

EPA Oil and Gas GHG Emissions Data

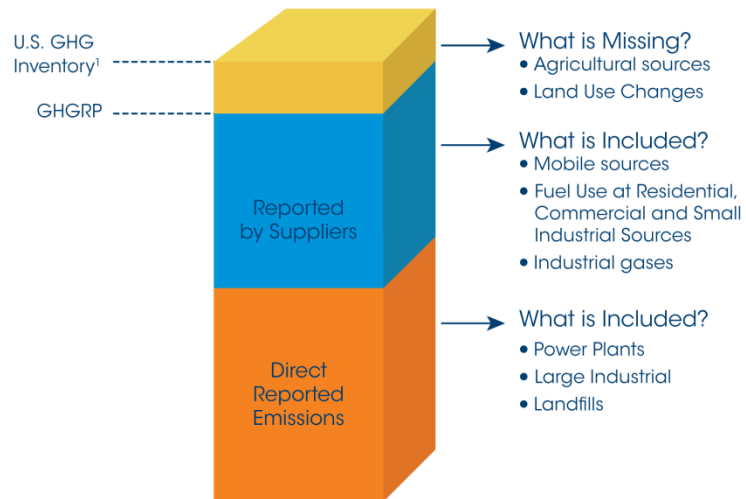


May 5, 2021

U.S. GHG Inventory (GHGI) and GHG Reporting Program (GHGRP)

- Inventory of U.S. Greenhouse Gas Emissions and Sinks (GHG Inventory) tracks total annual U.S. emissions across all sectors of the economy using national-level data
- GHGRP collects detailed emissions data from large greenhouse gas emitting facilities in the United States, as directed by the Clean Air Act
 - GHGRP covers most, but not all, U.S. GHG emissions
 - GHGRP does not include agriculture, land use, and small sources

GHGRP Covers the Majority of U.S. GHG Emissions



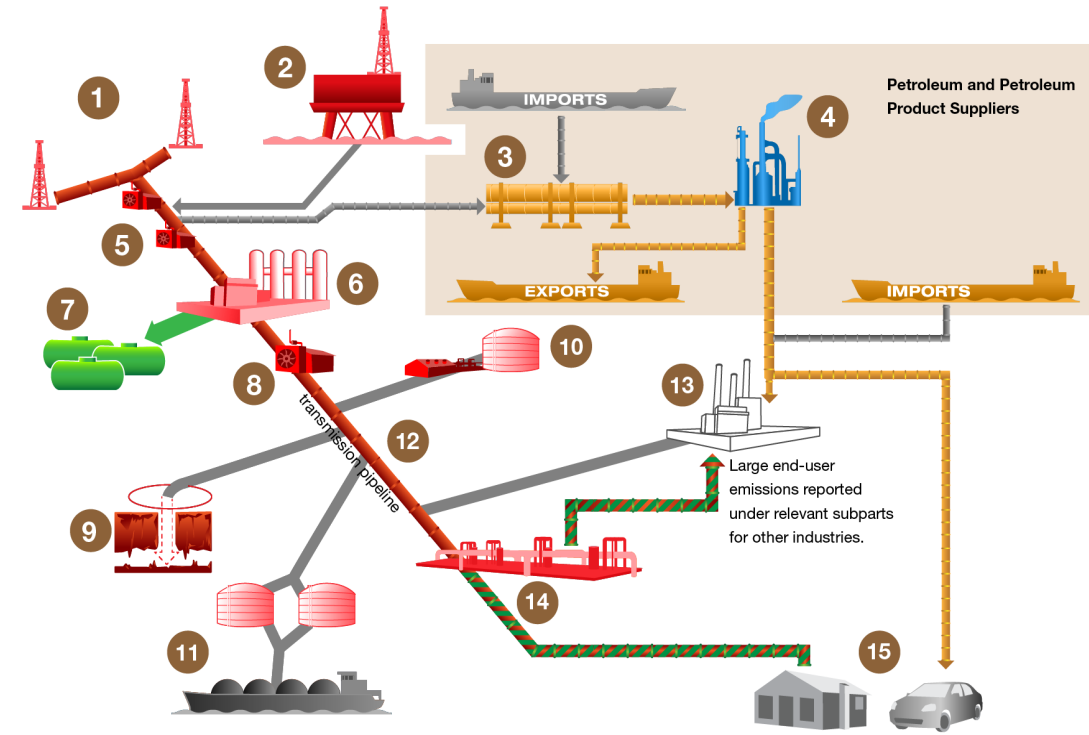
Task	Inventory of U.S. GHG Emissions and Sinks	Greenhouse Gas Reporting Program
Find total U.S. emissions	✓	
Review trend data for the past 20 years	✓	
Browse a map to find largest emitters in your area		✓
Compare facility emissions across an industrial sector		✓
Find <u>reported</u> emissions by state		✓

Overview of Greenhouse Gas Reporting Program (GHGRP)

- Launched in response to FY 2008 Consolidated Appropriations Act
- Annual reporting of GHGs by 41 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
- Direct reporting to EPA electronically
- EPA verification of GHG data

GHGRP Subpart W (Petroleum & Natural Gas Systems)

- Covers numerous emission sources across the oil and gas value chain
- Reporting by facilities with annual GHG emissions greater than or equal to 25,000 metric tons CO₂ equivalent (CO₂e)
- 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 (e.g., onshore production, gathering and boosting, transmission pipelines, distribution) have unique “facility” definitions



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 began in RY 2016
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 began in RY 2016

