U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

BLM Specialist Report on Annual Greenhouse Gas Emission Trends in 2025

from Coal, Oil, and Gas Exploration and Development on the Federal Mineral Estate

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Executive Summary

The "BLM Specialist Report on Annual Greenhouse Gas Emission Trends in 2025" presents the estimated emissions of greenhouse gases (GHGs) attributable to hydrocarbons produced on land and mineral estate managed by the Bureau of Land Management (BLM). More specifically, this technical report is focused on estimating GHG emissions from coal, oil, and gas development that is occurring, and is projected to occur on the federal onshore mineral estate. The report includes a summary of emissions estimates from reasonably foreseeable federal hydrocarbon development and production over the next 12 months, as well as longer term assessments of potential federal hydrocarbon GHG emissions. The report provides information regarding cumulative GHG emissions from hydrocarbon energy leasing and development authorizations on the federal onshore mineral estate relative to several emission scopes and base years. This report also serves to streamline any required step-down analyses of leasing and permitting actions where GHG emissions may result.

Emissions estimates were developed using fiscal year (FY) 2025 data for both direct and certain indirect emissions. Direct emissions can result from authorized activities such as drilling or venting, while indirect emissions occur following the authorized action and can result from activities such as processing, transportation, and any end-use combustion of hydrocarbon mineral products. The estimates are expressed as megatonnes (Mt) of carbon dioxide equivalents (CO_2e) on either a rate or absolute basis. Table ES-1 shows the estimated GHG emissions from actual hydrocarbon production from the federal mineral estate in FY 2025. Table ES-2 shows the estimated 2025 GHG emissions by mineral boundary, from which extraction is the direct portion of the emissions, and processing and transport represent a portion of the indirect emissions along with the end-use (assumed combustion) estimates.

Table ES-1. Estimated Annual GHG Emissions from Federal Hydrocarbon Production in 2025 (Mt CO2e)

BLM Authorized Development	Direct	Indirect	End Use	Total
Coal	3.51	6.30	390.91	400.73
Oil	48.30	39.85	283.83	371.97
Gas	25.54	64.84	245.55	335.93
Total 2025 Existing	***77.34***	***110.99***	***920.29***	***1,108.62***

2025 annual emissions based on fiscal year production data (i.e., Oct. 1 - Sept. 30)

Table ES-2. Estimated Annual Emissions by Mineral Boundary - 2025 (Mt CO_2e)

Area	Extraction	Processing	Transport	Combustion	Total C02e
U.S. Total	646.9071	344.361	676.2653	5,797.93	7,465.46
Federal Total	104.0427	79.409	84.227	1,259.05	1,526.73
Onshore Total	77.3448	43.0723	67.9176	920.29	1,108.62
New Mexico	53.3913	31.5773	38.1106	369.69	492.77
Wyoming	12.5381	5.6158	17.1681	409.56	444.88
Offshore	26.6979	36.3367	16.3094	338.76	418.1
Colorado	3.7791	1.5767	6.2021	44.97	56.53
North Dakota	3.9587	2.3947	2.2132	33.89	42.46

Utah	1.479	0.773	1.8517	25.07	29.17
Montana	0.372	0.1872	0.2795	23.03	23.87
Alaska	0.4611	0.2625	0.3897	3.3	4.42
California	0.5434	0.3595	0.1614	3.35	4.42
Texas	0.3045	0.1107	0.6295	2.86	3.9
Louisiana	0.2641	0.0961	0.5455	2.48	3.38
Oklahoma	0.1136	0.0551	0.1531	0.92	1.24
Arkansas	0.043	0.0147	0.0946	0.41	0.57
Alabama	0.0192	0.0067	0.0403	0.18	0.25
Kansas	0.0207	0.0093	0.032	0.17	0.24
Ohio	0.0111	0.0039	0.0235	0.1	0.14
Mississippi	0.0151	0.01	0.0045	0.09	0.12
Nevada	0.0138	0.0095	0.0019	0.08	0.11
South Dakota	0.0092	0.0056	0.0054	0.06	0.08
Michigan	0.004	0.0015	0.0078	0.04	0.05
Nebraska	0.0017	0.0012	0.0002	0.01	0.01
Virginia	0.0006	0.0002	0.0014	0.01	0.01
Kentucky	0.0006	0.0003	0.0009	0.01	0.01
Illinois	0.0007	0.0005	0.0001	0	0.01
Pennsylvania	0.0001	0.0001	0.0002	0	0
West Virginia	0.0001	0	0.0002	0	0

2025 annual emissions based on fiscal year production data (i.e. Oct. 1 - Sept. 30).

Table ES-3 provides an estimate of (1) current emissions from existing production that is anticipated to keep producing and (2) reasonably foreseeable GHG emissions, including (a) emissions from previously authorized development that is not currently producing but may begin production and (b) potential new leasing that could begin producing. This table also provides estimated cumulative (life-of-project) GHG emissions over the typical production life for existing and projected development. The typical production life for an oil and gas well can vary considerably based on multiple factors but generally ranges from 20 to 25+ years. The projected emissions estimates generated in this report are based on a conservative assumption that the production life for new oil and gas wells is 30 years (with decline). The typical production life assumed for coal is 1 year as most coal is typically produced and consumed in a single year. The annualized emissions rates shown in Table ES-3 are a subset of the life-of-project emissions data, specifically the emissions from year one (i.e., the next 12 months).

Table ES-3. Estimated GHG Emissions from Reasonably Foreseeable Federal Hydrocarbon Production over the Next 12 Months

BLM Authorized	Mt CO2e/yr				Mt CO2e
	Direct	**Indirect**	**Combustion**	**Total**	**Life-of-Project**
Existing Federal Production					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	39.21	32.35	230.44	302.01	2,672.24
Gas	20.59	52.28	198.01	270.89	2,845.75
Subtotal Existing Production	***59.8***	***84.6***	***428.5***	***572.9***	***5,518.0***

Permitted but NOT yet Developed Oil, Gas, and Coal Leases					
Coal	9.25	6.28	389.35	404.87	6,377.84
Oil	38.10	31.43	223.89	293.42	901.93
Gas	11.37	28.86	109.30	149.52	502.02
Subtotal Approved Permits	***58.7***	***66.6***	***722.5***	***847.8***	***7,781.8***
Potential New Leases in the Next 12 Months					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	3.20	2.64	18.79	24.63	74.17
Gas	1.26	3.19	12.07	16.52	59.49
Subtotal Potential Leases	***4.5***	***5.8***	***30.9***	***41.1***	***133.7***
Total Projected Emissions by Mineral Type					
Coal	9.25	6.28	389.35	404.87	6,377.84
Oil	80.51	66.42	473.12	620.06	3,648.34
Gas	33.22	84.33	319.38	436.93	3,407.26
Total CO2e	**123.0**	**157.0**	**1,181.9**	**1,461.9**	**13,433.4**

The emissions in Table ES-3 are based on life-cycle-assessment (LCA) data (see section 5 for methodologies) that are relative to total production and include non-combusted GHGs (e.g., fugitive CH_4). Indirect emissions include LCA values for transportation/distribution, processing/refining, but NOT end use (combustion), which is shown separately for illustrative purposes. Direct and Indirect emissions are additive for life-cycle accounting but represent a double count for annual reporting. Life-of-Project emissions for Oil and Gas are a 30-year decline projection for each authorization type shown. Coal emissions are based on forecasted production (see coal discussion in section 5.2). Projected existing federal coal emissions from operating mines (i.e., mines with currently leased reserves) are shown in the permitted but not yet developed subheading. Coal lease data is estimated from current actions before the BLM that have had public review.

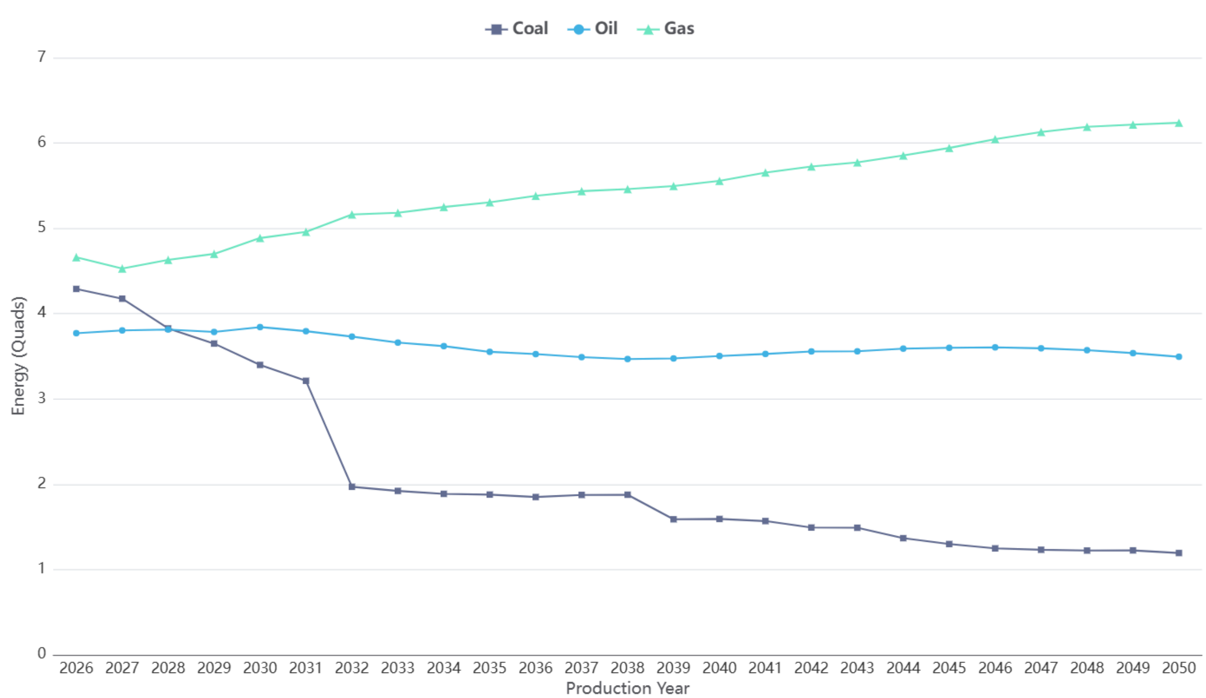

Figure ES-1. Long-Term Federal Onshore Production (Quads)

Table ES-4 provides long-term onshore federal mineral projections based on the Energy information Administration's (EIA) Annual Energy Outlook report (AEO). The data is the sum of the annual projections shown in Figure ES-1, which was estimated from the counterfactual baseline case via the methods described in section 5.7.

Table ES-4. Long-Term Onshore Federal Mineral Projections

Federal Minerals	**Production**	**Energy (Quads)**	**Emissions (Mt CO2e)**
Coal (MM short tons)	2,556	4.58E+01	4,574
Oil (MM bbl)	15,612	9.05E+01	8,870
Gas (Bcf)	132,914	1.36E+02	9,910
Projected Totals	**NA**	**2.73E+02**	**23,353**

AEO Counterfactual Baseline Case used for series projections; totals are the sum of the series (2026 - 2050). A quad is a unit of energy equal to 1×10^{15} BTU (a short-scale quadrillion) or 1.055×10^{18} joules.
See methodology discussion in section 5.7.

Report Recap

The total onshore federal mineral production forecasts for 2025 were higher than the actual totals recorded, save for coal. Federal coal production came in at 127% of the forecast value, while onshore federal oil and gas production totaled only 67% and 79% of forecast volumes, respectively. A roundup of the BLM oil and gas statistics shows that the application for permit to drill (APD) approvals increased by about 1000 units compared to the previous 4-year average. The total number of producible well counts rose by about 900 units to 91,935 wells. In terms of leasing, specifically the number of new lease acres sold, the data indicates an increase of 16% relative to 2024. Production of onshore federal oil and gas and their associated emissions were higher than the previous report year by about 2.5% and 3.7%, respectively. Due to the increases from oil and gas and a 6% increase in federal coal production relative to 2024, total onshore federal hydrocarbon mineral emissions rose by approximately 4% overall. Onshore federal coal, oil, and gas accounted for 42%, 13.2%, and 9.4% of total U.S. production and their related GHG emissions in 2025.

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1.0 Introduction

The "BLM Specialist Report on Annual Greenhouse Gas Emission Trends in 2025" provides a detailed technical assessment of greenhouse gas (GHG) emission trends from energy development projects, specifically those that may result from Bureau of Land Management (BLM)-authorized coal, oil, and gas leases. and approved development on public lands (including the federal mineral estate) managed by the BLM. This report examines GHG emissions from authorized development of the onshore federal mineral estate. The report provides estimates of both direct and reasonably foreseeable indirect emissions from development and consumption of onshore federal hydrocarbon minerals, including those fuels that are combusted by end users (when off-lease). This report incorporates discussions of scientific values relevant to the context within which the BLM authorizes development of the onshore federal mineral estate and is designed to provide decision makers with the best available data to implement management strategies consistent with regulatory requirements.

Chapters 2 through 4 of this report provide background information concerning GHG emissions, while chapters 5 and 6 describe the methodologies and data used by the BLM for projecting federal hydrocarbon emissions and the results of the projection calculations for various scopes.

1.1 Background

Coal, oil, and gas are examples of hydrocarbons found in the earth's crust. These fuels contain high concentrations of carbon and hydrogen that can be burned for energy. The extraction, production, and consumption of these hydrocarbons produce GHGs, particularly carbon dioxide and methane. The BLM's authorization of hydrocarbon development can result in both direct and indirect emissions of GHGs. Direct emissions can result from authorized activities such as drilling or venting, while indirect emissions occur following the authorized action and result from activities such as the processing, transportation, and any end-use combustion of the hydrocarbon products.

As the steward of the greatest percentage of federal lands, the BLM manages about 245 million acres of public lands encompassing approximately 10 percent of the nation's total surface area. In addition, the BLM administers the onshore federal mineral estate (subsurface) which covers a total of about 712 million acres from the Eastern United States to Alaska (BLM 2021).[1] In keeping with its multiple use and sustained yield mandate in accordance with the Federal Land Policy and Management Act (FLPMA) of 1976 (43 U.S.C. §§ 1701-17857) and with the Mineral Leasing Act (MLA) of 1920 (30 U.S.C § 181 et seq.), the BLM leases minerals including coal, oil, and gas on the onshore federal mineral estate and authorizes development of these leased minerals. Approximately 22.64 million acres of the federal mineral estate have been leased through BLM's coal leasing and oil and gas leasing programs. A little over half (approximately 56.74%, or 12.84 million acres) of the leased mineral estate is currently producing hydrocarbons (coal, oil, gas). Statistics maintained by the Office of Natural Resources Revenue (ONRR) show that approximately 211 million tons of coal, 638.5 million barrels of oil, and 4.3 trillion cubic feet of gas were produced from these leased acres in 2024, or about 41.2% of the nation's coal supply and 13.2% and 9.5% of the nation's oil and gas supply, respectively. The total area of onshore federal mineral estate does not imply that economically recoverable quantities of minerals exist at that scale; it is simply an administrative area.

