



# **Estimating Emissions from Oil and Gas Development**

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# Topics

- Definitions
- Emissions Inventory History
- Quality Assurance
- Emissions Inventory Results
- Effects of natural gas development on overall pollution
- Availability of data to public
- Contact Information

# Definitions

- Fracking
- Unconventional gas facilities
- Conventional gas facilities
- Coal-bed methane facilities
- Midstream facilities

# Definitions

- “Fracking”
  - Hydraulic Fracturing, Hydrofracking, and Fracking
  - Well-stimulation technique in which rock is fractured by a pressurized liquid
  - Used in rock formations where drilling is otherwise prohibitively expensive, due to geological structure
  - Chemicals introduced into liquid help dissolve minerals, initiate cracks in rocks, prevent equipment corrosion, prevent clay swelling or shifting, minimize friction, thicken liquids to suspend sand, and keep fractures open during extraction

# Definitions

- Unconventional gas well drilling
  - Drilled into unconventional formation below the base of Elk Sandstone or its geologic equivalent
  - In Pennsylvania most unconventional gas drilling is conducted in the Marcellus and Utica Formations
  - Natural gas cannot be extracted in these formations except by horizontal or vertical well bores stimulated by fracking
  - Natural gas contained in smaller rock pores

# Definitions

- Conventional gas well drilling
  - Traditional wells
  - Drilled into more permeable geologic formations, such as sandstone
  - Rock may contain reservoirs where gas or oil pool
  - Able to extract gas without as much stimulation by hydraulic fracturing
  - Do not require the volume of fluids typically required for unconventional wells

# Definitions

- Coal-bed Methane Facilities
  - Natural gas from coal
  - Southwestern Pennsylvania
  - Extracted to improve mine safety and for use as energy source
  - Historically seen as mining hazard
  - Also extracted from abandoned mines and coal beds too thin or deep to be economically mined
  - Typically from coal-bearing rocks at depths between 300-1800 feet

# Definitions

- **Midstream Facilities**
  - Infrastructure for transporting natural gas from well sites
  - Pipelines
  - Processing facilities
  - Compressor Stations



# Pennsylvania Emissions Inventory History

- 2011: All unconventional oil & gas facilities (well and midstream) required to submit emissions inventory
- 2012: All conventional and unconventional midstream oil & gas facilities required to submit emissions inventory. Unconventional drilling unaffected by change.
- 2013: Coalbed methane facilities required to submit. Midstream and unconventional drilling unaffected by change.
- 2014: Changes to Midstream inventory forms, requiring more information for use in quality assurance.

# Sources and Activities Subject to Reporting Requirements

- Compressor Stations
- Dehydration Units
- Drill Rigs
- Fugitive Sources
  - Connectors
  - Flanges
  - Pump Lines
  - Pump Seals
  - Valves
- Heaters
- Pneumatic Pumps
- Stationary Engines
- Tanks
  - Pressurized Vessels
  - Impoundments
- Venting
- Blowdown Systems
- Well Heads
- Well Completions

## Emissions Inventory Submittal History

Spreadsheet submittals have increased as more facility types have been required to report

Year	Drilling Companies	Drilling Sites	Midstream Companies	Midstream Facilities
2011	56	9,037	40	150
2012	57	8,966	71	453
2013	57	10,275	67	447

## Submittal Forms

- DEP provided two reporting formats for the submission of the data.
  - Well owners and operators reported emissions data electronically to the Oil and Gas Reporting Electronic (OGRE) database.
  - Mid-stream owners/operators submitted completed emission inventory spreadsheets to the Department via an email account.

## Midstream Submittal Change from 2012 to 2013

- Midstream companies reporting spreadsheets dropped from 71 to 67
- Midstream facilities being reported on spreadsheets dropped by 453 to 447
- Companies began reporting data in the regular point-source database, rather than on spreadsheets
- This trend will continue, as we get data entered into the point-source database in preparation for the 2015 and 2016 emissions inventories

# Quality Assurance

- Emission comparison between inventory years
- Review of spreadsheets upon submittal for missing data
- Review for outlier data
- Starting with 2014 data, comparing emissions reported with emissions factor and activity information provided by companies

# Inventory Results

## 2013 Inventory Results

## Data Summaries

- Reports of inventory data submitted by natural gas owners/operators are summarized as follows:
  - Total emissions by company
  - Total emissions by source category
  - Total emissions by county
  - Total emissions by well farm



## Reported Emissions for 2013

- Owners and operators reported 2013 natural gas emissions for CO, NO<sub>x</sub>, PM<sub>10</sub>, SO<sub>2</sub>, and VOCs.
- The increase in VOC emissions since 2011 is largely attributed to an increase in stationary engine and tank emissions, partially offset by a decrease in emissions from blowdown vents, heaters, and pumps.

