NEW MEXICO OIL AND GAS GREENHOUSE GAS EMISSIONS INVENTORY FOR YEAR 2023

Prepared for:
New Mexico Environment Department

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EXECUTIVE SUMMARY

To help the New Mexico Environment Department (NMED) meet the objectives of its Comprehensive Climate Action Plan (CCAP), ERG developed an oil and gas (O&G) greenhouse gas (GHG) emissions inventory (GHGI) for the year 2023 (NM 2023 O&G GHGI). Methane (CH_4) and carbon dioxide (CO_2) emissions were estimated for the following five categories (which include four industry segments and inactive oil and gas wells):

1. Production,
2. Gathering and boosting (G&B),
3. Natural gas processing,
4. Transmission and storage, and
5. Inactive oil and gas wells.

Emissions from natural gas distribution to end users (e.g. local utilities and industrial, commercial, and residential customers) are not included in the NM 2023 O&G GHGI. Details on the five categories listed above and the unique types of emission sources found in each category are provided in Section 2.

ERG calculated emissions using the best available information, which was obtained from several sources, including:

- NMED Emissions Inventory,
- NM Oil Conservation Division (OCD)
- EPA's Greenhouse Gas Reporting Program (GHGRP),
- EPA's Greenhouse Gas Inventory (GHGI),
- EPA's National Emissions Inventory (NEI), and
- O&G air emissions studies.

Emissions data reported directly to NMED and EPA were used as the basis of the NM 2023 O&G GHGI. Where this data was not available, emissions estimates were developed using data and methodologies from a variety of sources.

Details on the specific data sources and methodologies used to compile the NM 2023 O&G GHGI are provided in Sections 3, 4, and 5. Section 4 also includes details on the percentage of the emitting population represented by the emissions data reported directly to NMED and EPA. Emissions adjustments due to alternative flaring efficiencies are discussed in Sections 3.8 and 6.6. However, the emissions presented in this Executive Summary and the main body of Section 6 do not reflect flaring efficiency adjustments. For every category, the majority of the calculated emissions in the NM 2023 O&G GHGI were based on directly reported emissions and activity data. Section 6 provides a further breakdown of the NM 2023 O&G GHGI for each category, including emissions by basin and emission source. Section 7 provides a general perspective on uncertainty for the NM 2023 O&G GHGI. Section 8 compares the results of the NM 2023 O&G GHGI to the NM 2020 O&G GHGI.

Tables E-1 through E-3 below provide an overall summary of emissions.

Table E-1 presents a summary of CH_4, CO_2, and CO_2 equivalent (CO_2e) emissions for 2023 for each category. CO_2e emissions are calculated using a global warming potential (GWP) of 28 for CH_4. The production industry segment has the highest emissions of CH_4, while the gathering and boosting industry segment has the highest emissions of CO_2 and the highest total GHG emissions in CO_2e.

Table E-1. 2023 GHG Emissions by Category (Metric Tons)

Category	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Production	207,475	6,667,554	12,476,865
Gathering and Boosting	185,726	10,450,550	15,650,881
Natural Gas Processing	11,238	4,760,860	5,075,530
Transmission and Storage	14,848	682,127	1,097,870
Inactive Oil and Gas Wells	591	18	16,563
Total	**419,879**	**22,561,109**	**34,317,709**

Table E-2 presents a summary of CH_4, CO_2, and CO_2e emissions for 2023 for the highest emitting emission sources as well as the cumulative emissions from the remainder of sources. The highest emitting CH_4 sources are combustion (or combustion slip), pneumatic controllers, and equipment leaks which cumulatively account for 68 percent of CH_4 emissions. Combustion (e.g., from engines and turbines driving compressors) is the highest emitting CO_2 source, accounting for 81 percent of CO_2 emissions. Other significant CO_2 sources include acid gas removal units and miscellaneous flaring. Combustion is also the largest source of GHG emissions, responsible for 64 percent of total emissions on a CO_2e basis.

Table E-2. 2023 GHG Emissions by Emission Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Combustion	113,324	18,163,589	21,336,662
Pneumatic Controllers	101,019	10,396	2,838,926
Acid Gas Removal Units	0	2,067,351	2,067,351
Equipment Leaks	72,713	1,979	2,037,947
Miscellaneous Flaring	5,562	1,274,940	1,430,686
All Others	127,260	1,042,854	4,606,137
Total	**419,879**	**22,561,109**	**34,317,709**

Table E-3 presents a summary of CH_4, CO_2, and CO_2e emissions for 2023 for each O&G basin in NM. The Permian and San Juan basins account for over 98 percent of O&G GHG emissions in NM.

Table E-3. GHG Emissions by Basin (Metric Tons)

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Permian	268,836	18,153,822	25,681,218

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
San Juan	144,418	4,027,942	8,071,638
Las Vegas-Raton	4,239	24,435	147,443
Orogrande	1,397	108,320	143,123
Basin-And-Range Province	436	113,623	125,833
Pedregosa	258	102,097	109,317
Estancia	211	30,867	36,776
Palo Duro	40	1	1,120
San Luis	34	1	945
Sierra Grande Uplift	11	0	297
Total	**419,879**	**22,561,109**	**34,317,709**

1 INTRODUCTION

The New Mexico Environment Department (NMED) was awarded the Climate Pollution Reduction Grant (CPRG) from the Environmental Protection Agency (EPA) in July 2023. As part of the CPRG, NMED is required to develop a Comprehensive Climate Action Plan (CCAP), which includes developing a greenhouse gas (GHG) emissions inventory (GHGI) for the year 2023. NMED tasked ERG with developing the 2023 GHGI for the oil and gas (O&G) industry in New Mexico because the O&G industry is the largest GHG-emitting sector in the state and many emissions sources associated with the O&G industry are not captured in the disaggregated EPA national GHG emissions inventory. Therefore, a detailed state-specific O&G emissions inventory is needed to accurately estimate total GHG emissions in New Mexico for a given year. ERG prepared this report to present the emissions inventory results, which are referred to throughout this report as the NM 2023 O&G GHGI.

This report also serves as an initial assessment of state regulations that were implemented in 2021 and 2022. The NM Energy, Minerals and Natural Resources Department (EMNRD) promulgated Title 19, Chapter 15, Part 27 "Venting and Flaring of Natural Gas"[1] and Part 28 "Natural Gas Gathering Systems"[2] in 2021 to reduce CH_4 emissions and prevent waste of natural gas. In addition, NMED promulgated Title 20, Chapter 2, Part 50 "Oil and Gas Sector – Ozone Precursor Pollutants" in 2022, which focused on reducing emissions of volatile organic compounds (VOCs) and Nitrogen Oxides (NOx).[3] While the NMED rule does not specifically address CH_4, there are expected to be co-benefits of this rule in reducing CH_4 emissions from sources such as storage tanks and pneumatic controllers.

ERG previously developed a GHGI for the O&G industry in NM for the year 2020 (NM 2020 O&G GHGI).[4] Therefore, the NM 2020 O&G GHGI represents GHG emissions prior to the regulations and the NM 2023 O&G GHGI represents GHG emissions shortly after the regulations took effect (but before all requirements

[1] Available online at <https://www.srca.nm.gov/parts/title19/19.015.0027.html>
[2] Available online at <https://www.srca.nm.gov/parts/title19/19.015.0028.html>
[3] Available online at <https://www.srca.nm.gov/parts/title20/20.002.0050.html>
[4] ERG, Inc. New Mexico Oil and Gas Greenhouse Gas Emissions Inventory for Year 2020. August 31, 2022. Available online at <https://cloud.env.nm.gov/resources/_translator.php/YjMwMmZhMWY5NjEwMGMyMWQwZDkzODk5NV8xNzc2NjE~.pdf>

have been fully implemented). In general, ERG used the same sources of emissions data and emission factors for the NM 2023 O&G GHGI as the NM 2020 O&G GHGI, with a few exceptions. This consistency in approach helps ensure that any changes in emissions are due to changes in practices and operations, and not simply due to changes in calculation methodology which could distort emissions comparisons between the two inventories. In addition to the impact from the NM regulations, oil and gas production increased substantially between 2020 and 2023, which also necessarily impacts emissions. Oil production increased from 369 million barrels in 2020 to 671 million barrels in 2023 (an increase of 82 percent), and gas production increased from 1,941 trillion cubic feet in 2020 to 3,192 trillion cubic feet in 2023 (an increase of 64 percent); see Section 4.3.1 of this report and the NM 2020 O&G GHGI.

Section 2 of this report describes how the relevant emission sources for each industry segment included in the NM 2023 O&G GHGI were identified. Section 3 describes the emissions data considered in development of the NM 2023 O&G GHGI, including both federal and state datasets as well as various oil and gas emission studies and emission factor references. Section 4 describes the analysis of available datasets with respect to complete industry characterization in NM and how counts of sources such as wells and compressor stations were determined. Section 5 presents the NM 2023 O&G GHGI final steps and methodology for each industry segment. Section 6 presents a summary of the NM 2023 O&G GHGI methane (CH_4) and carbon dioxide (CO_2) emissions for each industry segment. Section 7 provides a general perspective on uncertainty for the NM 2023 O&G GHGI. Section 8 compares the results of the NM 2023 O&G GHGI to the NM 2020 O&G GHGI.

2 Emission Sources

The NM 2023 O&G GHGI includes emissions from five categories. The categories include four O&G industry segments plus inactive oil and gas wells:

1. Production (which also includes exploration),
2. Gathering and boosting (G&B),
3. Natural gas processing,
4. Transmission and storage (which includes transmission compressor stations, transmission pipelines, and underground natural gas storage stations), and
5. Inactive oil and gas wells.

Figure 1 illustrates the four industry segments, which follow the oil and gas production chain from drilling through to transmission. Note, the distribution segment is shown in Figure 1, but distribution segment emissions are not included in the NM 2023 O&G GHGI.

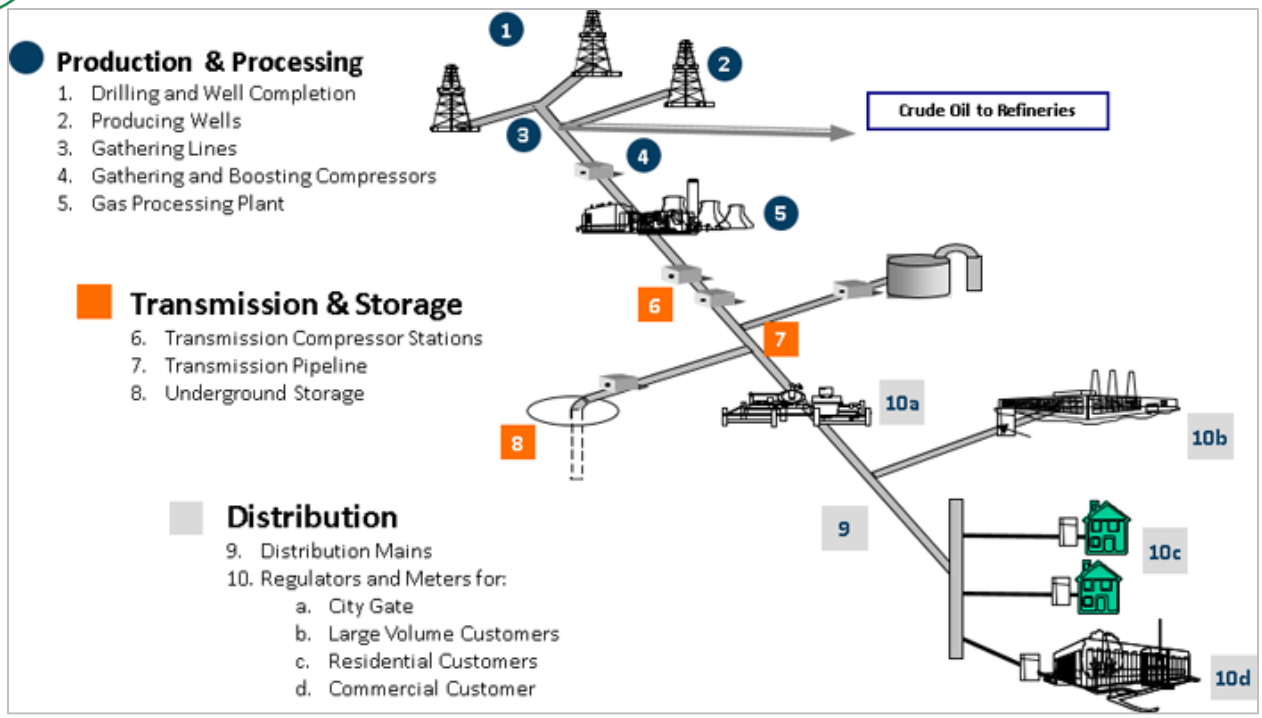


Figure 1. Industry Segments for the O&G Industry

The following sections identify the specific emission sources included in the NM 2023 O&G GHGI for each category. The categories and emission sources in the NM 2023 O&G GHGI align exactly with those included in the NM 2020 O&G GHGI.

2.1 Production

The production industry segment includes exploration and production emission sources. Table 1 identifies the emission sources included in the NM 2023 O&G GHGI for oil and gas exploration and Table 2 identifies the emission sources included in the NM 2023 O&G GHGI for oil and gas production.

Table 1. Emission Sources Included in NM 2023 O&G GHGI for Exploration

Emission Source
Well Completions
Mud Degassing
Well Testing

Table 2. Emission Sources Included in NM 2023 O&G GHGI for Production

Emission Source
Well Pad Equipment Leaks
Pneumatic Controllers (High, Low, and Intermittent)
Pneumatic Pumps
Dehydrators
Hydrocarbon Liquid Storage Tanks

Emission Source
Hydrocarbon Liquid Storage Tank Unloading
Produced Water Tanks
Liquids Unloading
Associated Gas Venting and Flaring
Miscellaneous Production Flaring
Reciprocating Compressors
Well Workovers
Combustion • Engines (e.g., compressor engines, artificial lift engines, well drilling engines, fracking engines) • Turbines (e.g., compressor turbines) • External Combustion (e.g., Heaters)

2.2 Gathering and Boosting

Table 3 and Table 4 identify the emission sources included in the NM 2023 O&G GHGI for G&B stations and gathering pipelines respectively.

Table 3. Emission Sources Included in NM 2023 O&G GHGI for G&B Stations

Emission Source
Station Blowdowns
Dehydrator Vents
Pneumatic Controllers (High, Low, and Intermittent)
Pneumatic Pumps
Flares
Reciprocating Compressors
Centrifugal Compressors
Hydrocarbon Liquid Storage Tanks
Acid Gas Removal Units
Station Leaks
Combustion • Engines • Turbines • External Combustion

Table 4. Emission Sources Included in NM 2023 O&G GHGI for Gathering Pipelines

Emission Source
Pipeline Leaks
Pipeline Blowdowns

2.3 Natural Gas Processing

Table 5 identifies the emission sources included in the NM 2023 O&G GHGI for natural gas processing.

Table 5. Emission Sources Included in NM 2023 O&G GHGI for Natural Gas Processing

Emission Source
Plant Leaks
Reciprocating Compressors
Centrifugal Compressors
Flares
Dehydrators
Blowdowns
Acid Gas Removal Units
Pneumatic Controllers
Combustion • Engines • Turbines

2.4 Transmission and Storage

Table 6 and Table 7 identify the emission sources included in the NM 2023 O&G GHGI for transmission compressor stations and transmission pipelines.

Table 6. Emission Sources Included in NM 2023 O&G GHGI for Transmission Compressor Stations

Emission Source
Station Leaks
Reciprocating Compressors
Centrifugal Compressors
Flares
Station Blowdowns
Pneumatic Controllers (High, Low, and Intermittent)
Hydrocarbon Liquid Storage Tanks
Combustion • Engines • Turbines

Table 7. Emission Sources Included in NM 2023 O&G GHGI for Transmission Pipelines

Emission Source
Pipeline Leaks
Pipeline Blowdowns

Table 8 identifies the emission sources included in the NM 2023 O&G GHGI for underground natural gas (NG) storage.

Table 8. Emission Sources Included in NM 2023 O&G GHGI for Underground NG Storage

Emission Source
Station Leaks
Reciprocating Compressors
Dehydrators
Flares
Blowdowns
Pneumatic Controllers (High, Low, and Intermittent)
Storage Wells
Metering and Regulating Equipment
Combustion • Engines • Turbines

2.5 Inactive Wells

Table 9 identifies the emission sources included in the NM 2023 O&G GHGI for inactive wells. Inactive wells can also be referred to as abandoned wells, and orphaned wells are a subset of inactive wells.

Table 9. Emission Sources Included in NM 2023 O&G GHGI for Inactive Wells

Emission Source
Unplugged inactive wells
Plugged inactive wells

3 EMISSIONS DATA

3.1 Introduction

This section identifies the emissions data and emission factors that ERG used to estimate emissions for the five categories included in the NM 2023 O&G GHGI. ERG evaluated data from the U.S. EPA, emissions inventory data submitted to the NMED, and measurement studies to identify relevant emissions data and emission factors for each category. Each of these data sources are discussed in Sections 3.1.1 through 3.1.3, and Section 3.1.4 then provides an overview of the approach for emissions data and emission factor selection. Section 3.2 through Section 3.6 present the specific data sources for each category, Section 3.7 presents the emission factors for engine exhaust (applicable to all industry segments), and Section 3.8 presents adjustments that were made for flare emissions.

