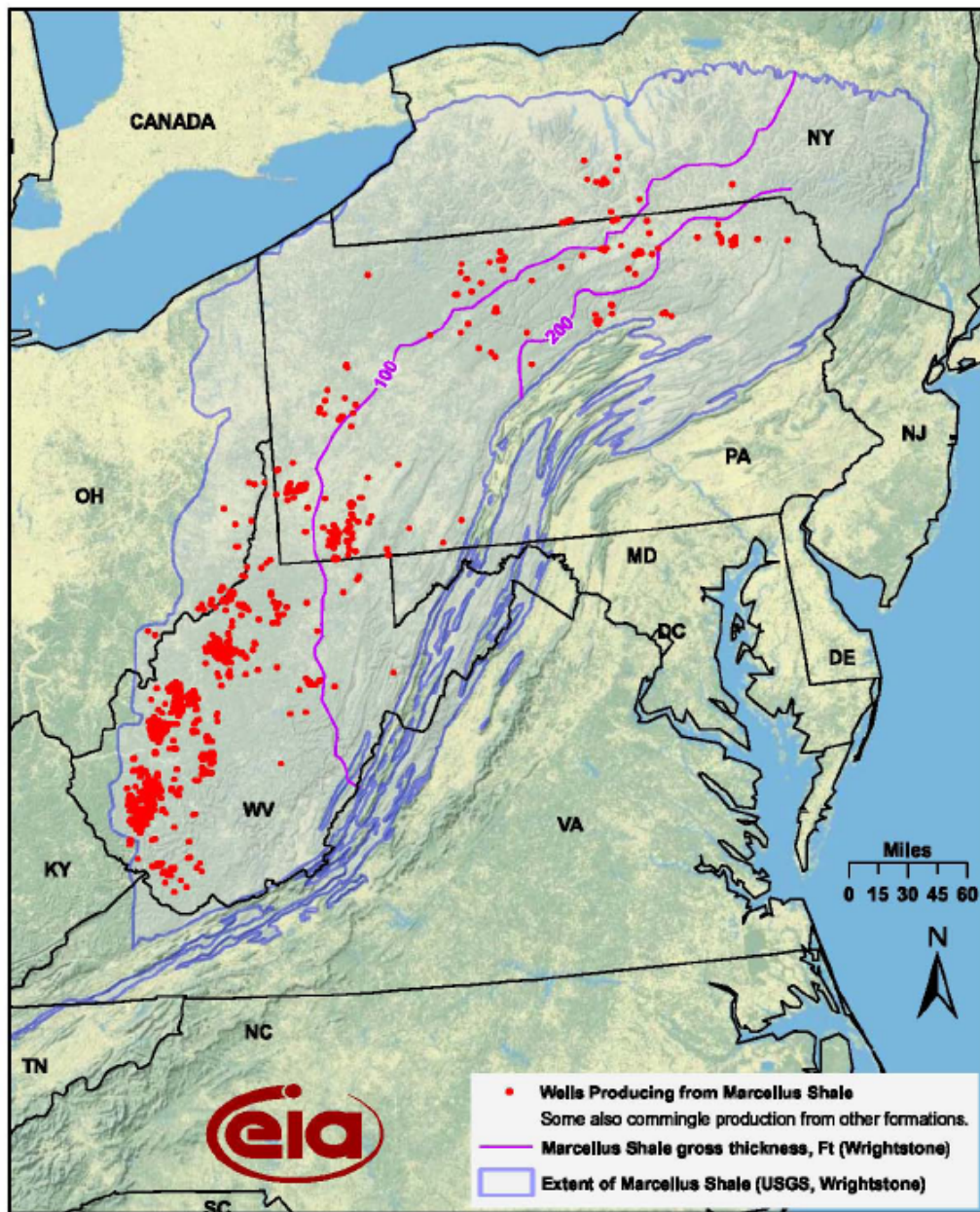
Marcellus
Utica
Devonian (OH shale)