1.2 Using this Report

Consistent with the Department of the Interior's implementing NEPA regulations, and the DOI NEPA Handbook, this technical document is intended to be incorporated by reference into BLM environmental documents prepared under NEPA to provide background information regarding reasonably foreseeable GHG emissions from the BLM's energy programs. While incorporating this report by reference, the NEPA document should also explicitly incorporate all linked content and reference materials used in this report to provide for a complete record. This report does not take the place of an analysis and disclosure of emissions at the project level that may be completed for NEPA analysis specific to a decision to lease or authorize development; rather, this report supplements that analysis by providing a technical evaluation of emissions from federal hydrocarbon authorizations on a state and national level.

This report was prepared by air quality, fluid minerals, and leasing specialists from across the BLM, and reflects a broad but concerted effort to present and use the best data and statistics available for estimating emissions associated with BLM-authorized actions in a consistent manner. These data were analyzed using the best available science applicable to the onshore federal mineral estate. As new information and models become available, the BLM will continue to improve and revise its emission estimates, methodologies, and assumptions as appropriate.

1.3 Updates and Breaking Changes

This report is intended to be consistent with the Department of the Interior's implementing NEPA regulations, the DOI NEPA Handbook, and the Supreme Court decision in Seven County Infrastructure Coalition, et al. v. Eagle County, CO, et al.[2] This report will not analyze climate trends because the effects of GHG emissions and global climate change are fundamentally cumulative phenomena; therefore, it is not possible to track the effects of GHG emissions from a proposed action to climate change effects in a localized manner to determine significance.

We note that the Environmental Protection Agency's (EPA) updates to its Inventory of U.S. Greenhouse Gas Emissions and Sinks were not available at the time of publication, nor was there an update to the Energy Information Administration's International Energy Outlook for 2025.

1.4 Disclaimer

Much of the information sourced for this report has been obtained from various reports, documents, and presentations from governmental agencies, international institutions, and non-governmental organizations. All information in this report is being provided "as is," and while the authors have made every effort to ensure that the information is timely, complete, accurate, and obtained from reliable sources, the BLM makes no guarantee that it is free from errors or omissions. The BLM does not make any representation as to the accuracy or any other aspect of information contained in linked content or data obtained from external application programming interfaces. The projections and evaluations of the data developed and disclosed in this technical report are presented strictly to display assumptions for analysis and should not be interpreted as an exacting prediction or guarantee of future conditions, emission trends, or as an emissions cap or authorization limit. This report is not intended to, and does not create any right or benefit, substantive or procedural, enforceable at law or in equity by a party against the United States, its departments, agencies, or entities, its officers, employees, agents, or any other person.

The BLM reserves the right to modify this document at any time to address deficiencies, inadvertent omissions and errors, or to address changes that warrant document updates to elevate awareness and inform agency decision making.

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2.0 Relationships with Other Laws and Policies

This chapter lists several laws and regulations that could affect sources of GHG emissions subject to review and disclosure under NEPA that are relative to federal mineral authorizations. This section of the report is not a legal treatise, analysis, or opinion. The statutes and regulations governing the BLM and mineral operations on federal lands speak for themselves. The information about legal requirements summarized in this report is not intended to be comprehensive; it is included for convenience of reference only.

2.1 Federal Land Policy and Management Act

The Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC §§ 1701-1785) provides the majority of the BLM's legislated authority, policy direction, and basic management guidance.

2.2 Mineral Leasing Act

The Mineral Leasing Act (MLA) of 1920 (30 U.S.C. § 181 et seq.), as amended, authorizes and governs leasing of public lands for development of deposits of coal, oil, gas and other hydrocarbons, sulfur, phosphate, potassium, and sodium.

2.3 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C § 4321 et seq.) ensures that information on the potential impacts to the quality of the human environment of proposed federal actions is available to public officials and citizens before decisions are made and before actions are taken.

2.4 Executive Orders

Several Executive Orders (E.O.) also provide direction on the science that should be considered in agency decisions. E.O. 14154 "Unleashing American Energy" states that agencies should provide an "opportunity for public comment and rigorous, peer-reviewed scientific analysis," and "adhere to only the relevant legislated requirements for environmental considerations". In E.O. 14303, "Restoring Gold Standard Science" agencies are directed to "make publicly available the following information within the agency's possession":

- the data, analyses, and conclusions associated with scientific and technological information produced or used by the agency, and
- the models and analyses (including, as applicable, the source code for such models) the agency used to generate such influential scientific information.

The E.O. also directs agencies to ensure that when using scientific information in agency decision-making, employees shall transparently acknowledge and document uncertainties and apply a "weight of scientific evidence" approach. This report follows the science directives outlined in these E.O.s to disclose to the public the peer-reviewed science and data on GHG emissions, including disclosure of any uncertainties.

2.5 Clean Air Act

GHGs are considered air pollutants and are regulated under the Clean Air Act (CAA) (42 U.S.C. § 7407 et seq.). The U.S. Supreme Court first ruled that GHGs are air pollutants in 2007 (Massachusetts v. Environmental Protection Agency, 549 U.S. 497 (2007)) and instructed the EPA to determine if GHG emissions endanger public health and welfare. In April 2009, the EPA issued its endangerment finding; in May 2010 it issued its GHG Tailoring Rule (40 CFR Part 57, 52, 70, et al.); and in January 2011, the EPA began regulating GHGs under its Prevention of Significant Deterioration (PSD) and Title V permitting programs. On February 12, 2026, the U.S. EPA finalized its rescission of the 2009 Greenhouse Gas Endangerment Finding, which severed the agencies statutory authority under Section 202(a) of the Clean Air Act to prescribe standards for GHG emissions.

In 2009, the EPA published a rule for the mandatory reporting of GHGs (40 CFR Part 98, Subpart C), which is referred to as the Greenhouse Gas Reporting Program (GHGRP). This rule establishes mandatory GHG reporting requirements for owners and operators of certain facilities that directly emit GHGs as well as for certain indirect emitters, or suppliers. Suppliers report the quantity of GHGs that would be emitted from combustion or use of the products supplied. The rule provides a basis for future EPA policy decisions and regulatory initiatives regarding GHGs. Facilities are generally required to submit annual reports under 40 CFR Part 98 if annual emissions exceed 25,000 metric tons of CO2e per year. On September 12, 2025, EPA released a proposal to permanently remove program obligations for 46 source categories of the GHGRP in accordance with Executive Order 14192, "Unleashing Prosperity Through Deregulation."

2.6 Other Regulatory Requirements

Various laws and regulations have been implemented by air quality regulatory agencies that effectively limit GHG emissions from mining activities and oil and gas production, transmission, and distribution facilities. Many of the laws and regulations primarily focus on limiting criteria air pollutants or precursors such as volatile organic compounds but also have a secondary benefit of limiting GHG emissions.[3]

Federal regulations require that GHG emissions related to coal be quantified and reported under 40 CFR 98. 40 CFR 98, Subpart FF, requires underground coal mines to report methane emissions. The Mine Safety and Health Administration requires methane monitoring in underground mines and sets limits on methane concentrations to protect the life, health, and safety of the miners, but it does not limit methane emission amounts. Coal-fired electric power plants are required to continuously monitor carbon dioxide emissions under 40 CFR 98, Subpart D, and submit quarterly emission reports to EPA under 40 CFR 75. Petroleum and natural gas systems are also required to report GHG emissions under 40 CFR 98, Subpart W.

The EPA has established emissions control requirements in the New Source Performance Standards (NSPS) at 40 CFR Part 60 that apply to coal, oil, and natural gas production facilities. 40 CFR 60, Subparts OOOO thru OOOOc, for example, serve to control methane emissions from oil and natural gas industry sources by requiring reduced emissions completions ("green" completions) on new hydraulically fractured gas wells as well as emissions controls on pneumatic controllers, pumps, storage vessels, and compressors. EPA estimates the updated rules will avoid 58 million tons of methane emissions, 16 million tons of VOCs, and approximately 590,000 tons of air toxics from now until 2038. Other relevant NSPS requirements under 40 CFR Part 60 include:

- **Subpart GG** - Standards of Performance for Stationary Gas Turbines
- **Subpart IIII** - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
- **Subpart JJJJ** - Standards of Performance for Stationary Spark Ignition Internal Combustion Engines
- **Subpart K** - Standards of Performance for Storage Vessels for Petroleum Liquids for which Construction, Reconstruction, or Modification Commenced after June 11, 1973, and prior to May 19, 1978
- **Subpart Ka** - Standards of Performance for Storage Vessels for Petroleum Liquids for which Construction, Reconstruction, or Modification Commenced after May 18, 1978, and prior to July 23, 1984
- **Subpart Kb** - Standards of Performance for Storage Vessels for Petroleum Liquids for which Construction, Reconstruction, or Modification Commenced after July 23, 1984
- **Subpart KKK** - Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants for Which Construction, Reconstruction, or Modification Commenced After January 20, 1984, and on or Before August 23, 2011
- **Subpart KKKK** - Standards of Performance for Stationary Combustion Turbines
- **Subpart OOOO** - Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution for which Construction, Modification, or Reconstruction Commenced after August 23, 2011
- **Subpart OOOOa** - Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution for which Construction, Modification, or Reconstruction Commenced on or after September 18, 2015, and before December 6, 2022
- **Subpart OOOOb** - Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced after December 6, 2022
- **Subpart OOOOc** - Standards of Performance for Existing Crude Oil and Natural Gas Facilities Constructed on or before December 6, 2022
- **Subpart TTTT** - Standards of Performance for Greenhouse Gas Emissions for Electric Generating Units
- **Subpart V** - Standards of Performance for Coal Preparation and Processing Plants

In addition to the EPA's rules, the BLM finalized the Waste Prevention, Production Subject to Royalties, and Resource Conservation Rule - also known as the Waste Prevention Rule in April 2024. The 2024 Waste Prevention Rule requires operators of oil and gas leases to take reasonable steps to avoid natural gas waste, as well as develop leak detection, repair and waste minimization plans. When natural gas loss could have been avoidable, the rule ensures public and Tribal mineral owners are properly compensated through royalty payments. The rule is expected to generate more than

$50 million in additional natural gas royalty payments each year and conserve billions of cubic feet of gas that might have otherwise been vented, flared, or leaked.

Several states have also implemented rules and regulations concerning GHGs, however the scope and application of those state regulations are beyond the purpose of this technical report. Where appropriate, environmental documents may list and discuss such regulations where their inclusion and analysis may benefit decision makers and the public.

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3.0 Greenhouse Gases

Gases that trap heat in the atmosphere are called greenhouse gases (GHGs). The primary GHGs emitted by natural and anthropogenic sources include water vapor, carbon dioxide, methane, ozone, nitrous oxide, and chlorofluorocarbons. Water vapor is the largest contributor to the natural greenhouse effect. However, water vapor is fundamentally different from other GHGs in that it can condense and rain out when it reaches high concentrations, and the total amount of water vapor in the atmosphere is in part a function of the earth's temperature (EPA 2021).[4] Water vapor has a short residence time of approximately 10 days in the atmosphere. While water vapor does have a warming effect on the earth, water vapor does not control the earth's temperature. Instead, water vapor concentrations in the atmosphere are controlled by the earth's temperature (NASA 2022).[5] More water evaporates from the earth at higher temperatures, which increases the amount of moisture in the clouds that eventually falls as precipitation.

Anthropogenic GHGs are commonly emitted air pollutants that include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N2O), and several fluorinated species of gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Carbon dioxide is by far the most abundant, and more than two-thirds of man-made CO_2 emissions in the U.S. come primarily from the transportation and electricity production sectors. Methane from human activities accounts for approximately 10% of total U.S. GHG emissions and primarily results from agriculture and natural gas and petroleum systems. Nitrous oxide emissions from agriculture, fuel combustion, and industrial sources account for approximately 7% of the total U.S. GHG emissions. Fluorinated gases are powerful GHGs that are emitted from a variety of industrial processes and are often used as substitutes for ozone-depleting substances (i.e., chlorofluorocarbons, hydrochlorofluorocarbons, and halons), but they are not typically associated with BLM-authorized activities and, as such, will not be discussed further in this report. This report will address the three major GHGs associated with BLM's hydrocarbon energy development authorizations, namely CO_2, CH_4, and N_2O. Not all of the emissions estimates contained in this report include separate values for each gas due to data limitations, particularly where some of the methodologies employed combine these gases into a single CO_2 equivalent output that the BLM cannot separate.

These gases become well mixed such that their measurement in the atmosphere is roughly the same all over the earth, regardless of the source or origin of the emissions. For this reason, cumulative or global GHG emissions are the most useful basis for the analysis of emissions related to BLM actions. Unlike other common air pollutants, any potential ecological impacts that may be attributable to the GHGs would not be the result of localized or even regional emissions but would be entirely dependent on the collective behavior and cumulative emissions of the world's societies.

3.1 Carbon Dioxide (CO_2)

Of the primary GHGs, CO_2 is the most widely occurring. It is a major component of natural carbon cycling in the terrestrial biosphere including photosynthesis (CO_2 uptake by plants) and respiration (CO_2 release by plants, animals, and microorganisms), decomposition, and ocean releases. Carbon dioxide is emitted from human activities including breathing, the combustion of hydrocarbons (i.e., coal, oil, and natural gas) and solid waste, deforestation and wood products manufacturing, and from certain chemical reactions such as steam reforming for the production of hydrogen and calcination for the production of cement clinker. Carbon dioxide emissions accounted for 80% of the total U.S. GHG emissions in 2022 (EPA 2022).[6] Global ambient CO_2 concentrations increased to an average of 422.8 parts per million (ppm) in 2024, according to NOAA's Global Monitoring Lab. This represents a 51% increase since the beginning of the Industrial Age, when the concentration was near 280 ppm, and a 14.2% increase since 2000, when it was near 370 ppm.[7]

The lifetime of CO_2 in the atmosphere is difficult to determine precisely because several processes remove it from the atmosphere. On average, approximately 50% of the CO_2 released into the atmosphere from the burning of hydrocarbons remains in the atmosphere while the other 50% is absorbed by plants and trees and certain areas of the ocean (NOAA).[8]

3.2 Methane (CH_4)

Methane is a powerful GHG that reportedly is more than 29 times more effective at trapping heat in the atmosphere than CO_2.[9] According to the EPA, methane concentrations in the atmosphere have more than doubled in the last two centuries, largely due to human-related activities.[10] Methane emissions accounted for 9.5% of U.S. GHG emissions in 2018. Methane is emitted during the production and transportation of coal, natural gas, and oil. It is also produced biologically under anaerobic conditions in ruminant animals, wetlands, landfills, and wastewater treatment facilities. In addition, fertilizer use, agriculture, and changes in land use (e.g., from forest to grazing) are major sources of CH_4 in the atmosphere.

