



Petroleum and Natural Gas Systems in the Greenhouse Gas Reporting Program 2014 Data

U.S. Environmental Protection Agency
Office of Atmospheric Programs, Climate Change Division

Overview of GHG Reporting Program



- Launched in response to FY 2008 Consolidated Appropriations Act
- Annual reporting of GHGs by 41 source categories
 - 33 types of direct emitters
 - 6 types of suppliers of fuel and industrial GHGs
 - Facilities that inject CO₂ underground for geologic sequestration, enhanced oil recovery, or any other purpose
- Most source categories began collecting data in 2010, with first annual reports submitted to EPA in September 2011
 - An additional 12 source categories began collecting data in 2011, with first annual reports submitted to EPA in September 2012
 - We now have 5 years of data for 29 source categories and 4 years of data for 12 source categories
- Facilities use uniform methods prescribed by the EPA to calculate GHG emissions, such as direct measurement, engineering calculations, or emission factors derived from direct measurement
 - In some cases, facilities have a choice of calculation methods for an emission source

Source Categories Covered by GHG Reporting Program



Power	Refining & Petrochem	Other Chemicals	Combustion	Waste	Metals	Minerals	Pulp & Paper	High GWP Gases
<ul style="list-style-type: none"> - Electricity Generation - Electrical Equipment Mfg. - Electrical Equipment Use 	<ul style="list-style-type: none"> - Petroleum Refineries - Petrochem. Production 	<ul style="list-style-type: none"> - Adipic Acid - Ammonia - Hydrogen Production - Nitric Acid - Phosphoric Acid - Titanium Dioxide 	<ul style="list-style-type: none"> - Stationary Combustion 	<ul style="list-style-type: none"> - Industrial Waste Landfills - Industrial Wastewater Treatment - MSW Landfills 	<ul style="list-style-type: none"> - Aluminum - Ferroalloy - Iron & Steel - Lead - Magnesium - Silicon Carbide - Zinc 	<ul style="list-style-type: none"> - Cement - Glass - Lime - Misc. Carbonate Use - Soda Ash 	<ul style="list-style-type: none"> - Pulp & Paper 	<ul style="list-style-type: none"> - Electronics Mfg. - Fluorinated GHG Production - HCFC-22 Prod./HFC-23 Destruction - Pre-Charged Equipment Import/Export - Industrial Gas Suppliers
Petroleum & Natural Gas Systems			Fuel Suppliers			Carbon Capture & Sequestration		Mining
<ul style="list-style-type: none"> - Onshore Production - Offshore Production - Natural Gas Processing - Natural Gas Transmission/Compression - Natural Gas Distribution - Underground Natural Gas Storage - Liquefied Natural Gas Storage - Liquefied Natural Gas Import/Export 			<ul style="list-style-type: none"> - Coal-Based Liquid Fuels Suppliers - Natural Gas and Natural Gas Liquids Suppliers - Petroleum Product Suppliers 			<ul style="list-style-type: none"> - Geologic Sequestration of CO₂ - Injection of CO₂ - CO₂ Suppliers 		<ul style="list-style-type: none"> - Underground Coal Mines
							<p style="text-align: right;">Direct Emitters Suppliers CO₂ Injection</p>	

Data Publication - FLIGHT



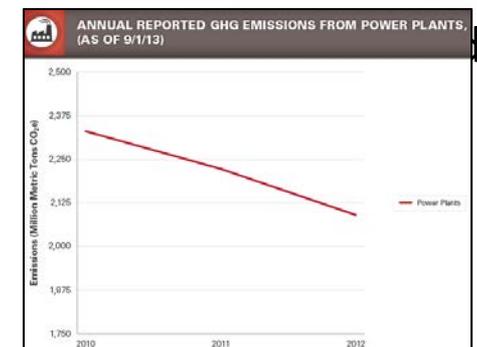
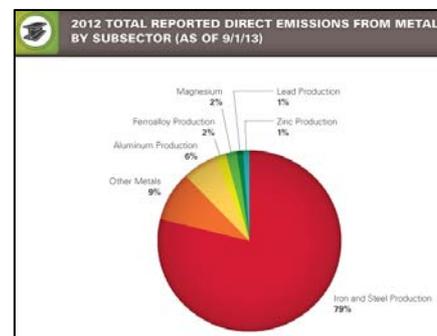
- EPA makes GHGRP data publicly through several websites
- **FLIGHT** (<http://ghgdata.epa.gov/>)
 - Allows stakeholders and the public to access the key data elements quickly and easily



- **Envirofacts** (<http://www.epa.gov/enviro/greenhouse-gas-customized-search>)
 - Contains all publicly available data collected by the GHGRP



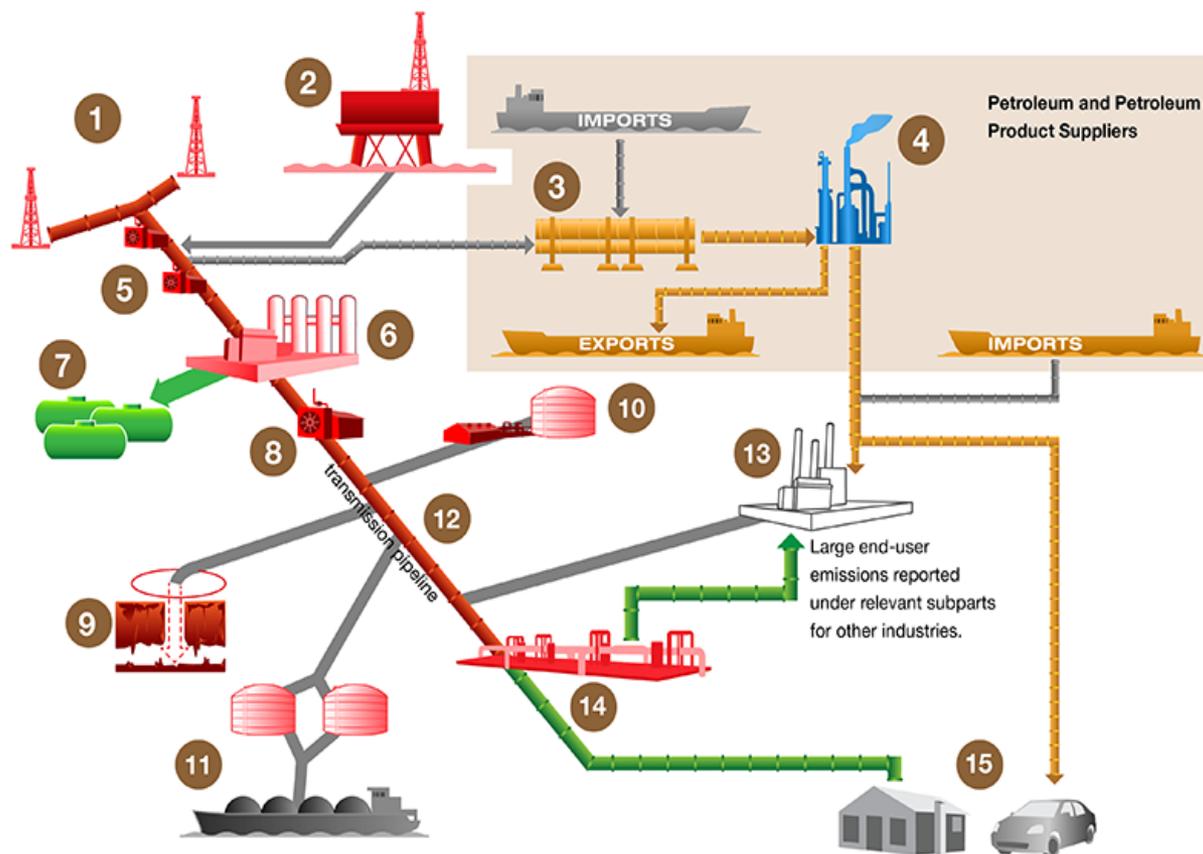
- **Data Highlights** (<http://www.epa.gov/ghgreporting/ghgrp-2014-reported-data>)
 - Contains a summary of data in each sector