Distribution

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

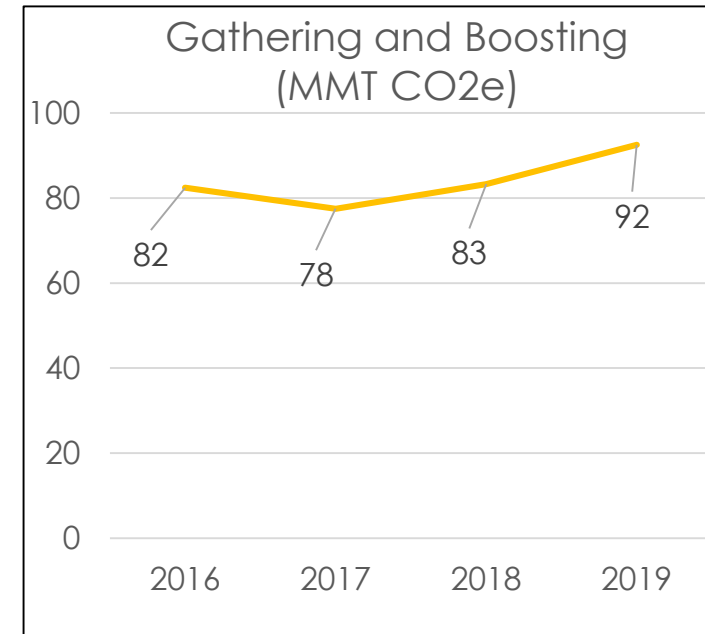
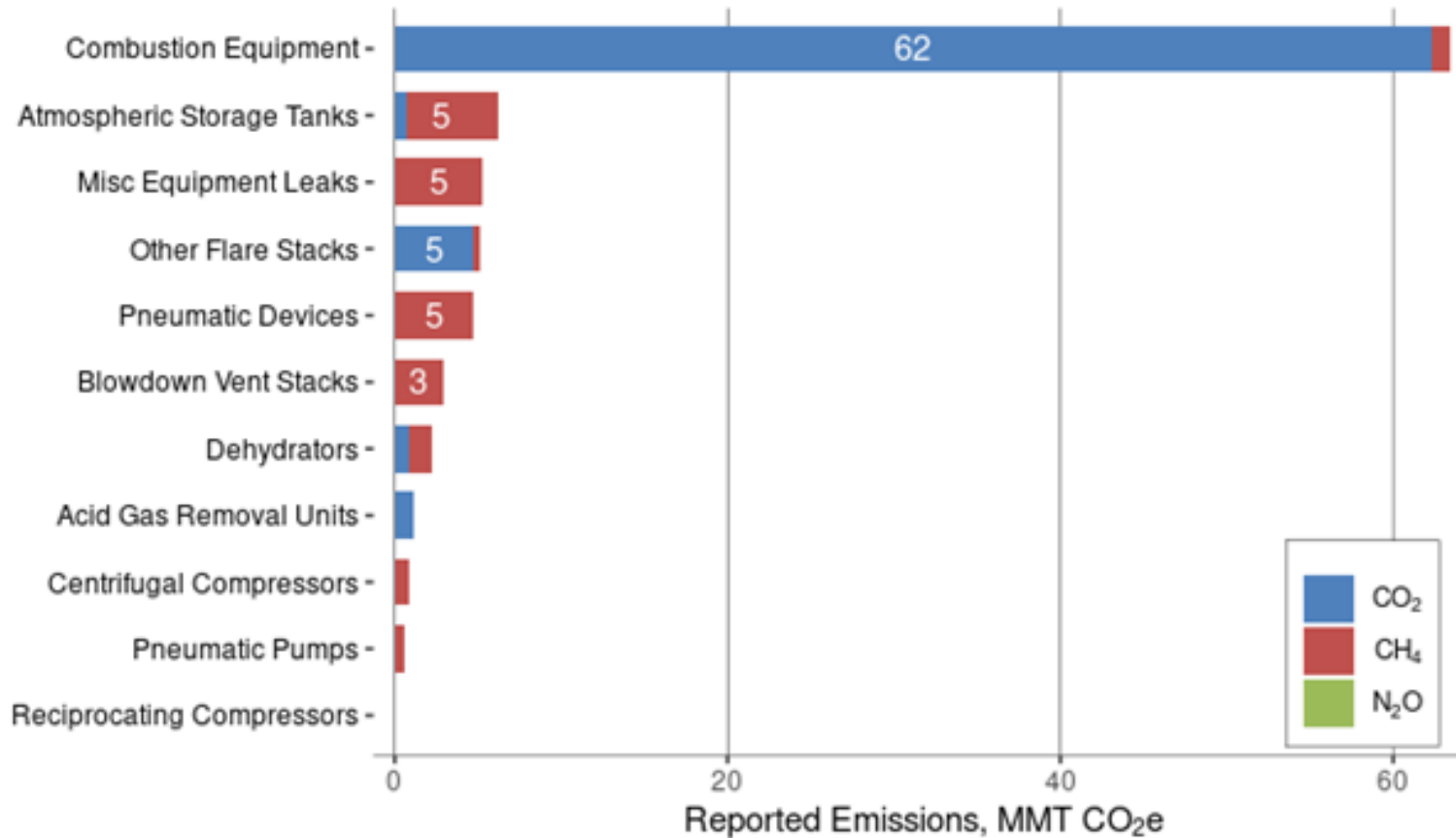
■	Subpart W: Emissions from petroleum & natural gas systems
■	Subpart Y: Emissions from petroleum refineries
■	Subpart MM: CO ₂ associated with supplies of petroleum products
■	Subpart NN: CO ₂ associated with supplies of natural gas & natural gas liquids
■	Not reported under GHGRP

GHGRP 2019: Reported GHG Emissions by Industry Segment

Segment	Number of Facilities	2019 Reported Emissions (Million Metric Tons CO ₂ e)
Onshore Production	478	117
Offshore Production	141	7
Gathering and Boosting	354	92
Natural Gas Processing	454	58
Natural Gas Transmission Compression	619	31
Natural Gas Transmission Pipeline	43	3
Underground Natural Gas Storage	49	2
LNG Import/Export	11	10
LNG Storage	5	<1
Natural Gas Distribution	163	13
Other Oil and Gas Combustion	56	8
Total	2,350	341

GHGRP 2019 Reported Emissions: Gathering and Boosting

2019 Gathering and Boosting: Top Reported Emission Sources



% Change
2018-19

11.0%

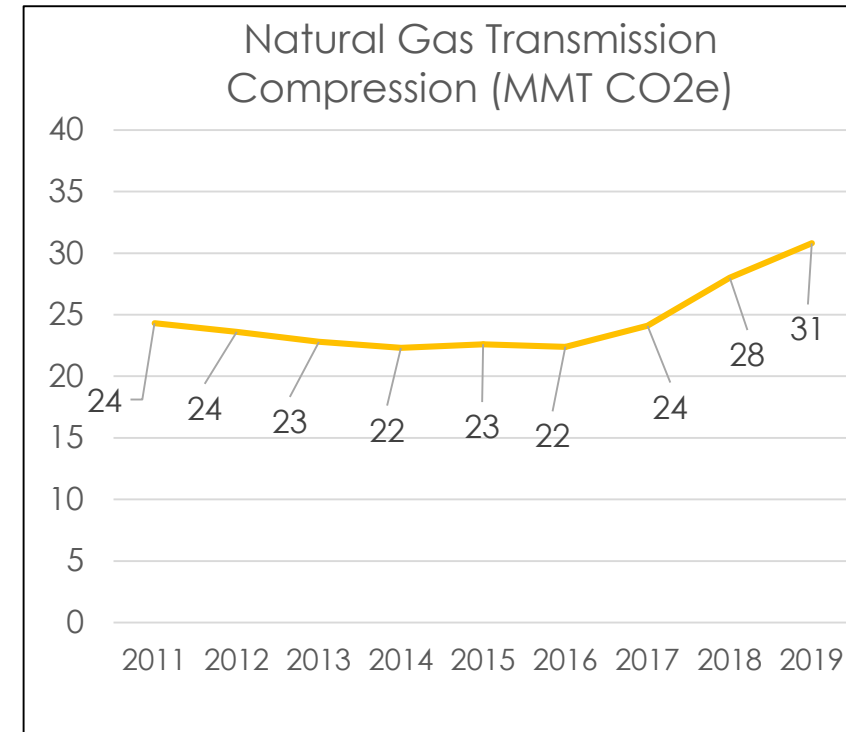
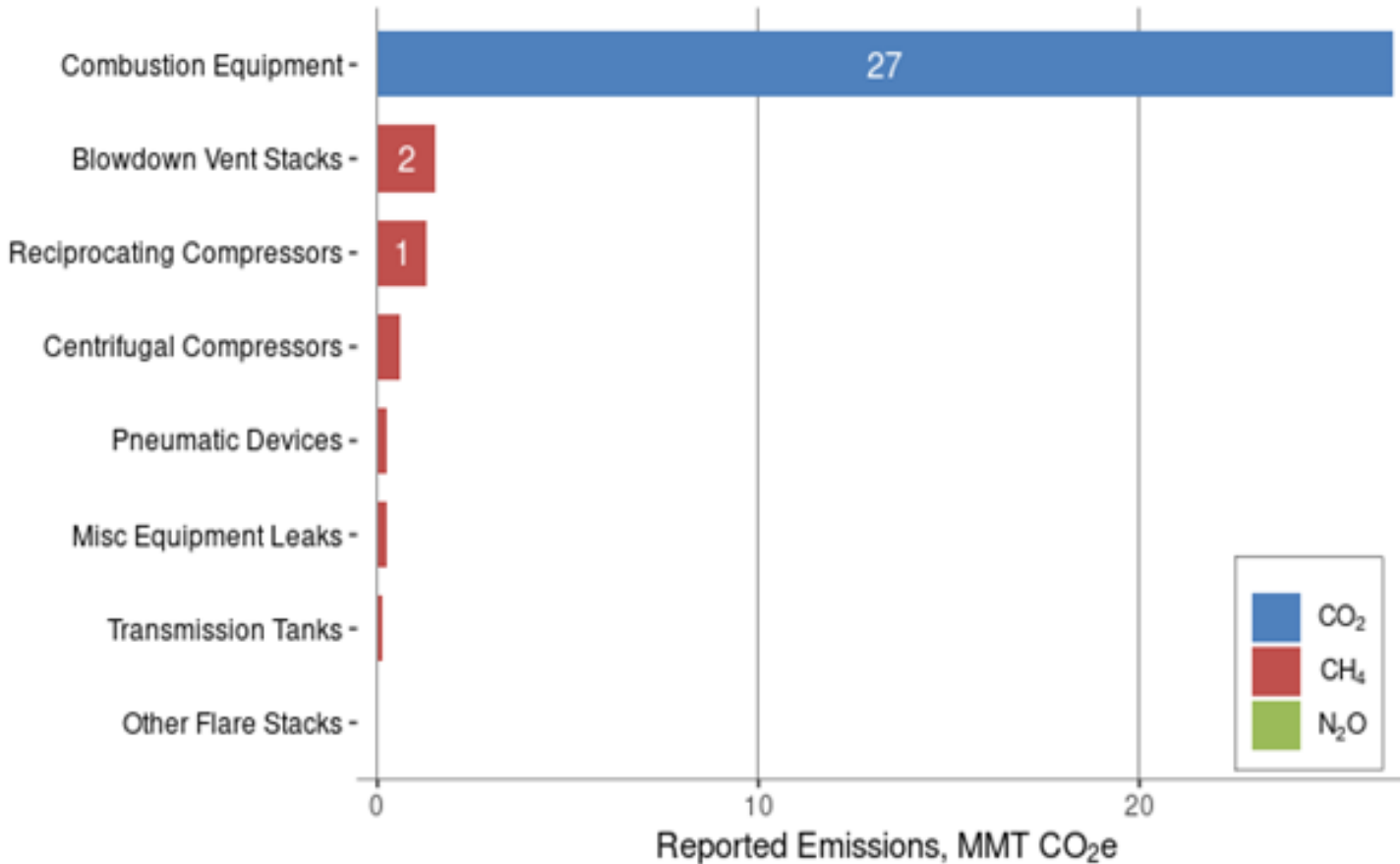
% Change
2011-19