November 2008

Miles
0   150   300   600

N

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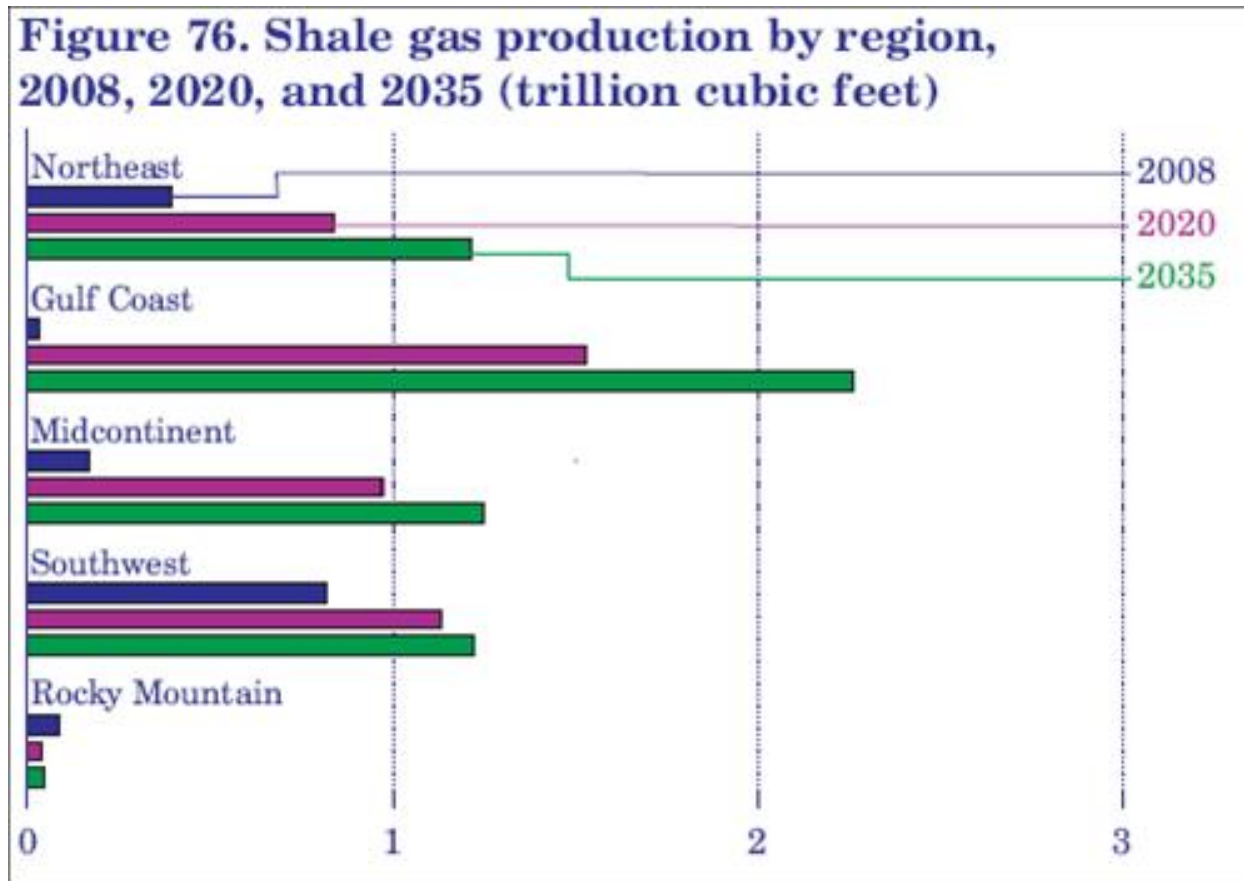
Marcellus Shale Gas Play, Appalachian Basin

Wells Producing from Marcellus Shale
Some also commingle production from other formations.

— Marcellus Shale gross thickness, Ft (Wrightstone)

Extent of Marcellus Shale (USGS, Wrightstone)

MARCELLUS SHALE
WHAT GROWTH CAN WE EXPECT?

Figure 76. Shale gas production by region, 2008, 2020, and 2035 (trillion cubic feet)

From: EIA 2010

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MARCELLUS SHALE POSSIBLE CONTROLS

– Engines – SNCR

- Catalytic converters similar to the ones on cars.
- May increase N2O emissions

– Condensate tanks - Vapor Recovery of VOC

– Piping, pumps and fixtures

- Sniffer devices coupled with maintenance

– Green completions – capture methane during installation operations

– Electric motors to drive compressors

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WHERE TO FIND THE INVENTORIES

- For more information on the inventories, please visit MARAMA's website:
  http://www.marama.org/technical-center/emissions-inventory/2007-emissions-and-projections/2007-emissions-inventory

- NIF and ORL Inventories can be accessed on the FTP site here:

  ftp.marama.org
     User: regionalei
     Password: marama2007
     Folders: Final 2007 and Projection Inventories

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