In general, ERG used the same sources of emissions data and emission factors for the NM 2023 O&G GHGI as the NM 2020 O&G GHGI, with exceptions for G&B station tank and leak emissions (see Section 3.3.1) and underground NG storage stations (see Section 3.5). Using a consistent approach for the two Inventories helps ensure that any changes in calculated emissions are due to changes in practices and operations, as opposed to being influenced by a calculation methodology change which could distort emissions changes due to operational changes.

3.1.1 U.S EPA Data

ERG evaluated the following five U.S. EPA datasets in preparing the NM 2023 O&G GHGI:

1. U.S. EPA GHG Reporting Program (GHGRP) Subpart W (subpart W)[5]
2. GHGRP Subpart C (subpart C)[6]
3. U.S. EPA GHG Inventories for Natural Gas Systems, Petroleum Systems, and Abandoned Wells (EPA GHGI)[7]
4. U.S EPA National Emissions Inventory, Nonpoint Oil and Gas Emission Estimation Tool (NEI Tool)[8]
5. U.S. EPA AP-42 (AP-42)[9]

The GHGRP collects annual emissions and related activity data from facilities that exceed the reporting threshold of 25,000 metric tons of CO_2 equivalent (CO_2e) per year. The most recent GHGRP data is for year 2023 and 2023 data were used in the analyses. GHGRP's subpart W collects data from petroleum and natural gas systems facilities, and subpart C collects stationary fuel combustion emissions from applicable facilities. Subpart W includes data for each of the four industry segments that are included in the NM 2023 O&G GHGI. A subpart W facility for transmission stations, underground NG storage stations, and natural gas processing plants is defined as each individual station and plant, consistent with other regulatory definitions of a facility.

For production and G&B facilities, subpart W defines facilities using a larger geographic region (i.e., basin) and not at the individual site-level. Subpart W production and G&B facilities include all equipment within a single basin, as detailed here:

- Petroleum and natural gas production facility refers to all petroleum or natural gas equipment on a single well-pad or associated with a single well-pad that are under common ownership or common control including leased, rented, or contracted activities by a petroleum and natural gas production owner or operator and that are located in a single hydrocarbon basin.
- Petroleum and natural gas gathering and boosting facility refers to all gathering pipelines and other equipment located along those pipelines that are under common ownership or common control by a gathering and boosting system owner or operator and that are located in a single hydrocarbon basin. If a person owns or operates more than one gathering and boosting system in a basin (for example, separate gathering lines that are not connected), then all gathering and boosting equipment that the person owns or operates in the basin would be considered one facility.

The GHGRP provides specific reporting forms for subpart W and subpart C, in spreadsheet format, that facilities may use to report their data. The reporting forms contain detailed information for each applicable emission source.

[5] https://www.epa.gov/ghgreporting/subpart-w-petroleum-and-natural-gas-systems
[6] https://www.epa.gov/ghgreporting/subpart-c-general-stationary-fuel-combustion-sources
[7] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
[8] 2023 Nonpoint Oil and Gas Emission Estimation Tool Version 1.0, May 21, 2025.
[9] https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors

Subpart W was also revised in 2024 and includes revised EFs for certain emission sources.[10] Of specific interest for this NM 2023 O&G GHGI, equipment leak EFs were revised to be based on more recent measured emissions data and multiple flare efficiency options are provided that depend on the rigor of flare monitoring used by companies.

The EPA GHGI estimates national-level GHG emissions for the O&G industry, including the five categories that emissions are estimated for in the NM 2023 O&G GHGI. While the GHGRP accounts for only those facilities that exceed the reporting threshold, the EPA GHGI accounts for all O&G activities in the U.S. The EPA GHGI estimates emissions for all of the main emission sources in each industry segment. Each emission source has a unique calculation methodology, emission factors, and activity specific to that source. The EPA GHGI estimates annual emissions over time with the most recent published EPA GHGI estimating emissions for 1990 through 2022 as of the time that this report was drafted.

The NEI Tool estimates county-level criteria pollutant emissions for the production industry segment with some overlap with G&B sources. Similar to the EPA GHGI, the NEI Tool estimates emissions for each emission source using a unique calculation methodology (i.e., emission factors and activity specific to each emission source). The most recent NEI Tool data is for year 2023.

The U.S. EPA's Compilation of Air Pollutant Emissions Factors (AP-42) contains emission factors for numerous emission sources. For the NM 2023 O&G GHGI, emission factors for combustion sources were reviewed, which include reciprocating engines that are commonly used in the O&G industry.

3.1.2 NMED Emissions Inventory

The NMED Air Quality Bureau emissions inventory (NMED EI) collects criteria pollutant (including NO_x, CO, SO_2, PM 2.5, PM 10, and lead), VOC, and GHG (i.e., CH_4 and CO_2) emissions data from major and minor sources. As a result of this data collection effort, the NMED EI is a fairly comprehensive dataset for GHG emissions and related activity data. To estimate GHG emissions, companies were required to follow subpart W and subpart C methodologies. NMED requests GHG data from all facilities, including facilities that are below the GHGRP reporting threshold and would otherwise generally not report their data to EPA.

Organizations submit their GHG data through the Air Emissions Inventory Reporting (AEIR) system at the facility-level (i.e., Agency Interest ID) or the organization-level. The GHG data available for these two methods differs and is summarized here:

1. Facility-level data: GHG emissions and activity data are available via the NMED EI database system, by Agency Interest ID and Subject Item (SI) ID. This is the same manner in which criteria pollutant and VOC data are made available. GHG emissions available in the AEIR system via this method are referred to as **NMEI** data for this report.
2. Organization-level data: GHG emissions are available by subpart (i.e., subpart W, subpart C) and supporting attachments are also provided. The attachments are preferably GHGRP subpart W and subpart C reporting forms, which include granular emissions and activity data, but also include

[10] Greenhouse Gas Reporting Rule: Revisions and Confidentiality Determinations for Petroleum and Natural Gas Systems. Final Rule. 89 FR 42062. May 14, 2024. https://www.govinfo.gov/content/pkg/FR-2024-05-14/pdf/2024-08988.pdf.

other types of summary spreadsheets and files. GHG emissions available in the AEIR system via this method are referred to as **AEIR** data for this report.

When the AEIR data are GHGRP reporting forms, NMED asked companies to adjust their EPA reporting forms to provide data only for their NM operations, where appropriate. As noted above, subpart W defines a facility, for purposes of the production and G&B industry segments, as all equipment within a given basin, which can cross state boundaries. For example, the Permian Basin includes activity in both Texas (TX) and NM. Therefore, if a company operates in the Permian Basin, while they can use the subpart W reporting form submitted to the EPA as a starting point, only the data for their NM operations were to be submitted (i.e., the TX emissions data were to be removed). Of note, while this request was made, several companies did not modify their GHGRP reporting forms to remove data from states other than NM.

While the NMED EI (and its NMEI and AEIR data) are considered fairly comprehensive, there are important caveats:

- The NMEI emission sources do not always align with subpart W emission sources. For example, pneumatic controller GHG emissions are rarely available with NMEI data and equipment leak emissions do not align between NMEI and subpart W. In these cases, the NMEI data are not appropriate to use.
- Not all organizations provided supporting details for their AEIR data and only total organization-level GHG emissions are available. If sufficient details are not available in the supporting attachments, the AEIR data are not appropriate to use.
- Some organizations did not report GHG emissions data through the NMED EI.

3.1.3 Measurement Studies

A number of studies have been conducted over the last ten years that measured CH_4 emissions from O&G emission sources. The results from these measurement studies are then published in peer-reviewed journal articles. While a number of these studies have been incorporated into EPA GHGI methodologies, others have not. Therefore, select measurement studies were considered for the NM 2023 O&G GHGI. These are specifically discussed in Sections 3.2.1, 3.3.1, 3.5.1, 3.6, and 3.7.

3.1.4 General Approach

Due to the quantity of GHGRP data reported through AEIR data, NMEI data, and the U.S. EPA, and its specificity to NM operations, ERG used GHGRP emissions data for the majority of the emission sources. Where AEIR, NMEI, and Subpart W are identified in the tables below in Sections 3.2 through 3.5, the reported emissions are used directly. However, in some instances, ERG used emission factors from the EPA GHGI, the NEI Tool, and measurement studies in conjunction with activity data from the NMEI, AEIR, and EPA datasets. A brief discussion below for each industry segment explains where unique emission factors are used. In most cases, these emission factors allow for more recent measurement data not included in GHGRP methodologies to be used in the NM 2023 O&G GHGI as well as for emission sources not included in the GHGRP.

Sections 3.2 through 3.5 present the source of the emissions data and emission factors used for each emission source in each industry segment. Section 3.6 presents the source of the emission factors used

for inactive wells. Section 3.7 presents the methodology used to estimate internal combustion engine CH_4 emissions for all industry segments and Section 3.8 presents adjustments that were made for flare emissions.

3.2 Production

Table 10 and Table 11 present the source of the emissions data for exploration and production.

Table 10. Exploration Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Well Completions	AEIR / Subpart W	AEIR / Subpart W
Mud Degassing	NEI Tool	CO_2:CH_4 Ratio[11]
Well Testing	AEIR / Subpart W	AEIR / Subpart W

Table 11. Production Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Well Pad Equipment Leaks	Other (See Section 3.2.1)	CO_2:CH_4 Ratio
Pneumatic Controllers (High, Low, and Intermittent)	AEIR / Subpart W	AEIR / Subpart W
Pneumatic Pumps	AEIR / Subpart W	AEIR / Subpart W
Dehydrators	AEIR / Subpart W	AEIR / Subpart W
Hydrocarbon Liquid Storage Tanks	AEIR / Subpart W	AEIR / Subpart W
Hydrocarbon Liquid Storage Tank Unloading	NEI Tool	CO_2:CH_4 Ratio
Produced Water Tanks	EPA GHGI	EPA GHGI
Liquids Unloading	AEIR / Subpart W	AEIR / Subpart W
Associated Gas Venting and Flaring	AEIR / Subpart W	AEIR / Subpart W
Miscellaneous Production Flaring	AEIR / Subpart W	AEIR / Subpart W
Reciprocating Compressors	AEIR / Subpart W	AEIR / Subpart W
Well Workovers	AEIR / Subpart W	AEIR / Subpart W

The miscellaneous production flaring emission source represents emissions reported under flare stacks in subpart W; these emissions are from smaller, miscellaneous emission sources that are not specifically identified in subpart W (e.g., it does not represent flaring from tanks or associated gas). Several emission sources in exploration and production are not required to be reported under GHGRP subpart W, including mud degassing, storage tank unloading, and produced water tanks. However, the EPA GHGI and the NEI Tool include emissions for these sources based on default emission factor data, which are used in the NM 2023 O&G GHGI.

[11] CO_2 emissions are estimated using CH_4 estimates and the ratio of CO_2 to CH_4 contents in natural gas. The CO_2 and CH_4 contents of natural gas may vary by industry segment and by basin.

The approach used to estimate equipment leak emissions from production well pads is discussed in Section 3.2.1.

3.2.1 Production Well Pad Equipment Leaks

ERG applied a methodology similar to the NM 2020 O&G GHGI for the NM 2023 O&G GHGI for well pad equipment leaks. ERG used two measurement studies for well pad equipment leaks emission factors:

- Pacsi et al. 2019 - Equipment leak detection and quantification at 67 oil and gas sites in the Western United States.[12]
- Rutherford et al. 2021 - Closing the methane gap in US oil and natural gas production emissions inventories.[13]

Pacsi et al. 2019 relies only on recent emissions data whereas Rutherford et al. 2021 uses emissions data from studies published between 1993 and 2019. Table 12 presents the CH_4 emission factors for production equipment leaks developed by the Pacsi et al. 2019 study and the Rutherford et al. 2021 study.

Table 12. Production Equipment leak Emission Factor Summary

Emission Source	CH_4 Emission Factor (kg/day/equipment)	
	Rutherford et al. 2021	Pacsi et al. 2019
Natural Gas Wells		
Wellheads	3.35	0.70
Separators	3.72	0.81
Meters/Piping	2.66	0.74
Heaters	2.04	0.15
Dehydrators	3.13	1.02
Compressors	5.33	1.91
Crude Oil Wells		
Wellheads	1.33	0.10
Separators	1.53	0.07
Heater/Treaters	1.01	0.08
Headers	3.86	0.10

The Pacsi et al. 2019 EFs are significantly lower than the Rutherford et al. 2021 EFs. As such, ERG used the Pacsi et al. EFs for well pad equipment where an operator performed leak detection and repair (LDAR) surveys (e.g., used optical gas imaging to monitor for leaks on well pad equipment and then repaired leaking components). ERG used the Rutherford et al. 2021 EFs for well pad equipment where an operator did not perform LDAR surveys.

[12] Adam P. Pacsi, Tom Ferrara, Kailin Schwan, Paul Tupper, Miriam Lev-On, Reid Smith, Karin Ritter; Equipment leak detection and quantification at 67 oil and gas sites in the Western United States. Elementa: Science of the Anthropocene 1 January 2019; 7 29. doi: https://doi.org/10.1525/elementa.368

[13] Rutherford, J.S., Sherwin, E.D., Ravikumar, A.P. et al. Closing the methane gap in US oil and natural gas production emissions inventories. Nat Commun 12, 4715 (2021). https://doi.org/10.1038/s41467-021-25017-4

While the emission factors were identical for the NM 2023 O&G GHGI and NM 2020 O&G GHGI, the prevalence of LDAR surveys was updated to reflect year 2023 data. For the NM 2023 O&G GHGI, ERG evaluated subpart W data to estimate the population of well pad equipment where LDAR surveys were performed. Subpart W production segment facilities report the total number of wells in a basin and also the number of wells where LDAR surveys were not conducted. From this data, ERG calculated the percent of wells where LDAR surveys were and were not conducted; Table 13 presents the results of the LDAR survey analysis. Well data were used as a surrogate to represent well pad equipment in general.

Table 13. LDAR Survey Analysis of Year 2023 Subpart W Data

Basin	Percent of Wells Where LDAR Surveys Were Conducted In 2023	Percent of Wells Where LDAR Surveys Were Not Conducted In 2023
Permian	49%	51%
San Juan	92%	8%

3.3 Gathering and Boosting

Table 14 and Table 15 present the source of the emissions data for G&B stations and gathering pipelines.

Table 14. G&B Station Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Station Blowdowns	AEIR / Subpart W	AEIR / Subpart W
Dehydrator Vents	AEIR / NMEI / Subpart W	AEIR / NMEI / Subpart W
Pneumatic Controllers (High, Low, and Intermittent)	AEIR / Subpart W	AEIR / Subpart W
Pneumatic Pumps	AEIR / Subpart W	AEIR / Subpart W
Flares	AEIR / NMEI / Subpart W	AEIR / NMEI / Subpart W
Compressors	EPA GHGI	CO_2:CH_4 Ratio
Hydrocarbon Liquid Storage Tanks	EPA GHGI and AEIR / NMEI / Subpart W (see Section 3.3.1)	AEIR / NMEI / Subpart W
Acid Gas Removal Units	AEIR / Subpart W	AEIR / Subpart W
Station Leaks	AEIR / NMEI / Subpart W (see Section 3.3.1)	AEIR / NMEI / Subpart W

Table 15. Gathering Pipelines Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Pipeline Leaks	AEIR / Subpart W	AEIR / Subpart W
Pipeline Blowdowns	Subpart W	Subpart W

For certain G&B sources, EPA GHGI emission factors and revised subpart W emission factors are used instead of or in conjunction with reported subpart W emissions; see Section 3.3.1 for details.

3.3.1 Gathering and Boosting Station Storage Tanks and Station Leaks

ERG modified the methodology to calculate emissions from G&B station leaks and storage tanks for the NM 2023 O&G GHGI compared to the NM 2020 O&G GHGI to better reflect 2023 emissions control practices.

For the NM 2020 O&G GHGI, ERG applied the EPA GHGI methodology. The EPA GHGI uses emission factors from a comprehensive CH_4 emissions measurement program conducted for the G&B industry segment (Zimmerle et al. 2020).[14,15] The Zimmerle et al. study conducted measurements in 2017 at 180 G&B stations across the U.S., including stations in NM. The Zimmerle et al. study captured emissions from large emission events, specifically from G&B storage tanks, which are important to reflect in inventories. Relying exclusively on process simulation software to estimate storage tank emissions, such as subpart W currently does, is appropriate to estimate typical emissions but does not capture large emission events such as those caused by malfunctioning equipment. However, the Zimmerle et al. emissions also only represent uncontrolled sources and do not reflect the use of flares or vapor recovery units to control storage tank emissions, nor do they reflect the increased use of LDAR surveys to monitor for leaks using technologies such as optical gas imaging and then repairing leaking components. Since 2017, when the Zimmerle et al. measurements were conducted, there has been a significant increase in control technologies and LDAR surveys at G&B stations. For example, based on EPA subpart W data for G&B storage tanks in NM, 27 percent of G&B storage tanks were controlled by flares in 2017 while 61 percent of G&B storage tanks were controlled by flares in 2023. In order to reflect control practices representative of 2023 operations for G&B stations in NM, ERG further reviewed subpart W data in addition to the GHGI emission factors and considered multiple options to estimate emissions.

3.3.1.1 G&B Storage Tanks

ERG considered three options to estimate storage tank emissions:

1. Use subpart W reported emissions for 2023 (as reported to NMED and EPA): reflects current operations, including use of flares and vapor recovery units. The number of tanks vented, number of tanks controlled by flares, and the number of tanks controlled by vapor recovery units are available, along with the corresponding CH_4 and CO_2 emissions. These emissions reflect tank working and breathing losses.
2. Apply the revised subpart W tank leak emission factor: a new emission factor specific to tank leaks is available from the subpart W revisions finalized in 2024.
3. Apply EPA GHGI emission factor: using this emission factor, as was used for the NM 2020 O&G GHGI, is an option to represent both tank working and breathing losses and tank leaks.