N/A*

* Gathering and Boosting industry segment began reporting in 2016.

GHGRP 2019 Reported Emissions: Natural Gas Transmission Compression

2019 Natural Gas Transmission Compression: Top Reported Emission Sources



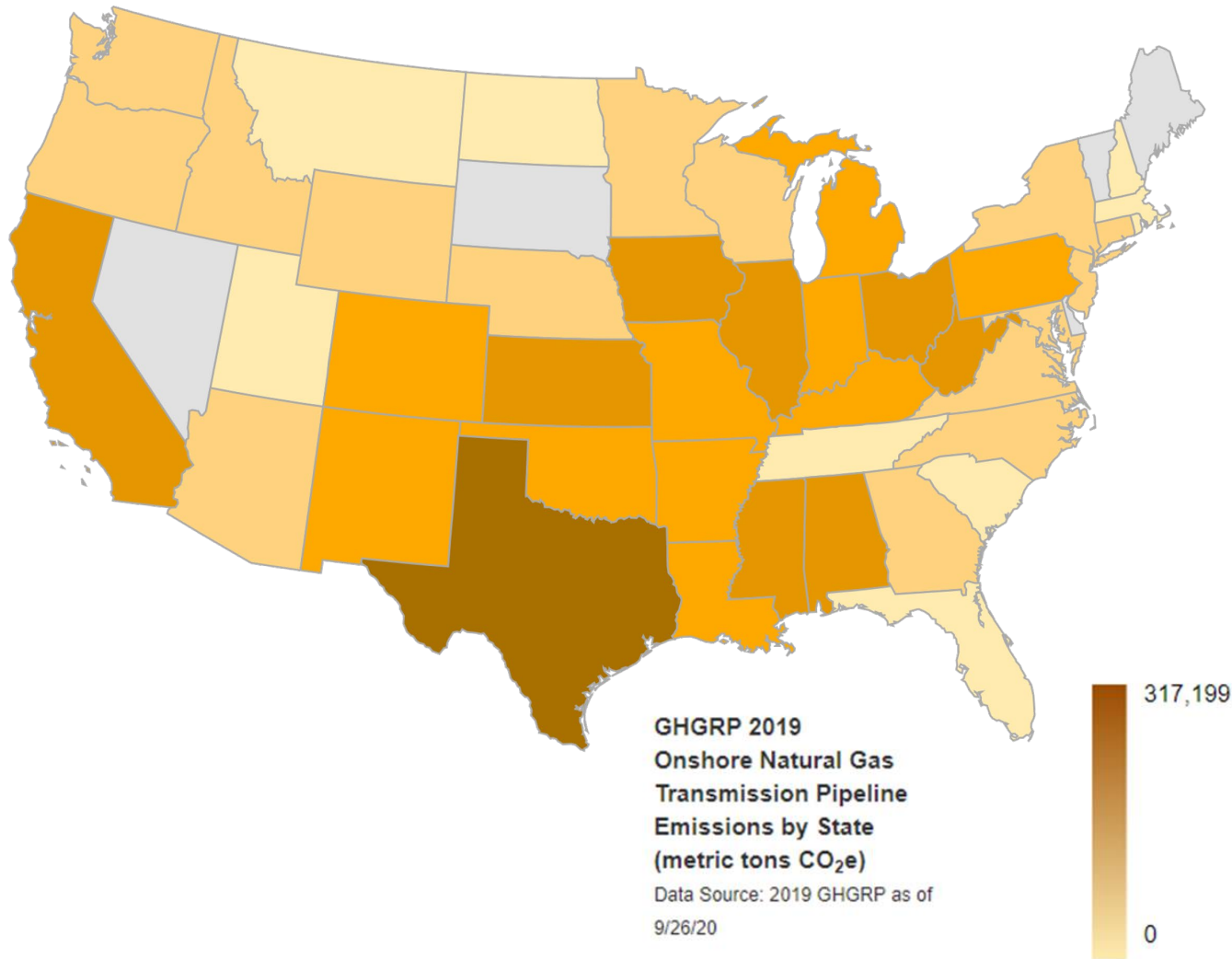
% Change
2018-19

9.8%

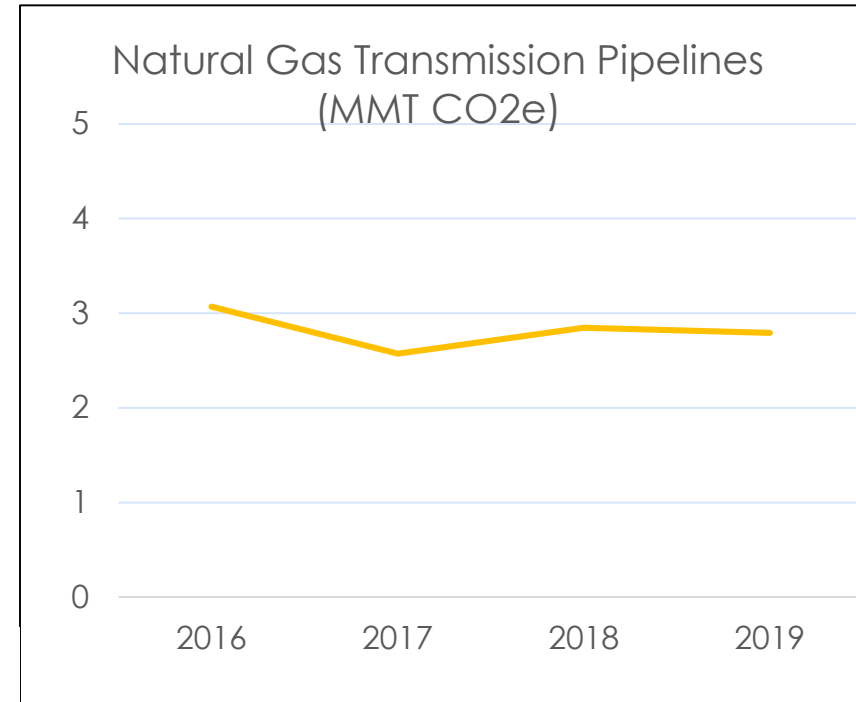
% Change
2011-19

26.8%

GHGRP 2019 Reported Emissions: Natural Gas Transmission Pipelines



GHGRP data as of 9/26/2020