GHGRP Petroleum and Natural Gas Systems (Subpart W)

Petroleum and Natural Gas in GHGRP



Production & Processing

1. Onshore Petroleum & Natural Gas Production
2. Offshore Petroleum & Natural Gas Production
3. Total Crude Oil to Refineries
4. Petroleum Refining
5. Gathering and Boosting
*Data collection will begin in RY16
6. Gas Processing Plant
*May contain NGL Fractionation equipment
7. Natural Gas Liquids (NGL) Supply

Natural Gas Transmission & Storage

8. Transmission Compressor Stations
9. Underground Storage
10. Liquefied Natural Gas (LNG) Storage
11. LNG Import-Export Equipment
12. Natural Gas Transmission Pipeline
*Data collection will begin in RY16

Distribution

13. Large End Users
14. Natural Gas Distribution
15. Natural Gas & Petroleum Supply to Small End Users

	Subpart W: Emissions from petroleum & natural gas systems
	Subpart Y: Emissions from petroleum refineries
	Subpart MM: CO ₂ associated with supplies of petroleum products
	Subpart NN: CO ₂ associated with supplies of natural gas & natural gas liquids
	Not reported under GHGRP

Note: Certain petroleum and/or natural gas operations are covered by subparts of the GHGRP other than Subpart W.

What is a Facility?



- In general, a “facility” for purposes of the GHGRP means all co-located emission sources that are commonly owned or operated
- However, certain industry segments within the Petroleum and Natural Gas Systems source category have unique “facility” definitions
 - Onshore production: the “facility” includes all emissions associated with wells owned or operated by a single company (the permit holder) in a specific hydrocarbon producing basin (as defined by the geologic provinces published by the American Association of Petroleum Geologists)
 - Natural gas distribution: the “facility” is a local distribution company as regulated by a single state public utility commission
- The other industry segments in the Petroleum and Natural Gas Systems source category follow the general GHGRP definition of “facility”



2014 Reported GHG Emissions from Petroleum and Natural Gas Systems

Reported GHG Emissions by Industry Segment



- EPA received annual reports from over 2,300 facilities
- Reported emissions totaled 236 Million Metric Tons (MMT) CO₂e
- This is an increase of 3.5% compared to 2013 GHG emissions from this sector

Segment	Number of Facilities	GHG Emissions (Million Metric Tons CO ₂ e)
Onshore Production	523	103
Offshore Production	128	7
Natural Gas Processing	464	60
Natural Gas Transmission	520	22
Underground Natural Gas Storage	53	2
Natural Gas Distribution	181	15
LNG Import/Export	7	1
LNG Storage	5	< 1
Other Oil and Gas Combustion	488	28
Total	2,350	236

Changes in Reported Emissions: 2011-2014



- Total reported emissions increased by 13.7 MMT CO₂e from 2011 to 2014.

Segment	2011 Reported Emissions (MMT CO ₂ e)	2012 Reported Emissions (MMT CO ₂ e)	2013 Reported Emissions (MMT CO ₂ e)	2014 Reported Emissions (MMT CO ₂ e)	2013-14 Change in Reported Emissions (MMT CO ₂ e)	2011-14 Change in Reported Emissions (MMT CO ₂ e)
Onshore Production	92	93	97	103	5.5	10.9
Offshore Production	6	7	6	7	0.3	0.4
Natural Gas Processing	59	60	59	60	0.3	0.5
Natural Gas Transmission	24	24	23	22	-0.4	-1.9
Underground Natural Gas Storage	2	2	2	2	0.2	0.0
Natural Gas Distribution	16	15	16	15	-1.1	-1.1
LNG Import/Export	1	1	<1	1	0.2	0.0
LNG Storage	<1	<1	<1	<1	0.0	0.0
Other Oil and Gas Combustion	23	25	25	28	2.8	4.8
Total	222	226	228	236	7.9	13.7