# Natural Gas Emissions by Year

Year	Emissions in Tons per Year				
	CO	NOx	PM10	SO2	VOC
2011	6,852	16,542	577	122	2,820
2012	7,350	16,361	600	101	4,024
2013	6,606	17,659	670	159	4,790

# Point Source Emissions

- Between 2011 and 2013, all criteria pollutants were reduced for point sources
- SO<sub>2</sub> and NO<sub>x</sub> emissions decreased as a result of the continued conversion to natural gas and installation of control equipment on the Electric Generating Units (EGUs)
- The availability of the natural gas has supported the increase in utilization of natural gas-fired EGUs

# Changes in Point Source Emissions

Expressed in Tons Per Year

Category	Year	CO	NOx	PM10	SO2	VOC
Point Sources (excluding natural gas)	2011	85,990	192,275	22,588	353,480	20,363
Point Sources (excluding natural gas)	2013	74,496	169,440	17,713	278,287	19,753
Difference		-11,494	-22,835	-4,875	-75,193	-610

# Changes in Emissions from EGUs

Emissions in Tons Per Year

Category	Year	CO	NOx	PM10	SO2	VOC
EGUs	2011	20,604	142,749	11,745	319,388	576
EGUs	2013	17,560	128,416	8,391	250,420	820
Difference		<b>-3,044</b>	<b>-14,333</b>	<b>-3,354</b>	<b>-68,968</b>	<b>+244</b>

# EGU Emissions Compared to Natural Gas Emissions

- In comparison to emissions from EGUs, the reported natural gas emissions are very low for all criteria pollutants, with the exception of VOCs.

# EGU Emissions Compared to Natural Gas Emissions

2013 Emissions in Tons Per Year

Category	CO	NOx	PM10	SO2	VOC
Point Sources – including EGU	74,496	169,440	17,713	278,287	19,753
EGU	17,560	128,416	8,391	250,420	820
Natural Gas	6,606	17,659	670	159	4,790

## Contribution of Natural Gas Emissions to Total Point Source Emissions

- For the natural gas sources, VOC emissions account for 19.52% of the point source emissions.
- VOC emissions are generated from natural gas sources, including stationary engines, fugitives, and tanks.



## Contribution of Emissions from Natural Gas Sources to the Total Point Source Emissions 2013 Emissions in Tons Per Year

Category	CO	NOx	PM10	SO2	VOC
Point Sources	74,496	169,440	17,713	278,287	19,753
Natural Gas	6,606	17,659	670	159	4,790
All Point Sources, including Natural Gas	81,102	187,099	18,383	278,446	24,543
% Point Source attributable to Natural Gas	8.15%	9.44%	3.65%	0.05%	19.52%

## EGU Emission Reductions

- The following table shows the reductions that have occurred at the EGUs in tons per year.
- Emissions from the natural gas sector are included for comparison with the emissions from all EGUs in Pennsylvania.

# EGU Emission Reduction

Expressed in Tons Per Year

Category	Year	CO	NOx	PM10	SO2	VOC
EGUs	2011	20,604	142,749	11,745	319,388	576
EGUs	2013	17,560	128,416	8,391	250,420	820
<b>Difference</b>		<b>-3,044</b>	<b>-14,333</b>	<b>-3,354</b>	<b>-68,968</b>	<b>+244</b>
Natural Gas	2011	3,852	16,452	577	122	2,820
Natural Gas	2013	6,606	17,659	670	159	4,790
<b>Difference</b>		<b>+2,754</b>	<b>+1,207</b>	<b>+93</b>	<b>+37</b>	<b>+1,970</b>

# Overall Change in Emissions

Expressed in Tons Per Year

Category	CO	NOx	PM10	SO2	VOC
<b>EGU Difference, 2011-2013</b>	-3,044	-14,333	-3,354	-68,968	+244
<b>Natural Gas Difference, 2011-2013</b>	+2,754	+1,207	+93	+37	+1,970
<b>Overall Difference, 2011-2013</b>	<b>-290</b>	<b>-13,126</b>	<b>-3,261</b>	<b>-68,931</b>	<b>+2,214</b>

## Inventory Availability to the Public

- The natural gas emissions inventory is made available to the public by posting the data on the DEP website.
- A fracking fluid chemical list is available at FracFocus ([www.fracfocus.org](http://www.fracfocus.org)). These data will be moved to a state database by next summer.



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