

Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2020: Updates Under Consideration for Activity Data

This memo discusses updates under consideration for the 2022 *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (GHGI) to update certain activity data using Enverus Midstream and PHMSA data.

1 Current GHGI Background

The current GHGI includes emissions from gathering and boosting (G&B) stations, gathering pipelines, transmission compressor stations, transmission pipelines, underground natural gas storage wells, and processing plants under the natural gas systems sector. Activity data used for these emission sources are as follows:

- G&B stations – The G&B station count for 2017 (6,110) is obtained from a Zimmerle et al. 2020 study.¹ Station counts are estimated for other years in the time-series using a ratio of gas production in 2017 to gas production in the year of interest.² These data are used to calculate emissions from yard piping in gathering and boosting.
- Gathering pipelines – Pipeline miles are obtained from GHGRP subpart W reported data and are used as-is for 2016 forward. Gathering pipeline miles for years prior to 2016 are estimated using the total producing gas wells in a given year multiplied by a factor of pipeline miles per well, plus an assumed 82,600 miles of gathering pipeline owned by transmission companies.³ These data are used to calculate emissions for pipeline leaks and blowdowns.
- Gas processing plants – The number of natural gas processing plants were obtained from the Oil and Gas Journal (OGJ) and the year 2014 plant count is used for 2014 forward.⁴ These data are used to calculate emissions for compressor leaks, compressor exhaust, acid gas removal vents, pneumatic controllers, and plant blowdowns.
- Transmission stations – Compressor station counts for 2011 forward are estimated using the number of stations that report to GHGRP subpart W data in each year multiplied by a scaling factor (3.52) developed using 2012 data. Compressor station counts for prior years are based on a 1992 estimate and linear interpolation.⁵ These data are used to calculate emissions for station leaks, compressor leaks, dehydrators, pneumatic controllers, and compressor station venting.
- Transmission pipelines – Pipeline miles are obtained from Pipeline and Hazardous Materials Safety Administration (PHMSA).⁶ These data are used to calculate emissions for pipeline leaks and blowdowns.

¹ Daniel Zimmerle, Timothy Vaughn, Ben Luck, Terri Lauderdale, Kindal Keen, Matthew Harrison, Anthony Marchese, Laurie Williams, and David Allen. *Methane Emissions from Gathering Compressor Stations in the U.S.* Environmental Science & Technology 2020, 54 (12), 7552-7561.

² See the memo *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2018: Updates for Natural Gas Gathering & Boosting Station Emissions* for details. Available online at: <<https://www.epa.gov/ghgemissions/natural-gas-and-petroleum-systems-ghg-inventory-additional-information-1990-2018-ghg>>.

³ See the memo *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017: Updates to Natural Gas Gathering & Boosting Pipeline Emissions* for details. Available online at: <<https://www.epa.gov/ghgemissions/natural-gas-and-petroleum-systems-ghg-inventory-additional-information-1990-2017-ghg>>.

⁴ "Worldwide Gas Processing." Oil & Gas Journal, PennWell Corporation. Available online at: <<http://www.ogj.com/>>.

⁵ See the memo *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions* for details. Available online at: <<https://www.epa.gov/ghgemissions/additional-information-oil-and-gas-estimates-1990-2014-ghg-inventory-published-april>>.

⁶ "Annual Report Mileage for Natural Gas Transmission and Gathering Systems." Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation. Available online at: <<http://phmsa.dot.gov/pipeline/library/data-stats>>.

- Underground natural gas (NG) storage wells – Number of wells are estimated using a 1992 estimate which is scaled to all other years using a ratio of residential gas consumption. These data are used to calculate emissions for storage well leaks.

2 Available Data

Enverus provides proprietary information regarding the oil and gas industry.⁷ Enverus data are currently used in the GHGI to estimate onshore production oil and gas well counts and production volumes. Enverus also provides data on midstream operations such as G&B stations, G&B pipelines, transmission compressor stations, transmission pipelines, and processing plants. Enverus data represents current midstream operations only and cannot be used to develop activity data estimates for previous years in the time series.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) collects data from underground NG storage field operators, including the number of injection and withdrawal wells.⁸ These data have been reported since year 2017.

EPA reviewed each dataset and is considering using these data to update the GHGI.

3 Analysis of Available Data

This section presents a summary of Enverus midstream data and PHMSA data that EPA is considering using to update the GHGI.

3.1 Gathering & Boosting Segment

Table 1 presents a summary of G&B compressor station counts available in Enverus data. The G&B station counts are available by station status. EPA is considering using the operational G&B compressor station counts to update the GHGI. Table 1 also presents the year 2019 G&B station count from the 2021 GHGI.

Table 1. G&B Compressor Station Counts.