Examples of Reported Activity Counts: 2011-2014

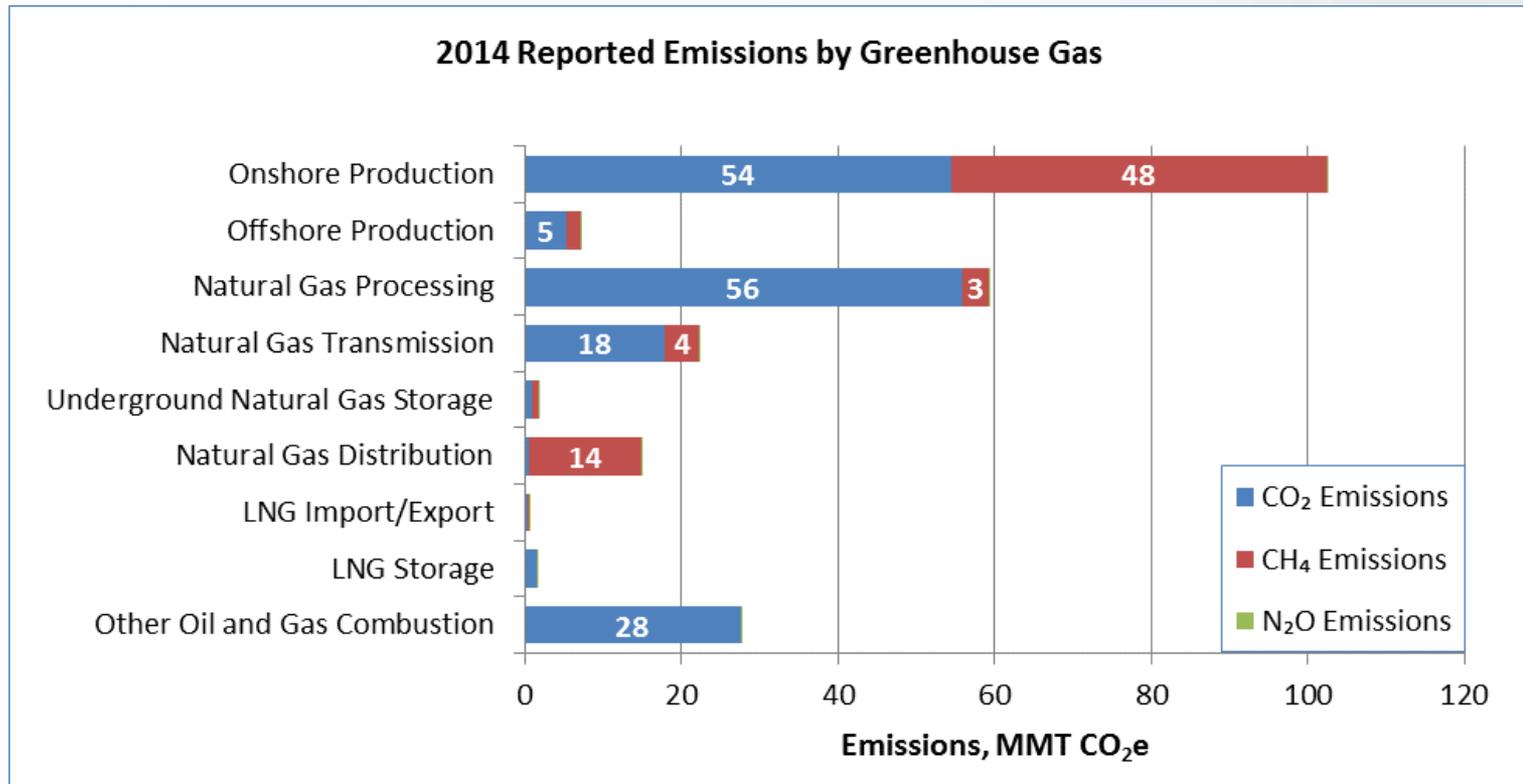


Industry Segment	Source Type	2011 Count	2012 Count	2013 Count	2014 Count
Onshore Production	Reporting Facilities	456	502	503	523
	Pneumatic Devices	574,057	628,890	707,974	785,113
	Pneumatic Pumps	64,490	77,538	77,355	79,881
	Wells	375,445	406,262	425,125	499,023
	Atmospheric Tanks	184,203	223,447	219,632	275,532
	Centrifugal Compressors	156	139	105	69
	Reciprocating Compressors	14,107	18,129	20,156	23,318
Natural Gas Processing	Reporting Facilities	373	403	437	464
	Centrifugal Compressors	457	458	489	489
	Reciprocating Compressors	2,039	2,197	2,514	2,635
Natural Gas Transmission	Reporting Facilities	421	457	487	520
	Pneumatic Devices	11,187	11,105	11,115	13,392
	Centrifugal Compressors	630	727	789	841
	Reciprocating Compressors	1,900	1,978	2,087	2,165
Underground Natural Gas Storage	Reporting Facilities	49	52	51	53
	Pneumatic Devices	2,894	2,958	2,985	3,635
	Centrifugal Compressors	36	40	36	36
	Reciprocating Compressors	301	338	341	351
Natural Gas Distribution	Reporting Facilities	183	183	175	181
	Miles of Unprotected Steel Mains	59,599	58,426	60,216	55,568
	Miles of Protected Steel Mains	396,775	412,299	416,756	415,491
	Miles of Plastic Mains	512,917	531,902	548,414	563,156
	Miles of Cast Iron Mains	30,401	29,282	29,650	28,909

Reported Emissions by Greenhouse Gas



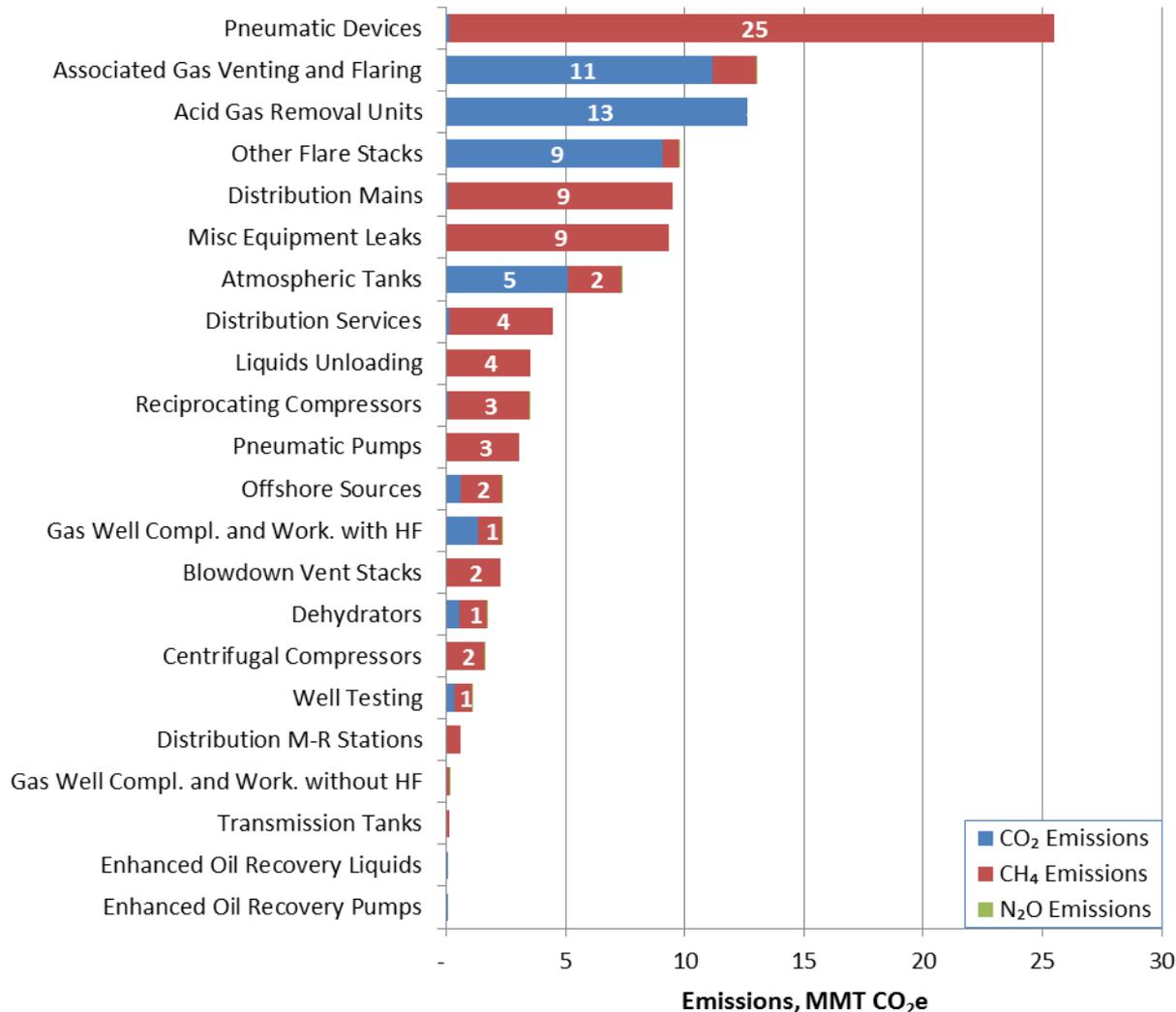
- Carbon dioxide (CO₂) emissions accounted for 163 MMT CO₂e and methane (CH₄) emissions accounted for 73 MMT CO₂e
- Emissions from natural gas distribution were primarily methane while emissions from natural gas transmission, natural gas processing, and other oil and gas combustion were primarily carbon dioxide