% Change
2018-19

-1.9%

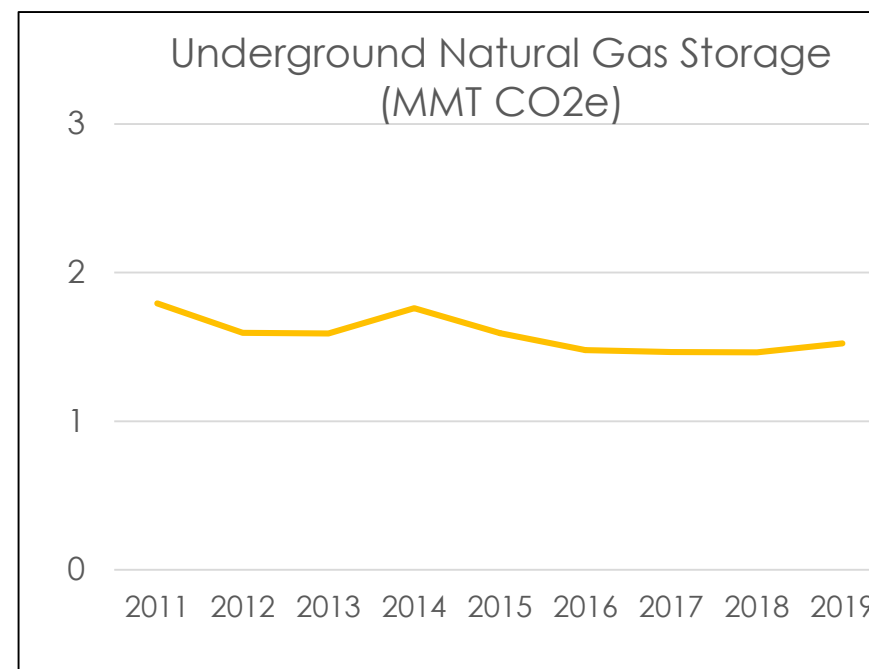
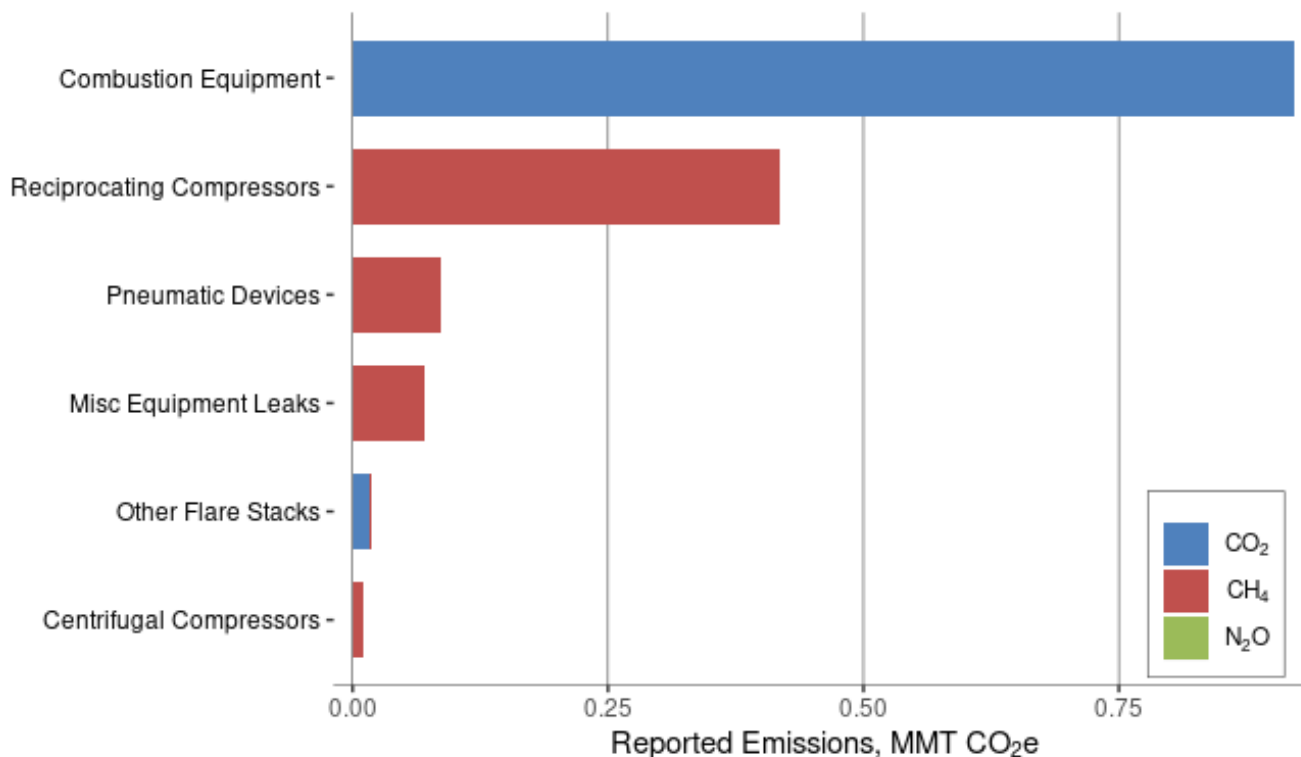
% Change
2011-19

N/A*

* Natural Gas Transmission Pipelines industry segment began reporting in 2016.

GHGRP 2019 Reported Emissions: Underground Natural Gas Storage

2019 Underground Natural Gas Storage: Top Reported Emission Sources



% Change
2018-19

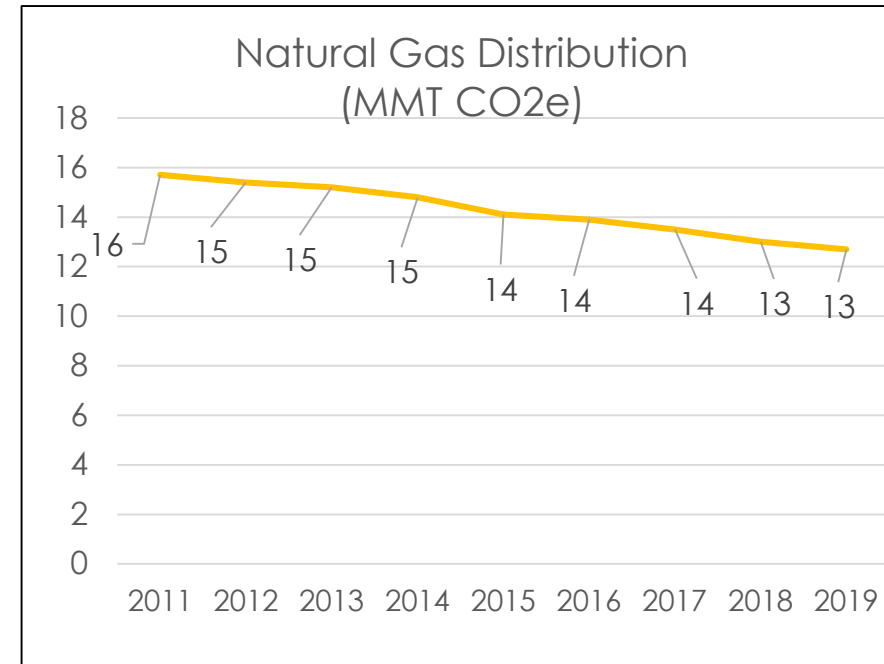
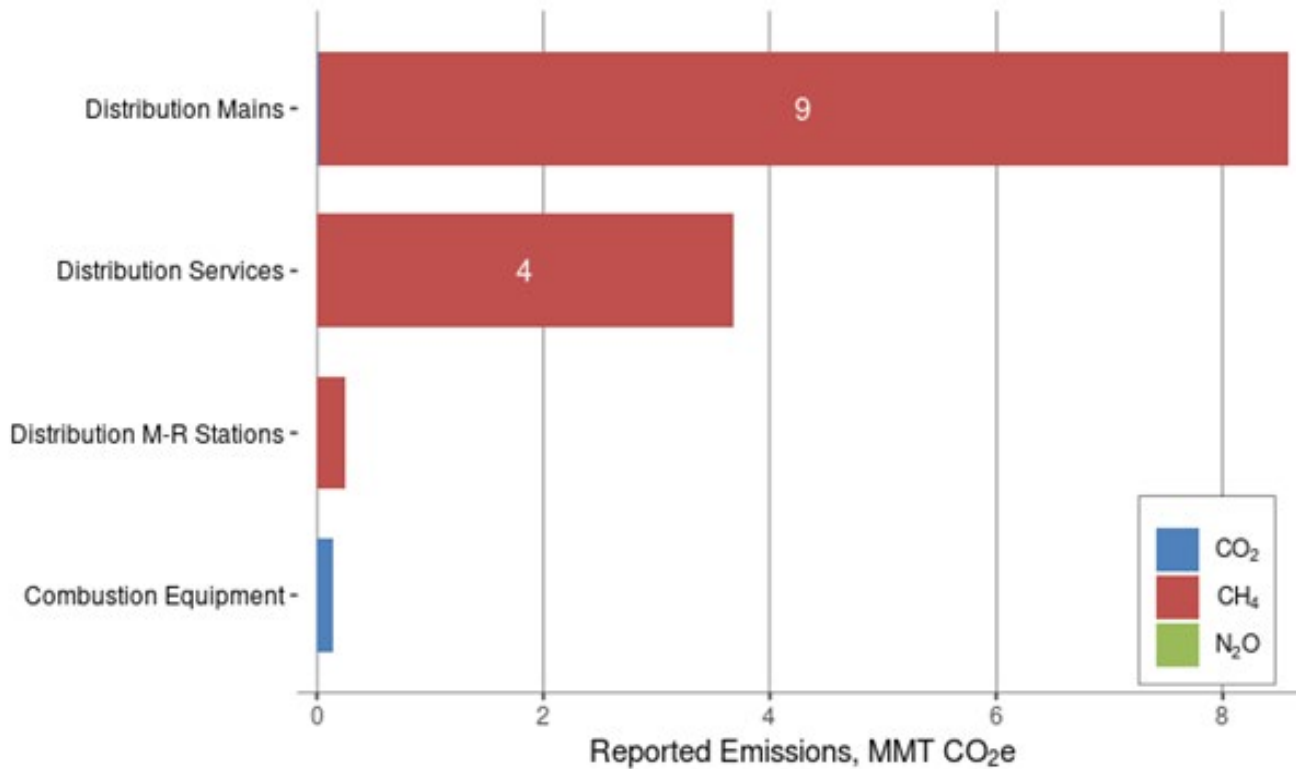
4.2%