In order to reflect current control practices but also acknowledge that large emission events do still occur from tanks, ERG used a hybrid approach to estimate G&B storage tank emissions for the NM 2023 O&G GHGI. This approach is summarized as follows:

[14] Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2018: Updates to Natural Gas Gathering & Boosting Station Emissions. Available at: https://www.epa.gov/sites/default/files/2020-04/documents/2020_ghgi_update_-_gb_stations_final.pdf

[15] Zimmerle et al. Methane Emissions from Gathering Compressor Stations in the U.S. Environmental Science & Technology, 2020, 54, 12, 7552–7561. https://pubs.acs.org/doi/10.1021/acs.est.0c00516

- For all storage tanks, ERG used 2023 subpart W CO_2 emissions as reported to NMED and EPA (option 1).
- For tanks controlled with flares and vapor recovery units, ERG summed 2023 subpart W reported CH_4 emissions (option 1) with CH_4 leak emissions calculated using the revised subpart W storage tank leak emission factor (option 2).
- For vented storage tanks, ERG used the EPA GHGI CH_4 emission factor to calculate CH_4 emissions (option 3).

3.3.1.2 G&B Station Leaks

ERG considered three options to estimate G&B station leak emissions:

1. Use subpart W reported station leak emissions for 2023 (as reported to NMED and EPA): reflects use of LDAR surveys. Reporters can count major equipment and apply population emission factors and/or conduct LDAR surveys to identify leaking components and apply leaker emission factors.
2. Adjust reported subpart W station leak emissions using revised subpart W emission factors: revised equipment leak emission factors are available for leaker emission factors and for major equipment population emission factors from the 2024 subpart W revisions. The reported station leak emissions can be directly updated to reflect the use of the new emission factors.
3. Apply EPA GHGI emission factor: using this emission factor, as was used for the NM 2020 O&G GHGI, is also an option.

ERG selected option 2 to estimate G&B station leak emissions. This option allows the emissions to reflect year 2023 practices (e.g., use of LDAR surveys to minimize leaks) and applies the 2024 revised subpart W emission factors which reflect the most recent data available.

3.4 Natural Gas Processing

Table 16 presents the source of the emissions data for natural gas processing.

Table 16. Natural Gas Processing Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Plant Leaks	AEIR / Subpart W	AEIR / Subpart W
Reciprocating Compressors	AEIR / Subpart W	AEIR / Subpart W
Centrifugal Compressors	AEIR / Subpart W	AEIR / Subpart W
Flares	AEIR / Subpart W	AEIR / Subpart W
Dehydrators	AEIR / Subpart W	AEIR / Subpart W
Blowdowns	AEIR / Subpart W	AEIR / Subpart W
Acid Gas Removal Units	AEIR / Subpart W	AEIR / Subpart W
Pneumatic Controllers	EPA GHGI	EPA GHGI

Pneumatic controllers powered by natural gas are not common at natural gas processing plants and are not subject to subpart W requirements. However, the EPA GHGI does include pneumatic controllers based on default data, which are used in the NM 2023 O&G GHGI.

3.5 Transmission and Storage

Table 17, Table 18, and Table 19 present the source of the emissions data for transmission compressor stations, transmission pipelines, and underground NG storage stations, respectively.

For underground NG storage stations in the NM 2020 O&G GHGI, reported emissions data were not available from NM or EPA GHGRP data and average emissions from the EPA GHGI were used as a result. One of the two underground NG storage stations reported 2023 GHG emissions to the EPA GHGRP and these reported emissions were used for the NM 2023 O&G GHGI.

Table 17. Transmission Compressor Station Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Station Leaks	NMEI / Subpart W	NMEI / Subpart W
Reciprocating Compressors	NMEI / Subpart W plus Other (see Section 3.5.1)	CO_2:CH_4 Ratio
Centrifugal Compressors	NMEI / Subpart W plus Other (see Section 3.5.1)	CO_2:CH_4 Ratio
Flares	NMEI / Subpart W	NMEI / Subpart W
Station Blowdowns	NMEI / Subpart W	NMEI / Subpart W
Pneumatic Controllers (High, Low, and Intermittent)	Subpart W	Subpart W
Hydrocarbon Liquid Storage Tanks	NMEI / Subpart W	NMEI / Subpart W

Table 18. Transmission Pipelines Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Pipeline Leaks	EPA GHGI	EPA GHGI
Pipeline Blowdowns	Subpart W	Subpart W

Table 19. Underground NG Storage Station Emissions Data Summary

Emission Source	CH_4 Emissions Data Source	CO_2 Emissions Data Source
Station Leaks	Subpart W	Subpart W
Reciprocating Compressors	Subpart W	Subpart W
Dehydrators	Subpart W	Subpart W
Flares	Subpart W	Subpart W
Station Blowdowns	Subpart W	Subpart W
Pneumatic Controllers (High, Low, and Intermittent)	Subpart W	Subpart W
Storage Wells	Subpart W	Subpart W
Metering and Regulating Equipment	Subpart W	Subpart W

A few emission sources in the transmission segment are not subject to subpart W reporting, including dehydrators and pipeline leaks. However, the EPA GHGI includes emissions for these sources, based on default emission factor data, which are used in the NM 2023 O&G GHGI.

The approach used to estimate compressor emissions is further discussed in Section 3.5.1.

3.5.1 Transmission and Storage Station Compressors

ERG used the approach from the NM 2020 O&G GHGI to augment reciprocating compressor and centrifugal compressor emissions for the NM 2023 O&G GHGI. As discussed more fully in the NM 2020 O&G GHGI report, a Pipeline Research Council International (PRCI) white paper noted that emissions from certain compressor components and compressor modes are not required to be measured and reported under subpart W compressor requirements.[16] The components and compressor modes not required to be reported under subpart W are:

- reciprocating compressor rod packing during standby, pressurized mode
- centrifugal compressor dry seals during operating mode
- centrifugal compressor dry seals during standby, pressurized mode

To provide a complete picture of compressor emissions, the PRCI white paper includes an emission factor for each component and compressor mode. Table 20 presents the emission factors from PRCI for the components and compressor modes that are not required to be reported under subpart W.

Table 20. PRCI Compressor CH_4 Emission Factors for Certain Compressor Components and Modes

Compressor Type	Component and Compressor Mode	CH_4 Emission Factor (mt CH_4/yr/compressor)
Reciprocating	Rod packing during standby, pressurized mode	10.9
Centrifugal	Dry seals during operating mode	24.6
Centrifugal	Dry seals during standby, pressurized mode	2.0

For the NM 2023 O&G GHGI, ERG used a combination of subpart W emissions and PRCI emission factors to estimate total emissions from transmission station and underground NG storage station reciprocating and centrifugal compressors. ERG used subpart W emissions to reflect NM-specific operations and then adjusted the emissions by applying the emission factors presented in Table 20 for each reported compressor, as applicable, to estimate total compressor emissions from reciprocating and centrifugal compressors.

3.6 Inactive Oil and Gas Wells

ERG used the approach from the NM 2020 O&G GHGI to estimate inactive oil and gas well emissions for the NM 2023 O&G GHGI. ERG applied CH_4 emission factor data for inactive oil and gas wells from the following sources:

[16] PRCI White Paper: Methane Emission Factors for Compressors in Natural Gas Transmission and Underground Storage based on Subpart W Measurement Data (Oct. 17, 2019). PR-312-18209-E01.

- Townsend-Small et al. 2016: Emissions of coal bed and natural gas methane from abandoned oil and gas wells in the United States[17]
- Townsend-Small et al. 2021 - Direct measurements from shut-in and other abandoned wells in the Permian Basin of Texas indicate some wells are a major source of methane emissions and produced water[18]

These two Townsend-Small studies measured inactive well emissions in the western U.S. Townsend-Small et al. 2016 conducted measurements in Colorado, Utah, and Wyoming and Townsend-Small et al. 2021 conducted measurements in the Permian Basin in TX. Table 21 summarizes CH_4 emission factors from the two studies.

Table 21. Inactive Oil and Gas Well Emissions Data

Data Source	Region	Plugged / Unplugged	CH_4 Emission Factor (g/hr/well)	Used in NM O&G GHGI?
Townsend-Small et al. 2016	Western U.S. (CO, UT, WY)	Plugged	0.002	Yes
Townsend-Small et al. 2016	Western U.S. (CO, UT, WY)	Unplugged	1.7	No
Townsend-Small et al. 2021	Permian Basin (TX)	Unplugged	6.1	Yes

ERG used the unplugged inactive well emission factor from Townsend-Small et al. 2021 as this data is from the closest regional location. Since that study did not conduct measurements on plugged wells, ERG used the Townsend-Small et al. 2016 emission factor for plugged inactive wells.

3.7 Internal Combustion Engine Exhaust

ERG used the approach from the NM 2020 O&G GHGI to adjust natural gas-fired internal combustion engine (ICE) exhaust CH_4 emissions (e.g., combustion slip or unburned CH_4) for the NM 2023 O&G GHGI. As discussed more fully in the NM 2020 O&G GHGI report, the GHGRP CH_4 emission factor for natural gas fired ICE exhaust is taken from subpart C, which applies a single emission factor for all units that combust natural gas. The subpart C emission factor is fuel-based and does not recognize differences in the type of combustion units, so engines, turbines, and all other units that combust natural gas use the same CH_4 emission factor. This CH_4 emission factor is not representative of exhaust from natural gas-fired ICEs that dominate the oil and gas industry and is orders of magnitude lower than emission factors that are specific to natural gas-fired ICE exhaust.

Based on this, ERG used AP-42 CH_4 emission factors to estimate exhaust emissions from natural gas engines for all oil and gas industry segments (production, G&B, natural gas processing, and transmission and storage) in the NM 2023 O&G GHGI. The AP-42 emission factors are unique for each engine type (e.g., 4-stroke rich burn, 4-stroke lean burn). The fractions of rich burn and lean burn 4-stroke natural gas

[17] Townsend-Small A, Ferrara T W, Lyon D R, Fries A E and Lamb B K. Emissions of coal bed and natural gas methane from abandoned oil and gas wells in the United States. Geophys. Res. Lett., 43, 2283–90. 2016. https://doi.org/10.1002/2015GL067623

[18] Amy Townsend-Small and Jacob Hoschouer. Direct measurements from shut-in and other abandoned wells in the Permian Basin of Texas indicate some wells are a major source of methane emissions and produced water. Environmental Research Letters, 16, 5, 2021. https://iopscience.iop.org/article/10.1088/1748-9326/abf06f

engines were developed using NM-specific data for the NM 2020 O&G GHGI and ERG retained these fractions for the NM 2023 O&G GHGI. Table 22 presents the AP-42 CH_4 emission factors, the fraction of rich and lean burn engines for the production segment in NM, and the calculated composite EF for the production segment. Table 23 presents the AP-42 CH_4 emission factors; the fraction of rich and lean burn engines for the G&B, natural gas processing, and transmission segments in NM; and the calculated composite EF for the G&B, natural gas processing, and transmission segments.

Table 22. Production Segment Natural Gas Engine Exhaust Composite CH_4 Emission Factor

Emission Source	AP-42 CH_4 Emission Factor (lbs/MMBtu fuel input)	% of Engine Type
4-Stroke, Lean Burn	1.25	16%
4-Stroke, Rich Burn	0.23	84%
All Engines (Composite EF)	**0.39**	

Table 23. G&B, Natural Gas Processing, and Transmission Natural Gas Engine Exhaust Composite CH_4 Emission Factor

Emission Source	AP-42 CH4 Emission Factor (lbs/MMBtu fuel input)	% of Engine Type
4-Stroke, Lean Burn	1.25	90%
4-Stroke, Rich Burn	0.23	10%
All Engines (Composite EF)	**1.15**	

The engine combustion CO_2 emissions reported under subpart W, the NMEI, and AEIR data are calculated using the default emission factor from subpart C for natural gas fuel type. Using the CO_2 emission factor from subpart C and the composite CH_4 emission factors presented in Table 22 and Table 23, CO_2 to CH_4 ratios (i.e., CO_2 emission factor divided by CH_4 emission factor) were developed for the production, G&B, natural gas processing, and transmission segments as part of the NM 2020 O&G GHGI. ERG applied these same ratios, as shown in Table 24, to estimate CH_4 emissions from combustion of natural gas in engines for 2023. ERG divided the reported CO_2 combustion emissions by the CO_2:CH_4 ratios developed for each segment to estimate CH_4 emissions. For example, if a G&B facility reported 1,000 metric tons of combustion CO_2 for NM operations, the CH_4 emissions were estimated to be 9.8 metric tons (i.e., 1,000 metric tons of CO_2 divided by the G&B segment CO_2:CH_4 ratio of 102).

Table 24. Natural Gas Engine Exhaust CO_2:CH_4 Ratio

Industry Segment	Composite CH_4 Emission Factor (lbs/MMBtu fuel input)	Subpart C CO_2 Emission Factor (lbs/MMBtu fuel input)	CO_2:CH_4 Ratio
Production	0.39	116.98	300
G&B, Natural Gas Processing, and Transmission	1.15	116.98	102

3.8 Flaring Efficiency

Flares are a prevalent control strategy throughout the O&G industry to reduce CH_4 emissions. However, higher than expected CH_4 emissions have been observed in multiple emissions studies, including in NM,[19] indicating that relying on a default flare efficiency of 98 percent (as is allowed by EPA subpart W methodologies) is not always appropriate. While EMNRD has implemented regulations to minimize flaring (Title 19, Chapter 15, Part 27 and 28; as noted in Section 1), flaring emissions are still a significant source of emissions in NM.

Recognizing that flare efficiencies are variable, the revised subpart W now includes three flare efficiency tiers, in lieu of the single 98 percent default.[20] Table 25 compares the flare efficiency options between the original subpart W rule and the revised subpart W rule. The revised subpart W flare efficiency tiers provide separate flare efficiencies for combustion of CO_2 and destruction of CH_4.

Table 25. Flare Efficiencies for the Original EPA Subpart W Rule Versus the Revised EPA Subpart W Rule

Option	CO_2 Combustion Efficiency	CH_4 Destruction Efficiency
Original EPA Subpart W	98%	98%
Revised EPA Subpart W – Tier 1	96.5%	98%
Revised EPA Subpart W – Tier 2	93.5%	95%
Revised EPA Subpart W – Tier 3	90.5%	92%

To use Tier 1 efficiencies, O&G companies must implement rigorous flare monitoring requirements like those required for large refineries. To use Tier 2 efficiencies, O&G companies must implement flare monitoring requirements comparable to those required by the Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification or Reconstruction Commenced After December 6, 2022 (EPA NSPS OOOOb). If the requirements for Tier 1 and Tier 2 are not met, then O&G companies must use the Tier 3 efficiencies.

The production and G&B industry segments account for most flaring emissions. ERG does not expect that production and G&B companies would install the necessary equipment to meet the Tier 1 requirements and does not assume that many production and G&B companies would have installed the necessary monitoring equipment to meet Tier 2 requirements. As such, ERG adjusted flaring emissions for this NM 2023 O&G GHGI using the Tier 3 flare combustion and destruction efficiencies. Note that the emissions presented in the Executive Summary and the main body of Section 6 do not reflect the Tier 3 adjustments. Instead, the adjusted flaring emissions are only presented in Section 6.6, in order to broadly assess the impact of flaring efficiencies in NM. ERG evaluated flare data reported to EPA subpart W and determined that applying the Tier 3 flare efficiencies would lead to a 7.5 percent decrease in CO_2 emissions and a 300 percent increase in CH_4 emissions. ERG applied these percentages to calculate the adjusted flare emissions presented in Section 6.6.

[19] https://www.permianmap.org/flaring-emissions

[20] Greenhouse Gas Reporting Rule: Revisions and Confidentiality Determinations for Petroleum and Natural Gas Systems. Final Rule. 89 FR 42062. May 14, 2024. Flare requirements are discussed on 89 FR 42139. https://www.govinfo.gov/content/pkg/FR-2024-05-14/pdf/2024-08988.pdf.

4 INDUSTRY SEGMENT COVERAGE

4.1 Introduction

This section describes the methods used to identify the total population of facilities in NM for each O&G industry segment included in the NM 2023 O&G GHGI and presents the results of the coverage analyses for each segment.

To estimate total emissions for the NM 2023 O&G GHGI, ERG evaluated two populations of facilities for each industry segment. The first group (Group 1) is those facilities for which emissions data are available from AEIR, NMEI, or GHGRP (see Section 3.1.1 and Section 3.1.2 for discussion of these datasets). The second group (Group 2) is those facilities for which emissions data are not available. ERG developed emission estimates for the Group 2 facilities using data from the Group 1 facilities.

Generally, the percent coverage for each industry segment equals the population of facilities in Group 1 divided by the total population of facilities in NM (Group 1 plus Group 2). The coverage of a particular industry segment provides context for how much the Group 1 emissions need to be scaled and the representativeness of the Group 1 emissions for the NM 2023 O&G GHGI. Emissions are presented at the basin-level for the NM O&G GHGI, and therefore ERG estimated the coverage at the basin-level.

The total NM population is known and available in public datasets for production, transmission pipelines, and underground natural gas storage. Production population data rely on NM OCD datasets; these are further discussed in Section 4.3.1. The transmission pipeline and underground natural gas storage station populations are provided by the Pipeline and Hazardous Materials Safety Administration (PHMSA); these are further discussed in Section 4.3.4.