Reported Process Emission Sources



2014 Reported Process Emission Sources

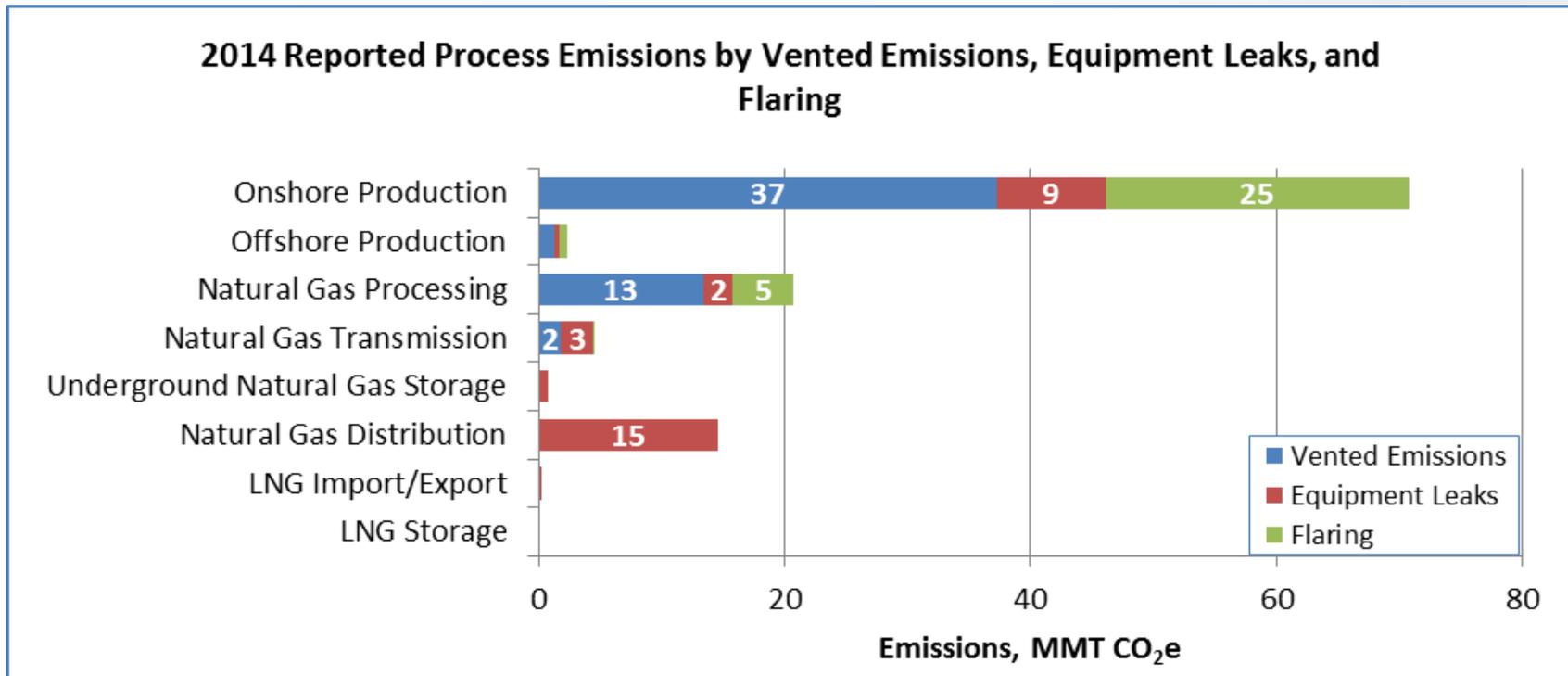


- The figure to the left shows total reported process emissions across all Petroleum and Natural Gas Systems facilities
- The largest reported process emission sources were pneumatic devices, associated gas venting and flaring, acid gas removal units, and miscellaneous flaring

Reported Process Emissions by Type



- Process emissions may be further subdivided by type of process, such as vented emission sources, equipment leaks, and flaring
- Vented emissions totaled 54 MMT CO₂e, equipment leaks totaled 29 MMT CO₂e, and flaring totaled 30 MMT CO₂e