% Change
2011-19

-15.0%

GHGRP 2019 Reported Emissions: Natural Gas Distribution

2019 Natural Gas Distribution: Top Reported Emission Sources



% Change 2018-19
-2.7%

% Change 2011-19
-19.1%

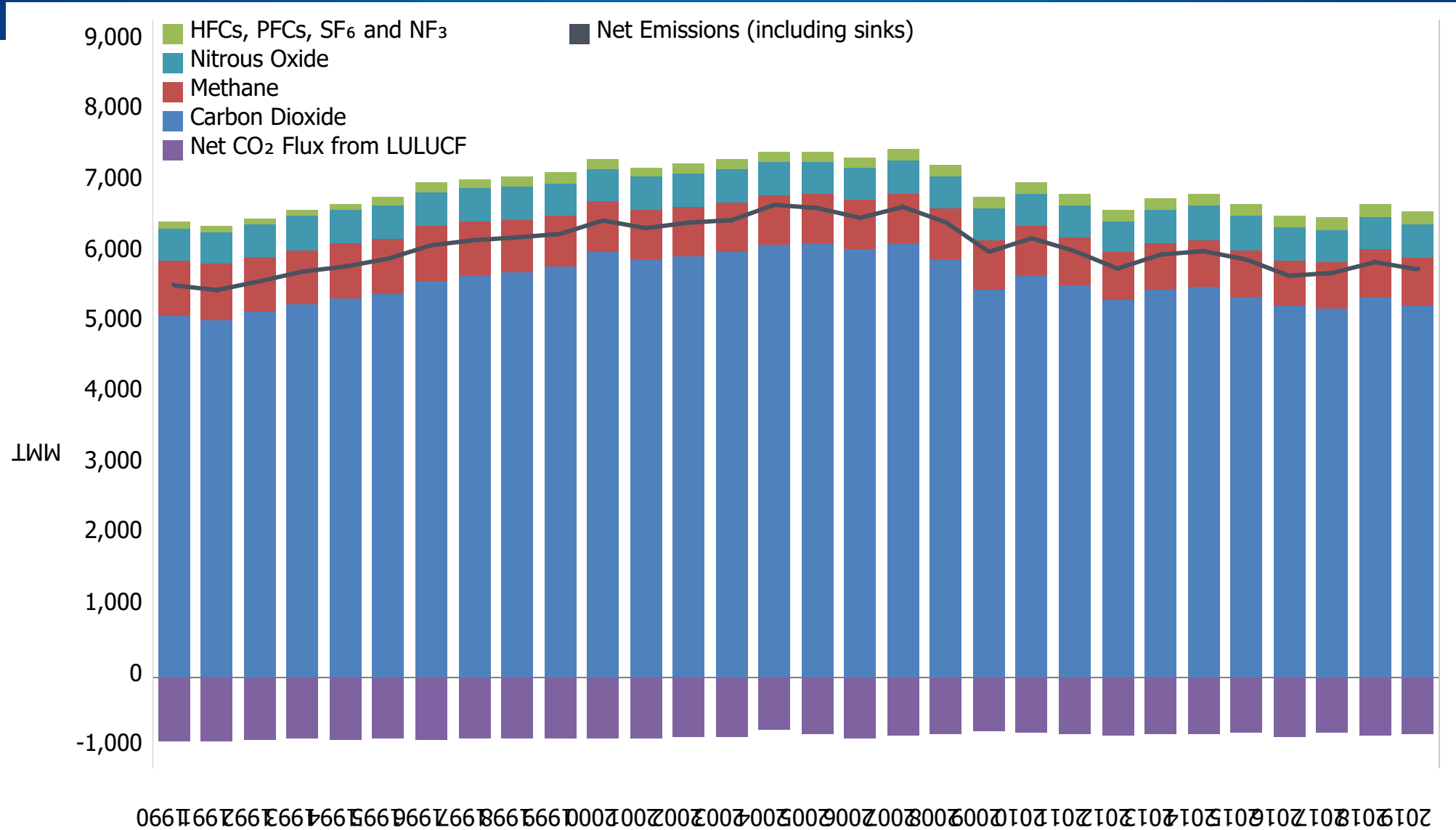
How to Access GHGRP Data on Petroleum and Natural Gas Systems

- GHGRP website: <https://www.epa.gov/ghgreporting>
- EPA's easy-to-use Facility Level Information on GreenHouse gas Tool (FLIGHT) allows users to view GHG data in a variety of ways
 - View GHG data reported by individual facilities
 - Aggregate reported emissions based on industry segment or geographic level
 - Search for facilities by name, location, corporate parent, or NAICS code
 - Visit FLIGHT: <https://ghgdata.epa.gov>
- Detailed non-confidential data is available in Envirofacts
 - Access GHG data in Envirofacts: <https://www.epa.gov/enviro/greenhouse-gas-customized-search>
- GHGRP Help Desk email address: GHGReporting@epa.gov

U.S. GHG Inventory Overview

- **EPA annually compiles a national U.S. GHG Inventory Report**
 - Official U.S. Government data on national GHG emissions and sinks over time by gas, source/sink and economic sector
 - All GHGs: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃
 - Policy-neutral
 - Fulfills U.S. reporting commitment under the UNFCCC
 - Started reporting in 1993
- **Interagency effort led by EPA's Office of Atmospheric Programs (OAP)**
 - Involves other USG agencies (e.g., DoE/EIA, USDA/USFS, USGS, DOT data) academic and research institutions, and industry associations

Trends in U.S. GHG emissions by gas 1990-2019



Calculating Oil and Gas Emissions in the GHGI

- Calculated with an IPCC tier 2/3 approach
- Inventory covers leaks, vents, and flares, and is stratified into natural gas and petroleum pathways of the industry
 - Natural gas - offshore production, onshore production, gas processing, gas transmission, underground gas storage, LNG storage, LNG import and export terminals, and gas distribution
 - Petroleum – offshore production, onshore production, oil transportation, and refineries
- Oil and gas in inventory covers hundreds of types of sources
- General approach is to multiply national activity data by emission factors, e.g.:
 - Miles cast iron pipeline x CH₄ per mile cast iron pipeline
 - # residential meters x CH₄ per residential meter