3.3 Nitrous Oxide (N_2O)

Nitrous oxide is produced by biological processes that occur in soil and water and by a variety of anthropogenic activities in the agricultural, energy, industrial, and waste management fields. While total N_2O emissions are much lower than CO_2 emissions, N_2O reportedly is 273 times more powerful than CO_2 at trapping heat in the atmosphere. [11] The main anthropogenic activities producing N_2O in the United States are agricultural soil management, stationary fuel combustion, manure management, fuel combustion in motor vehicles, and adipic acid production.

3.4 Measurements

Each GHG varies with respect to its concentration in the atmosphere and the amount of outgoing radiation absorbed by the gas relative to the amount of incoming radiation it allows to pass through (i.e., radiative forcing). Different GHGs also have different atmospheric lifetimes. To standardize the measurements of different GHGs and their persistence in the atmosphere, they have been converted to carbon dioxide equivalents (CO_2e).

The BLM is using EPA's CO_2e conversion values at the 100-year time horizon to calculate CO_2e emissions in this report and to be consistent with other report metrics used by the scientific and regulatory community. The 100-year time horizon allows the BLM to compare GHG emissions from its authorized coal, oil, and gas development to other available state and national emissions inventories which also use 100-year horizon.

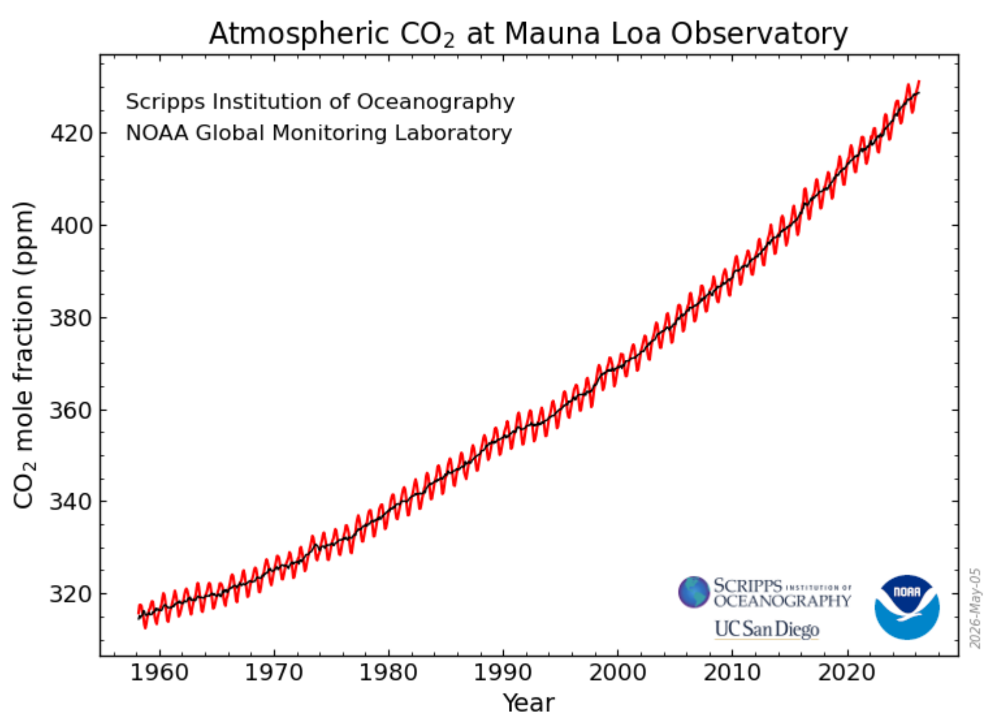
Table 3-1. CO_2e Conversions

GHG Species	Atmospheric Lifetime (years)	20-years	20-years (Annex 6)	100-years	100-years (Annex 6)
CO_2	20 - 1000	1	1	1	1
CH_4 (hydrocarbon)	11.8 ± 1.8	88	82.5	36	29.8
N_2O	109 ± 10	268	273	298	273

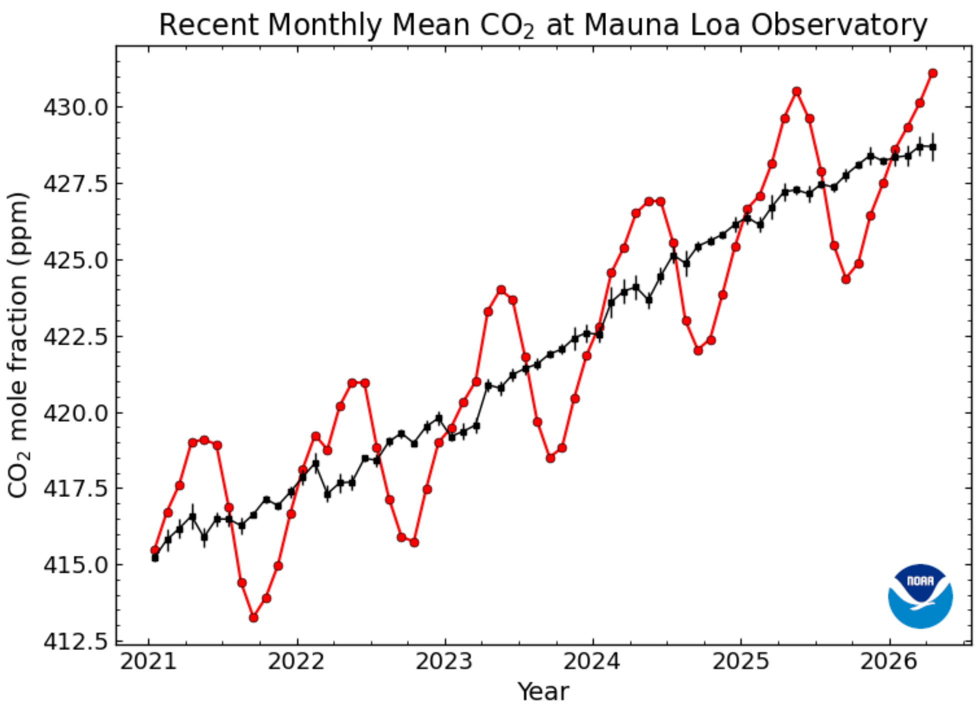
Data Sources: https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-annex-6-additional-information.pdf
Carbon dioxide's lifetime is shown as a range because the gas is not destroyed over time but rather is transferred between the various reservoirs within the ocean-atmosphere-land system at varying rates. All values include any attributable climate feedbacks.

3.5 Mauna Loa Monitoring Data

The Mauna Loa CO_2 monitor in Hawaii, operated by National Oceanic and Atmospheric Administration (NOAA), has recorded atmospheric concentrations of CO_2 going back to 1960, at which point the average annual concentration was recorded at approximately 317 ppm. The record shows that approximately 72% of the increase in atmospheric CO_2 concentration since pre-industrial times has occurred within the last 60 years. The Mauna Loa site also contains updated trend data for CH_4 and N_2O (see Figure 3-1).

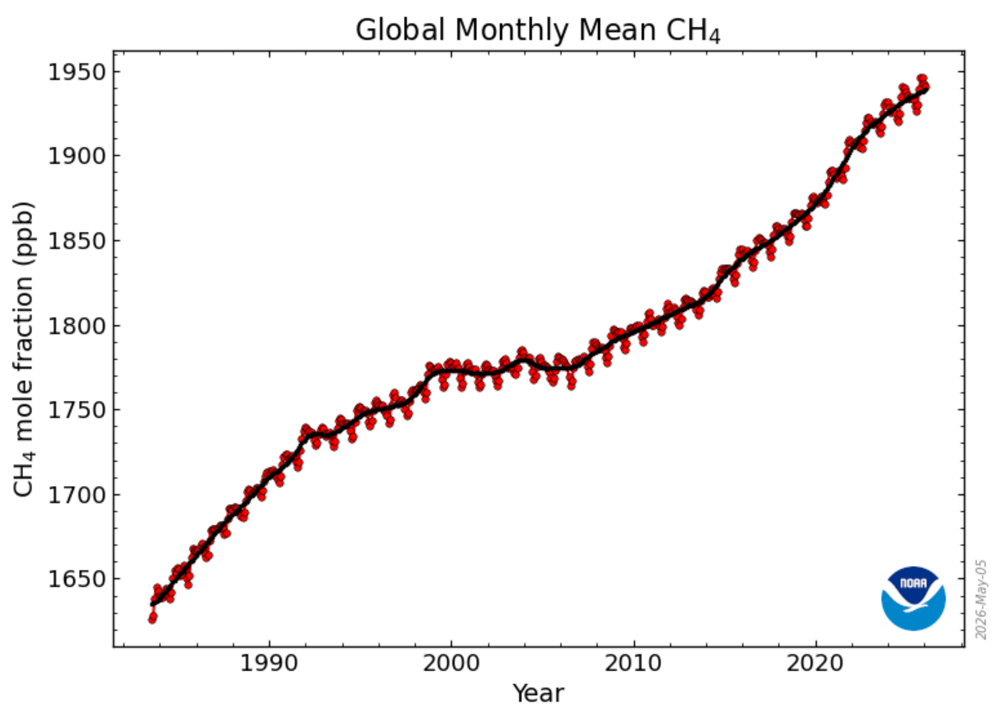


(A)



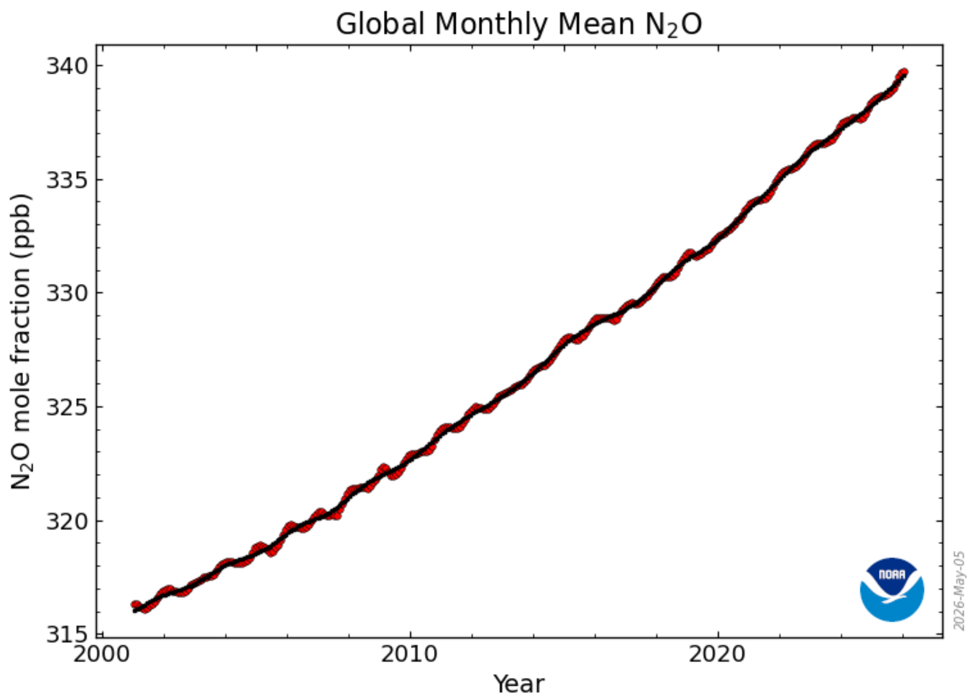
Recent Monthly Mean CO_2 at Mauna Loa Observatory
CO_2 mole fraction (ppm)
430.0
427.5
425.0
422.5
420.0
417.5
415.0
412.5
2021
2022
2023
2024
2025
2026
Year
2026-May-05

(B)



Global Monthly Mean CH_4
CH_4 mole fraction (ppb)
1950
1900
1850
1800
1750
1700
1650
1990
2000
2010
2020
Year
2026-May-05

(C)



(D)

Figure 3-1. Mauna Loa GHG Monitoring Data

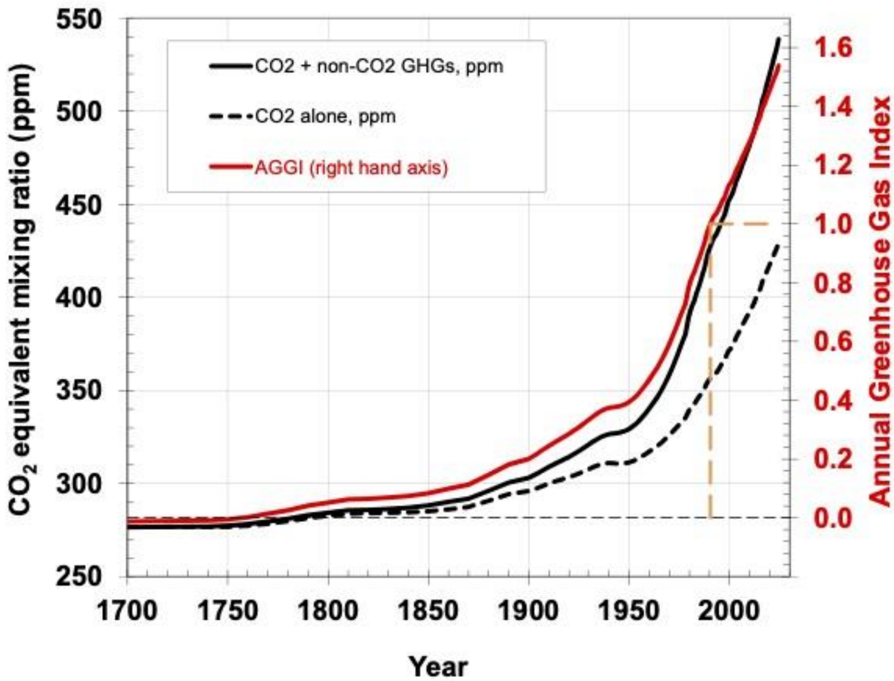
Table 3-2 shows a summary of the anthropogenic changes to atmospheric GHGs since pre- industrial times. The estimated concentrations of CH_4 have more than doubled (722 ppb to 1,932.2 ppb), while N_2O concentrations have increased by a fifth (270 ppb to 337.3 ppb). NOAA estimates that the January 2024 to January 2025 monitoring period provided the largest increase in CO_2 concentrations ever recorded by the agency, eclipsing the previous 2015 record by 27%.