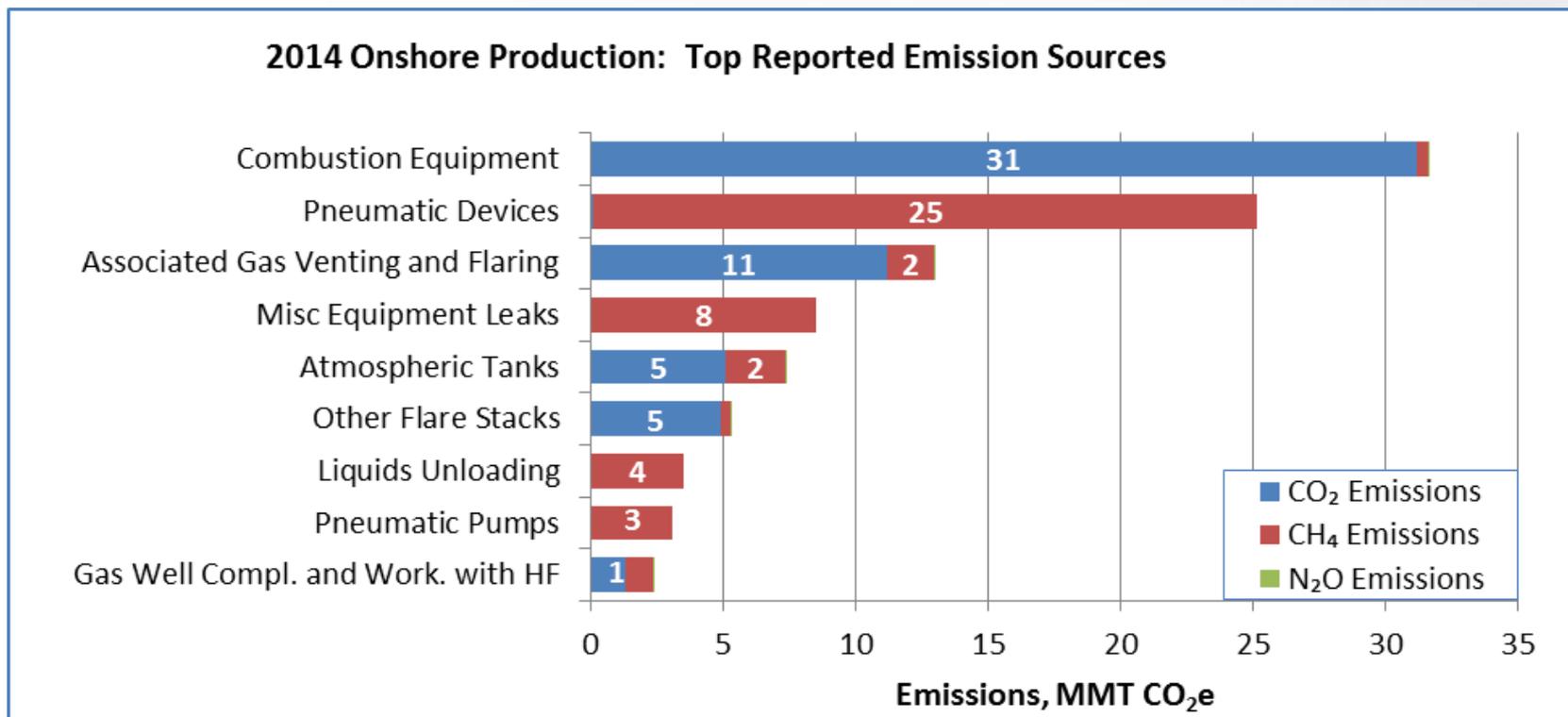


Reported GHG Emissions by Industry Segment and Source

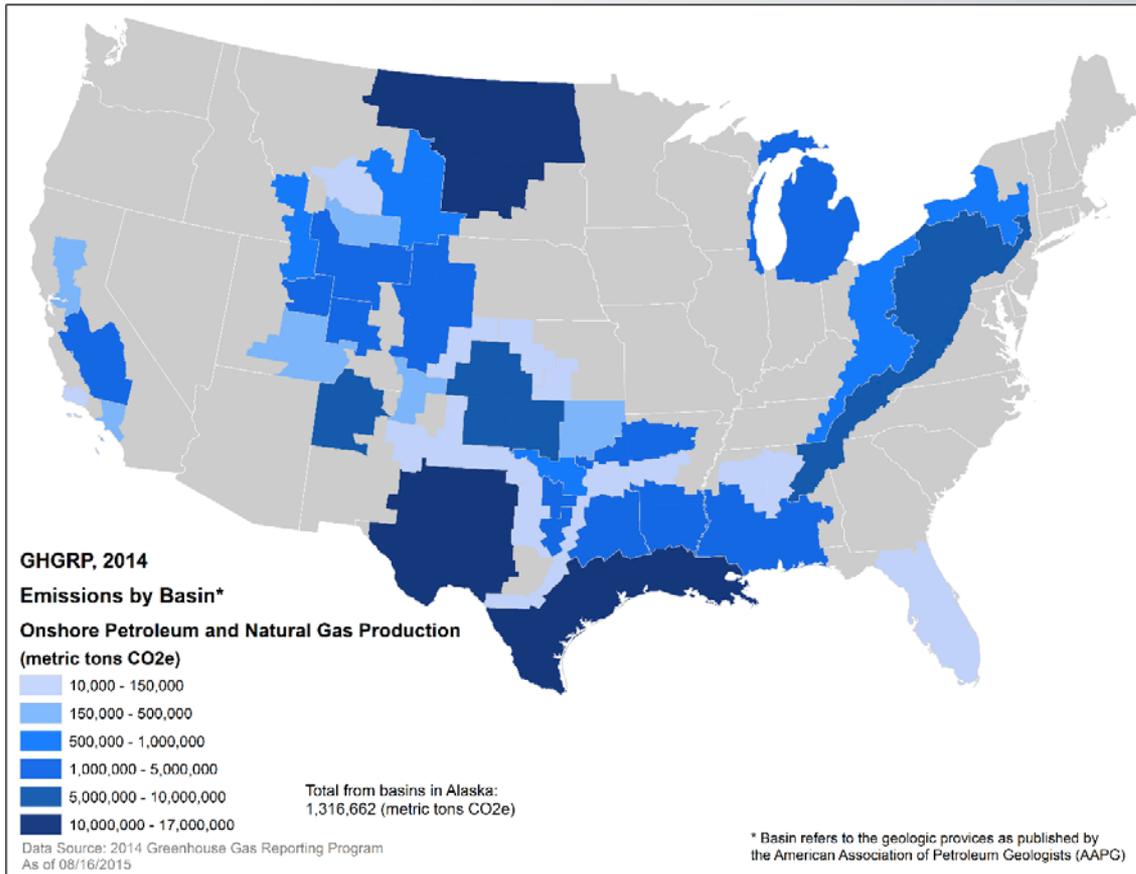
Onshore Production



- Reported emissions in onshore production totaled 103 MMT CO₂e
- 523 facilities reported under this sector
- Methane emissions totaled 48 MMT CO₂e and carbon dioxide emissions totaled 54 MMT CO₂e



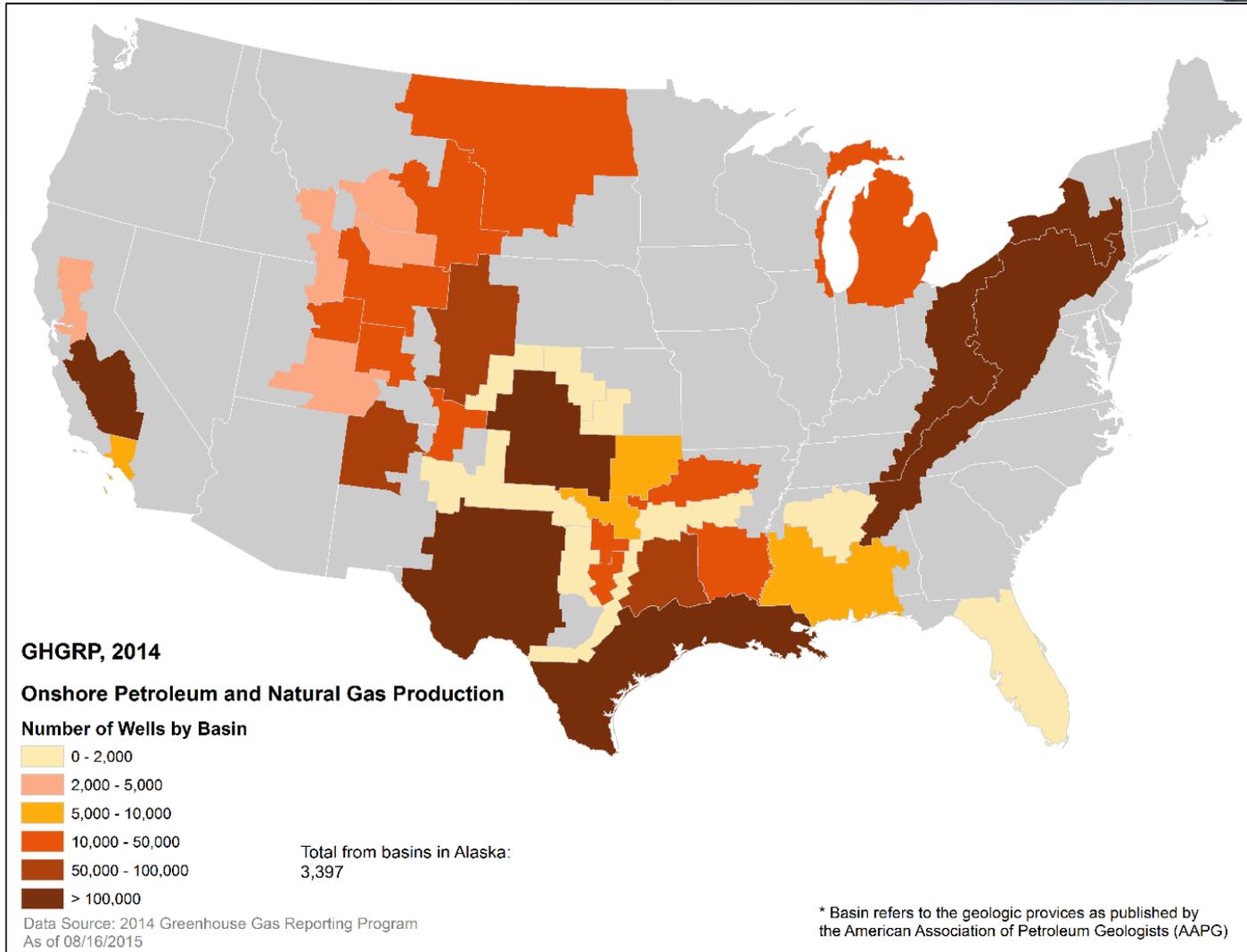
Onshore Production Basin Emissions



- Emissions in onshore production are reported by basin
- The map to the left shows reported emissions aggregated for all onshore production facilities by basin
- The basins with highest reported emissions were:
 - Williston Basin (16.4 MMT CO₂e)
 - Gulf Coast Basin (15.6 MMT CO₂e)
 - Permian Basin (10.9 MMT CO₂e)
 - Anadarko Basin (9.4 MMT CO₂e)
 - San Juan Basin (7.3 MMT CO₂e)

Note: For the onshore production segment, the “facility” includes all emissions associated with wells owned or operated by a single company in a specific hydrocarbon producing basin. A basin refers to a geologic region where sediment infilling has occurred. The GHG Reporting Program definition of basin refers to the geologic provinces as published by the American Association of Petroleum Geologists (AAPG).