The total NM population is not directly available in public datasets for G&B, natural gas processing, and transmission compressor stations. However, the NMED EI does include the industry segment for each Agency Interest ID, as reported by each organization. The industry segment was not available in the NMED EI for the NM 2020 O&G GHGI analyses, and so this provides a much better starting point for the 2023 GHGI. While the industry segment was provided, ERG still reviewed the NMED EI industry segment data to ensure the industry segment assignments aligned with the emissions data.

Section 4.2 presents the steps for the review of the NMED EI industry segment data. Section 4.3 presents the coverage analyses for each industry segment.

Inactive oil and gas wells are not applicable to this coverage analysis. The total population of inactive wells in NM is estimated using NM OCD data and the total well counts are used to estimate inactive well emissions for the NM 2023 O&G GHGI. Emissions data specific to inactive wells are not otherwise reported by individual organizations.

4.2 NMED Emissions Inventory Industry Segment Review

The NMED EI for year 2023 is a comprehensive dataset of all O&G facilities in operation. Of note, the NMED EI includes data not just for facilities with Title V operating permits, but for all facilities regardless of the type of permit required. Therefore, the NMED EI is assumed to fully include all facilities for all industry segments. The NMED EI includes the organization name and identifier, individual facility names

and identifiers (i.e., Agency Interest), and equipment information (e.g., numbers and descriptions of tanks and internal combustion engines). New for the 2023 NMED EI, compared to the 2020 NMED EI, is the inclusion of the industry segment applicable to each facility. The industry segment options that organizations could report were:

- Well site
- Standalone tank battery
- Gathering and boosting station
- Transmission compressor station
- Pre-production operations

These segment options are similar to the industry segments that are covered with this NM 2023 O&G GHGI, but do not always have a direct relationship (e.g., standalone tank battery could apply to the production or G&B segment) and natural gas processing is not an option. Furthermore, ERG observed that incorrect industry segments were reported by operators for some facilities. Due to the need to re-assign all standalone tank battery facilities as either production or G&B, identify natural gas processing plants, and correct certain reported industry segment information, ERG performed a comprehensive review of all facility industry segments in the NMED EI. A related and important consideration is the need for the industry segment assignments to align with the GHG emissions data. Since almost all GHG emissions data are reported using subpart W methods, this means aligning the NMED EI facility industry segment assignments with the subpart W industry segment definitions, to the extent practicable.

ERG reviewed facility names and equipment information in the NMED EI and compared the organization-level activity data to data in GHGRP reports to review and assign industry segments for each facility. Some records in the NMED EI listed zero operating hours, indicating they did not operate in 2023; ERG excluded these records from the analyses. Sections 4.2.1 through 4.2.5 provide details on the specific approach applied for each industry segment to use the NMED EI data.

4.2.1 Facilities Reported as Well Sites

ERG maintained almost all well site facilities (98 percent of facilities) as part of the production industry segment, though there were a few exceptions. For a few organizations with both production and G&B emissions reported, the majority of their facilities (if not all) were classified as well sites. As such, ERG assigned some of these records to the G&B industry segment using the following approach (see Section 4.2.2 for related discussion):

- Facilities with large engines (e.g., engine > 1,300 hp) and/or six or more tanks were assigned to G&B.
- Facility names that included “compressor station” were assigned to G&B.

There was also one organization that classified five facilities as well sites but the organization did not have wells in the NM OCD dataset. Each of the facility names included “central delivery point” which is a term related to G&B. ERG assigned each of this organization’s facilities to the G&B industry segment.

4.2.2 Facilities Reported as Standalone Tank Battery

ERG assigned all standalone tank battery facilities as either production sites or G&B stations. For these records, ERG first reviewed the GHG emissions data for the organization to determine whether emissions data were reported for the production segment, G&B segment, or both. If the organization reported GHG emissions data for only one of the industry segments, ERG assigned all standalone tank battery facilities to that industry segment. If GHG emissions data were reported for both industry segments, which is common, further scrutiny was warranted.

The subpart W petroleum and natural gas production industry segment includes equipment "on a single well-pad or associated with a single well-pad." Therefore, equipment that is associated with multiple well-pads, such as a central tank battery that collects production from multiple wells, is part of the G&B industry segment for purposes of subpart W emissions data. G&B sites are also likely to have larger compressor engines/turbines and more tanks than a production site. ERG reviewed the size of the engines/turbines and the number of tanks at a facility to help distinguish between production and G&B. In addition, when possible, ERG compared tank and engine counts for an organization between the NMED EI and counts reported with the GHG emissions data, if the emissions data were available from EPA or through subpart W reporting forms included with AEIR data.

Whether GHG emissions data (and supporting activity data) were available or not for an organization, ERG always considered the following general guidelines when assigning specific facilities as production or G&B:

- If the NMED EI facility record indicated large engines (e.g., engine > 1,300 hp), then this is likely a G&B station. It is not common for production sites to have such large engines.
- If the NMED EI facility record indicated the presence of turbines, then this is likely a G&B station. It is not common for production sites to have turbines.
- If the NMED EI facility record indicated six or more tanks, then this is more likely a G&B station. G&B stations collect production from multiple wells and thus frequently need many tanks to handle the volume of production.
- ERG also confirmed that all facility records assigned as production were for organizations in NM OCD production datasets.

The following are common observations when GHG emissions data (and supporting activity data) were available and how ERG handled the industry segment assignment:

- Organization reports most of their emissions, tanks, and/or compressors under the G&B segment → assigned most/all standalone tank battery facilities as G&B.
- Organization reports most of their emissions and/or tanks under the production segment → assigned most/all standalone tank battery facilities as production.

Since GHG emissions data were not available for all organizations (i.e., only criteria pollutant and VOC emissions were reported), ERG also used the following information to make industry segment assignments for organizations without GHG emissions and supporting activity data:

- Organization has wells in NM OCD dataset and no obvious indication of G&B operations → assigned all standalone tank battery facilities as production.

- Organization does not have wells in NM OCD dataset → assigned all standalone tank battery facilities as G&B.

4.2.3 Facilities Reported as Gathering and Boosting

ERG maintained almost all facilities reported under the G&B segment (95 percent of facilities) as part of the G&B industry segment in this GHGI. Almost all other facilities that ERG did not maintain as G&B were identified as natural gas processing plants. As noted above, organizations did not have the option to select a natural gas processing industry segment in the NMED EI and these organizations sometimes selected G&B as the best option. Processing plants are clearly identified in the facility name where terms such as "gas plant", "processing plant", and "gas treatment plant" are used. In addition, most of the natural gas processing plants reported to EPA's GHGRP which created an easy cross check. There was one facility reported as G&B that ERG identified as a production facility based on the facility name and the fact that the organization has wells in NM OCD data and only reported one facility.

4.2.4 Facilities Reported as Transmission Compressor Station

ERG maintained less than half of the facilities initially reported as a transmission compressor station as part of the transmission and storage industry segment in this GHGI. Most of the facilities were re-assigned to the G&B industry segment and some re-assigned to the production or natural gas processing industry segments. The facilities that ERG maintained as part of the transmission and storage industry segment were related to organizations with transmission pipeline miles reported in PHMSA, had little equipment other than compressors, and/or reported to the transmissions segment under EPA's GHGRP.

Facilities that ERG moved to another industry segment were due to:

- the organization not having transmission industry segment operations (e.g., organization only had production or G&B operations and data);
- the facility not having equipment representative of transmission compressor stations, but instead having equipment representative of G&B operations (e.g., dehydrators, separators, tanks); or
- the facility name indicating it was a natural gas processing plant.

4.2.5 Facilities Reported as Not Applicable

There were a small number of facilities that reported to the NMED emission inventory and selected Not Applicable for the industry segment, but which ERG assigned to be part of the production, G&B, or natural gas processing industry segment. Most importantly, about one third of all natural gas processing plants reported as Not Applicable. Again, as stated above, the natural gas processing segment was not an option that organizations could select for their facilities. ERG assigned these facilities to the natural gas processing industry segment using the same approach discussed in Section 4.2.3 (i.e., ERG identified natural gas processing plants based on the facility name and information reported to EPA's GHGRP).

4.2.6 Facilities Reported as Pre-production Operations

There was one facility that reported to the NMED emission inventory and selected Pre-Production Operations for the industry segment; ERG assigned this facility to the production segment since all GHG emissions reported by the organization were for the production segment.

4.3 O&G Industry Segment Coverage

4.3.1 Production

Production coverage was based on the number of oil and gas wells and the amount of gas and oil production from the Oil Conservation Division's NM Water Data Act API. Oil and gas wells for organizations that submitted AEIR or EPA subpart W data for the production industry segment are Group 1 facilities. Oil and gas wells identified for organizations that did not report subpart W data or AEIR data are Group 2 facilities. Table 26 presents the coverage results for oil and gas wells.

Table 26. 2023 Production Wells Coverage

Basin	2023 Well Count for Group 1	Total 2023 Well Count	% Coverage
Permian	28,231	32,379	87%
San Juan	18,687	20,496	91%
Total	**46,918**	**52,875**	**89%**

Some production emissions were also calculated using oil and gas production as a basis, which are not attributed to a specific facility, but rather to a specific operator. Organizations that submitted AEIR or subpart W data for the production industry segment are Group 1 operators, while those that did not report AEIR or subpart W data are Group 2 operators. Table 27 and Table 28 present the coverage results for oil production in units of barrels (bbl) and gas production in units of thousand standard cubic feet (mscf), respectively.

Table 27. 2023 Oil Production Coverage

Basin	2023 Oil Production Group 1 (bbl)	Total 2023 Oil Production (bbl)	% Coverage
Permian	560,276,254	659,225,570	85%
San Juan	11,605,787	12,023,351	97%
Total	**571,882,041**	**671,248,921**	**85%**

Table 28. 2023 Gas Production Coverage

Basin	2023 Gas Production for Group 1 (mscf)	Total 2023 Gas Production	% Coverage
Permian	2,260,853,648	2,681,981,363	84%
San Juan	493,338,112	496,459,394	99%
Total	**2,754,191,760**	**3,178,440,757**	**87%**

4.3.2 Gathering and Boosting

ERG calculated G&B coverage based on the number of G&B stations identified in the NMED EI. G&B stations identified for organizations that submitted GHG emissions data for the G&B industry segment (i.e., AEIR data, NMEI data, subpart W data) are Group 1 facilities. G&B stations identified for organizations that did not report GHG emissions data for the G&B industry segment are Group 2 facilities. Table 29

presents the coverage results for G&B stations for year 2023. Sufficient data are not available on total gathering pipeline miles in NM.

Table 29. 2023 G&B Station Coverage

Basin	2023 G&B Station Count for Group 1	Total 2023 G&B Station Count	% Coverage
Permian	430	523	82%
San Juan	107	121	88%
Total	**537**	**644**	**83%**

4.3.3 Natural Gas Processing

ERG calculated natural gas processing coverage based on the number of natural gas processing plants included in the Group 1 data sources (i.e., those natural gas processing plants that reported subpart W data to the NMED EI or EPA) compared to the total number of natural gas processing plants based on NMEI data. Table 30 presents the coverage results for natural gas processing for year 2023.

Table 30. 2023 Natural Gas Processing Coverage

Basin	2023 Processing Plant Count for Group 1	Total 2023 Processing Plant Count	% Coverage
Permian	19	25	76%
San Juan	4	5	80%
Total	**23**	**30**	**77%**

4.3.4 Transmission and Storage

ERG calculated transmission and storage coverage based on the number of transmission compressor stations and compressors, transmission pipeline miles, and the number of underground natural gas storage stations. Transmission compressor stations and compressor data are based on using NMEI data to identify transmission stations, as discussed in Section 4.2. All transmission compressor stations identified for organizations with subpart W data are Group 1 facilities. All transmission compressor stations identified for organizations that do not have subpart W data, but were identified using NMEI data, are Group 2 facilities. Table 31 and Table 32 present the coverage of the available emissions data for transmission compressor stations and compressors.

Transmission pipeline miles are available from PHMSA. However, the miles are not available for each county or basin, only as a total for NM. The two emission sources for transmission pipelines are pipeline leaks and pipeline blowdowns. For the NM 2023 O&G GHGI, ERG applied a pipeline leak emission factor to all pipeline miles, and thus the PHMSA data provide 100 percent coverage for leak emissions. Pipeline blowdowns are intermittent and unique to an individual organization's operations in a particular year (e.g., maintenance activities in a given year). Pipeline blowdown data are reported under subpart W, including the number of blowdowns, blowdown emissions, and a reporter's total pipeline miles. These data are available through the subpart W submittals to the NMED EI and EPA. ERG calculated transmission pipeline coverage at the state-level, based on the number of miles for the organizations that reported pipeline blowdown data to the NMED EI or EPA (Group 1 facilities); see Table 33 for the coverage results.

Underground NG storage station data are also available from PHMSA. There was one Group 1 facility for underground NG storage stations (i.e., one station that reported emissions to the EPA GHGRP) and one Group 2 facility which did not report emissions. Table 34 presents the coverage of the available emissions data for underground NG storage stations.

Table 31. 2023 Transmission Compressor Station Coverage

Basin	2023 Compressor Station Count for Group 1	2023 Total Compressor Station Count	% Coverage
Permian	10	14	71%
San Juan	6	11	55%
Orogrande	3	3	100%
Basin-And-Range Province	1	2	50%
Pedregosa	1	1	100%
Estancia	1	1	100%
Total	**22**	**32**	**69%**

Table 32. 2023 Transmission Compressor Station Compressor Coverage

Basin	2023 Compressor Count for Group 1	Total 2023 Compressor Count	% Coverage
Permian	33	52	63%
San Juan	30	48	63%
Orogrande	10	10	100%
Basin-And-Range Province	6	7	86%
Pedregosa	5	5	100%
Estancia	5	5	100%
Total	**89**	**127**	**70%**

Table 33. 2023 Transmission Pipelines Coverage

Basin	2023 Pipeline Miles for Group 1	Total 2023 Pipeline Miles	% Coverage
All	4,326	6,376	68%

Table 34. 2023 Underground NG Storage Station Coverage

Basin	2023 Underground NG Storage Station Count for Group 1	Total 2023 Underground NG Storage Station Count	% Coverage
Permian	1	2	50%
San Juan	0	0	n/a
Orogrande	0	0	n/a
Basin-And-Range Province	0	0	n/a
Pedregosa	0	0	n/a
Estancia	0	0	n/a

Basin	2023 Underground NG Storage Station Count for Group 1	Total 2023 Underground NG Storage Station Count	% Coverage
Total	**1**	**2**	**50%**

5 INVENTORY DEVELOPMENT FOR EACH INDUSTRY SEGMENT

The NM 2023 O&G GHGI development approach was generally similar for each industry segment. The basis of the NM 2023 O&G GHGI is GHGRP subpart W and subpart C emissions and activity data submitted to the NMED EI and EPA (see Section 3); facilities that submitted these data are classified as Group 1 facilities (see related discussion in Section 3.8). For each industry segment, average emissions for each emission source were calculated from the entire Group 1 dataset and the average emissions were then applied to estimate emissions for the industry segment as a whole. Specific details on the approach for each industry segment are discussed in Sections 5.1 through 5.5.

5.1 Production

The methodology to develop the production segment, including exploration, emissions in the NM 2023 O&G GHGI relies on AEIR and subpart W data reported by facilities with production in NM (Group 1 facilities). In the production segment in 2023, 64 facilities operating in NM reported subpart W emissions to EPA, to NMED through the AEIR data, and/or to NMED through the NMEI data. ERG used the following framework to determine which source to use when calculating emission factors for each emission source in the production segment.

- ERG first collected all available data from EPA, AEIR, and NMEI. EPA subpart W data were available at the sub-basin level (i.e., county level) for some emission sources in the production segment, but if sub-basin data was not available, data were collected at the basin level. Where possible, ERG evaluated AEIR data and manually compiled operator submissions that included production segment emissions broken down by emission sources. ERG used NMEI data to determine which operators in the production segment reported emission totals and manually compiled the emissions.
- For each operator in the production segment, ERG compared available data from each of the 3 data sources to determine which data would be used to calculate emission factors. If only AEIR data or only EPA subpart W data were available for an operator, ERG selected that source to calculate emission factors. If both AEIR and EPA subpart W data were available, ERG used the more complete dataset in the emission factor calculations (e.g., used EPA data if emissions were reported across most or all emission sources in the production segment, used AEIR data if it contained NM-specific emission totals where EPA subpart W data only had basin level emission totals). Overall, ERG used AEIR data for 17 operators and EPA subpart W data for 36 operators when calculating emission factors.
- ERG opted not to use NMEI data for the 8 operators that reported emissions through NMEI, because 4 of those operators had reported more complete data in another data source, and the other 4 operators did not consistently report emissions across all emission sources in the production segment.

Once ERG selected emissions data for each operator, ERG separated the operators into two categories: NM-specific operators and multi-state operators. NM-specific operators either specified that their AEIR data did not include the operator's emissions in neighboring states, reported AEIR data that was consistently lower than the operator's subpart W data which signified specificity to NM, or reported EPA subpart W data that indicated that all of the operator's wells were in NM in 2023. ERG considered all other data as multi-state data, which included data from Texas (for the Permian basin) or Colorado (for the San Juan basin). For the multi-state data used in the calculations, ERG also implemented a 50 percent threshold for each operator to ensure the data were representative of NM operations and were not unduly impacted by data from another state. If more than 50 percent of the well counts, gas production, or oil production (as applicable for each emission source, see Table 35) for an operator were in NM, then the data were retained in the calculations. If less than 50 percent of the well counts, gas production, or oil production for an operator were in NM, then the data were excluded from calculations.