Table 3-2. Global Atmospheric Concentration and Rate of Change of Greenhouse Gases

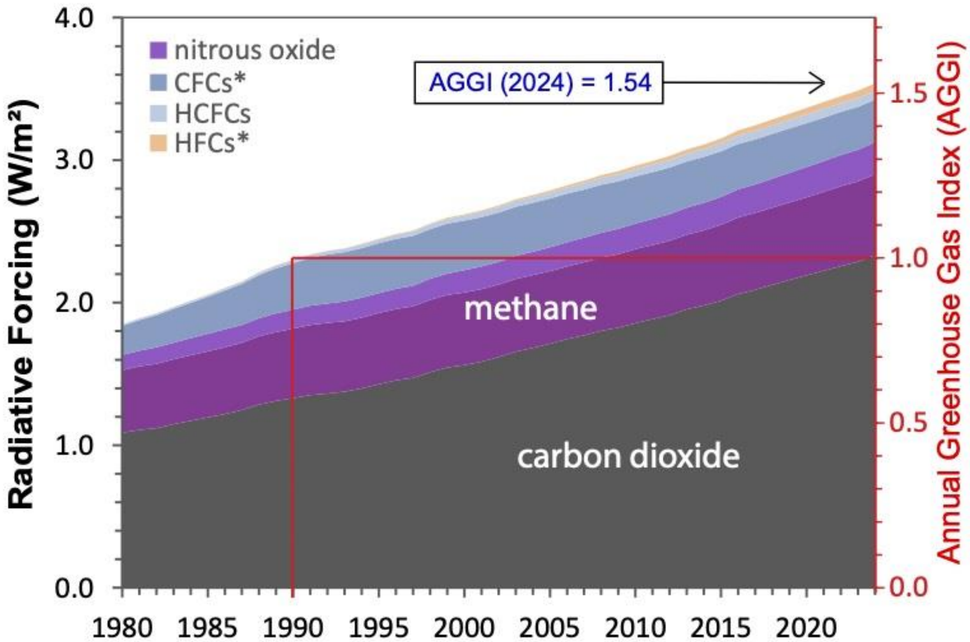
GHG Metric	**CO_2 (ppm)**	**CH_4 (ppb)**	**N_2O (ppb)**
Pre-Industrial Concentration	278	722	270
2024 Atmospheric Concentration	422.80	1,929.56	337.71
2024 Concentration Relative to Pre-Industrial	152%	267%	125%
Report Year Annual Rate of Change (ppm | ppb/yr)	3.72	9	1

Source: https://gml.noaa.gov/aggi/aggi.html
ppm = parts per million, ppb = parts per billion.

Since 2006, NOAA has published updates to its Annual Greenhouse Gas Index (AGGI). The 1990 baseline year is given an AGGI value of 1.0, and the pre-industrial era is given a value of 0.0 (see Figure 3-3) (Lindsey 2020).[12] The AGGI for 2024 was 1.54 which corresponds to CO_2 equivalents atmospheric concentration of 548 ppm.



(A)



(B)

Figure 3-3. 2024 Annual GHG Index

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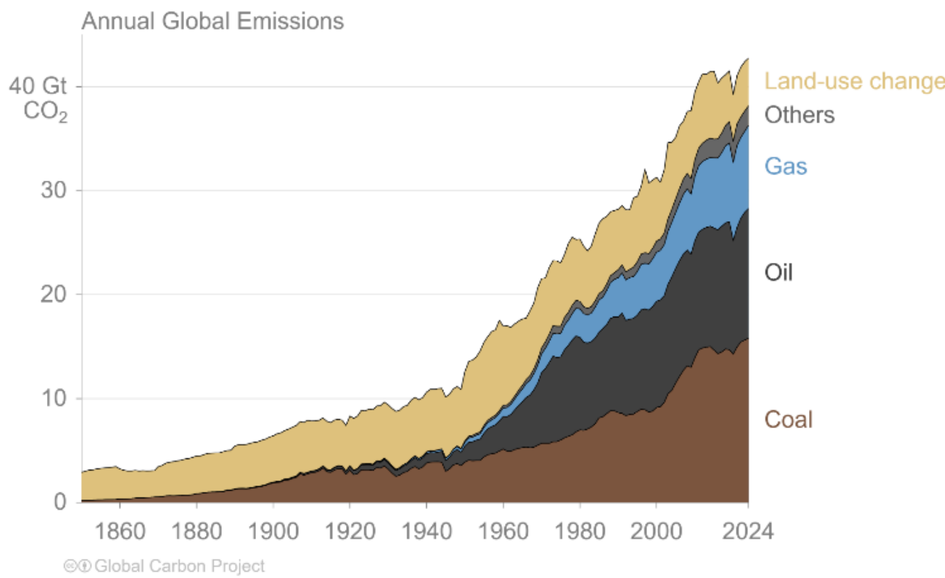
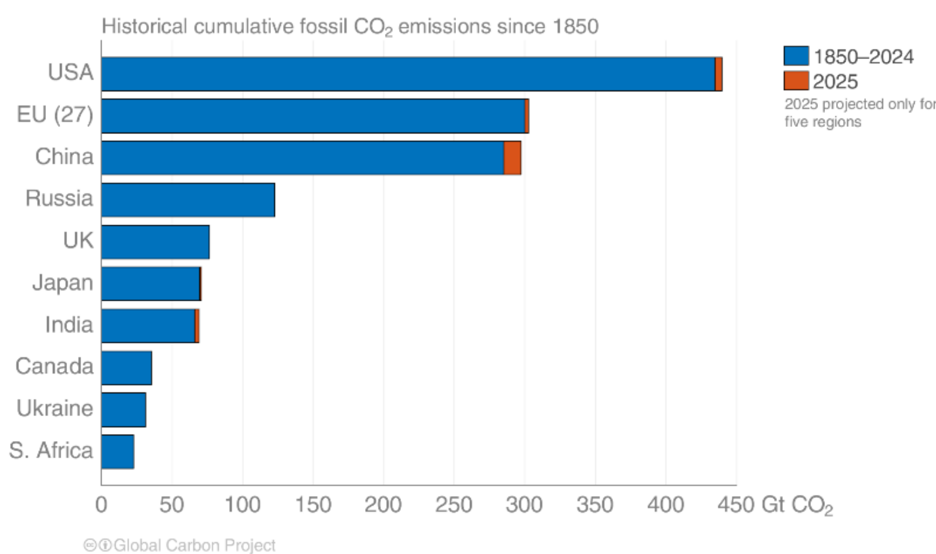
4.0 Global, National, and State GHG Emissions

This chapter discusses past, present, and projected cumulative GHG emissions at various scales. Emissions are summarized from the latest global and national inventories and provide explicit accounting for GHGs from all sources of hydrocarbon combustion. State-level data is also provided for multiple sectors of emitters, including hydrocarbon development.

From pre-industrial times to present, emissions from hydrocarbon combustion and cement production have released approximately 375 [345 to 405] GtC to the atmosphere (68%), while deforestation and other land use change are estimated to have released 180 [100 to 260] GtC (32%). Figure 4-1 shows the estimated annual and cumulative emissions by source and largest emitters from 1850 to present.



(A)

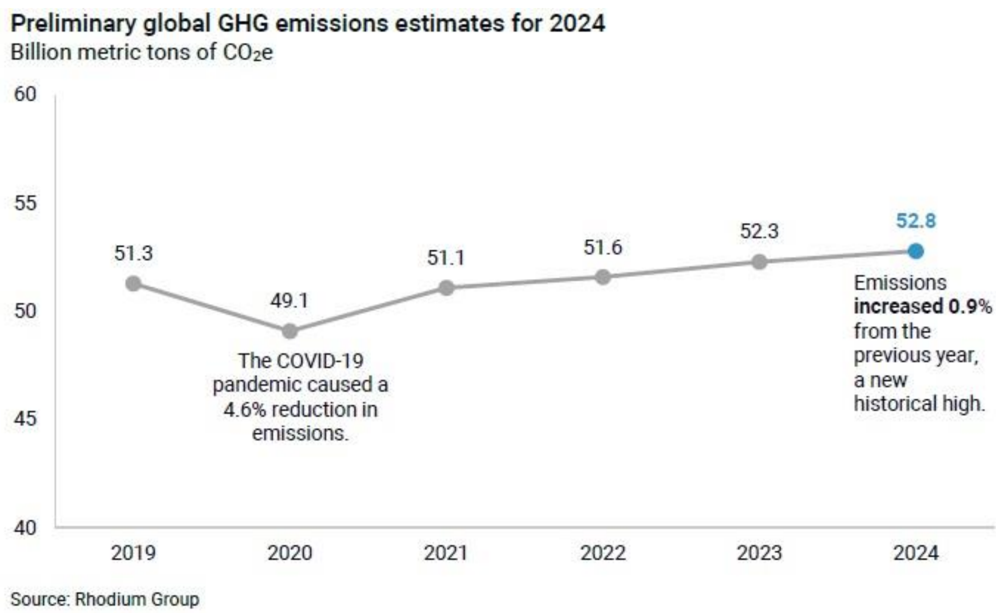


(B)

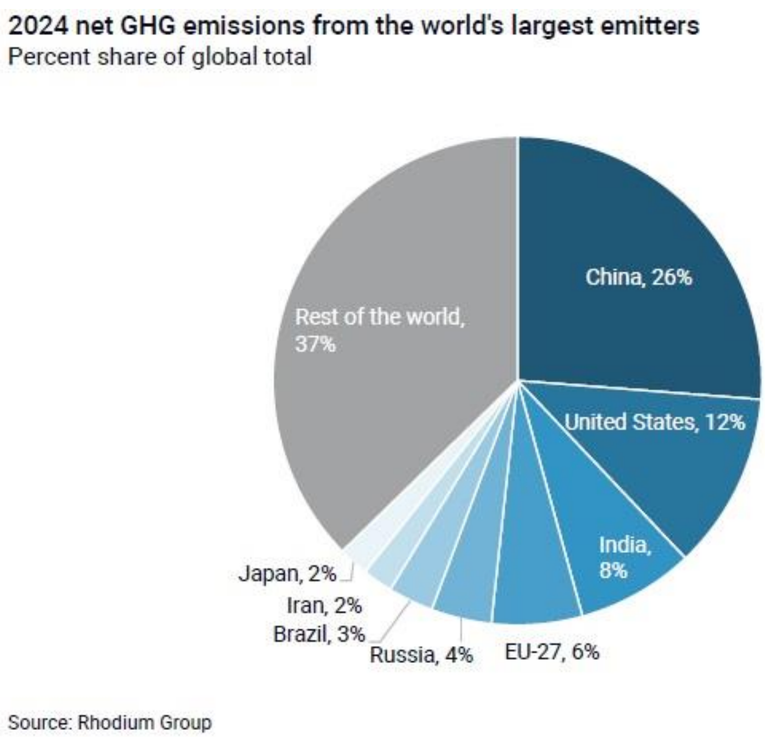
Figure 4-1. Cumulative Global Historical Emissions

4.1 Annual Global Emissions and Concentrations

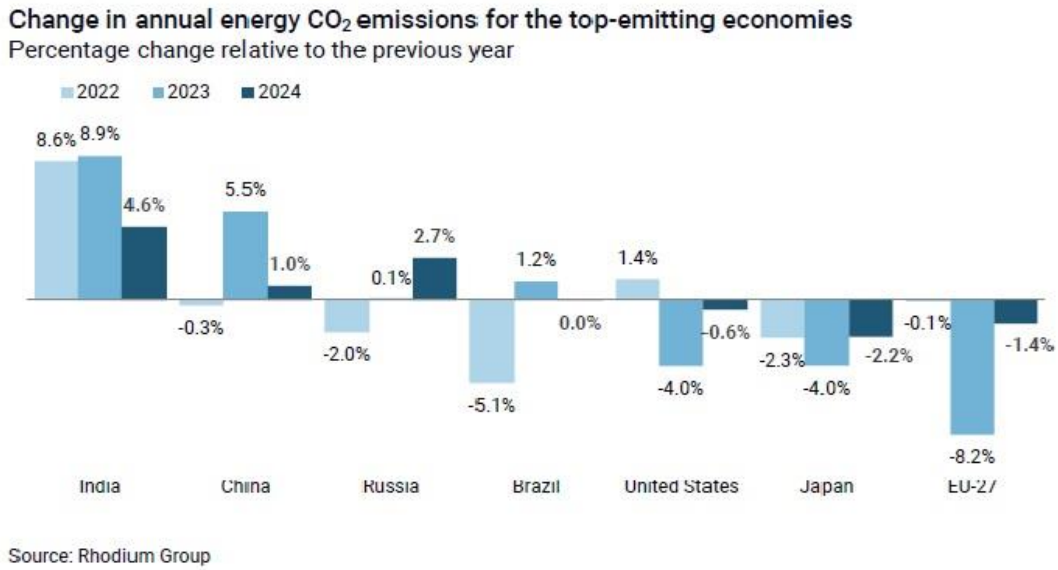
According to preliminary data estimates provided by the Rhodium Group[13] (an independent research provider), cumulative global net GHG emissions increased approximately 0.9% in 2024. Figure 4-2 shows the global CO_2e emissions from GHGs for all sectors, including land-use and land-use changes, increase from 52.3 $GtCO_2e$ in 2023 to approximately 52.8 $GtCO_2e$ in 2024. Figure 4-2 also shows the percent of emissions from the largest emitters by country or region and the annual percent change in emissions relative to the recent previous years. The data shows that the top-emitters were responsible for approximately 63% of the total emissions, and that China alone was responsible for nearly half of that.