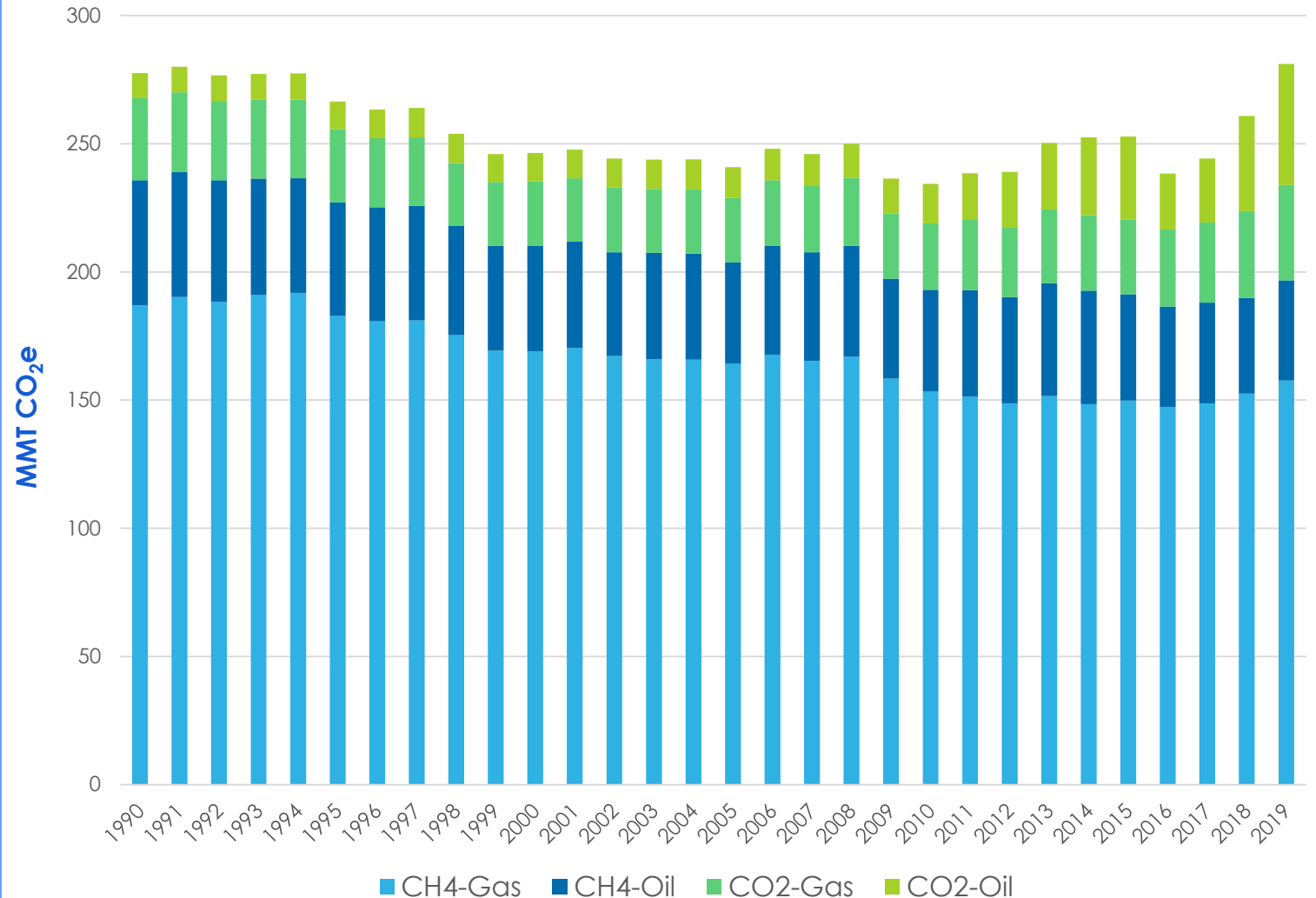
Trends in CH₄ and CO₂ Emissions from Oil and Gas Systems

1990-2019 Trends and Key Drivers

- CH₄-decrease of 17%
 - Distribution (upgrades to pipeline and stations)
 - Transmission and storage (changes in compressor types)
- CO₂-increase of 102%
 - Oil and gas production (increased flaring)

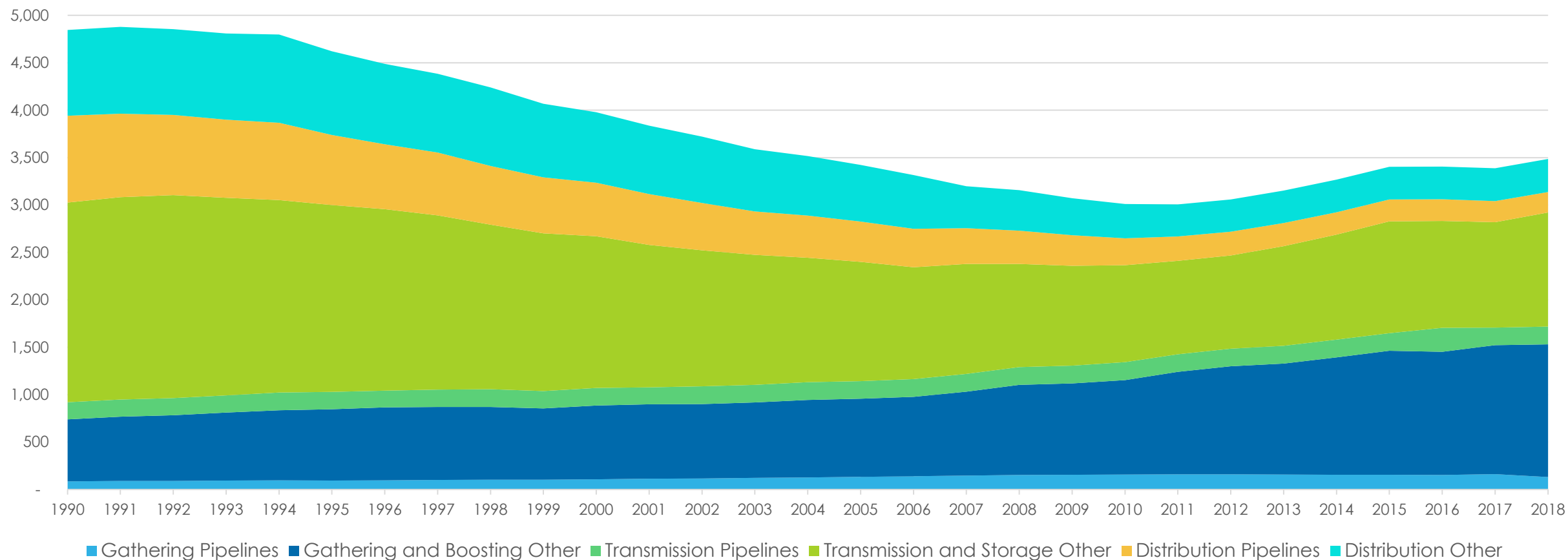
2018-2019 Trends and Key Drivers

- CH₄-increase of 4%
 - Oil and gas production (increase in emissions from pneumatic controllers)
- CO₂-increase of 19%
 - Oil production (increased flaring of associated gas)



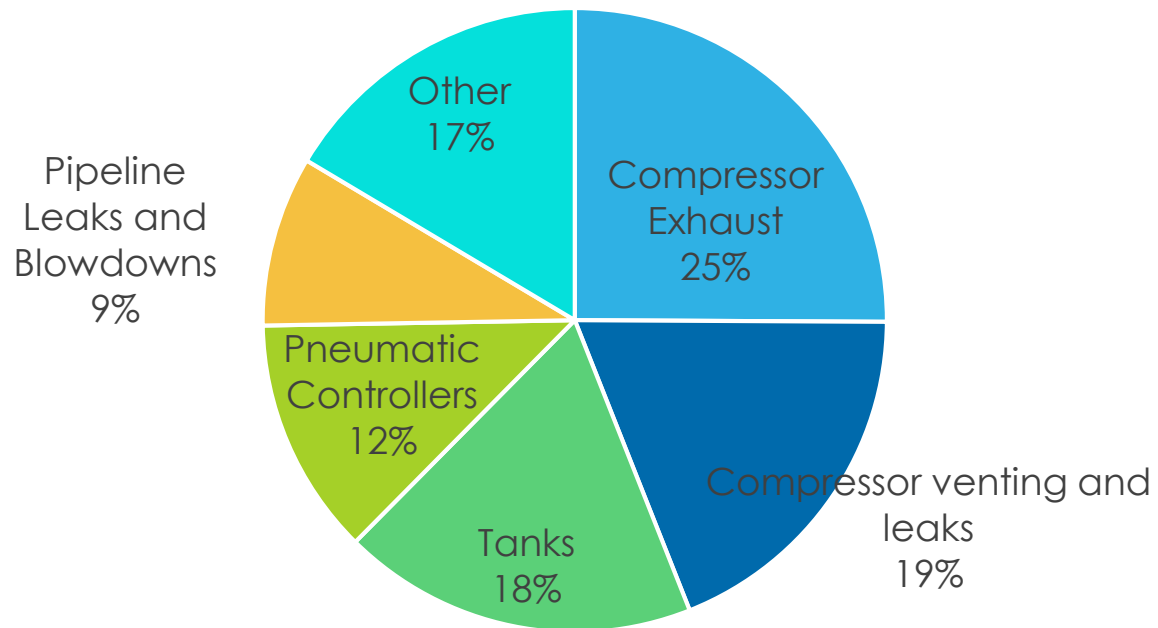
Gathering and Boosting, Transmission and Storage, and Distribution Methane

