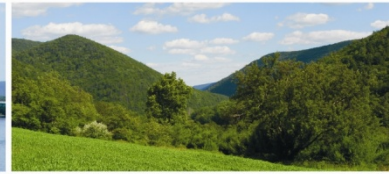




pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION



Bureau of Air Quality

2012 Natural Gas Emissions Inventory

Citizens Advisory Council

May 21, 2014

New Requirements for 2012 Inventory

- Expansion of Natural Gas Source Reports for 2012.
 - Reporting was required for conventional gas processing plants and compressor stations.
 - Conventional well development/production were not required to report.
 - Reporting of greenhouse gas (CO₂, CH₄, N₂O) emissions was required for:
 - Unconventional gas well operations
 - Unconventional gas processing plants and compressor stations
 - Conventional gas processing plants and compressor stations

Natural Gas Emissions Inventory

- Owners/operators of natural gas air contamination sources submitted source reports and emission inventories for 2012.
- “Unconventional natural gas” is defined in Act 13 of 2012.
- Emissions inventory of natural gas production facilities included:
 - 56 companies involved in drilling and gas production. (Unconventional only)
 - 69 companies involved in Mid-stream operations. (Unconventional/Conventional)

Natural Gas Emissions Inventory

- Sources and activities subject to reporting requirement include:
 - 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

Summary of Criteria Emissions

- The reported criteria pollutant emissions from the natural gas sector for 2012 are:

Category	Year	CO (TPY)	NOx (TPY)	PM10 (TPY)	SOx (TPY)	VOC (TPY)
Natural Gas	2012	7,342	16,347	600	101	4,005

Summary of Criteria Emissions

- The 2012 emissions from the natural gas sector are compared to the 2012 emissions from all point sources and all electrical generating units (EGUs) in Pennsylvania.

Category	CO (TPY)	NOx (TPY)	PM10 (TPY)	SOx (TPY)	VOC (TPY)
Point Sources	78,943	165,771	19,064	275,765	19,382
EGUs	17,998	125,033	9,381	247,876	801
Natural Gas	7,342	16,347	600	101	4,005

Comparison of Criteria Emissions

- Emissions from point sources have decreased since the emissions inventory was developed for 2008. The following table shows the emissions from all point sources has decreased since 2008. The SO_x emissions have decreased significantly as a result of the installation of control equipment on the electric generating units as well as the conversion to natural gas.

Category	Year	CO (TPY)	NO _x (TPY)	PM ₁₀ (TPY)	SO _x (TPY)	VOC (TPY)
All Point Sources	2008	94,409	235,485	30,719	864,789	24,671
All Point Sources	2012	78,943	165,771	19,064	275,765	19,382
Difference		(15,466)	(69,714)	(11,655)	(589,024)	(5,289)
Natural Gas	2012	7,342	16,347	600	101	4,005

Summary of Criteria Pollutant Emissions

- The reported criteria pollutant emissions (tons per year) by source category from the natural gas sector for 2012 are:

Source Type	Count	CO		NOx		PM10	
		Total	Avg	Total	Avg	Total	Avg
Blowdown Vents	668	3	0.0	7	0.0	0	0.0
Completions	1,057	2,317	2.2	4,871	4.6	189	0.2
Dehydrators	358	210	0.6	32	0.1	1	0.0
Drill Rigs	1,192	1,266	1.1	6,260	5.3	223	0.2
Engines	401	3,068	7.7	4,670	11.6	157	0.4
Fugitives	2,905	0	0.0	0	0.0	0	0.0
Heaters	1,819	465	0.3	505	0.3	31	0.0
Pumps	1,521	0	0.0	0	0.0	0	0.0
Tanks, Vessels	1,689	13	0.0	3	0.0	0	0.0

Summary of Criteria Pollutant Emissions

- Additional reported criteria pollutant emissions (tons per year) by source category from the natural gas sector for 2012:

Source Type	Count	PM2.5		SOx		VOC	
		Total	Avg	Total	Avg	Total	Avg
Blowdown Vents	668	0	0.0	0	0.0	97	0.1
Completions	1,057	159	0.2	27	0.0	433	0.4
Dehydrators	358	0	0.0	0	0.0	393	1.1
Drill Rigs	1,192	214	0.2	57	0.0	427	0.4
Engines	401	145	0.4	7	0.0	1,129	2.8
Fugitives	2,905	0	0.0	4	0.0	544	0.2
Heaters	1,819	29	0.0	6	0.0	26	0.0
Pumps	1,521	0	0.0	0	0.0	557	0.4
Tanks, Vessels	1,689	0	0.0	0	0.0	399	0.2

Summary of HAPs Emissions

- The reported hazardous air pollutant emissions (tons per year) from the natural gas sector for 2012:

Source	Count	Benzene		Ethyl Benzene		Formaldehyde		n-Hexane	
		Total	Avg	Total	Avg	Total	Avg	Total	Avg
Blowdown Vents	668	0	0.0	0	0.0	0	0.0	6	0.0
Completions	1,057	2	0.0	0	0.0	0	0.0	3	0.0
Dehydrators	358	8	0.0	4	0.0	4	0.0	14	0.0
Drill Rigs	1,192	3	0.0	0	0.0	2	0.0	0	0.0
Engines	401	8	0.0	1	0.0	367	0.9	6	0.0
Fugitives	2,905	3	0.0	0	0.0	0	0.0	12	0.0
Heaters	1,819	0	0.0	0	0.0	0	0.0	6	0.0
Pumps	1,521	6	0.0	0	0.0	0	0.0	17	0.0
Tanks, Vessels	1,689	1	0.0	0	0.0	0	0.0	33	0.0

Summary of HAPs Emissions

- Additional reported hazardous air pollutant emissions (tons per year) from the natural gas sector for 2012:

Source	Count	Toluene		Xylenes		2,2,4-Trimethylpentane	
		Total	Avg	Total	Avg	Total	Avg
Blowdown Vents	668	0	0.0	0	0.0	0	0.0
Completions	1,057	1	0.0	1	0.0	1	0.0
Dehydrators	358	13	0.0	17	0.0	0	0.0
Drill Rigs	1,192	1	0.0	1	0.0	0	0.0
Engines	401	4	0.0	2	0.0	2	0.0
Fugitives	2,905	10	0.0	12	0.0	1	0.0
Heaters	1,819	0	0.0	0	0.0	6	0.0
Pumps	1,521	2	0.0	1	0.0	0	0.0
Tanks, Vessels	1,689	2	0.0	0	0.0	8	0.0

Summary of Criteria Pollutant Emissions

- Reported greenhouse gas pollutant emissions (tons per year) from the natural gas sector for 2012:

Source Type	Count	Carbon Dioxide		Methane		Nitrous Oxide	
		Total	Avg	Total	Avg	Total	Avg
Blowdown Vents	668	550	0.8	8,056	12.1	4	0.0
Completions	1,057	1,125,980	1,065.3	39,949	37.8	8	0.0
Dehydrators	358	71,741	200.4	23,421	65.4	0	0.0
Drill Rigs	1,192	645,008	541.1	48	0.0	5	0.0
Engines	401	1,837,830	4,583.1	3,889	9.7	189	0.5
Fugitives				6,877	2.4		
Heaters	1,819	607,670	334.1	133	0.1	3	0.0
Pumps	1,521	96	0.1	23,738	15.6	478	0.3
Tanks, Vessels	1,689	371	0.2	17,270	10.2	0	0.0

▶ NOx/VOC Emissions 2011 - 2012

- Below is a comparison of reported NOx and VOC emissions (tons per year) from the natural gas sector for reporting years 2011 and 2012:

Source Type	NOx 2012			NOx 2011			VOC 2012			VOC 2011		
	Count	Total	Avg	Count	Total	Avg	Count	Total	Avg	Count	Total	Avg
Blowdown Vents	668	7	0.0	572	2	0.0	668	97	0.1	572	52	0.1
Completions	1,057	4,871	4.6	1,000	5,163	5.2	1,057	433	0.4	1,000	527	0.5
Dehydrators	358	32	0.1	182	16	0.1	358	393	1.1	182	326	1.8
Drill Rigs	1,192	6,260	5.3	1,415	8,341	5.9	1,192	427	0.4	1,415	392	0.3
Engines	401	4,670	11.6	150	2,698	18.0	401	1,129	2.8	150	717	4.8
Fugitives	2,905	0	0.0	1,713	0	0.0	2,905	544	0.2	1,713	319	0.2
Heaters	1,819	505	0.3	1,172	322	0.3	1,819	26	0.0	1,172	18	0.0
Pumps	1,521	0	0.0	576	0	0.0	1,521	557	0.4	576	159	0.3
Tanks, Vessels	1,689	3	0.0	991	0	0.0	1,689	399	0.2	991	307	0.3
Totals	11,610	16,347	1.4	7,771	16,542	2.1	11,610	4,005	0.3	7,771	2,817	0.4

Emissions Summary by County

- Top ten counties for criteria pollutant emissions (tons per year) from the unconventional natural gas sector for 2012:

County Emissions	CO	NOx	PM10	PM2.5	SOx	VOC
Washington	937	2,094	67	66	5	697
Bradford	731	2,032	79	76	13	293
Lycoming	473	1,949	69	69	21	205
Susquehanna	651	1,903	57	56	3	227
Greene	804	1,890	82	71	13	368
Tioga	640	1,200	48	48	5	197
Clearfield	329	700	24	15	5	90
Westmoreland	322	618	17	16	4	205
Fayette	224	551	20	20	6	170
Butler	255	454	31	29	1	606



Emissions Summary by County

- Top ten counties for hazardous air pollutant emissions (tons per year) from the unconventional natural gas sector for 2012:

County Emissions	Benzene	Ethyl Benzene	Formaldehyde	n-Hexane	Toluene	Xylenes	2,2,4-Trimethylpentane
Washington	8.1	0.4	53.9	40.1	7.9	10.9	8.7
Greene	3.1	0.3	32.2	5.3	2.5	2.2	3.9
Fayette	2.7	0.2	24.5	4.2	2.8	2.7	0.2
Westmoreland	2.1	0.4	23.0	6.6	2.0	1.6	2.2
Tioga	2.0	2.3	30.6	2.4	2.2	2.8	0.5
Butler	1.2	0.2	2.6	14.6	2.9	4.0	0.3
Lycoming	1.1	0.2	12.2	1.8	0.8	0.7	0.6
Susquehanna	0.9	0.0	40.6	3.3	1.0	0.6	0.2
Bradford	0.6	0.0	30.9	0.8	0.3	0.2	0.0
Clearfield	0.6	0.1	5.3	1.0	0.5	0.4	0.2

Emissions Summary by County

- Top ten counties for greenhouse gas emissions (tons per year) from the unconventional natural gas sector for 2012:

County Emissions	Carbon		Nitrous
	Dioxide	Methane	Oxide
Bradford	682,302	23,350	2.8
Washington	680,979	9,327	68.2
Susquehanna	560,881	36,607	1.9
Tioga	420,683	7,269	1.6
Lycoming	398,300	14,648	3.4
Greene	307,169	6,823	241.6
Fayette	192,359	1,795	200.1
Butler	146,405	1,104	1.2
Westmoreland	139,383	1,687	100.5
Clearfield	99,482	1,691	0.4



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