For each basin, ERG calculated EFs separately for NM-specific data and multi-state data. ERG calculated EFs for the NM-specific data by dividing the sum of reported NM-specific emissions for a particular source by the sum of the NM-specific basis, which was either well counts, gas production, or oil production. ERG applied the same approach to calculate EFs for the multi-state data, with the numerator and denominator including the data from states other than NM. ERG used both NM-specific and multi-state totals for the basis of the calculations for basin-level EFs because subpart W includes NM-specific data for some sources, but only basin-level data for other sources. Table 35 displays the basis for EF calculations according to the emission source, for both NM-specific and multi-state EF calculations. This method ensures that the numerator and denominator in the EF calculation are on the same basis.

Table 35. Basis of Production Emission Sources

Emission Source	Basis of NM-Specific EF Calculations	Basis of Multi-State EF Calculations
Pneumatic Devices	NM well count	Total well count
Pneumatic Pumps	NM well count	Total well count
Dehydrators	NM gas production	Total gas production
Liquids Unloading	NM well count	NM well count
Completions and Workovers	NM well count	NM well count
Well Testing	NM well count	Total well count
Tanks	NM oil production	NM oil production
Associated Gas	NM oil production	NM oil production
Miscellaneous Flaring	NM oil production	Total oil production
Combustion	NM gas production	Total gas production
Reciprocating Compressors	NM well count	Total well count

After calculating the NM-specific and multi-state EFs for each emission source in each basin, ERG combined the two EFs for each basin by weighing them according to the basis that was used to calculate the EFs. See Equation 1 for the weighted average EF calculation, where the equation terms are defined in the following pneumatic pump EF calculation example. To calculate a pneumatic pump EF, ERG added the product of the NM-specific pneumatic pump EF (EF_{NM})and the well count used in the NM-specific EF calculation (NM Wells) to the product of the multi-state pneumatic pump EF (EF_{multi})and the well count

used in the multi-state EF calculation (MultiState Wells). ERG then divided that sum by the sum of the well count used in the NM-specific calculation and the well count used in the multi-state calculation for pneumatic pumps. Table 36, Table 37, and Table 38 display the resulting basin-level EFs for the emission sources in the production segment. ERG disaggregated certain emission sources into subcategories to reflect unique types and operations. For pneumatic controllers, the EFs are specific to bleed type (i.e., high-bleed, intermittent-bleed, low-bleed). There are also several emission sources that have EFs categorized by vented versus flared emissions (i.e., completions, workovers, well testing, tanks, associated gas).

Equation 1:

$$Weighted\ Average\ EF = \frac{EF_{NM} * NM\ Wells + EF_{multi} * MultiState\ Wells}{NM\ Wells + MultiState\ Wells}$$

Table 36. Average Production Emissions per Well

Emission Source	Permian Basin		San Juan Basin	
	Average CH_4 Emissions (mt/well)	Average CO_2 Emissions (mt/well)	Average CH_4 Emissions (mt/well)	Average CO_2 Emissions (mt/well)
High-Bleed Pneumatic Devices	0.032	0.002	0.002	0.000
Intermittent-Bleed Pneumatic Devices	0.466	0.018	3.300	0.393
Low-Bleed Pneumatic Devices	0.022	0.001	0.124	0.014
Pneumatic Pumps	0.006	0.000	0.013	0.002
Liquids Unloading	0.004	0.000	0.163	0.008
Completions – Venting	0.001	0.000	0.000	0.000
Completions – Flaring	0.018	3.782	0.000	0.060
Workovers – Venting	0.001	0.000	0.003	0.000
Workovers – Flaring	0.000	0.000	0.000	0.000
Well Testing – Venting	0.000	0.000	0.000	0.000
Well Testing – Flaring	0.000	0.037	0.000	0.000
Reciprocating Compressors	0.013	0.002	0.022	0.003

Table 37. Average Production Emissions per Volume of Gas Produced

Emission Source	Permian Basin		San Juan Basin	
	Average CH_4 Emissions (mt/MMscf)	Average CO_2 Emissions (mt/MMscf)	Average CH_4 Emissions (mt/MMscf)	Average CO_2 Emissions (mt/MMscf)
Dehydrators	0.004	1.150	0.241	0.028
Combustion	3.3	1,611.6	5.9	1,812.2

Table 38. Average Production Emissions per Volume of Oil Produced

Emission Source	Permian Basin		San Juan Basin	
	Average CH_4 Emissions (mt/MMbbl)	Average CO_2 Emissions (mt/MMbbl)	Average CH_4 Emissions (mt/MMbbl)	Average CO_2 Emissions (mt/MMbbl)
Tanks – Venting	4.4	6.7	227.1	104.9
Tanks – Flaring	0.3	410.4	0.1	85.7
Associated Gas – Venting	4.4	0.2	0.0	0.0
Associated Gas – Flaring	3.0	622.8	0.0	0.0
Miscellaneous Flaring	4.4	896.1	0.6	179.2

Then, ERG calculated basin-level emissions for each emission source. For emission sources where EFs used well counts as a basis, ERG multiplied the total well count for each basin by the basin-specific EF. For emission sources where EFs used production as a basis, ERG multiplied the total oil or gas production volume, as applicable, by the basin-specific EF. ERG used the Oil Conservation Division's NM Water Data Act API to determine total well counts and production volumes for each basin in 2023.

ERG calculated emissions for equipment leaks, produced water, tank unloading, and mud degassing using emission source-specific methodologies that differed from the methodology discussed above. For equipment leaks, ERG calculated emissions separately for well pad equipment where LDAR surveys were performed and well pad equipment where LDAR surveys were not performed, as discussed in Section 3.2.1. ERG multiplied the number of gas or oil wells in a basin by the applicable LDAR survey percentage for the basin (see Table 13), the applicable number of equipment per well in the basin (see Table 39), and the applicable emission factor for each equipment type in each basin (see Table 12). ERG calculated the equipment per well activity factors shown in Table 39 using EPA subpart W data by summing the number of equipment (e.g., number of separators at gas wells) in a basin divided by the total number of gas or oil wells reported for that basin. ERG used this method to calculate CH_4 emissions for each equipment type in each basin and calculated CO_2 emissions by using a CO_2:CH_4 ratio at the basin-level (0.0213 for Permian and 0.0342 for San Juan).

Table 39. Well Pad Equipment Leaks Activity Factors

Emission Source	Well Type (Gas or Oil)	Equipment / Well	
		Permian Basin	San Juan Basin
Wellheads	Gas	1.0	1.0
Separators	Gas	1.0	0.97
Meters and Piping	Gas	1.2	1.0
Compressors	Gas	0.15	0.21
In-line Heaters	Gas	0.091	0.001
Dehydrators	Gas	0.005	0.005
Wellheads	Oil	1.0	1.0
Separators	Oil	0.53	0.92
Heater-Treater	Oil	0.25	0.004
Header	Oil	0.16	0.11

ERG calculated produced water emissions by multiplying the produced water volume for each basin by a CH_4 EF retained from the NM 2020 O&G GHGI. Similarly, ERG calculated tank unloading emissions by multiplying the oil production volume for each basin by a CH_4 EF retained from the NM 2020 O&G GHGI. There were not sufficient produced water or tank unloading data in the NMEI for 2023 to support developing an updated EF, but ERG used 2023 oil and water production volumes from the NM Water Data Act API for the activity data. ERG calculated CO_2 emissions for both produced water and tank unloading by using the same CO_2:CH_4 ratio that was applied to equipment leak emissions at the basin-level. ERG calculated mud degassing emissions based on default emission factor data in the NEI Tool.

5.2 Gathering and Boosting

The methodology to develop the G&B segment emissions in the NM 2023 O&G GHGI relies mainly on subpart W data reported by facilities with operations in NM (Group 1 facilities). For reporting year 2023, 39 facilities (or organizations) operating in NM reported subpart W emissions to EPA, to NMED through the AEIR data, and/or to NMED through the NMEI data. ERG used the reported subpart W data as follows:

- ERG used only subpart W data reported to EPA for 19 facilities, with 171 G&B stations. Most of these facilities either reported subpart W data to EPA only or reported AEIR data at the basin level (i.e., did not modify the subpart W emissions to remove data for states other than NM). Two of the facilities also reported NMEI data, but ERG deemed the NMEI data provided for these facilities unreliable because they were missing emissions data from source types that were reported by the facilities as operational in 2023.
- ERG used a combination of datasets for 12 facilities, with 358 G&B stations (i.e., a combination of EPA data and either AEIR or NMEI data). ERG used this approach in cases where the available AEIR or NMEI data included emissions and activity data only for relevant NM operations, but EPA data were determined to be more representative for certain emission sources (e.g., when facilities did not report emissions from a source to AEIR or NMEI). ERG used EPA data for these emission sources on a case-by-case basis and used AEIR or NMEI data for all other sources.
- ERG used only AEIR data for three facilities, with 8 G&B stations, for which the AEIR dataset was the only dataset with reported data.
- ERG used NMEI data for five facilities, with 45 G&B stations, where the NMEI dataset was the only dataset with reported data. Since NMEI data is missing several emission sources that are reported under subpart W for G&B, emission estimates for those sources (i.e., pneumatic controllers, pneumatic pumps, station blowdowns, pipeline blowdowns, tanks, miscellaneous flaring, pipeline leaks, and acid gas removal units) were calculated based on data from the other thirty-four facilities that reported subpart W data (Group 1 facilities). ERG used reported NMEI data for all other emission sources at these facilities. Facilities that only reported NMEI data are considered as Group 2 facilities because their emissions and station counts were not used to calculate average station emissions.

For facilities where EPA data were used, ERG used EPA emissions data for tanks and dehydrators located in NM since location data were available for those emission sources. For all other source types, emissions data were only available from the EPA dataset at the basin level, so ERG apportioned basin-level emissions to the state-level by using the ratio of tanks reported by each facility at the state level and at the basin

level (e.g., if a G&B facility has a total of 100 tanks operating in the Permian Basin and only 30 tanks are in NM, then ERG apportioned 30 percent of their total basin-level G&B emissions to NM).

ERG applied the following changes to the state-level emissions data for the thirty-nine G&B facilities (see Section 3.3 for background):

- Tanks without Controls – Subpart W CH_4 emissions were replaced with estimates developed using the EPA GHGI CH_4 emission factor (5.6 metric tons/tank). Subpart W CO_2 emissions for tanks were used as reported.
- Tanks with Vapor Recovery Units or Flares – Adjustments based on basin-specific revised subpart W CH_4 leak emission factors (0.22 metric tons/tank for Permian and 0.25 metric tons/tank for San Juan, accounting for the unique CH_4 gas content in each basin) were added to reported subpart W CH_4 emissions. Subpart W CO_2 emissions for tanks were used as reported.
- Centrifugal and Reciprocating Compressors – Subpart W CH_4 emissions were replaced with estimates developed using the EPA GHGI CH_4 emission factor (16 metric tons/compressor). Subpart W CO_2 emissions were replaced with estimates developed using a CO_2:CH_4 ratio at the basin-level (0.0213 for Permian and 0.0342 for San Juan). These CO_2:CH_4 ratios were developed using subpart W reported average CH_4 and CO_2 mole fractions by production facilities operating in NM.
- Equipment Leaks – Subpart W CH_4 emissions were replaced with estimates developed using revised subpart W CH_4 population emission factors and leaker emission factors. Subpart W CO_2 emissions were replaced with estimates developed using a CO_2:CH_4 ratio at the basin-level (0.0213 for Permian and 0.0342 for San Juan).
- Combustion – Subpart W CH_4 emissions were replaced with estimates developed using reported CO_2 emissions and a CO_2:CH_4 ratio developed for combustion emissions (102); see Section 3.7 for more information. All combustion emissions were assumed to be from engines and turbines.

After the changes listed above were made to the G&B emissions data, ERG calculated average station emissions for the Permian and San Juan basins based on Group 1 facility emissions. ERG aggregated Group 1 G&B emissions for each basin and divided them by the total number of Group 1 stations in each basin. Table 40 presents the average G&B station emissions for the Permian and San Juan basins.

Table 40. Average Emissions per G&B Station

Emission Source	Permian Basin		San Juan Basin	
	Average CH_4 Emissions (mt/station)	Average CO_2 Emissions (mt/station)	Average CH_4 Emissions (mt/station)	Average CO_2 Emissions (mt/station)
Acid Gas Removal Units	n/a	260.03	n/a	0.00
Centrifugal Compressors	0.07	0.00	3.29	0.11
Combustion	158.51	16,171.98	109.50	11,168.84
Dehydrators w/ Flares	0.46	125.79	0.02	8.65
Dehydrators w/o Controls	0.11	0.06	0.62	4.00
Equipment Leaks	18.29	0.54	11.45	0.96
High-bleed Pneumatics	2.81	0.07	9.21	2.51
Intermittent-Bleed Pneumatics	10.33	0.30	19.73	3.50

Emission Source	Permian Basin		San Juan Basin	
	Average CH_4 Emissions (mt/station)	Average CO_2 Emissions (mt/station)	Average CH_4 Emissions (mt/station)	Average CO_2 Emissions (mt/station)
Low-Bleed Pneumatics	0.61	0.03	1.70	0.49
Miscellaneous Flaring	2.97	666.95	0.21	40.31
Pipeline Blowdowns	9.98	0.17	0.73	0.03
Pipeline Leaks	9.91	1.71	21.22	5.64
Pneumatic Pumps	2.37	0.06	0.52	0.07
Reciprocating Compressors	50.22	1.03	37.20	1.27
Station Blowdowns	5.55	0.11	10.50	2.13
Tanks w/ Flares	1.89	252.95	0.11	13.89
Tanks w/o Controls	15.64	0.26	16.43	0.37
Tanks w/ VRUs	0.67	1.69	0.51	0.01

ERG then assigned average station emissions to the G&B stations that did not report any subpart W data or only reported NMEI data for a limited number of emission sources (Group 2 facilities). For Group 2 facilities that did not report any subpart W data, ERG used the average station emissions for all emission sources to calculate total facility emissions. For the facilities that reported data for some emission sources to the NMEI dataset, ERG used the average station emissions only for the emission sources that were not reported, then combined the reported and calculated facility emissions to calculate total facility emissions. Based on NMED EI data, ERG determined that 21 G&B facilities (or organizations) did not report to subpart W in 2023 and operated a combined total of 62 G&B stations in NM. Another five G&B facilities only reported NMEI data for 2023 and operated a combined total of 45 G&B stations in NM. Of these 107 stations, 93 were reported to be in the Permian basin and 14 were reported to be in the San Juan basin.

5.3 Natural Gas Processing

ERG used subpart W data that were submitted to the NMED EI and EPA for 23 natural gas processing plants as-is (Group 1 facilities) in the NM 2023 O&G GHGI. ERG also used the data submitted for these plants to develop average emissions per plant for each emission source, to apply to the seven natural gas processing plants that did not have reported subpart W data (Group 2 facilities). The average emissions equal the sum of emissions for a given emission source from Group 1 facilities divided by the total count of Group 1 facilities. Table 30 above summarizes the Group 1 and Group 2 plant counts. Table 41 presents the average emissions per plant, calculated from the Group 1 data.

Subpart C data were available for all 23 Group 1 facilities, and ERG used reported combustion CO_2 emissions as-is for these facilities. ERG also used these emissions to develop average combustion CO_2 emissions per plant. The average emissions equal the sum of subpart C CO_2 emissions from Group 1 facilities divided by the total count of Group 1 facilities. For the seven Group 2 facilities, five of the plants had compressors in the NMED EI, and the average combustion CO_2 emissions were applied to those plants.

ERG adjusted (i.e., increased) combustion CH_4 emissions for compressor engines (see Section 3.7 for related emission factor discussion). Where subpart C data were available for individual combustion units that identified the type of unit (i.e., whether or not the unit was an engine), ERG calculated CH_4 emissions

for units identified as engines by dividing each unit's combustion CO_2 emissions by the combustion CO_2:CH_4 ratio of 102 (see Table 24), and CH_4 emissions were used as-is for other unit types. For subpart C records that did not specify the type of combustion unit, ERG adjusted CH_4 emissions based on fuel volumes available from the NMEI dataset. For these records, adjustments were based on the percentage of the fuel used for compressor engines versus other fuel combustion sources at a specific plant. For example, if 30 percent of the fuel combusted at a given plant was for compressor engines and 70 percent was for other fuel combustion sources in NMEI data, then only 30 percent of the emissions were considered for adjustment. CH_4 emissions from unidentified combustion units at this example natural gas processing plant would be calculated as the combustion CO_2 emissions divided by the combustion CO_2:CH_4 ratio of 102 times 30 percent. Table 41 presents the average combustion emissions per plant, calculated from the Group 1 facilities.

Table 41. Average Emissions per Natural Gas Processing Plant

Emission Source	Average CH_4 Emissions (mt/plant)	Average CO_2 Emissions (mt/plant)
Acid Gas Removal Units	0	64,379
Blowdown Vent Stacks	6	1
Centrifugal Compressors	49	1.6
Combustion	174	88,684
Dehydrators	1	603
Equipment Leaks	14	3
Flare Stacks	36	10,915
Pneumatic Controllers	3.2	0.4
Reciprocating Compressors	103	20

5.4 Transmission and Storage

Subpart W data submitted to the NMEI and EPA datasets were available for 22 transmission compressor stations (Group 1 facilities). There were 11 facilities that only reported subpart W data to EPA, so ERG used EPA data for those facilities. Of the other 11 Group 1 facilities, six facilities reported both NMEI and EPA data, while five facilities only reported NMEI data. ERG opted to use NMEI data for these 11 facilities for consistency; all 11 facilities are owned by the same organization, and using NMEI data allowed for the same dataset to be used for all the facilities since some facilities did not report to EPA. Additionally, the facilities' NMEI data included both subpart W and subpart C data, including fuel throughput data, but the EPA data did not include fuel throughput data. Using NMEI data meant that the values used for calculating average emissions came from a single dataset for those facilities.