Methane Emissions--Gathering through Distribution, kt CH₄



Gathering and Boosting

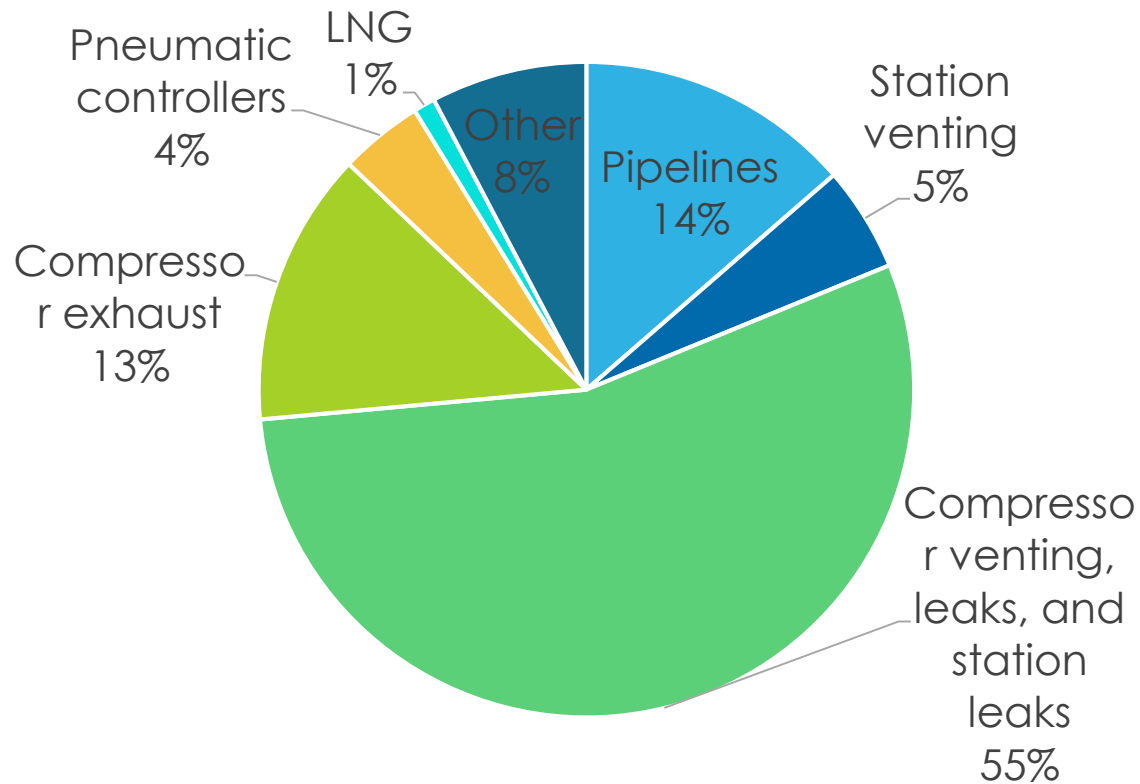
2019 Methane Emissions from Gathering and Boosting Sources
1,640 kt, or 41 MMT CO₂e



- Gathering and Boosting Segment is 21% of O&G CH₄
- Gathering and Boosting segment emissions have increased by 121% from 1990 and increased by 42% from 2010
- Largest increases in compressor exhaust, and compressor venting and leaks

Transmission and Storage

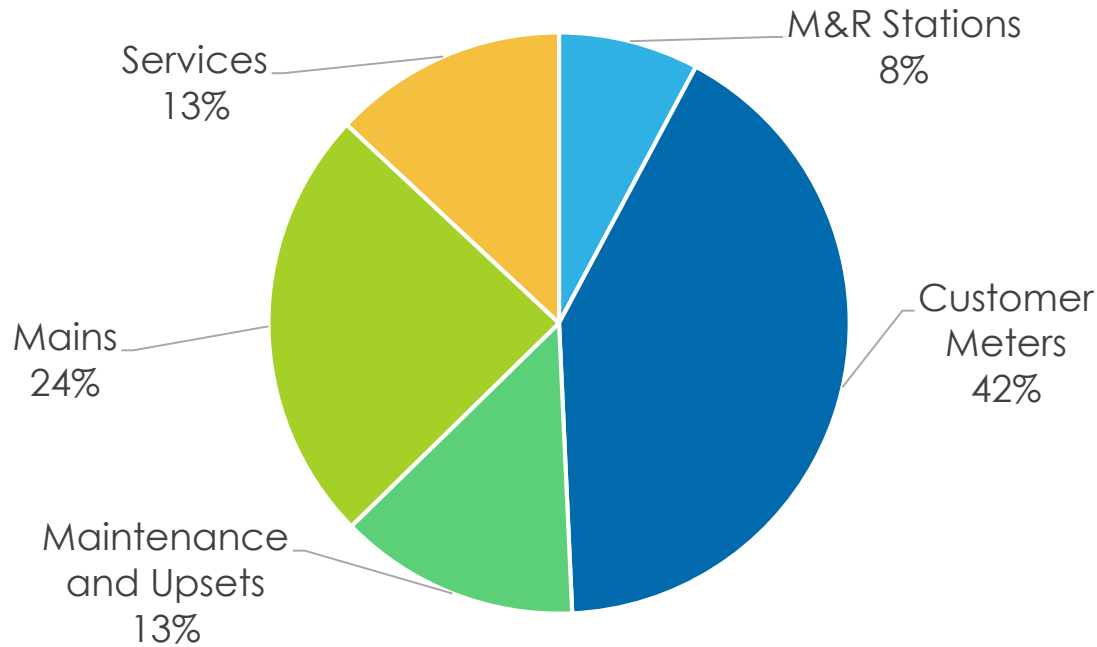
2019 Methane Emissions from Transmission and Storage Sources
1,480 kt, or 37 MMT CO₂e



- Transmission and Storage Segment is 19% of O&G CH₄
- Transmission and Storage segment emissions have decreased by 35% from 1990 and increased by 22% from 2010
- Compressor venting, leaks and station leak emissions largest impact on trends

Distribution

2019 Methane Emissions from
Distribution Sources
560 kt CH₄, or 14 MMT CO₂e



- Distribution Segment is 7% of O&G CH₄
- Distribution segment emissions have decreased by 69% from 1990 and by 13% from 2010
- Largest decreases in M&R stations, mains, and services

EPA Oil and Gas Stakeholder Process

- Annual stakeholder process to discuss new data and improvements to GHGI data
- Stakeholder website (<https://www.epa.gov/ghgemissions/natural-gas-and-petroleum-systems>)
 - Information on workshops and memos on updates under consideration
 - Full time series of data and information on methods
- 2021 GHGI Stakeholder Process
 - September and November 2020 Webinars
 - EPA presentations on GHGRP data, updates under consideration for meters, mud degassing, produced water, uncertainty and storage wells
 - Stakeholder presentations on pneumatic controllers, analyses of top-down bottom-up discrepancies, and storage stations
- 2022 GHGI Stakeholder Process will start summer of 2021