New - Onshore Production Basin Well Counts



New – Onshore Production Reported Equipment Counts per Basin



- A count of major equipment is reported in Onshore Petroleum and Natural Gas Production.
- Data shown are the 2014 equipment totals for all reporters in the Permian Basin.
- Similar counts are available for individual basin-level facilities.

Type of Equipment	Permian Basin Total Count
Header	10,509
Wellheads	112,230
Separators	22,900
Compressors	1,489
Dehydrators	82
Meters/piping	25,856
Heater-treater	8,709
In-line heaters	380

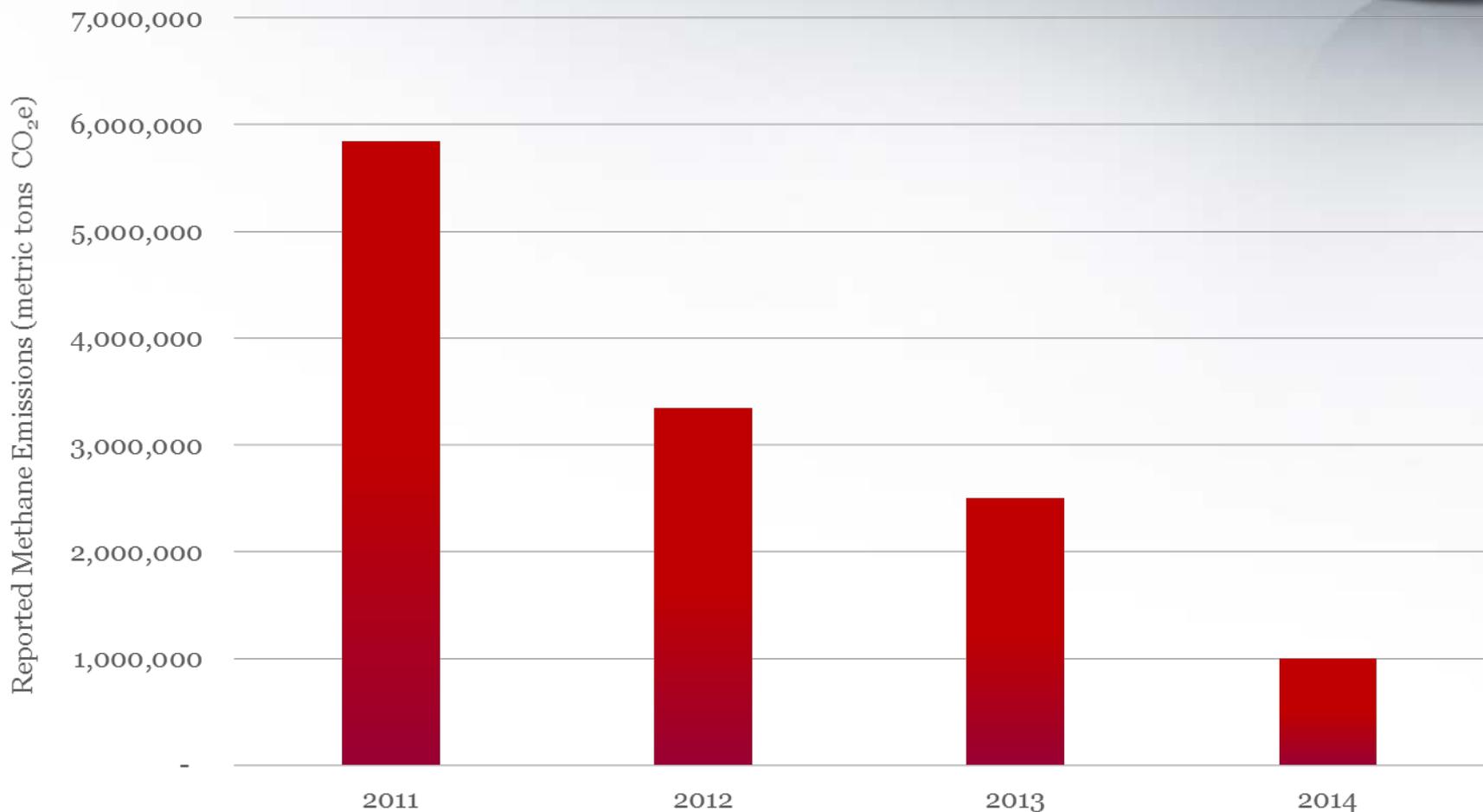
Gas Well Completions and Workovers with Hydraulic Fracturing



- 183 onshore production facilities reported emissions from gas well completions and workovers with hydraulic fracturing, which totaled 2.3 MMT CO₂e
- GHGRP calculation methods allow facilities to measure or estimate the backflow rate in order to report emissions using an engineering calculation, or the backflow vent or flare volume may be measured directly