ERG used subpart W emissions data for transmission stations as-is in the NM GHGI, with the exception of compressor emissions. For reciprocating and centrifugal compressors, the reported subpart W emissions were augmented with additional emissions from a PRCI White Paper (see discussion in Section 3.5.1 and Table 20) based on the number of reciprocating compressors and centrifugal compressors with dry seals reported for each Group 1 facility. The Group 1 data were then used to develop average emissions per compressor for certain emission sources, to apply to the 10 facilities that did not have reported subpart W data (Group 2 facilities). The average emissions equal the sum of emissions for a given emission source from Group 1 facilities divided by the sum of compressors (reciprocating plus centrifugal compressors) at

Group 1 facilities. Table 42 presents the average emissions per compressor, calculated from the Group 1 facilities.

Table 42. Transmission Compressor Station Average Emissions per Compressor

Emission Source	Average CH_4 Emissions (mt/compressor)	Average CO_2 Emissions (mt/compressor)
Pneumatic Controllers	0.84	0.02
Centrifugal Compressors	12.59	0.18
Reciprocating Compressors	12.14	0.15
Flare Stacks	0.00	6.87
Blowdown Vent Stacks	31.47	0.66
Equipment Leaks	7.47	0.10
Transmission Storage Tanks	14.10	0.23

Subpart C data were available for all 22 Group 1 transmission compressor stations, and ERG used reported combustion CO_2 emissions as-is for these stations. These emissions were also used to develop average combustion CO_2 emissions per compressor fuel throughput (see Table 43). The average emissions equal the sum of subpart C CO_2 emissions from Group 1 facilities divided by the total compressor fuel throughput (engine plus turbine fuel throughput) at Group 1 facilities. ERG used the same datasets for subpart C emissions data that were used for subpart W data for each Group 1 facility (i.e., NMEI data or EPA data, as applicable). The compressor fuel throughput was available from the NMEI dataset for all transmission compressor stations.

ERG adjusted (i.e., increased) subpart C combustion CH_4 emissions for compressor engines (see Section 3.7 for related emission factor discussion). ERG did not adjust subpart C combustion CH_4 emissions for turbines. In the NMEI dataset, combustion CH_4 emissions for engines and turbines were reported separately, so for facilities where ERG used NMEI combustion emissions data, ERG calculated engine emissions by dividing combustion CO_2 engine emissions by the combustion CO_2:CH_4 ratio of 102 and used turbine emissions as-is. In the data reported to EPA, combustion CH_4 emissions were reported for the entire compressor station, so for facilities where ERG used EPA data, emissions were adjusted based on the percentage of the fuel used for engines versus turbines at a specific compressor station (e.g., if 30 percent of the compressor fuel was for engines and 70 percent for compressor turbines in the NMEI data, then only 30 percent of the combustion CH_4 emissions were considered for adjustment). It was assumed that all combustion emissions were due to compressors for transmission compressor stations. Of note, most compressor stations only operated engines or turbines. Continuing the previous example, combustion CH_4 emissions would increase for 30 percent of the combustion emissions at the example compressor station. This example compressor station's CH_4 emissions would be calculated as the combustion CO_2 emissions divided by the combustion CO_2:CH_4 ratio of 102 (see Table 24) times 30 percent plus the reported CH_4 combustion emissions times 70 percent. After adjusting the CH_4 emissions for each of the Group 1 compressor stations, average combustion CH_4 emissions per compressor fuel throughput were developed. Table 43 presents the average combustion emissions per compressor fuel throughput, calculated from the Group 1 compressor stations.

For the 10 transmission compressor stations that did not report subpart C data to the NMEI or EPA datasets, the average combustion emissions in Table 43 were applied to the engine and turbine fuel throughput volumes from the NMEI dataset to estimate combustion emissions.

Table 43. Transmission Compressor Station Average Combustion Emissions per Compressor Fuel Throughput

Emission Source	Average CH_4 Emissions (mt/MMscf fuel)	Average CO_2 Emissions (mt/MMscf fuel)
Engines	0.51	51.7
Turbines	.001	51.5

ERG relied on the subpart W data reported to the NMED EI and EPA for transmission pipeline blowdown emissions and pipeline mileage reported to PHMSA. Subpart W emissions are reported to EPA for each organization and include emissions from pipelines in states other than NM. ERG summed the total blowdown emissions from operators with pipelines in NM and divided those emissions by the total pipeline mileage for the same operators in all states to develop average blowdown emissions per mile, see Table 44. The average blowdown emissions per mile were then applied to the total 6,376 miles of transmission pipelines reported to PHMSA in NM (see Table 33) to estimate total blowdown emissions in NM.

Transmission pipeline leak emissions were estimated by applying average emission factors from the EPA GHGI (see Table 44) to all transmission pipelines in NM.

Table 44. Average Emissions per Transmission Pipeline Mile

Emission Source	Average CH_4 Emissions (mt/mile)	Average CO_2 Emissions (mt/mile)
Pipeline Blowdowns	0.35	0.01
Pipeline Leaks	0.01	0.0003

One of the two underground NG storage stations reported subpart W emissions to EPA, and ERG applied these reported emissions for both stations, see Table 45.

Table 45. Underground Natural Gas Storage Station Average Emissions Per Station

Emission Source	Average CH_4 Emissions (mt/station)	Average CO_2 Emissions (mt/station)
Station Leaks	30	0.9
Reciprocating Compressors	66	1.3
Dehydrators	0.4	71
Flares	0	10
Station Blowdowns	636	18
Pneumatic Controllers (High, Low, and Intermittent)	6	0.2
Storage Wells	14	0.4

Emission Source	Average CH_4 Emissions (mt/station)	Average CO_2 Emissions (mt/station)
Metering and Regulating Equipment	0	0
Engine Combustion	133	13,541

5.5 Inactive Oil and Gas Wells

Inactive oil and gas well GHG emissions were estimated uniquely. ERG used the OCD Wells Database to determine the count of inactive wells in each county.[21] Each of the 112,000 wells in the OCD Wells Database that produced during years 2023 through 2025 were assumed not to be inactive.

ERG then reviewed the completion status of the remaining 55,000 wells to determine those wells that should be identified as inactive. Each status type was then assigned as either plugged or unplugged. Table 46 presents the unique completion status, the number of wells with that completion status, and the assigned inactive well plugging status (unplugged, plugged, or n/a).

Certain completion statuses were easily assigned (i.e., plugged, temporarily abandoned, zone plugged, zones abandoned/not plugged). Wells with a Completion Status of "Active" and "Unknown" required further evaluation. It appears the Active status may not be fully representative, as the majority of these wells had not produced in years or decades. Therefore, ERG assumed that all Active wells (that did not produce in years 2023 through 2025) were unplugged inactive wells. Little information is available for the "Unknown" Completion Status; few have any type of date information, and location and operator information are the only other information that is available. Therefore, ERG treated "Unknown" wells similarly as Active wells and classified them as unplugged inactive wells.

Table 46. Summary of Well Completion Status and Assigned Plugging Status

Completion Status	Count of Wells	Assigned Plugging Status
Active	4,033	Unplugged
Dry Hole	6	Unplugged
Never Drilled	8	n/a
New (Not drilled or completed)	1,770	n/a
Plugged	42,352	Plugged
TA	219	Unplugged
Unknown	6,874	Unplugged
Zone Plugged	9	Plugged
Zones Abandoned, not plugged	2	Unplugged
Total	**55,273**	

ERG compared the Table 46 data to the estimated plugged and unplugged inactive well counts from the NM 2020 O&G GHGI to evaluate the reasonableness of the results. The plugged inactive well counts from Table 46 (42,361) are lower than the plugged inactive wells from the NM 2020 O&G GHGI (43,293). NM

[21] See the "All Wells" data by clicking on the "Go-Tech Site" link at <https://www.emnrd.nm.gov/ocd/ocd-data/statistics/>.

has a program in place to plug wells each year, and so a decrease in the plugged well population does not seem reasonable. NM OCD also has a dataset providing the number of wells that are plugged each year, showing that 2,165 oil and gas wells were plugged from 2021 to 2023.[22] To estimate the plugged inactive well population for this NM 2023 O&G GHGI, ERG started with the number of plugged wells from the NM 2020 O&G GHGI and added 2,165, resulting in 45,458 plugged inactive wells. ERG retained the unplugged well counts from Table 46 (11,134), for a total of 56,592 inactive wells. To estimate inactive well CH_4 emissions, ERG multiplied the number of plugged and unplugged wells by the applicable emission factor (0.002 g/hr/well for plugged wells and 6.1 g/hr/well for unplugged wells, from Table 21) and 8,720 hours.

6 GHG Emissions Summary

Detailed NM O&G GHGI emissions for the five categories (four industry segments and inactive wells) are summarized in sections 6.1 through 6.5 (emissions are shown by emission source and basin), section 6.6 presents emissions calculated using alternative flaring efficiencies, and section 6.7 presents an overall compilation of the NM O&G GHGI emissions. CO_2e emissions are calculated for CH_4 using a GWP of 28.

Attachment A "NM_Oil+Gas_GHGInventory_2023_Emissions.xlsx" contains the complete set of results for the NM 2023 O&G GHGI, including a breakdown of emissions by industry segment, emissions source, and basin.

6.1 Production

State-level GHG emissions from the production industry segment, including exploration, are shown in Table 47. Combustion emissions were the single largest source for CO_2 emissions in the industry segment, accounting for 79 percent of the total. Other notable contributions to the CO_2 total emissions were miscellaneous flaring, associated gas venting and flaring, and tanks, contributing a combined 19 percent. Pneumatic controllers and well pad equipment leaks were the largest sources of CH_4 emissions, contributing 43 and 27 percent of the total CH_4 emissions, respectively.

Table 47. Production Emissions by Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Associated Gas Venting and Flaring	4,883	410,723	547,448
Combustion	11,968	5,245,975	5,581,067
Completions	637	123,737	141,561
Dehydrators	133	3,099	6,830
Equipment Leaks	56,270	1,505	1,577,075
Liquids Unloading	3,628	172	101,760
Miscellaneous Flaring	2,897	592,900	674,020
Mud Degassing	14,768	1,043	414,542
Pneumatic Controllers	89,901	9,381	2,526,622
Pneumatic Pumps	471	42	13,217

[22] See the "Plugged and Abandoned Wells" dataset at <https://www.emnrd.nm.gov/ocd/ocd-data/statistics/>.

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Produced Water	14,678	317	411,313
Reciprocating Compressors	897	136	25,257
Tank Unloading	447	10	12,535
Tanks	5,800	277,295	439,695
Well Testing	4	1,212	1,316
Workovers	93	8	2,606
Total	**207,475**	**6,667,554**	**12,476,865**

Basin-level annual emissions estimates for the production industry segment are shown in Table 48. The Permian basin accounted for 48 percent of CH_4 emissions and 86 percent of CO_2 emissions in NM in 2023. The San Juan basin accounted for 50 percent of CH_4 emissions and 14 percent of CO_2 emissions.

Table 48. Production Emissions by Basin (Metric Tons)

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Permian	99,620	5,728,341	8,517,707
San Juan	103,671	914,779	3,817,572
Las Vegas-Raton	4,181	24,433	141,493
Sierra Grande Uplift	3	0	93
Total	**207,475**	**6,667,554**	**12,476,865**

6.2 Gathering and Boosting

State-level GHG emissions from the G&B industry segment are shown in Table 49. Combustion emissions at G&B stations were the single largest GHG emission source, accounting for 51 percent of CH_4 emissions and 93 percent of CO_2 emissions from the G&B industry segment. Other notable CH_4 emission sources were reciprocating compressors and equipment leaks, collectively accounting for 25 percent of CH_4 emissions from the G&B industry segment. Pneumatic controllers accounted for about 6 percent of total CH_4 emissions from the G&B industry segment, and intermittent-bleed pneumatic controllers accounted for almost 72 percent of CH_4 from pneumatic controllers.

Table 49. G&B Emissions by Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Acid Gas Removal Units	0	135,994	135,994
Centrifugal Compressors	405	13	11,345
Combustion	95,605	9,753,639	12,430,580
Dehydrators	370	68,062	78,432
Equipment Blowdowns	4,172	316	117,145
Equipment Leaks	15,018	374	420,873
Miscellaneous Flaring	1,580	353,692	397,919

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Pipeline Blowdowns	5,307	90	148,684
Pipeline Leaks	7,749	1,575	218,540
High Bleed Pneumatic Controllers	2,568	338	72,252
Intermittent Bleed Pneumatic Controllers	7,803	585	219,072
Low Bleed Pneumatic Controllers	522	76	14,680
Pneumatic Pumps	1,304	37	36,556
Reciprocating Compressors	31,742	717	889,491
Tanks	11,581	135,040	459,319
Total	**185,726**	**10,450,550**	**15,650,881**

Basin-level annual emissions estimates for the G&B industry segment are presented in Table 50. The Permian basin accounts for approximately 82 percent of CH_4 emissions and 88 percent of CO_2 emissions.

Table 50. G&B Emissions by Basin (Metric Tons)

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Permian	152,261	9,155,489	13,418,797
San Juan	33,465	1,295,061	2,232,084
Total	**185,726**	**10,450,550**	**15,650,881**

6.3 Natural Gas Processing

Table 51 presents the state-level GHG emissions for the natural gas processing industry segment. Combustion emissions are the largest source of CO_2 emissions, accounting for 52 percent, and CH_4 emissions, accounting for 43 percent. Other large CH_4 emission sources are reciprocating compressors and centrifugal compressors, which cumulatively account for 41 percent of CH_4 emissions. Acid gas removal units, accounting for 41 percent of CO_2 emissions, and miscellaneous flaring, accounting for 7 percent of CO_2 emissions, are the other key CO_2 emission sources.

Table 51. Natural Gas Processing Emissions by Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Acid Gas Removal Units	0	1,931,357	1,931,357
Centrifugal Compressors	1,473	47	41,302
Combustion	4,872	2,483,161	2,619,590
Dehydrators	26	18,102	18,831
Equipment Blowdowns	188	25	5,298
Equipment Leaks	417	85	11,751
Miscellaneous Flaring	1,085	327,456	357,843

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Pneumatic Controllers	96	12	2,700
Reciprocating Compressors	3,080	614	86,857
Total	**11,238**	**4,760,860**	**5,075,530**

Table 52 shows the basin-level GHG emissions for the natural gas processing industry segment. All natural gas processing plants are in either the Permian or San Juan basins, with the Permian accounting for about 80 percent of CH_4 emissions and 64 percent of CO_2 emissions.

Table 52. Natural Gas Processing Emissions by Basin (Metric Tons)

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Permian	8,989	3,055,052	3,306,744
San Juan	2,249	1,705,808	1,768,786
Total	**11,238**	**4,760,860**	**5,075,530**

6.4 Transmission and Storage

Table 53 presents the state-level GHG emissions for transmission compressor stations and transmission pipelines. Combustion emissions from engines and turbines are collectively the dominant CO_2 emissions source, accounting for more than 99 percent of CO_2 emissions. Transmission equipment blowdowns are the largest source of CH_4 emissions (accounting for 31 percent of total CH_4), with pipeline blowdowns, transmission storage tanks, centrifugal compressors, and reciprocating compressors each accounting for between 13 and 17 percent of CH_4 emissions.

Table 53. Transmission Emissions by Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Centrifugal Compressors	1,675	23	46,911
Reciprocating Compressors	1,635	19	45,807
Engine Combustion	547	177,006	192,309
Turbine Combustion	66	476,726	478,587
Equipment Blowdowns	3,997	83	112,005
Equipment Leaks	948	13	26,562
Miscellaneous Flaring	0	873	873
Pneumatic Controllers	117	3	3,286
Transmission Storage Tanks	1,791	29	50,170
Pipeline Blowdowns	2,232	64	62,546
Pipeline Leaks	69	2	1,948
Total	**13,077**	**654,842**	**1,021,004**

Table 54 shows the basin-level GHG emissions for transmission compressor stations and pipelines. These transmission sources exist across the state of NM, with the top 3 emitting basins (Permian, San Juan, and Orogrande) accounting for 73 percent of total GHG emissions in terms of CO_2e.

Table 54. Transmission Emissions by Basin (Metric Tons)

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Permian	5,683	187,639	346,768
San Juan	4,955	112,292	251,043
Orogrande	1,397	108,320	147,434
Basin-And-Range Province	436	113,623	125,829
Pedregosa	258	102,097	109,317
Estancia	211	30,867	36,773
Las Vegas-Raton	58	2	1,612
Palo Duro	39	1	1,094
San Luis	34	1	945
Sierra Grande Uplift	7	0	189
Total	**13,077**	**654,842**	**1,021,004**

Table 55 presents the state-level GHG emissions for underground NG storage stations. Combustion emissions are the dominant CO_2 emissions source, representing over 99 percent of total CO_2 emissions. Equipment blowdowns are responsible for 72 percent of total CH_4 emissions.