Voluntary Programs



The Natural Gas STAR Program began in 1993, providing a framework for EPA to partner with U.S. oil and gas operators and to promote voluntary methane reducing technologies and practices



The Methane Challenge Program launched in 2016, building on Natural Gas STAR and providing a mechanism for companies to make more rigorous, and transparent, commitments to voluntarily reduce methane

Voluntary Program Accomplishments and Resources

25 **2019** **MMTCO₂e Reductions**

METHANE CHALLENGE
U.S. EPA

Natural Gas
EPA POLLUTION PREVENTER

812 **Total** **MMTCO₂e Reductions**

METHANE CHALLENGE
U.S. EPA

Natural Gas
EPA POLLUTION PREVENTER

122 **Partners**

METHANE CHALLENGE
U.S. EPA

Natural Gas
EPA POLLUTION PREVENTER

Library of Technical Methane Mitigation Information

Lessons Learned from Natural Gas STAR Partners

Installing Plunger Lift Systems In Gas Wells

Executive Summary

In mature gas wells, the accumulation of fluids in the well can impede and sometimes halt gas production. Gas flow is maintained by removing accumulated fluids through the use of a beam pump or remedial treatments, such as acidizing, surging, or venting the well to atmospheric pressure (referred to as "blowing down" the well). Fluid removal operations, particularly well blowdowns, may result in substantial methane emissions to the atmosphere.

Installing a plunger lift system is a cost-effective alternative for removing liquids. Plunger lift systems have the additional benefit of increasing production, as well as significantly reducing methane emissions associated with blowdown operations. A plunger lift uses gas pressure buildup in a well to lift a volume of accumulated fluid out of the well. The plunger lift system helps to maintain gas production and may reduce the need for other remedial operations.

Natural Gas STAR Partners report significant economic benefits and methane emission reductions from installing plunger lift systems in gas wells. Companies have reported annual gas savings averaging 600 thousand cubic feet (Mcf) per well by avoiding blowdowns. In addition, increased gas production following plunger lift installation has yielded total gas benefits of up to 14,250 Mcf per well, worth an estimated \$127,750. Benefits from both increased gas production and emissions savings are well- and reservoir-specific and will vary considerably.

Technology

Liquid buildup during production can impede or "plug" the well. Plunger lift systems use gas pressure buildup in a well to lift a volume of accumulated fluid out of the well. The plunger lift system helps to maintain gas production and may reduce the need for other remedial operations.

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Economic and Environmental Benefits

Method for Reducing Natural Gas Losses	Potential Gas Savings from Production and Avoided Emissions (Mcf/yr)	Value of Natural Gas Production and Savings (\$)	Implementation Cost (\$)	Payback (Months)
Install a Plunger Lift System	4,760 - 14,250	\$14,130 - \$127,750	\$3 - \$7 per Mcf	1 - 2

Lessons Learned from Natural Gas STAR Partners

Installing Vapor Recovery Units on Storage Tanks

Executive Summary

There are about 500,000 crude oil storage tanks in the United States. These tanks are used to hold oil for brief periods of time in order to stabilize flow between production wells and pipeline or trucking transportation sites. In addition, the condensate liquids contained in produced gas that are captured by a mist eliminator filter condenser ahead of the first compressor station in transmission pipelines are often directed to a storage tank as well. During storage, light hydrocarbons dissolved in the crude oil or condensate—including methane and other volatile organic compounds (VOCs), natural gas liquids (NGLs), hazardous air pollutants (HAP), and some inert gases—evaporate or "blow out" and collect in the space between the liquid and the fixed roof of the tank. As the liquid level in the tank fluctuates, these vapors are often vented to the atmosphere.

One way to prevent emissions of these light hydrocarbon vapors and yield significant economic savings is to install vapor recovery units (VRUs) on storage tanks. VRUs are relatively simple systems that can capture about 95 percent of the blow-out vapors for sale or for use as fuel. Currently, between 7,000 and 9,000 VRUs are installed in the oil production sector, with an average of four tanks connected to each VRU.

Natural Gas STAR partners have generated significant savings from recovering and marketing these vapors while at the same time substantially reducing methane and HAP emissions. Partners have found that when the volume of vapors is sufficient, installing a VRU on one or multiple storage tanks can:

- Flash losses a traster, operate require much up which are at an
- Working losses

Economic and Environmental Benefits

Method for Reducing Natural Gas Losses	Volume of Natural Gas Savings (Mcf/yr)	Value of Natural Gas Savings (\$/yr)	Implementation Cost (\$)	Payback (Months)
Installing Vapor Recovery Units (VRUs) on Oil Production Storage Tanks	4,800 - 91,000	\$11,865 - \$22,275 - \$22,845 - \$171,600	\$15,000 - \$450,000	6 - 10

Lessons Learned from Natural Gas STAR Partners

Using Pipeline Pump-Down Techniques To Lower Gas Line Pressure Before Maintenance

Executive Summary

Operators of natural gas pipeline systems routinely reduce line pressure and discharge gas from pipeline sections to ensure safe working conditions during maintenance and repair activities. Typically, operators block the smallest possible linear section of the pipeline and depressure it by venting gas to the atmosphere. In 2004, an estimated 12 billion cubic feet (Bcf) of methane was vented to the atmosphere during routine maintenance and repair activities.

Using pump-down techniques to lower gas line pressure before performing maintenance and repair activities is an effective way to reduce emissions and yield significant economic savings. Pipeline pump-down techniques involve using in-line compressors either alone or in sequence with portable compressors. Using in-line compressors is almost always justifiable because there are no capital costs, and payback is immediate. The cost-effectiveness of also using a portable compressor to increase gas recovery, however, depends greatly on site-specific factors and operating costs.

Another alternative is to install an ejector. An ejector is a venturi nozzle that uses high-pressure gas as motive fluid to draw suction on a lower pressure gas source, discharging into an intermediate pressure gas stream. The ejector can be installed on vent connections up and down stream of a partially closed valve, or between the discharge and suction of a compressor which creates the necessary pressure differential.

Regardless of the pump-down technique selected, emission reductions are directly proportional to how much pipeline pressure is reduced before venting occurs. On average, up to 90 percent of methane emissions can be avoided by using pump-down techniques to lower gas line pressure before performing maintenance and repair activities. Many Natural Gas STAR partners have implemented these techniques, and their lifetime methane emission reductions can be significant. Emissions reductions from these techniques are equal to that of 50 percent of the methane emissions that would otherwise be emitted.

Technology

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Economic and Environmental Benefits

Method for Reducing Natural Gas Losses	Volume of Natural Gas Savings (Mcf/yr)	Value of Natural Gas Savings (\$/yr)	Implementation Cost (\$)	Payback (Months)
Pump down gas pipelines before maintenance	200,000 per year	\$600,000 per year	\$1,000,000 per year	166,767
Ejector	100,000 per year	\$300,000 per year	\$500,000 per year	166,767

<https://www.epa.gov/natural-gas-star-program/recommended-technologies-reduce-methane-emissions>

2019 **Natural Gas STAR & Methane Challenge Workshop**

Dozens of Workshops and Conferences with Industry

November 4-6, 2019 · Pittsburgh, PA

<https://www.epa.gov/natural-gas-star-program/outreach-and-events>

Regulatory Status

- On January 20, 2021, President Biden issued Executive Order (EO) 13990 **“Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis.”**
- The EO instructs EPA to consider taking two actions by September 2021 focused on reducing methane from the oil and gas sector:
 - Proposing a rule to reduce methane emissions in the oil and gas sector by **suspending, revising, or rescinding previously issued standards** known as **new source performance standards**.
 - Proposing **new regulations** to reduce methane and VOC emissions from **existing operations** in the oil and gas sector, including the exploration and production, processing, transmission, and storage segments.

Regulatory Status

Outreach



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graph TD; A[Outreach] --> B[Proposed Rule]; B --> C[Comment Period]; C --> D[Public Hearing]; D --> E[Final Rule];
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Proposed Rule

Comment Period

Public Hearing

Final Rule

- EPA is working to complete the review directed by EO 13990
- EPA will **engage broadly** with stakeholders to develop a proposal that achieves **ambitious** and **cost-effective** reductions in climate- and health-harming pollution, and encourages continued development of **innovative technologies**