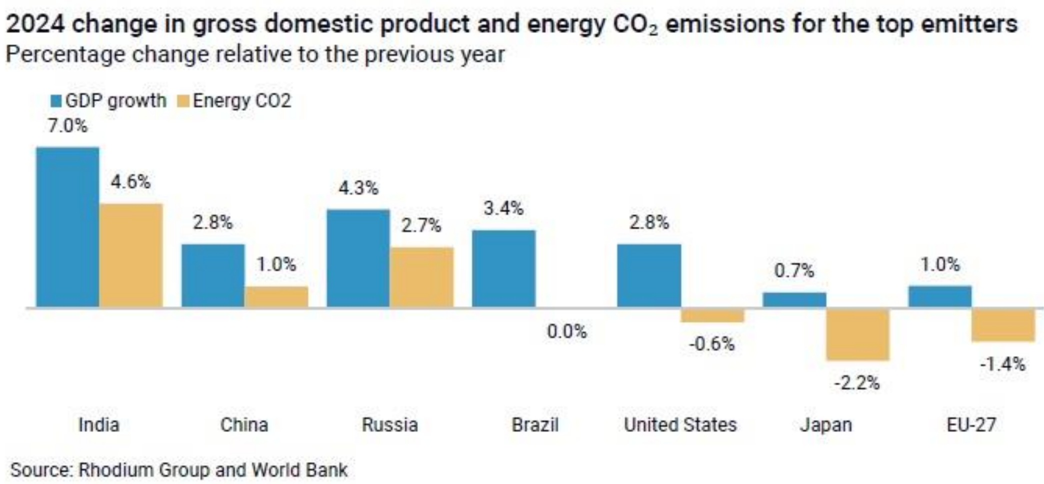
(A)



(B)



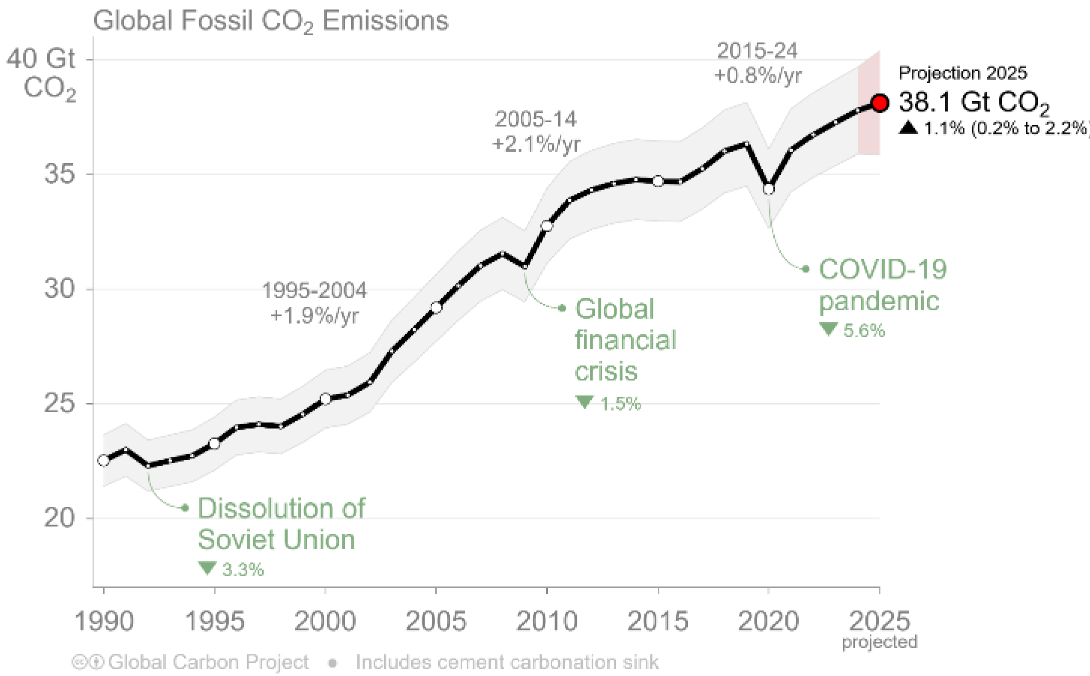
(C)



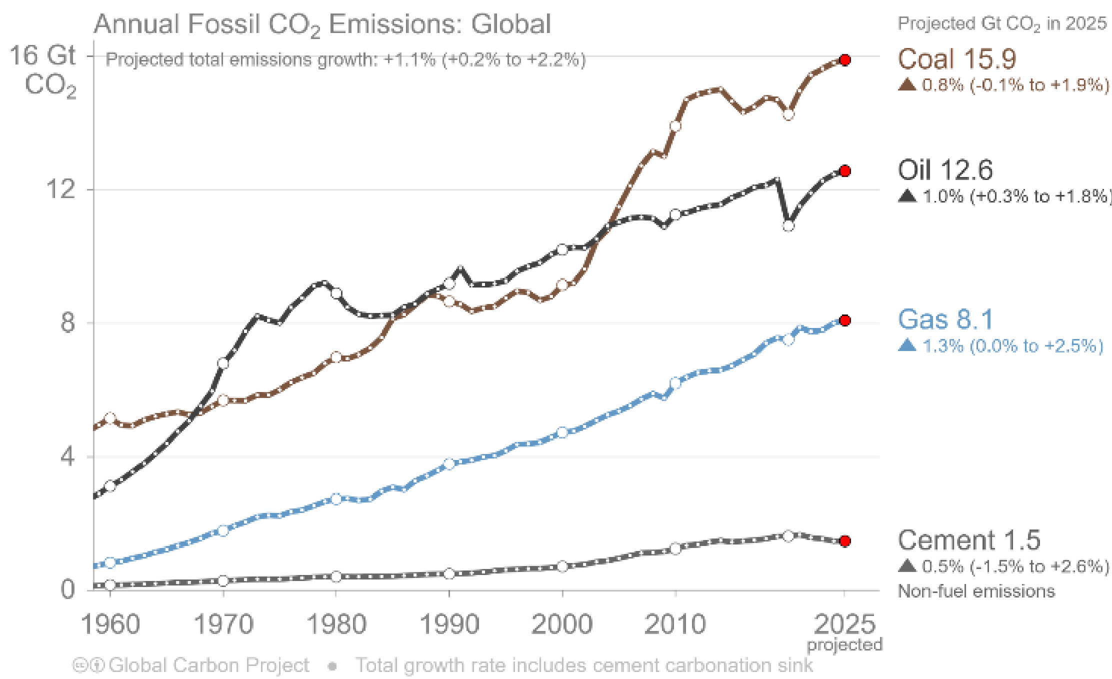
(D)

Figure 4-2. Global GHG Emissions and Top Contributors

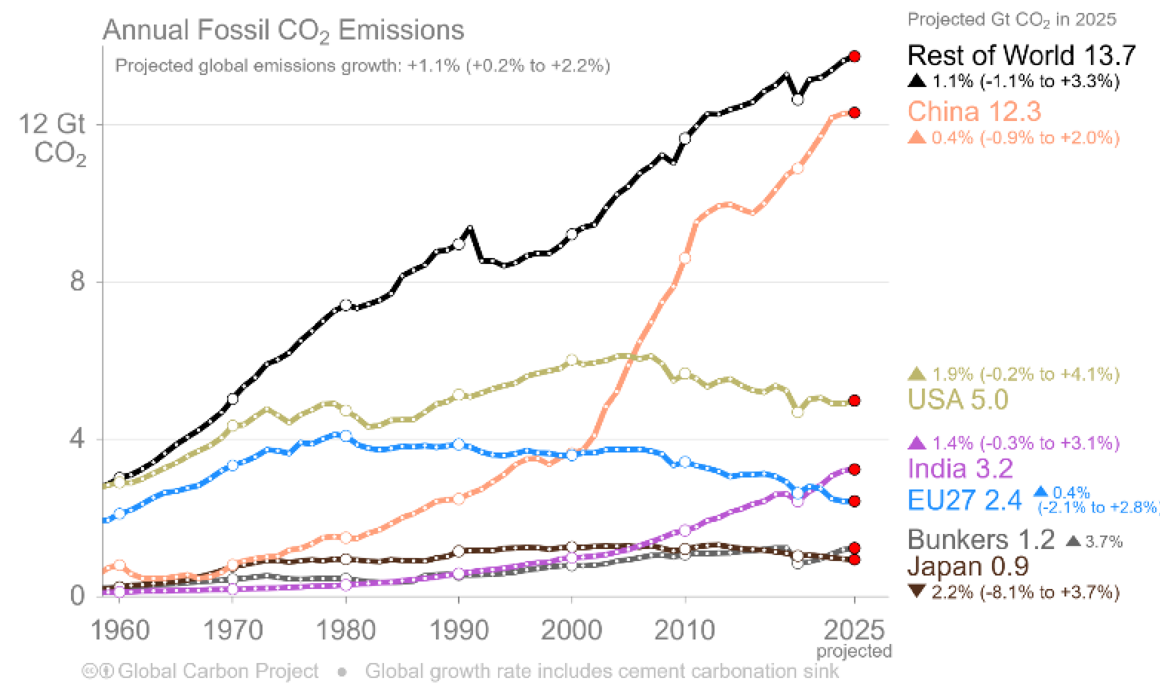
Globally, the use of all hydrocarbons and the CO_2 emissions associated with the combustion of these fuels continue to rise. Figure 4-3 shows global CO_2 emissions from total hydrocarbon consumption, by fuel type, and region. The large increases in global coal emissions since 2000 can largely be attributed to China’s, and more recently, India's increased use of coal-fired power plants.


Global Fossil CO_2 Emissions
40 Gt CO_2
35
30
25
20
2015-24
+0.8%/yr
2005-14
+2.1%/yr
1995-2004
+1.9%/yr
Projection 2025
38.1 Gt CO_2
▲ 1.1% (0.2% to 2.2%)
COVID-19 pandemic
▼ 5.6%
Global financial crisis
▼ 1.5%
Dissolution of Soviet Union
▼ 3.3%
1990
1995
2000
2005
2010
2015
2020
2025
projected
Global Carbon Project • Includes cement carbonation sink

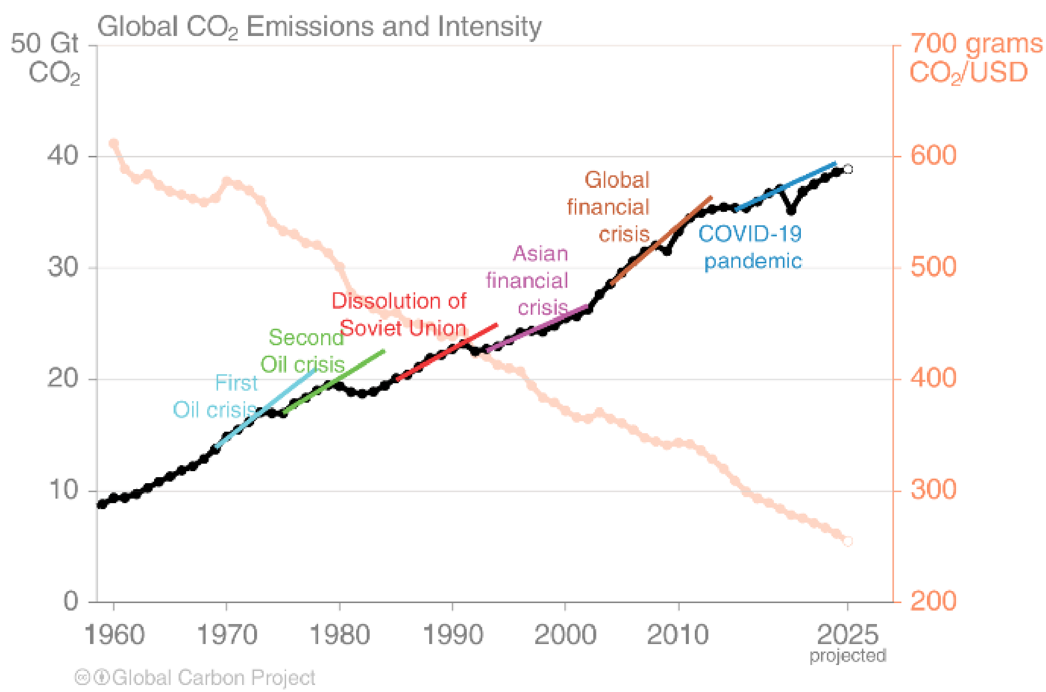
(A)


Annual Fossil CO_2 Emissions: Global
16 Gt CO_2
12
8
4
0
Projected total emissions growth: +1.1% (+0.2% to +2.2%)
Projected Gt CO_2 in 2025
Coal 15.9
▲ 0.8% (-0.1% to +1.9%)
Oil 12.6
▲ 1.0% (+0.3% to +1.8%)
Gas 8.1
▲ 1.3% (0.0% to +2.5%)
Cement 1.5
▲ 0.5% (-1.5% to +2.6%)
Non-fuel emissions
1960
1970
1980
1990
2000
2010
2025
projected
Global Carbon Project • Total growth rate includes cement carbonation sink

(B)



(C)

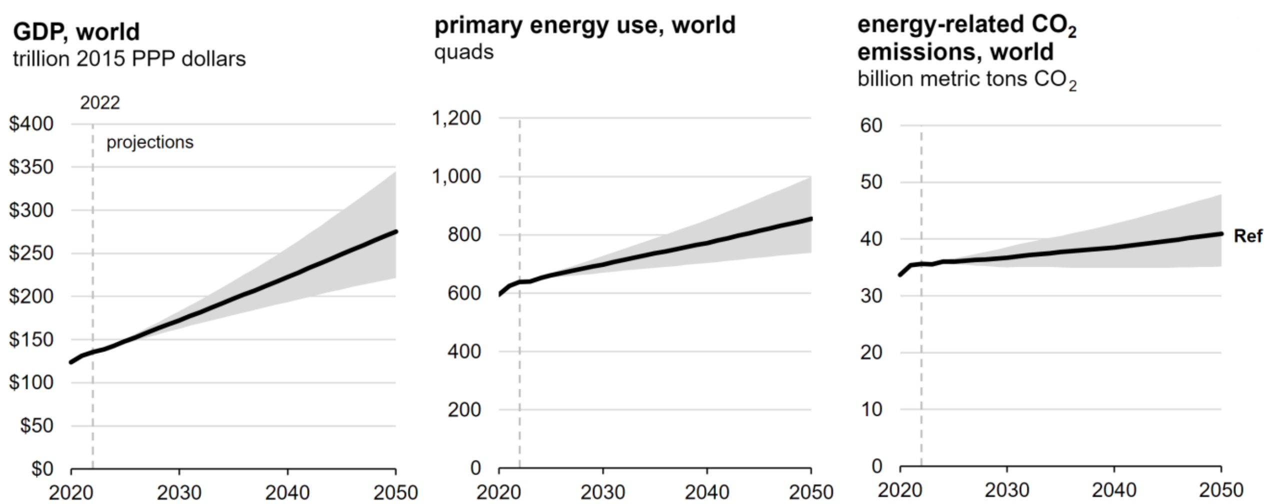


(D)

Figure 4-3. Global CO_2 Emissions

4.2 Projected Global Emissions

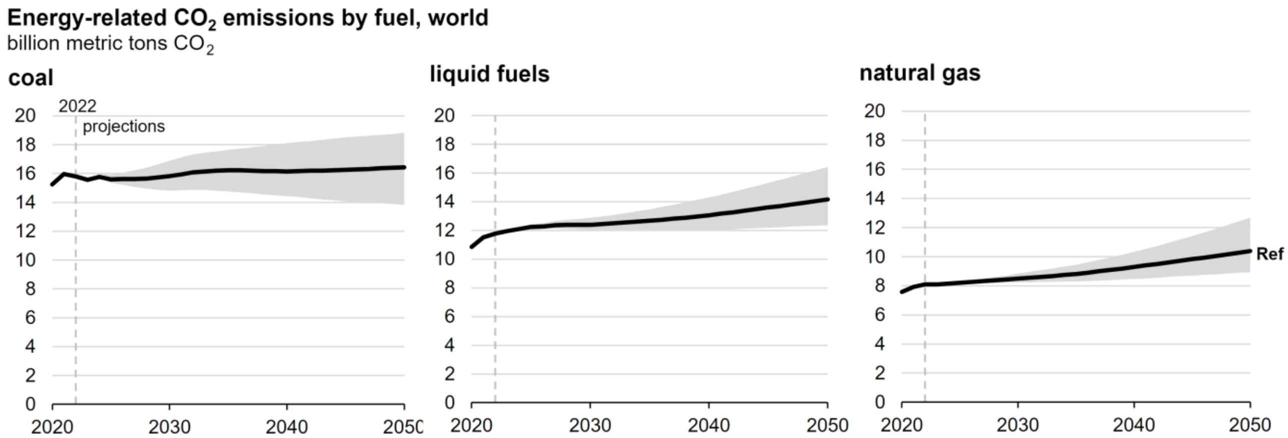
The U.S. Energy Information Administration (EIA) provides long-term (2020-2050) world energy and emissions projections in its International Energy Outlook (IEO). The most recent IEO that contains CO_2 emissions data is the IEO2023, released in October 2023. The IEO provides several different scenarios (cases) to forecast future energy needs and associated hydrocarbon consumption. The reference case reflects current trends and relationships among supply, demand, and prices in the future and is a reasonable baseline case to compare with cases that include alternative assumptions about the future energy system. The IEO reference case assumes global energy consumption will rise nearly 38% between 2022 and 2050. According to the reference case projections, the use of all hydrocarbons increases through 2050, with much of the increased demand coming from Asia. Natural gas consumption is projected to grow between 11% to 57% through 2050, which is limited by the projected growth in renewable energy sources (approximately 32% in 2050). Constant petroleum growth is forecast for the entire projection period, with almost all the supply going towards meeting transportation demand and growth. Global energy-related CO_2 emissions are projected to increase by 15% from 2022 to 2050 from about 35.7 billion metric tons CO_2 to approximately 41 billion metric tons. Although aggregate CO_2 emissions from the energy sector are projected to continue to rise, the carbon intensity of future energy sources (i.e., the amount of CO_2 emissions produced per unit of energy used) is projected to decrease indicating that sources of energy that do not produce CO_2 emissions (e.g., renewables) will comprise a larger portion of meeting future energy demands. Figure 4-4 (EIA IEO graphs) shows some of the energy mix and emissions estimates derived from projected global energy use.