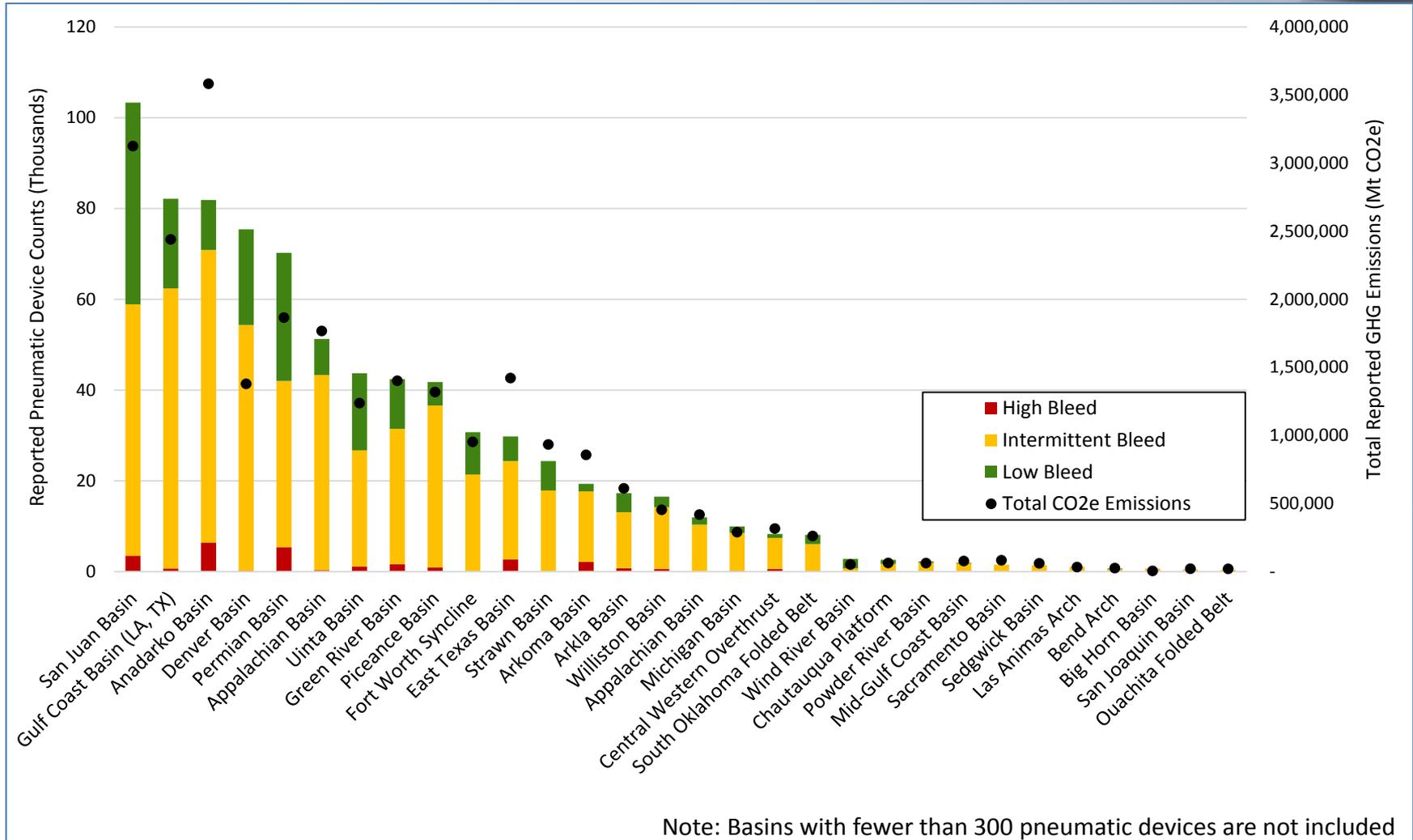
Activity	Total Number	Number of RECs	Reported Venting CO ₂ Emissions (MT CO ₂ e)	Reported Venting CH ₄ Emissions (MT CO ₂ e)	Reported Flaring CO ₂ Emissions (MT CO ₂ e)	Reported Flaring CH ₄ Emissions (MT CO ₂ e)	Total Reported Emissions (MT CO ₂ e)
Gas Well Completions with Hydraulic Fracturing	7,139	4,928	6,533	902,202	1,230,755	177,903	2,145,152
Gas Well Workovers with Hydraulic Fracturing	445	138	133	83,612	83,563	4,100	171,427
Total	7,584	5,066	6,666	985,813	1,314,318	182,003	2,316,580

Gas Well Completions and Workovers with Hydraulic Fracturing: 2011-2014 Reported CH₄ Emissions