Data Source	Station Status	Station Counts
Enverus Midstream	Abandoned	14
	Cancelled Project	1
	Idle	1
	Operational	3,634
	Under Development	61
2021 GHGI (Year 2019)	Operational	7,494

Apart from the G&B station counts, Enverus midstream data also contains current mileage information for gathering pipelines. The gathering pipeline data are available by type of commodity and by onshore and offshore operations. EPA is considering using the onshore natural gas gathering pipeline mileage data to update the GHGI. Table 2 presents a summary of gathering pipeline data available from Enverus. In addition, Table 2 also contains the year 2019 onshore natural gas gathering pipeline data used in the 2021 GHGI.

⁷ <https://www.enverus.com/>

⁸ <https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids>

Table 2. Gathering Pipeline Miles.

Data Source	Type	Pipeline Miles
Enverus Midstream	Onshore Natural Gas	434,076
	Offshore Natural Gas	5,940
	Onshore Crude	47,126
	Offshore Crude	2,586
2021 GHGI (Year 2019)	Onshore Natural Gas	381,909

3.2 Natural Gas Processing Segment

Enverus data contains current counts of operational gas processing plants, by type of plant. EPA is considering using the gas processing plant counts to update the GHGI. A summary of processing plant data available from Enverus is shown in Table 6. The table also presents the year 2019 processing plant count from the current GHGI.

Table 6. Natural Gas Processing Plants.

Data Source	Plant Type	Plant Counts
Enverus Midstream	Processing Plant	1,021
	Central Delivery Facility	1
	Central Processing Facility	67
	CO2 Extraction	7
	Condensate Stabilizer	10
	Cryogenic	127
	Cryogenic/Fractionator	4
	Cryogenic/Refrigeration	2
	Dehydrator	29
	Enhanced Oil Recovery	21
	Ethane Cracker	1
	Fractionator	55
	Gas Plant Sweet	2
	Helium Recovery Unit	1
	JT Plant	8
	Lean Oil	1
	Processing Plant/Fractionator	25
	Production Facility	43
Refrigeration	20	
Treating Facility	168	
Treating Facility/Dehydrator	1	
2021 GHGI (Year 2019)	Processing Plants	667

3.3 Transmission and Storage Segment

Enverus midstream data contains information on current natural gas transmission compressor stations, by station status. EPA is considering using operational transmission compressor station counts from the Enverus data to update the GHGI. Table 3 presents a summary of Enverus transmission compressor station data along with the year 2019 station counts from the GHGI.

Table 3. Transmission Compressor Station Counts.

Data Source	Station Status	Station Counts
Enverus Midstream	Abandoned	7
	Cancelled Project	2
	Idle	1
	Operational	2,212
	Under Development	41
2021 GHGI (Year 2019)	Operational	2,196

Enverus data also contains current mileage information for transmission pipelines. Similar to the gathering pipelines, the transmission pipeline data are available by type of commodity and by onshore and offshore operations. EPA is considering using the onshore natural gas transmission pipeline mileage data to update the GHGI. Table 3 presents a summary of transmission pipeline data available from Enverus and the year 2019 transmission pipeline miles from the current GHGI.

Table 4. Transmission Pipeline Miles.

Data Source	Type	Pipeline Miles
Enverus Midstream	Onshore Natural Gas	317,904
	Offshore Natural Gas	7,312
	Onshore Crude	82,205
	Offshore Crude	5,484
2021 GHGI (Year 2019)	Onshore Natural Gas	302,252

PHMSA provides the numbers of underground NG storage injection and withdrawal wells by reservoir type. Table 5 summarizes the PHMSA data for 2017-2020 compared to the current GHGI.

Table 5. Underground NG Storage Wells.

Data Source	Type	2017	2018	2019	2020
PHMSA	Depleted Field	12,422	12,353	12,231	12,145
	Aquifer	1,721	1,729	1,718	1,716
	Salt Dome	123	123	122	122
	PHMSA Total	14,266	14,205	14,071	13,983
2021 GHGI	Total	16,936	19,181	19,250	n/a

4 Time Series Considerations

Currently, there is no time series information available in the Enverus midstream data. Enverus data represents current midstream operations only and cannot be used to develop activity data estimates for previous years in the time series. However, if Enverus data are used, EPA will develop approaches to estimate activity data for the time series (e.g., using ratios to apply to all prior years, retaining 1992 estimates and applying linear interpolation for intermediate years).

The current GHGI includes an estimate of underground NG storage wells for 1992 and EPA is considering retaining this value, using PHMSA well counts for 2017 forward, and applying linear interpolation for intermediate years.

5 Requests for Stakeholder Feedback

EPA seeks stakeholder feedback on the update under consideration discussed in this memo and the questions below.

1. EPA seeks feedback on using Enverus data to estimate the national number of G&B stations and gathering pipeline miles.
2. EPA seeks feedback on using Enverus data to estimate the national number of processing plants.
3. EPA seeks feedback on using Enverus data to estimate the national number of transmission compressor stations.
4. EPA seeks feedback on using PHMSA data to estimate the number of underground NG storage well counts for years 2017 forward.