Data source: U.S. Energy Information Administration, *International Energy Outlook 2023* (IEO2023)
Note: Shaded regions represent maximum and minimum values for each projection year across the IEO2023 Reference case and side ca ses. Ref=Reference case; GDP=gross domestic product; quads=quadrillion British thermal units; PPP=purchasing power parity.

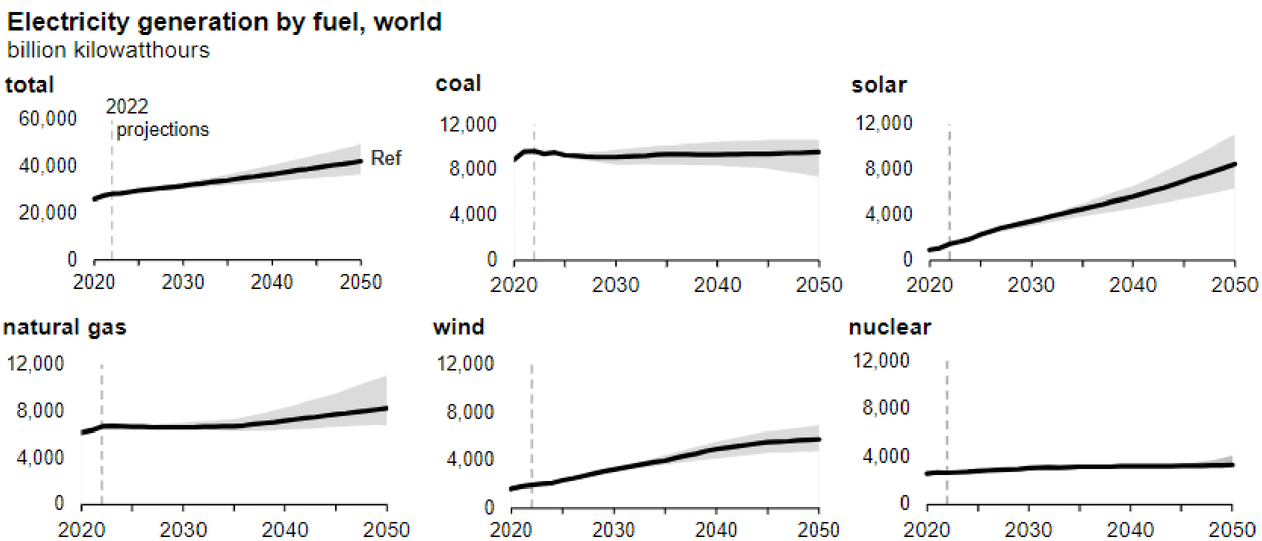
(A)

Energy-related CO2 emissions by fuel, world



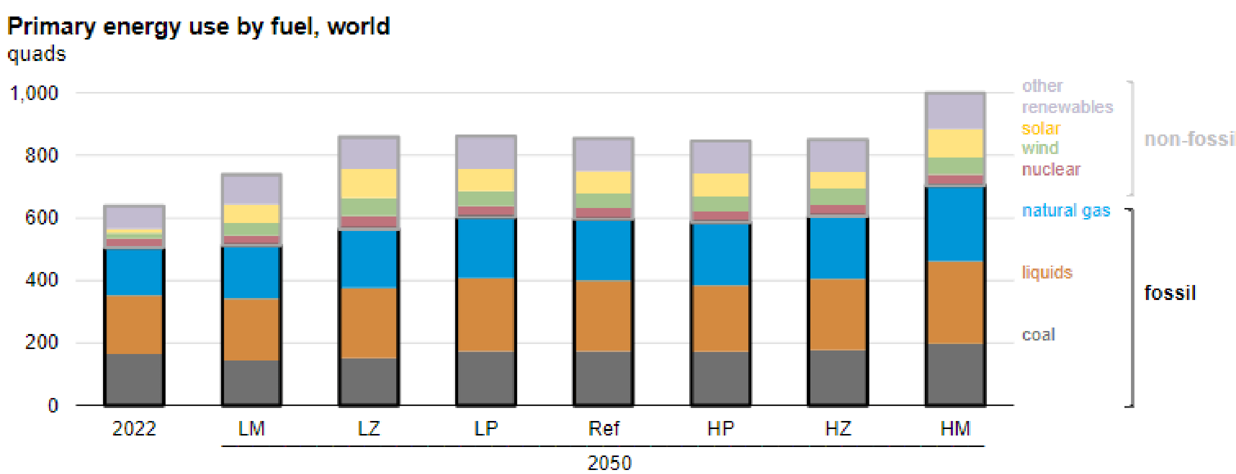
Data source: U.S. Energy Information Administration, *International Energy Outlook 2023* (IEO2023)
Note: Shaded regions represent maximum and minimum values for each projection year across the IEO2023 Reference case and side ca ses. Ref=Reference case.

(B)



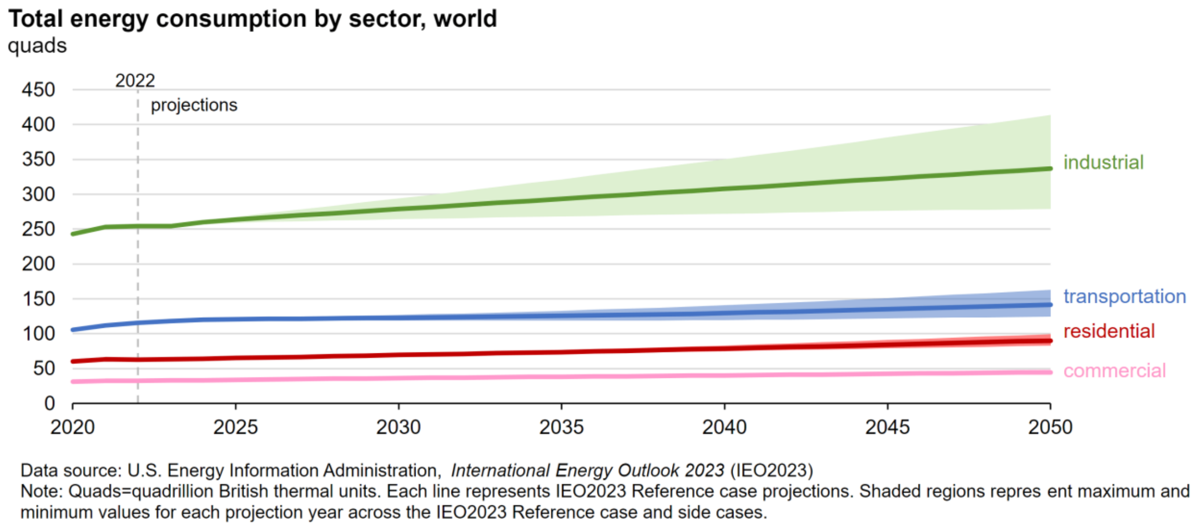
Data source: U.S. Energy Information Administration, *International Energy Outlook 2023* (IEO2023)
Note: Shaded regions represent maximum and minimum values for each projection year across the IEO2023 Reference case and side cases. Ref=Reference case.

(C)



Data source: U.S. Energy Information Administration, *International Energy Outlook 2023* (IEO2023)
Note: Biofuels are included in the "other renewables" category. Quads=quadrillion British thermal units; HZ=High Zero -Carbon Tec hnology Cost case; LZ=Low Zero-Carbon Technology Cost case; HM=High Economic Growth case; LM=Low Economic Growth case; HP=High Oil Price case; LP=L ow Oil Price case; Ref=Reference case.

(D)



(E)

Figure 4-4. IEO - Future Global Energy Related Projections

4.3 Annual U.S. Emissions

The U.S. EPA provides a comprehensive accounting of total GHG emissions for all man-made sources in the United States. The results of these tracking and quantification efforts are published in the annual "Inventory of U.S. Greenhouse Gas Emissions and Sinks." The inventory report is a top-down assessment of national annual GHG emissions and is prepared to comply with commitments under the United Nations Framework Convention on Climate Change (UNFCCC). The EPA generally uses national energy data, data on national agricultural activities, and other national statistics to provide a comprehensive accounting of total GHG emissions. The use of the aggregated national data results in total coverage of sources including small emitters but means that the national emissions estimates for most source categories are not broken down at the geographic or facility level.

According to the latest version of the "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022 (EPA 2024)," total gross U.S. GHG emissions were 6,343.2 Mt of CO2e in 2022, which represents an increase of approximately 1.3% from the previous year and a decrease of 16.7% from the peak emissions in 2005. The decrease in total GHG emissions between 2019 and 2020 was largely due to the impacts of the coronavirus (COVID-19) pandemic on travel and economic activity. The decline also reflects the combined impacts of many long-term trends, including population, economic growth, energy market trends, technological changes including energy efficiency, and the carbon intensity of energy fuel choices. Approximately 82% (5,199.8 Mt) of the total emissions were from the energy sector, primarily hydrocarbon combustion for transportation and electricity generation. The tonnages presented in this paragraph were calculated by the EPA using GWPs from the IPCC's AR5 (shown in Table 4-1). The EPA also presents emissions estimates using GWPs from IPCC's AR6 in the annexes to the "Inventory of U.S. Greenhouse Gas Emissions and Sinks."

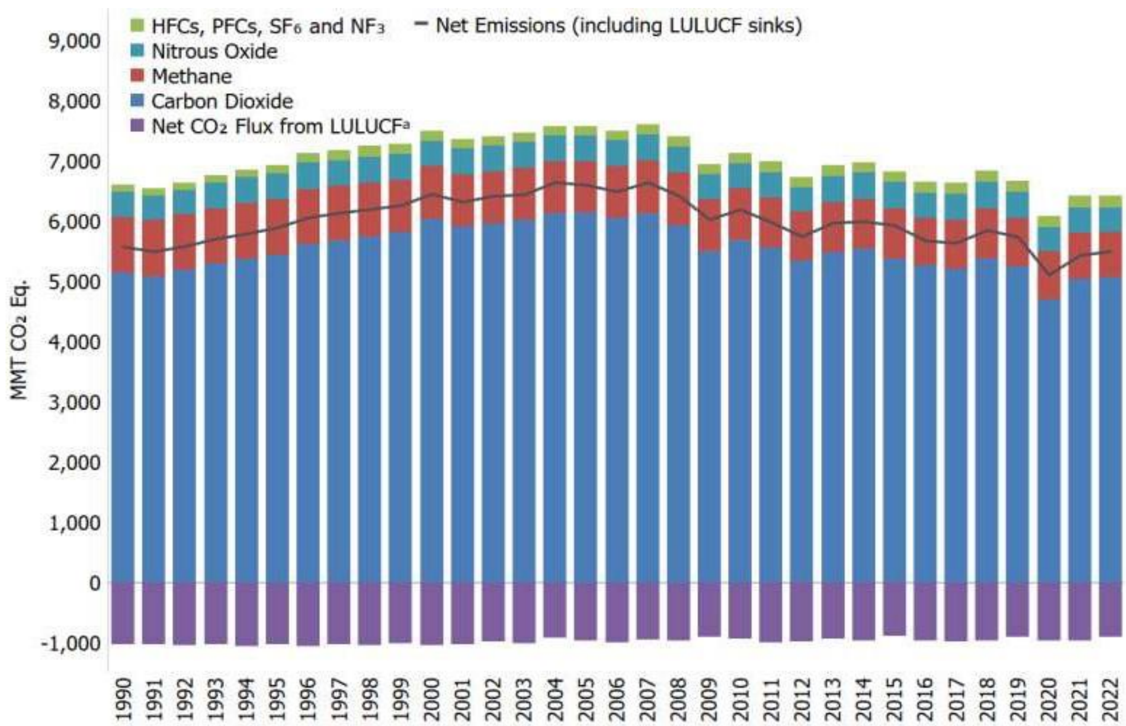
Table 4-1. Select U.S. Total GHG Emissions