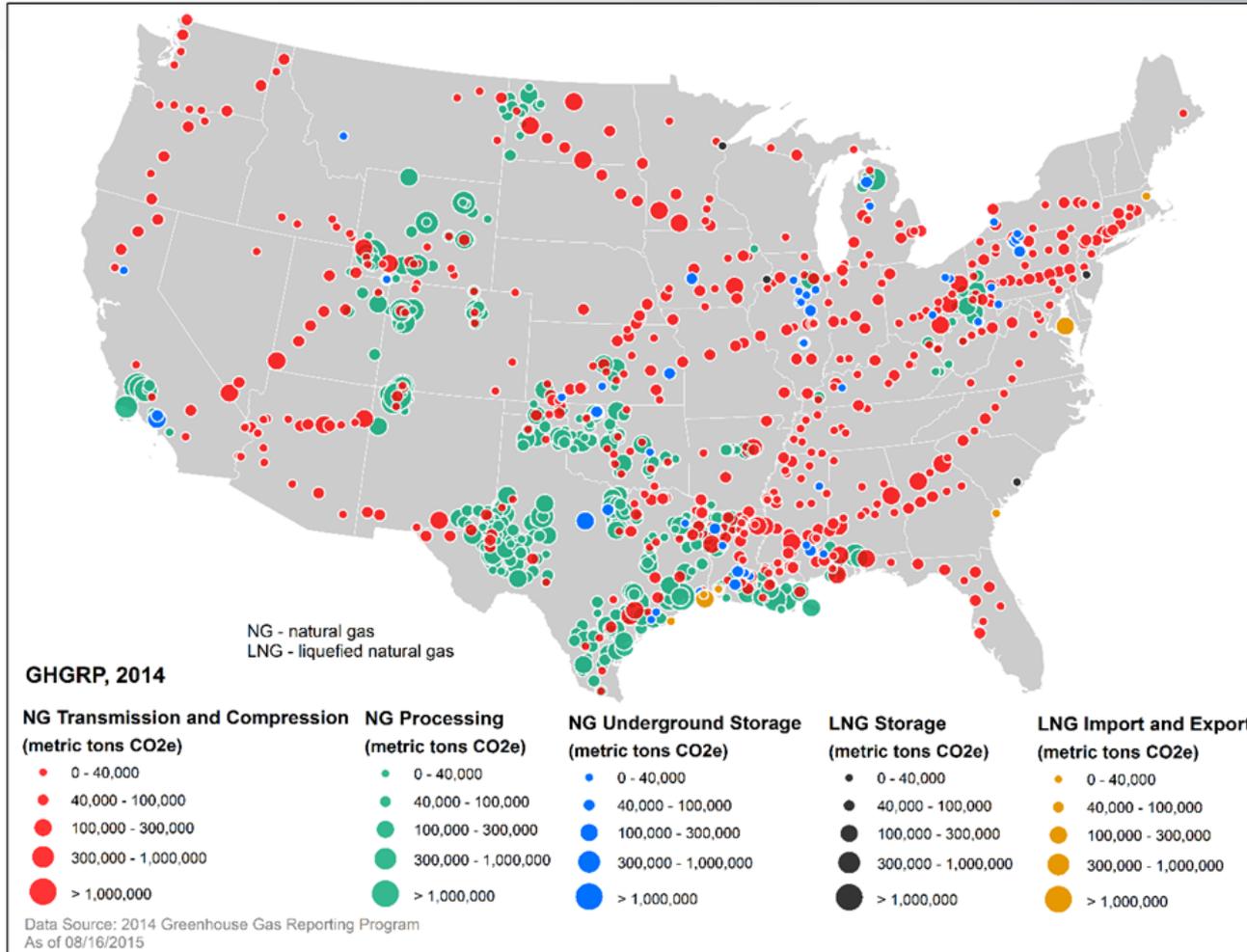
New - Onshore Production

2014 Pneumatic Device Types by Basin & by Facility

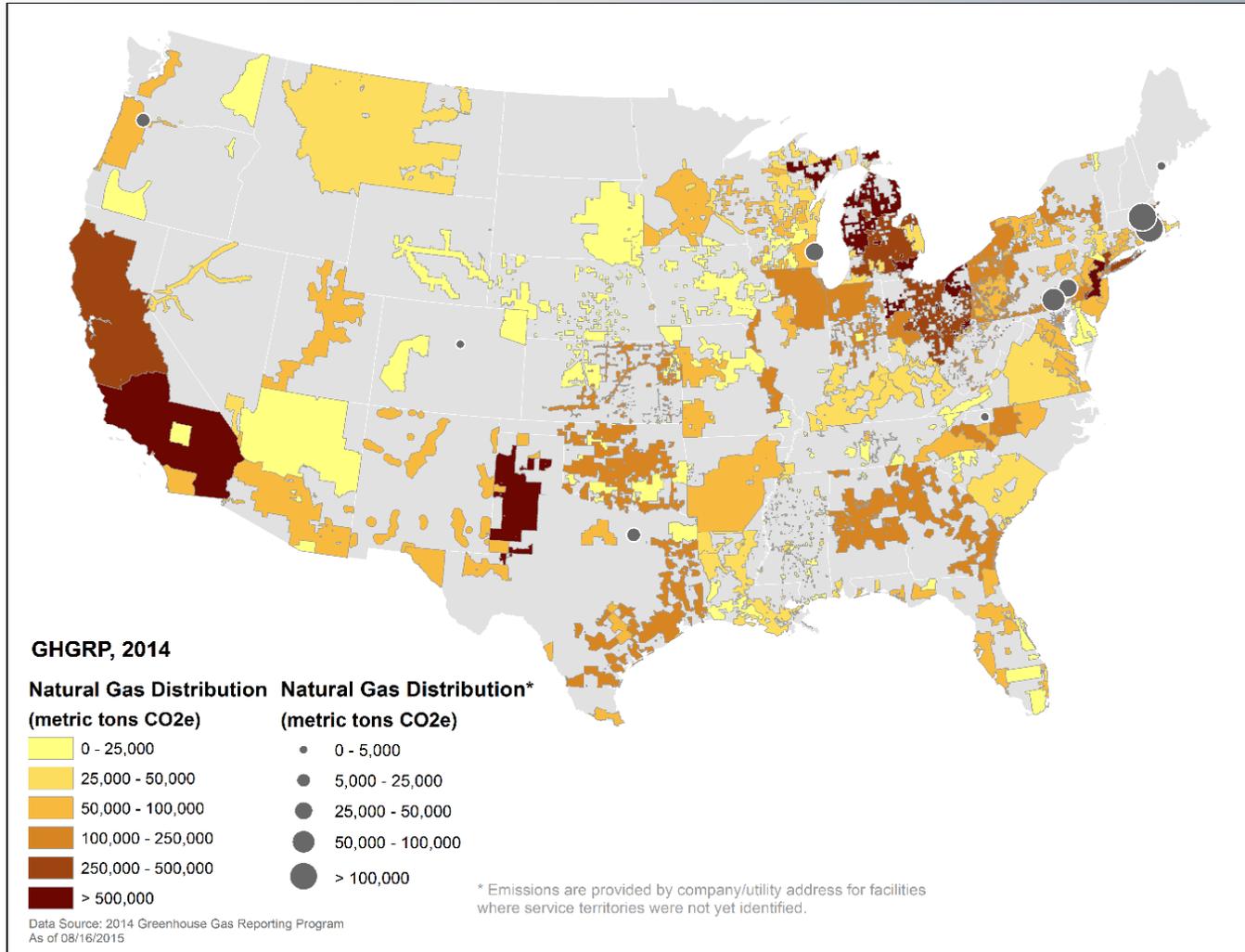


Note: Basins with fewer than 300 pneumatic devices are not included

NG Processing, Storage, Transmission, LNG

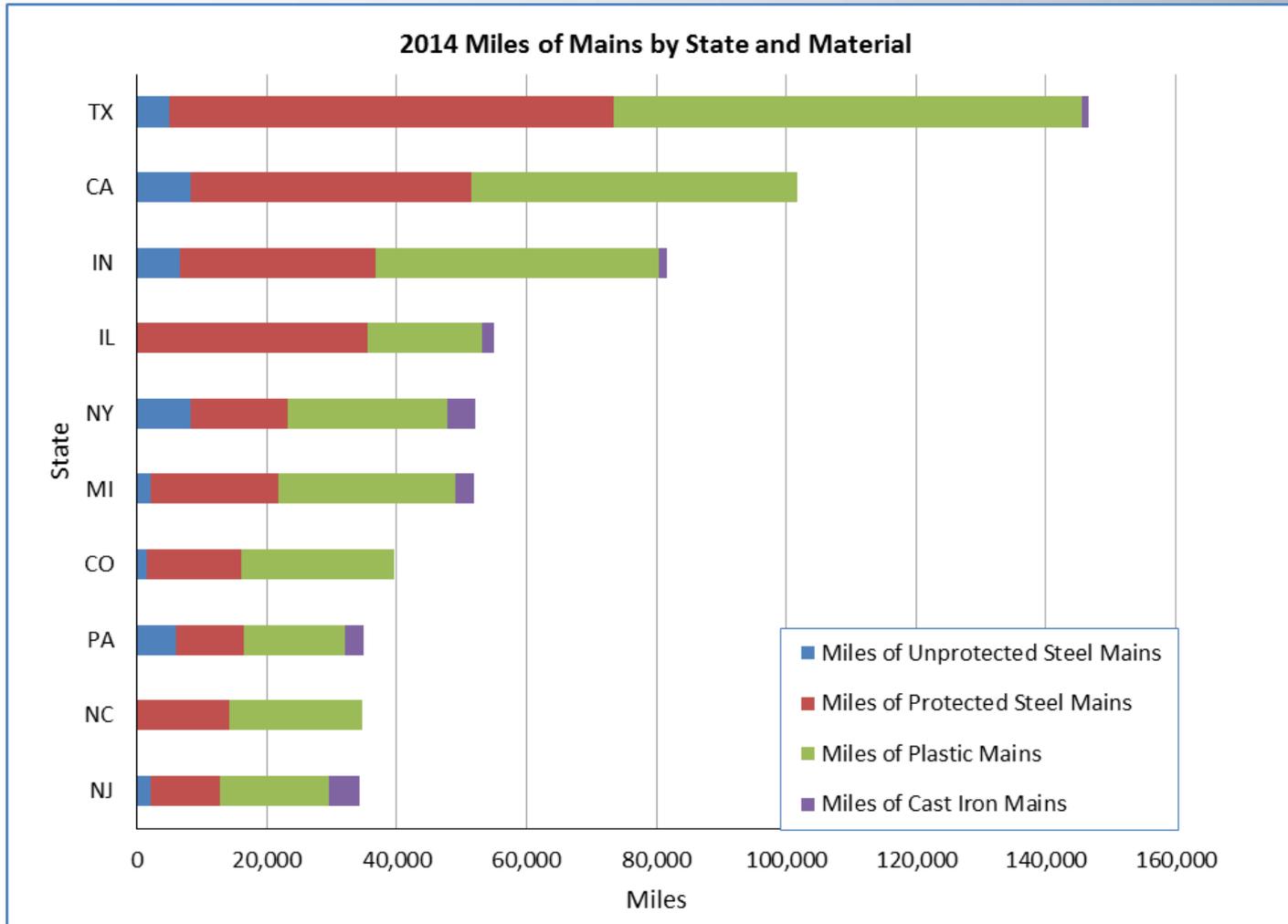


Natural Gas Distribution



New – Natural Gas Distribution

Miles of distribution mains by state and material



Additional Resources



- Access GHGRP data: <http://www.epa.gov/ghgreporting/>
- Additional information about Petroleum and Natural Gas Systems in the GHGRP, including reporting requirements and calculation methods: <http://www.epa.gov/ghgreporting/subpart-w-petroleum-and-natural-gas-systems>
- 2014 Petroleum and Natural Gas Systems Data Highlights Page: <http://www.epa.gov/ghgreporting/ghgrp-2014-petroleum-and-natural-gas-systems>
- Facility Level Information on Greenhouse Gases Tool (FLIGHT): <http://ghgdata.epa.gov/ghgp/>