Table 55. Underground NG Storage Emissions by Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Engine Combustion	266	27,082	34,530
Dehydrators	1	142	162
Equipment Blowdowns	1,272	37	35,656
Equipment Leaks	60	2	1,686
Miscellaneous Flaring	0	19	29
Pneumatic Controllers	11	0	316
Reciprocating Compressors	133	3	3,719
Storage Wells	27	1	769
Total	**1,771**	**27,285**	**76,866**

6.5 Inactive Oil and Gas Wells

Table 56 shows the state-level GHG emissions for plugged and unplugged inactive wells. Unplugged inactive wells account for more than 99 percent of emissions of both CH_4 and CO_2 (and therefore total GHG emissions in terms of CO_2e).

Table 56. Plugged and Unplugged Inactive Oil and Gas Well Emissions (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Plugged Inactive Wells	1	0	22
Unplugged Inactive Wells	590	18	16,541
Total	**591**	**18**	**16,563**

Table 57 shows the basin-level GHG emissions for inactive wells. Most unplugged inactive wells are in the Permian basin (87 percent of CH_4 emissions) and San Juan basin (13 percent of CH_4 emissions).

Table 57. Plugged and Unplugged Inactive Oil and Gas Well Emissions by Basin (Metric Tons)

Basin	Plugged Inactive Wells		Unplugged Inactive Wells		Annual CO_2e Emissions
	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CH_4 Emissions	Annual CO_2 Emissions	
Permian	1	0	511	15	14,335
San Juan	0	0	77	2	2,153
Palo Duro	0	0	1	0	25
Las Vegas-Raton	0	0	1	0	18
Sierra Grande Uplift	0	0	1	0	15
Orogrande	0	0	0	0	9
Basin-And-Range Province	0	0	0	0	4
Estancia	0	0	0	0	3
Pedregosa	0	0	0	0	0
Total	**1**	**0**	**590**	**18**	**16,563**

6.6 Flaring Emissions Adjustments

As discussed in Section 3.8, to assess the potential for higher CH_4 emissions from flares as observed in recent studies, ERG adjusted flaring emissions for this NM 2023 O&G GHGI using the Tier 3 flare efficiencies from the revised subpart W rule for combustion of CO_2 and destruction of CH_4. Some emission sources have both flared and vented emissions (e.g., tanks, dehydrators, associated gas). In these cases, only the flaring emissions were adjusted, and the venting emissions were left as-is. Table 58 presents flaring GHG emissions by source, considering all industry segments, before and after applying adjustments to flaring emissions. The adjustments led to an overall 25 percent increase in flaring CO_2e emissions.

Table 58. Comparison of Flaring Emissions by Source Before and After Adjustment (Metric Tons)

Emission Source	Non-Adjusted Emissions			Emissions Adjusted Using Revised Subpart W Tier 3 Flaring Efficiencies		
	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Miscellaneous Flaring	5,562	1,274,940	1,430,686	22,249	1,179,320	1,802,302

Emission Source	Non-Adjusted Emissions			Emissions Adjusted Using Revised Subpart W Tier 3 Flaring Efficiencies		
	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Dehydrators - flaring	228	66,629	73,012	912	61,632	87,163
Tanks - flaring	1,186	405,576	438,798	4,746	375,158	508,044
Completions - flaring	591	123,735	140,294	2,366	114,455	180,690
Workovers - flaring	0	0	0	0	0	1
Well Testing - flaring	4	1,212	1,316	15	1,121	1,539
Associated Gas - flaring	2,010	410,591	466,865	8,039	379,797	604,892
Total	**9,582**	**2,282,684**	**2,550,971**	**38,327**	**2,111,482**	**3,184,631**

Table 59 presents GHG flaring emissions for each industry segment before and after applying adjustments to the flaring emission sources. ERG did not include inactive oil and gas wells in this comparison since there were no flaring emissions from that category. The adjustments led to a substantial increase in total flaring emissions in units of CO_2e for the production, G&B, and natural gas processing industry segments of 24 percent, 31 percent, and 19 percent, respectively. The transmission and storage segment had a 4 percent *decrease* in total flaring emissions since flaring emissions reported to that segment were almost entirely CO_2. However, this decrease for transmission and storage has a very small overall impact since flaring emissions from transmission and storage are substantially lower than those from other segments; they represent less than 1 percent of total flaring emissions in terms of CO_2e.

Table 59. Comparison of Flaring Emissions by Industry Segment Before and After Adjustment (Metric Tons)

Industry Segment	Non-Adjusted Emissions			Emissions Adjusted Using Revised Subpart W Tier 3 Flaring Efficiencies		
	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Production	5,687	1,400,040	1,559,281	22,749	1,295,037	1,932,002
G&B	2,809	554,296	632,944	11,235	512,724	827,315
Natural Gas Processing	1,085	327,456	357,843	4,341	302,897	424,447
Transmission and Storage	0	892	902	1	825	867
Total	**9,582**	**2,282,684**	**2,550,971**	**38,327**	**2,111,482**	**3,184,631**

Table 60 presents overall GHG emissions by industry segment before and after applying adjustments to flaring emissions. Total GHG emissions for all segments combined increased by less than 2 percent (approximately 634,000 MT CO_2e). Production had the largest increase in total GHG emissions due to

flaring adjustments of approximately 373,000 MT CO_2e, which is an increase of nearly 3 percent in total production emissions. This accounted for approximately 59 percent of the overall increase in GHG emissions for all segments combined. G&B and natural gas processing each saw an increase in overall emissions of around 1 percent due to the flaring adjustments. The increase in G&B emissions accounted for around 31 percent of the overall increase in emissions for all segments combined, while the increase in natural gas processing emissions was responsible for around 11 percent of the overall increase.

Table 60. Comparison of Total Emissions by Industry Segment Before and After Flaring Adjustments (Metric Tons)

Industry Segment	Non-Adjusted Emissions			Emissions Adjusted Using Revised Subpart W Tier 3 Flaring Efficiencies		
	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Production	207,475	6,667,554	12,476,865	224,537	6,562,551	12,849,586
G&B	185,726	10,450,550	15,650,881	194,153	10,408,978	15,845,253
Natural Gas Processing	11,238	4,760,860	5,075,530	14,494	4,736,301	5,142,133
Transmission and Storage	14,848	682,127	1,097,870	14,849	682,060	1,097,834
Inactive Oil and Gas Wells	591	18	16,563	591	18	16,563
Total	**419,879**	**22,561,109**	**34,317,709**	**448,624**	**22,389,907**	**34,951,369**

6.7 Overall Summary

Table 61 through Table 63 and Figure 2 compile the GHG emissions by category, emission source, and basin.

Table 61 presents a summary of CH_4, CO_2, and CO_2e emissions for the NM 2023 O&G GHGI for each category.

Table 61. GHG Emissions by Category (Metric Tons)

Category	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Production	207,475	6,667,554	12,476,865
Gathering and Boosting	185,726	10,450,550	15,650,881
Natural Gas Processing	11,238	4,760,860	5,075,530
Transmission and Storage	14,848	682,127	1,097,870
Inactive Oil and Gas Wells	591	18	16,563
Total	**419,879**	**22,561,109**	**34,317,709**

Figure 2 presents the percent contribution to total CO_2e emissions by pollutant for production, G&B, natural gas processing, and transmission. Underground NG storage and inactive wells contribute less than 0.3 percent to total CO_2e and are therefore omitted from the figure.

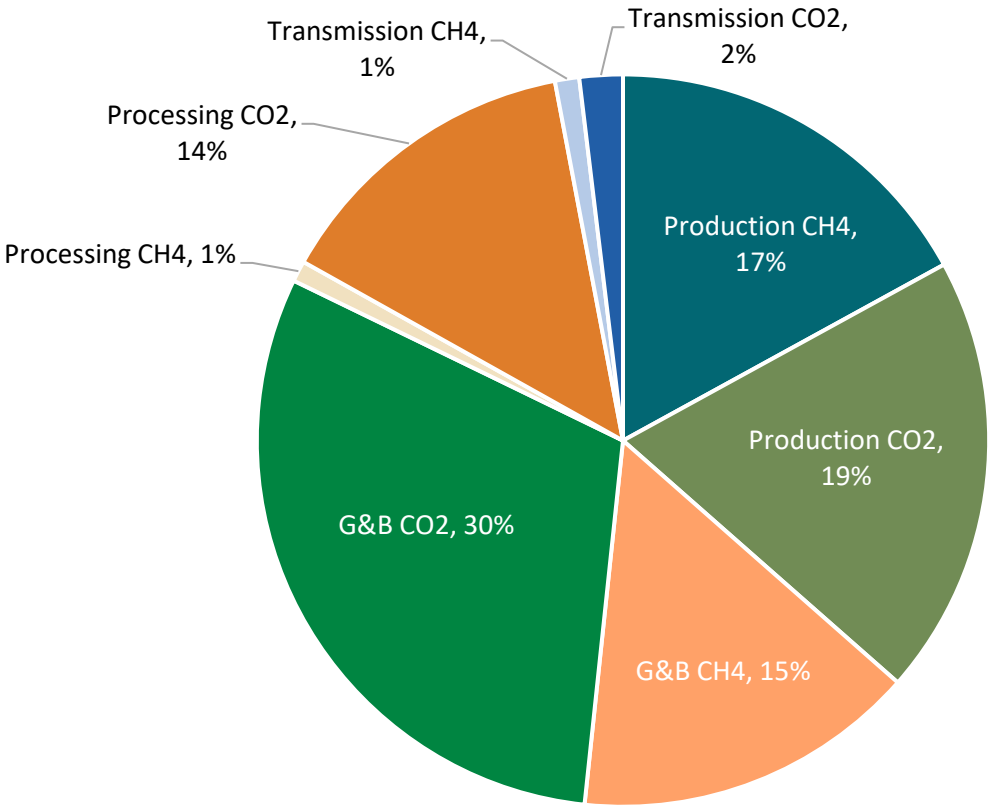


Figure 2. Percent Contribution to Total CO_2e Emissions by Industry Segment and Pollutant

Table 62 presents a summary of CH_4, CO_2, and CO_2e emissions for 2023 for each emission source. Table 62 is ordered from highest to lowest CO_2e emissions. The highest emitting CH_4 sources are combustion (or combustion slip), pneumatic controllers, and equipment leaks which cumulatively account for 68 percent of CH_4 emissions. Combustion (e.g., from engines and turbines driving compressors) is the highest emitting CO_2 source, accounting for 81 percent of CO_2 emissions. Other significant sources of CO_2 emissions include acid gas removal units and miscellaneous flaring.

Table 62. 2023 GHG Emissions by Emission Source (Metric Tons)

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Combustion	113,324	18,163,589	21,336,662
Pneumatic Controllers	101,019	10,396	2,838,926
Acid Gas Removal Units	0	2,067,351	2,067,351
Equipment Leaks	72,713	1,979	2,037,947
Miscellaneous Flaring	5,562	1,274,940	1,430,686

Emission Source	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Reciprocating Compressors	37,487	1,490	1,051,130
Tanks	17,381	412,336	899,014
Associated Gas	4,883	410,723	547,448
Mud Degassing	14,768	1,043	414,542
Produced Water	14,678	317	411,313
Equipment Blowdowns	9,630	462	270,104
Pipeline Leaks	7,818	1,577	220,488
Pipeline Blowdowns	7,538	153	211,231
Completions	637	123,737	141,561
Dehydrators	530	89,405	104,255
Liquids Unloading	3,628	172	101,760
Centrifugal Compressors	3,553	84	99,558
Transmission Storage Tanks	1,791	29	50,170
Pneumatic Pumps	1,775	79	49,774
Inactive Wells	591	18	16,563
Tank Unloading	447	10	12,535
Workovers	93	8	2,606
Well Testing	4	1,212	1,316
Storage Wells	27	1	769
Total	**419,879**	**22,561,109**	**34,317,709**

Table 63 presents a summary of CH_4, CO_2, and CO_2e emissions for 2023 for each O&G basin in NM. The Permian and San Juan basins account for over 98 percent of O&G GHG emissions in NM.

Table 63. GHG Emissions by Basin (Metric Tons)

Basin	Annual CH_4 Emissions	Annual CO_2 Emissions	Annual CO_2e Emissions
Permian	268,836	18,153,822	25,681,218
San Juan	144,418	4,027,942	8,071,638
Orogrande	1,397	108,320	147,443
Las Vegas-Raton	4,239	24,435	143,123
Basin-And-Range Province	436	113,623	125,833
Pedregosa	258	102,097	109,317
Estancia	211	30,867	36,776
Palo Duro	40	1	1,120
San Luis	34	1	945
Sierra Grande Uplift	11	0	297
Total	**419,879**	**22,561,109**	**34,317,709**

Figure 3 through Figure 6 depict CH_4 and CO_2 emissions for high emitting emission sources by industry segment.

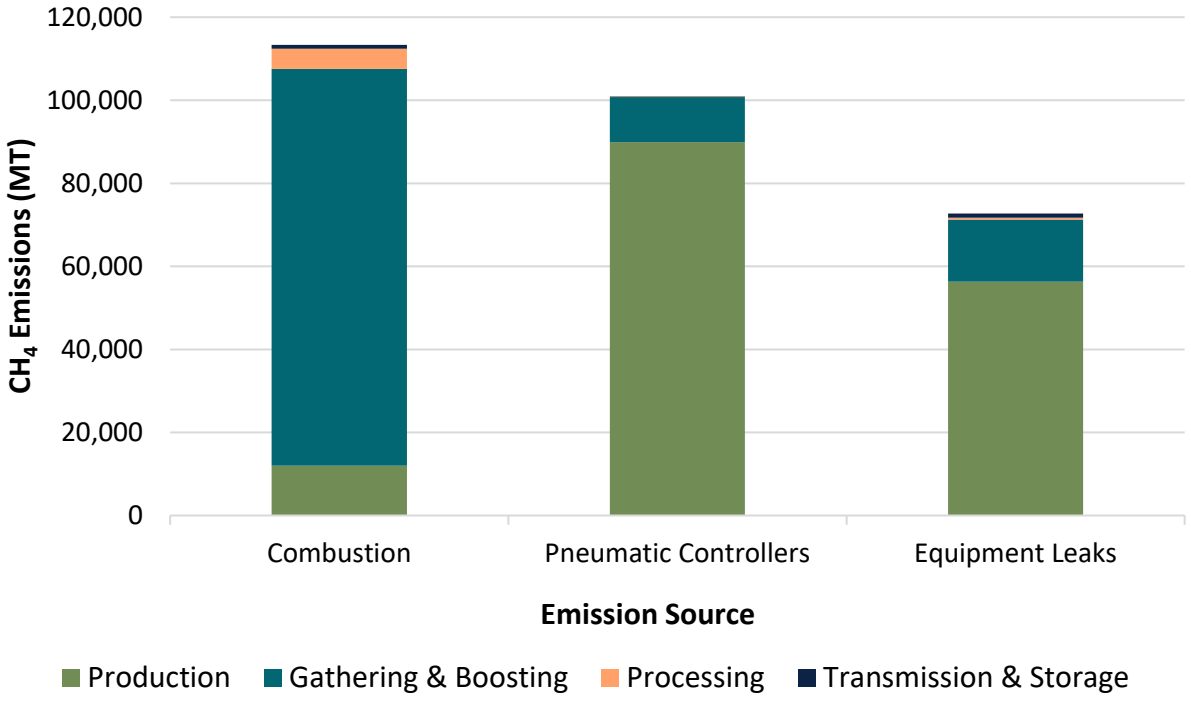


Figure 3. CH_4 Emissions for Highest Emitting Sources by Industry Segment (Metric Tons)

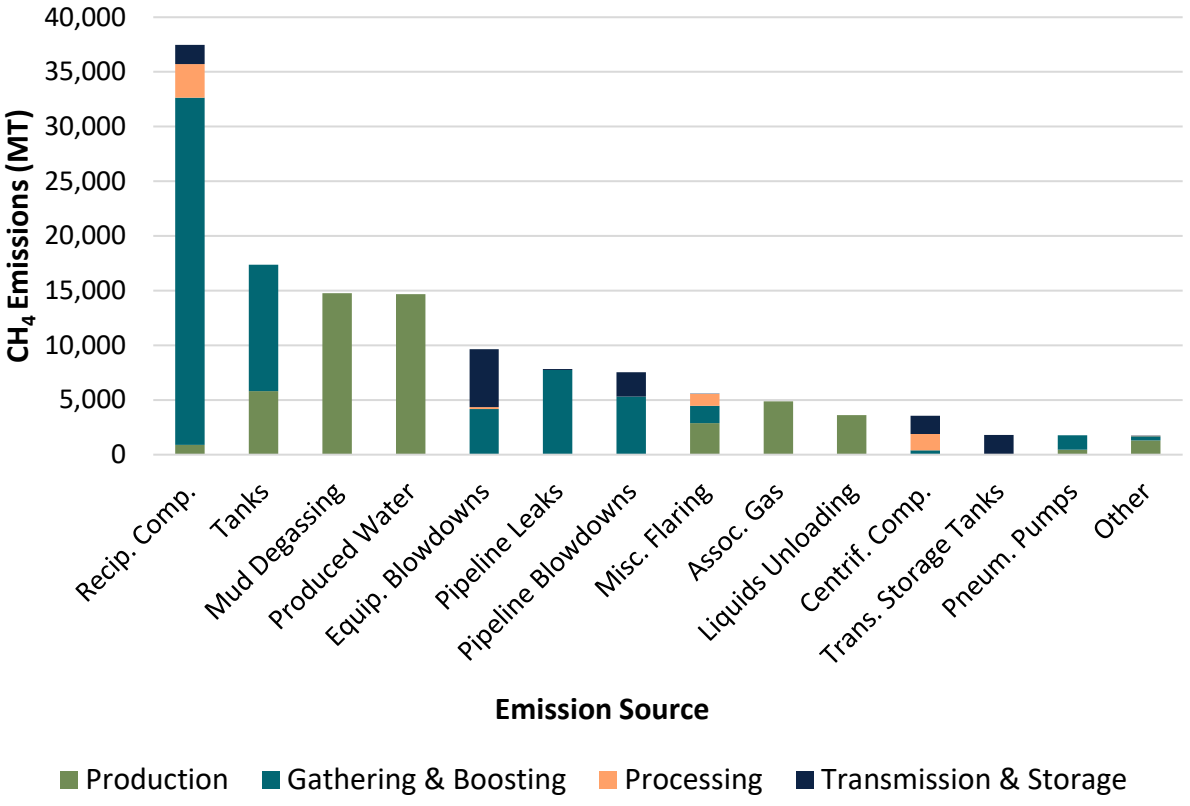


Figure 4. CH_4 Emissions for Select Emission Sources by Industry Segment (Metric Tons)