IPCC Sector / Category	1990	2005	2018	2019	2020	2021	2022
Energy	5,381.0	6,349.5	5,570.0	5,422.4	4,862.6	5,173.3	5,199.8
Hydrocarbon Combustion	4,752.2	5,744.1	4,988.2	4,852.6	4,341.7	4,654.3	4,699.4
Natural Gas Systems	251.2	236.5	223.0	227.3	217.0	210.4	209.7
Non-Energy Use of Fuels	99.1	125.0	118.4	106.5	97.8	111.6	102.8
Petroleum Systems	59.0	58.5	93.8	97.8	82.3	72.8	61.6
Coal Mining	112.7	75.6	62.2	56.0	48.3	47.1	46.1
Stationary Combustion	32.0	39.3	34.7	32.0	28.5	30.1	33.3
Mobile Combustion	45.6	41.3	20.5	21.9	18.7	19.4	19.3
Incineration of Waste	13.3	13.6	13.7	13.3	13.3	12.8	12.7
Abandoned Oil and Gas Wells	7.8	8.2	8.4	8.5	8.5	8.6	8.5
Abandoned Underground Coal Mines	8.1	7.4	6.9	6.6	6.5	6.3	6.3
Cement Production	33.5	46.2	39.0	40.9	40.7	41.3	41.9
Petrochemical Production	20.1	26.9	27.2	28.5	27.9	30.7	28.8
Field Burning of Agricultural Residues	0.7	0.8	0.8	0.9	0.8	0.8	0.8
Waste	235.9	192.0	173.2	175.8	171.7	169.2	166.9
Landfills	197.8	147.7	126.3	128.7	124.1	122.0	119.8
Wastewater Treatment	37.5	40.7	42.5	42.7	43.2	42.7	42.7
Composting	0.7	3.6	4.3	4.3	4.4	4.4	4.4
Total Gross Emissions (Sources)	6,536.9	7,494.6	6,752.7	6,590.1	6,001.8	6,328.8	6,343.2
LULUCF Sector Net Total	-976.7	-907.7	-915.5	-863.6	-904.4	-910.6	-854.2
Forest Land	-1,069.0	-960.2	-963.8	-907.3	-946.6	-924.2	-872.0
Cropland	40.4	2.9	14.2	12.0	20.5	2.9	3.4
Grassland	59.8	46.7	54.9	54.3	45.8	36.0	39.6
Wetlands	44.0	41.2	38.9	38.9	38.8	38.8	38.8
Settlements	-51.9	-38.1	-59.7	-61.4	-63.0	-64.1	-64.1
Net Emission (Sources and Sinks)	**5,560.2**	**6,586.9**	**5,837.3**	**5,726.6**	**5,097.4**	**5,418.2**	**5,489.0**

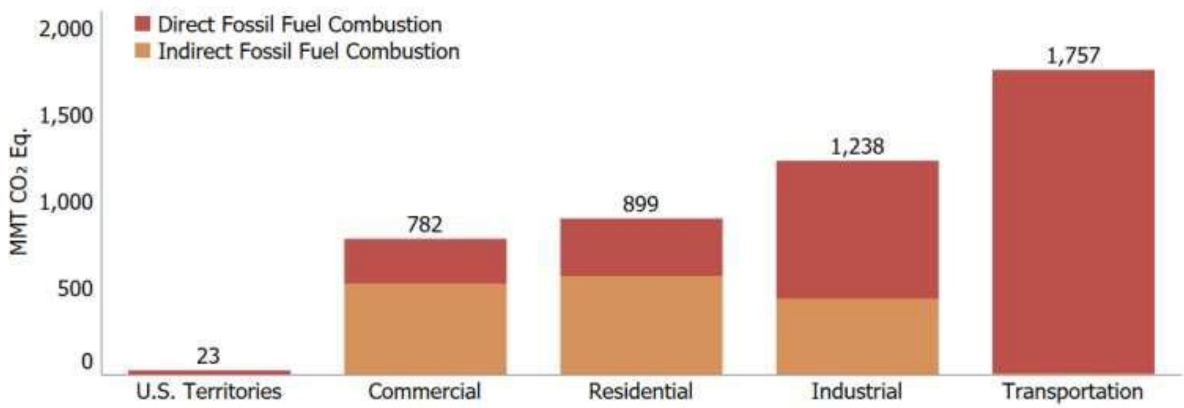
The primary GHG emitted by human activities in the U.S. was CO_2, representing approximately 79.7% of total 2022 GHG emissions on a GWP-weighted basis. The largest source of CO_2, and of overall GHG emissions, was hydrocarbon combustion (4,699 Mt). CH_4 emissions from all sectors (760.8 Mt) accounted for 11.1% of U.S. emissions in 2022. The major sources of CH_4 include natural gas systems, enteric fermentation and manure management associated with domestic livestock, and decomposition of wastes in landfills. N_2O emissions accounted for 6.1% of total GHG emissions (398.8 Mt). The agricultural sector including fertilizers and soil management and manure management was the largest source of N_2O emissions. Figure 4-5 shows total U.S. GHG emissions by greenhouse gas and source sector.

The EPA GHG inventory report includes emissions data broken out by five different emissions sectors. The energy sector includes three different subcategories—coal mining, natural gas and petroleum systems, and hydrocarbon combustion. The emissions itemized under the coal mining and natural gas and petroleum systems subcategories include emissions for all U.S. sources in each of these categories and are not differentiated by mineral ownership (i.e., federal, state, or private minerals). The coal mining sector includes emissions from underground and surface mining as well as post mining activities and abandoned underground mines. In 2021, GHG emissions from this subcategory were 53.6 Mt, a decrease of 2.4% from the previous year. The natural gas and petroleum systems subcategory includes emissions from oil and gas exploration, production, and processing as well as other sources. In 2021, GHG emissions from this subcategory were 300.7 Mt, a decrease of 6% from the previous year.

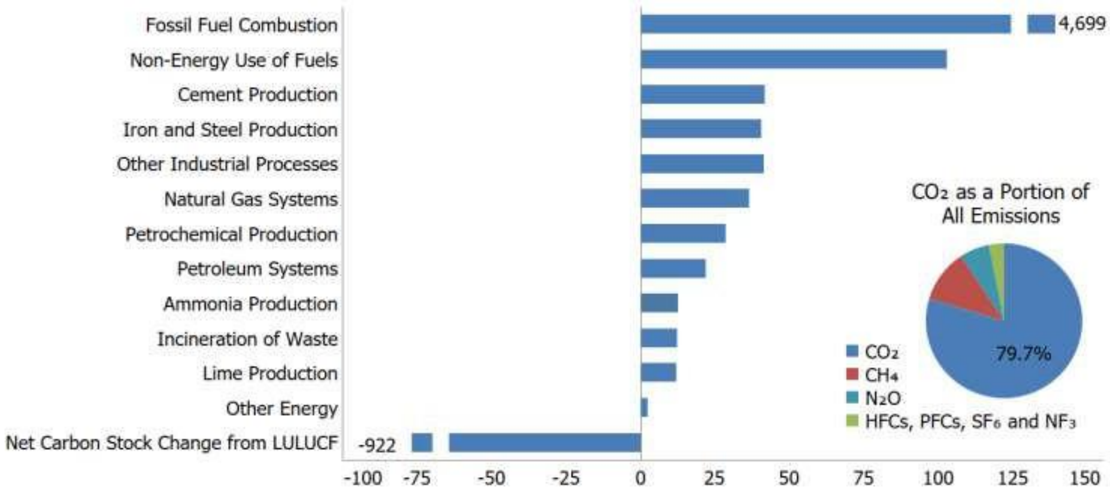
The hydrocarbon combustion subcategory includes emissions from the use of hydrocarbons in transportation, electricity generation, industry, and residential use. In 2021, the total GHG emissions from this subcategory were 4,689.4 Mt, up 6.3% from the previous year. Figure 4-4 shows the CO_2 emissions from hydrocarbon combustion since 1990.



(A)



(B)



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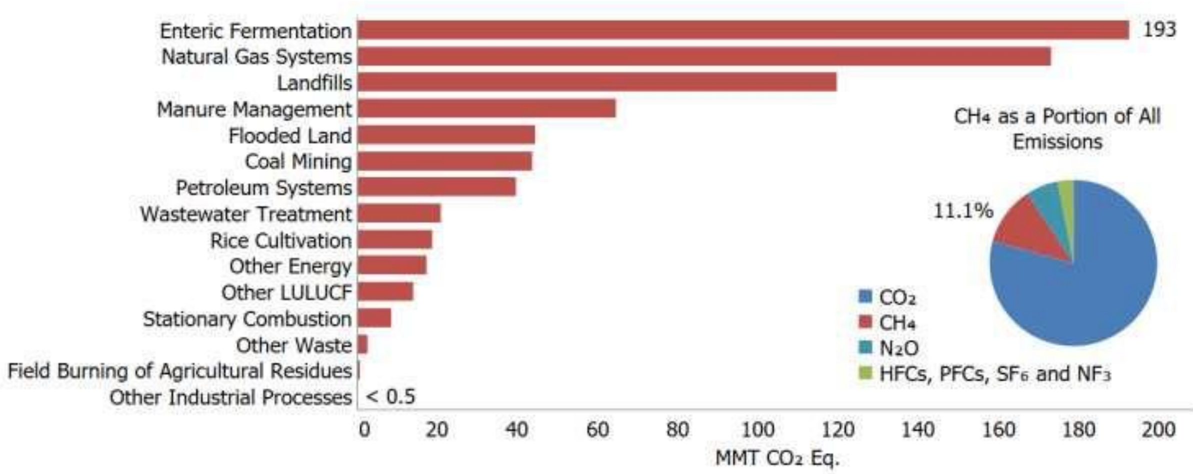
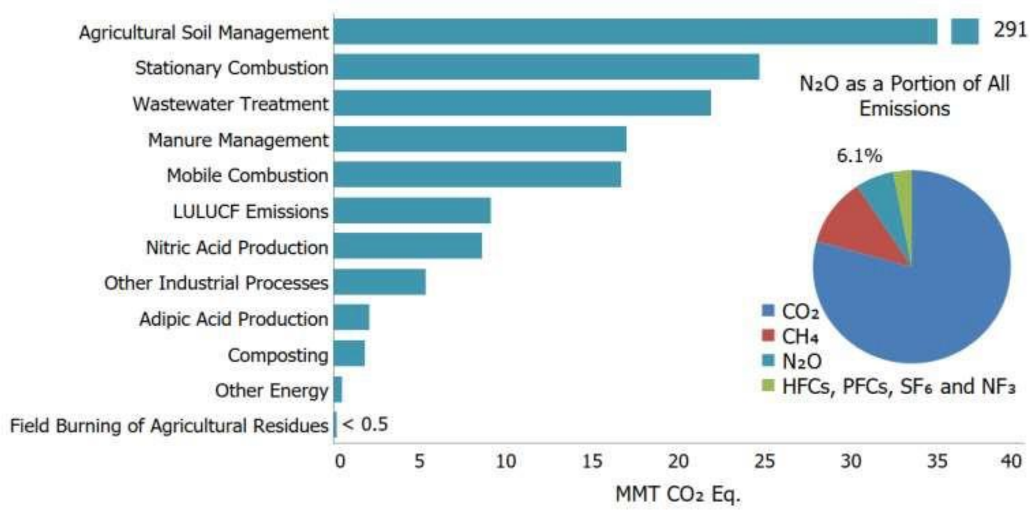


(D)



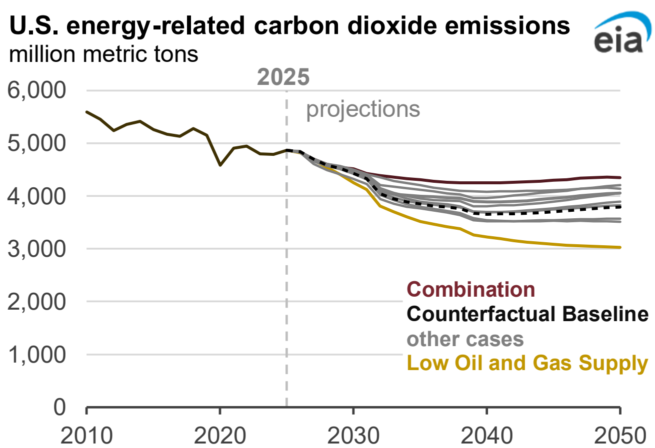
(E)

Figure 4-5. U.S. GHG Emissions

4.4 Projected U.S. Emissions

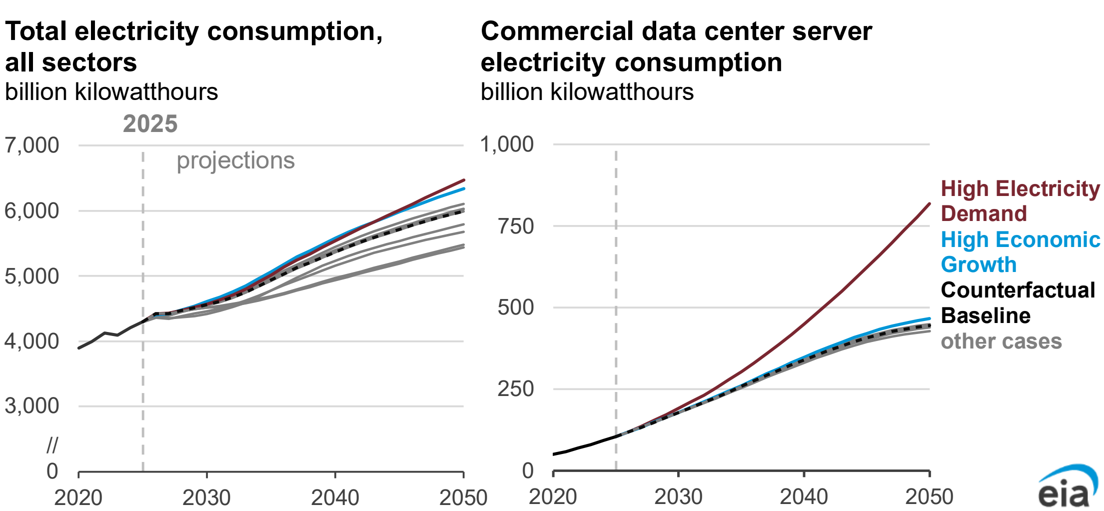
In addition to providing long-term projections for global energy demand and associated CO_2 emissions, the EIA produces an assessment of domestic energy and emissions trends through 2050 in its Annual Energy Outlook (AEO) report. Based on the range of assumptions the EIA modeled (including the modifying assumptions incorporated under the One Big Beautiful Bill Act (OBBBA)) projections for energy-related CO_2 emissions from hydrocarbon consumption are projected to fall between 11% to 38% by 2050.

There are no major anticipated shifts in domestic oil and gas consumption through about 2040, but high international demand leads to continued growth in domestic production and allows the U.S to remain a net exporter of petroleum products and natural gas through 2050. The domestic use of coal is projected to decline significantly by 2032, especially in terms of its use for electricity production. Coal exports are forecast to remain steady or grow slightly over the projection period. Figure 4-6 shows the projected changes in U.S. hydrocarbon use and emissions through 2050.