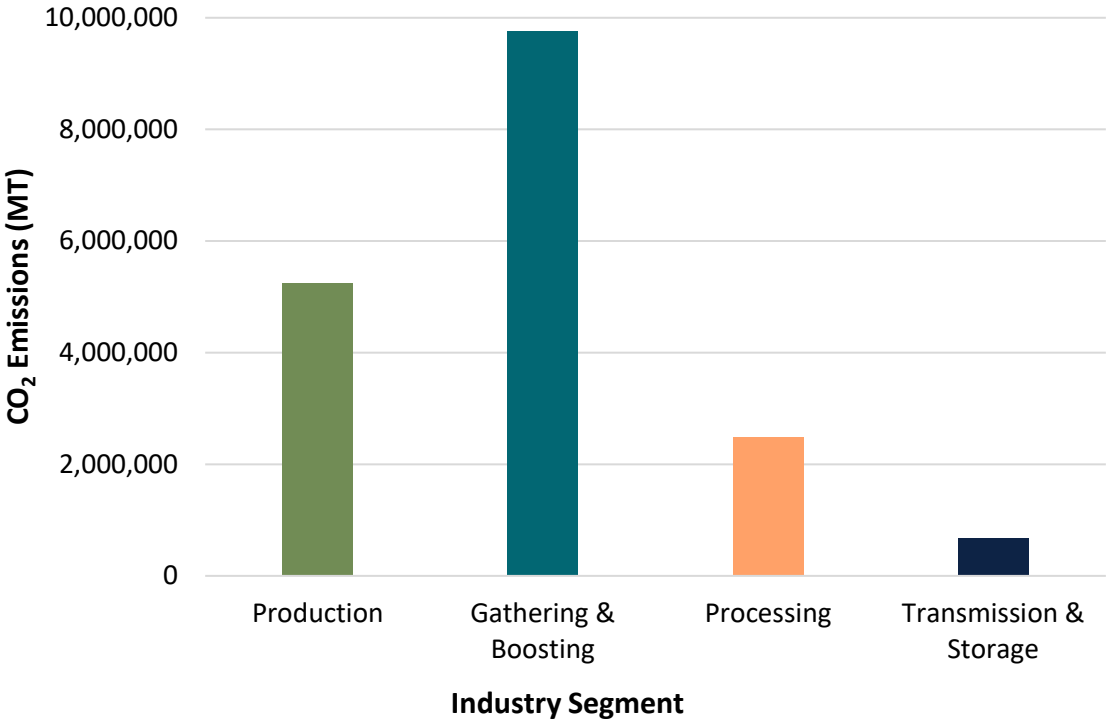


Figure 5. Combustion CO_2 Emissions by Industry Segment (Metric Tons)

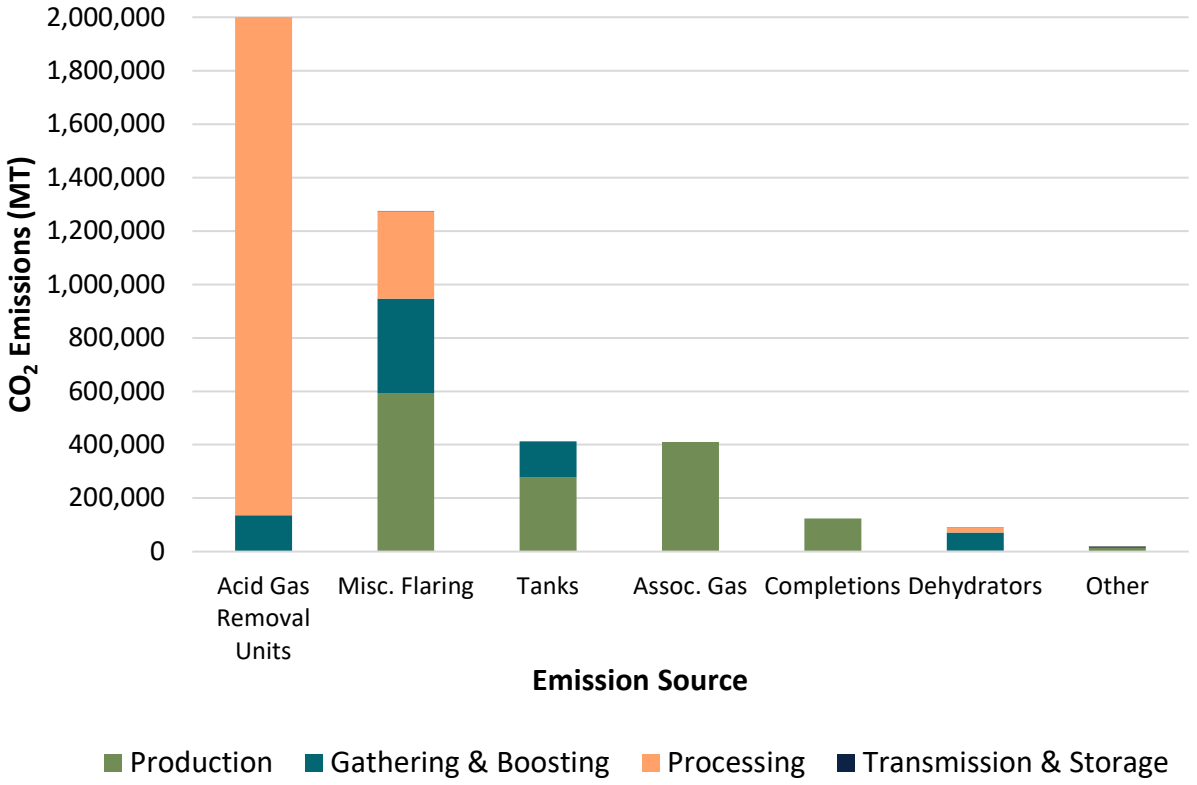


Figure 6. CO_2 Emissions for Select Emission Sources by Industry Segment (Metric Tons)

7 UNCERTAINTY

The NM 2023 O&G GHGI was compiled using the best data currently available, including O&G exploration and production activity tracked by the NM OCD, emissions data reported by industry directly to the NMED EI, emissions data reported by industry directly to EPA, and current research and studies on emissions from O&G activities. However, there are uncertainties in the estimated emissions as discussed in the following.

Direct emissions and activity are not available for all O&G facilities. Emission estimates for the Group 2 facilities (those without reported emissions data available) were developed using data from the Group 1 facilities (those with reported emissions data). While the Group 1 facilities account for the majority of the O&G operations in NM (see coverage results in Section 4.3), the Group 2 facilities may have characteristics that are not represented by the Group 1 facilities. These unique characteristics could lead to their emissions being mis-characterized in the inventory.

The NM 2023 O&G GHGI relies on a bottom-up approach to estimate emissions (i.e., emissions are estimated for each emission source and then scaled up to the facility/county-level) versus a top-down approach (i.e., emissions are estimated using facility-level or regional-level emissions data). While the bottom-up approach is preferred in order to identify the specific sources that contribute the most to GHG emissions, top-down GHG emissions estimates are commonly higher. The reasons for these differences are typically because a top-down approach accounts for emissions that are not accounted for in the

bottom-up methodology. For example, emissions may not fully account for infrequently occurring large emission events that can disproportionately contribute to emissions. The NM 2023 O&G GHGI methodology did attempt to account for certain large emission events for production well pad leaks (see Section 3.2.1) and the G&B segment (see Section 3.3.1). However, large emission events are applicable to other industry segments and emission sources. In addition, the efficiency of flares is currently being evaluated by environmental and academic groups and assuming 98 percent flare efficiency (the current default assumption for subpart W flare emissions) may overestimate the actual efficiency; the NM 2023 O&G GHGI methodology also examined the potential impact from this in Section 6.6. The emissions from a flare that is not operating correctly would be captured via top-down measurement methods but not necessarily bottom-up methods. Finally, bottom-up methodologies rely on emission factors that simply may not be representative of a facility's operations.

The numerical uncertainty bounds were not calculated for the NM 2023 O&G GHGI. However, the EPA GHGI does calculate uncertainty bounds for natural gas systems (which includes gas wells in production, G&B, natural gas processing, and transmission and storage) and petroleum systems (which includes oil wells in production) separately for CH_4 and CO_2 emissions. The EPA GHGI natural gas systems CH_4 emissions uncertainty bounds are -18% / +17% and petroleum systems CH_4 emissions uncertainty bounds are -18% / +23%.[23] The EPA GHGI and NM 2023 O&G GHGI methodologies have many similarities, so the EPA GHGI uncertainty bounds are appropriate for context.

8 Comparison of 2020 and 2023 GHG Emissions

Table 64 compares the CO_2e emissions from the NM 2020 O&G GHGI to the NM 2023 O&G GHGI for each category and overall. The CO_2e emissions for both the 2020 and 2023 GHGIs reflect a CH_4 GWP of 28. There are notable differences in the emissions changes between 2020 and 2023 for the five categories. While the production industry segment had a large decrease in emissions (-29 percent), the gathering and boosting industry segment had a significant increase in emissions (62 percent). Production industry segment CO_2e emissions decreased due to decreases in CH_4 emissions from equipment leaks (related to increased use of LDAR surveys) and pneumatic controllers. Gathering and boosting industry segment emissions increased due to increases in engine combustion CH_4 and CO_2 emissions. Natural gas processing industry segment emissions were consistent between the two years, transmission and storage industry segment emissions increased (9 percent), and inactive oil and gas well emissions decreased between 2020 and 2023 (-25 percent). Cumulatively, there was a slight increase in CO_2e emissions of 2 percent between 2020 and 2023.

Table 64. Comparison of 2020 Versus 2023 GHG Emissions by Category (Metric Tons)

Category	2020 CO_2e Emissions	2023 CO_2e Emissions	% Change From 2020 to 2023
Production	17,695,788	12,476,865	-29%
Gathering and Boosting	9,686,767	15,650,881	62%
Natural Gas Processing	5,090,857	5,075,530	0%

[23] The natural gas and petroleum systems information, including uncertainty bounds, are available in Chapter 3 (Energy Chapter) of the 2024 Annual Inventory Report. The 2024 Annual Inventory Report includes emissions for 1990 – 2022. The report can be accessed at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.

Category	2020 CO_2e Emissions	2023 CO_2e Emissions	% Change From 2020 to 2023
Transmission and Storage	1,003,953	1,097,870	9%
Inactive Oil and Gas Wells	21,977	16,563	-25%
Total	**33,499,342**	**34,317,709**	**2%**

Figure 7 and Figure 8 present a comparison of the emissions intensities for the entire state, Permian basin, and San Juan basin, for 2020 and 2023. The intensities were calculated separately for CH_4 and carbon (on a CO_2e basis). The CH_4 emissions intensity equals CH_4 emissions (converted to thousand cubic feet, mcf) divided by the CH_4 content of natural gas produced (converted to mcf, assuming a CH_4 content of 80 percent by volume). The carbon intensity equals CO_2e emissions (converted to kilograms) divided by total barrels of production (oil production plus gas production converted to barrels of oil equivalent using 6 mcf of gas per barrel). The intensities are lower in 2023 for all geographic regions and the San Juan basin has a much higher intensity than the Permian basin in both years.

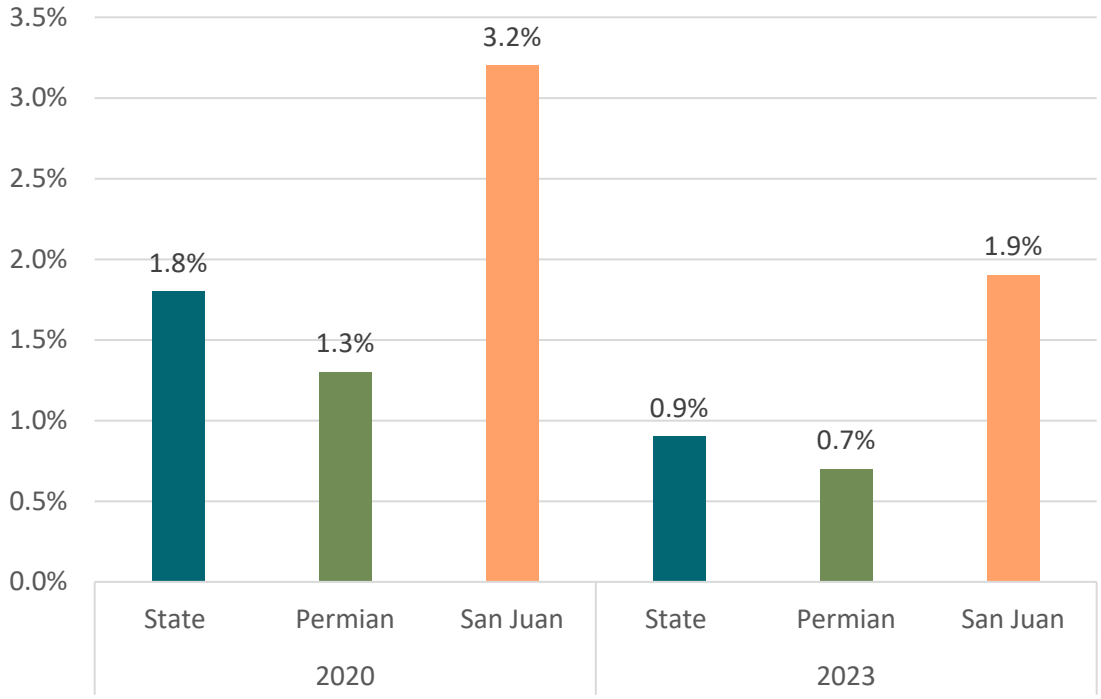


Figure 7. CH_4 Emissions Intensity for 2020 and 2023, by Basin

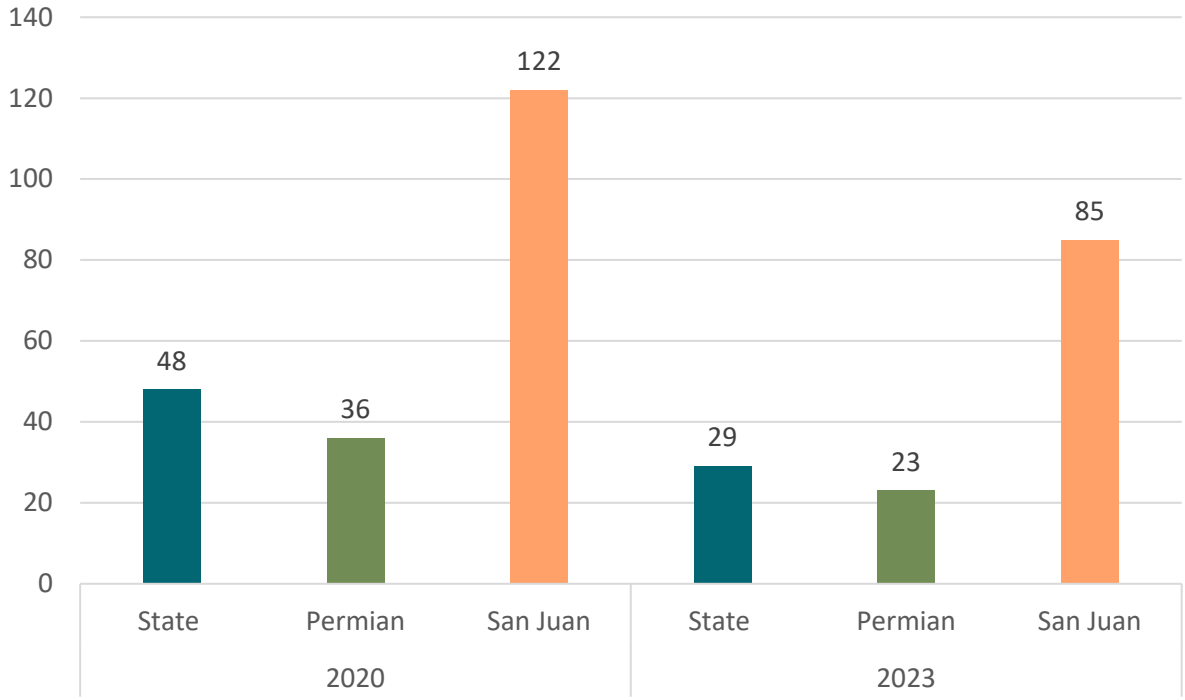


Figure 8. Carbon Intensity for 2020 and 2023, by Basin (kilogram CO_2e per barrel of oil equivalent)