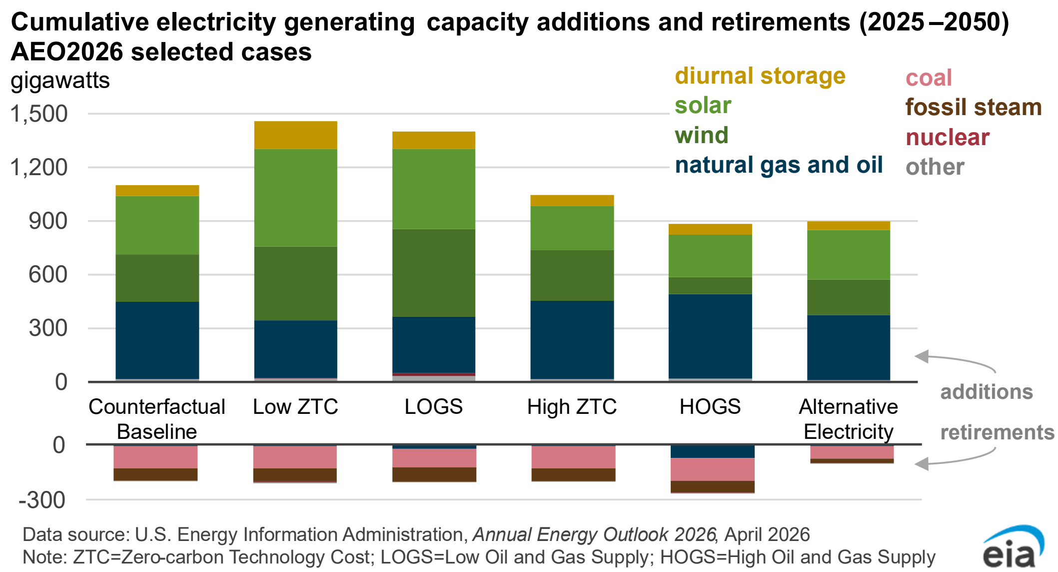
Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2026,* April 2026
Note: Combination=Alternative Transportation-Alternative Electricity

(A)



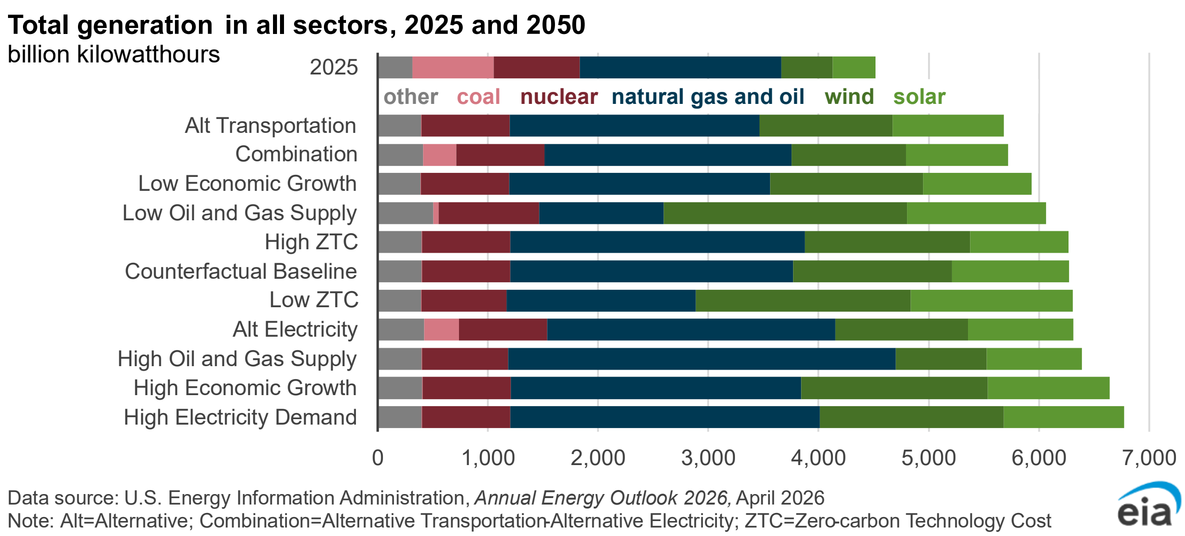
Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2026,* April 2026

(B)



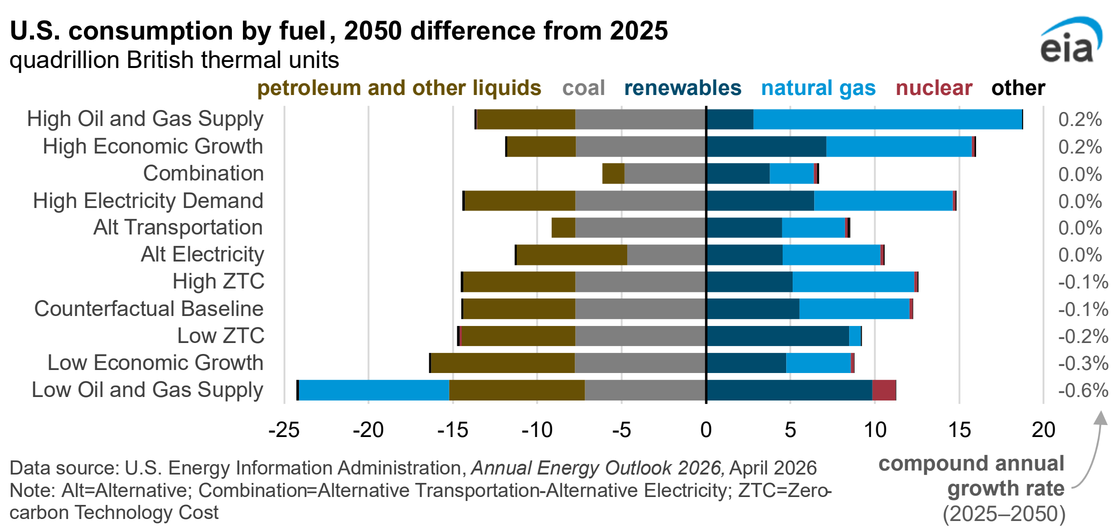
Cumulative electricity generating capacity additions and retirements (2025–2050)
AEO2026 selected cases
gigawatts
1,500
1,200
900
600
300
0
-300
diurnal storage
solar
wind
natural gas and oil
coal
fossil steam
nuclear
other
Counterfactual Baseline
Low ZTC
LOGS
High ZTC
HOGS
Alternative Electricity
additions
retirements
Data source: U.S. Energy Information Administration, Annual Energy Outlook 2026, April 2026
Note: ZTC=Zero-carbon Technology Cost; LOGS=Low Oil and Gas Supply; HOGS=High Oil and Gas Supply

(C)



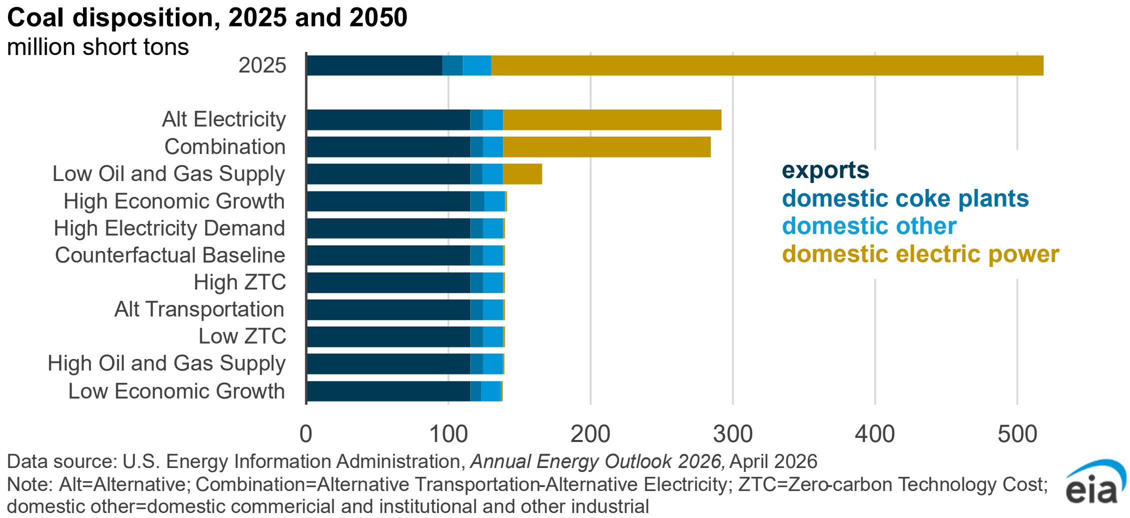
Total generation in all sectors, 2025 and 2050
billion kilowatthours
2025
other
coal
nuclear
natural gas and oil
wind
solar
Alt Transportation
Combination
Low Economic Growth
Low Oil and Gas Supply
High ZTC
Counterfactual Baseline
Low ZTC
Alt Electricity
High Oil and Gas Supply
High Economic Growth
High Electricity Demand
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
Data source: U.S. Energy Information Administration, Annual Energy Outlook 2026, April 2026
Note: Alt=Alternative; Combination=Alternative Transportation-Alternative Electricity; ZTC=Zero-carbon Technology Cost

(D)



U.S. consumption by fuel, 2050 difference from 2025
quadrillion British thermal units
petroleum and other liquids
coal
renewables
natural gas
nuclear
other
High Oil and Gas Supply
High Economic Growth
Combination
High Electricity Demand
Alt Transportation
Alt Electricity
High ZTC
Counterfactual Baseline
Low ZTC
Low Economic Growth
Low Oil and Gas Supply
0.2%
0.2%
0.0%
0.0%
0.0%
0.0%
-0.1%
-0.1%
-0.2%
-0.3%
-0.6%
-25
-20
-15
-10
-5
0
5
10
15
20
compound annual growth rate (2025–2050)
Data source: U.S. Energy Information Administration, Annual Energy Outlook 2026, April 2026
Note: Alt=Alternative; Combination=Alternative Transportation-Alternative Electricity; ZTC=Zero-carbon Technology Cost

(E)



(F)

Figure 4-6. U.S. Projected Emissions & Energy Mix (2026 AEO)

4.5 State Emissions

Each year, the U.S. EPA compiles disaggregated data on GHG emissions at both a state and facility level. The state-level emissions are derived from the national inventory report. Detailed emissions data from the largest GHG-emitting facilities in the U.S. are collected through EPA's GHG Reporting Program (GHGRP). Large emitters of GHG emissions (> 25,000 tons/year) in each state are required to report their annual emissions along with other relevant facility data. Approximately 8,000 facilities report their emissions annually. The data is compiled by facility and by state and are available through EPA's Facility Level Information on Greenhouse gases Tool (FLIGHT). The GHGRP data are useful for understanding the major sources and types of GHG emissions within a state; however, it is not a comprehensive emissions inventory for each state as many sources of emissions (e.g., agriculture and land use sectors) are not required to report. The EPA has estimated that GHGRP reporting covers approximately 85% of the total GHG emissions for sector-specific sources. Table 4-2 shows the most recent GHG emissions estimates by the EPA for the states in which the BLM authorizes leasing and development of federal hydrocarbon minerals. The information below is shown as the sum of all sectors.

Table 4-2. State GHG Emissions - All Sectors (Mt CO_2e)

State	1990	2005	2018	2019	2020	2021	2022
Alabama	143.10	172.88	133.52	138.98	131.56	125.26	135.33
Alaska	36.02	48.88	34.36	33.53	33.70	35.63	37.92
Arkansas	78.80	90.20	93.00	99.70	92.60	81.20	88.00
Arizona	80.51	117.13	106.32	111.38	109.55	97.02	100.00
California	439.40	465.79	418.21	418.19	421.60	373.77	393.35
Colorado	100.48	138.63	129.13	129.51	131.85	118.41	122.50
Idaho	22.79	31.81	34.73	34.83	36.45	36.98	37.83

Illinois	253.89	294.55	248.75	255.56	243.07	209.67	223.38
Indiana	237.78	270.55	211.51	224.53	209.97	183.17	193.63
Kansas	118.86	126.10	112.02	112.76	112.42	107.69	109.01
Kentucky	170.05	191.12	146.83	152.05	142.27	127.93	138.71
Louisiana	229.55	230.75	220.14	227.68	232.29	215.72	224.55
Maryland	82.33	94.98	64.43	71.23	66.41	57.68	62.58
Michigan	220.03	227.89	189.21	195.97	190.63	168.11	178.95
Mississippi	64.42	80.72	76.91	79.79	79.05	79.76	79.36
Montana	50.85	59.70	55.31	56.43	58.64	48.80	52.25
Nebraska	65.71	81.71	87.34	92.98	90.37	83.62	85.39
Nevada	36.02	58.44	44.59	45.89	46.76	42.07	45.06
New Mexico	78.28	96.77	80.08	76.65	81.97	76.31	75.84
New York	236.32	242.27	192.58	200.79	197.15	175.53	185.74
North Dakota	62.25	71.31	85.66	97.39	100.97	86.50	88.39
Ohio	301.03	319.69	242.30	249.35	232.37	222.79	235.42
Oklahoma	143.68	157.11	146.49	152.34	143.12	131.07	133.48
Oregon	44.28	55.10	51.42	52.11	54.61	50.44	51.43
Pennsylvania	303.25	329.13	275.14	280.94	277.23	251.81	267.73
South Dakota	31.56	37.48	42.09	44.54	43.92	41.35	42.22
Tennessee	127.73	148.95	114.97	111.16	110.31	101.92	111.43
Texas	769.43	838.26	856.34	888.68	893.84	826.29	873.11
Utah	65.36	83.86	73.58	74.90	75.67	72.33	76.91
Virginia	135.91	152.85	125.51	130.21	125.03	120.12	120.13
West Virginia	144.99	143.96	127.09	124.07	118.43	108.02	117.69
Wyoming	79.35	100.68	92.43	93.82	87.32	84.96	83.73

Source: State GHG Emissions and Removals I US EPA
Updated data not available from EPA

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5.0 Methods and Assumptions

This report contains estimates of both direct and indirect (including downstream combustion) emissions from BLM-authorized hydrocarbon development on the federal mineral estate for the three primary GHGs of concern (CO_2, CH_4, N_2O). In addition, the estimated emissions are aggregated at different scales for comparison to emissions reports and inventories completed by other entities at state, national, and global scales and for relevant industrial sectors. Estimated emissions from BLM-authorized activities are aggregated by BLM state administrative units for comparison to state emissions inventories and to put the scale of emissions into context.

The term direct is used to describe emissions from hydrocarbon mineral development and production-related activities authorized by the BLM that typically take place on leased acres of the federal mineral estate. Direct emissions could result from a variety of activities, such as lease exploration, access road construction, well pad or coal mine development, well drilling and completions, recurring maintenance and production equipment operations, and site reclamation. Indirect emissions are those that result from activities outside of the BLM's oversight authority and for which the agency exercises no continuing program of responsibility, such as off-lease infrastructure development and maintenance, transportation and distribution, processing and refining, and the end use (including combustion) of any federal minerals produced. End use emissions make up the majority of GHG emissions related to federal energy resource development. The sum of the direct and indirect GHG emissions from hydrocarbon mineral production and consumption/end-use is also known as a Life-Cycle-Assessment (LCA).

The emissions estimates are also presented at two cumulative scales: geographic and temporal. The geographic cumulative scale is the entire onshore federal mineral estate managed by the BLM. The temporal cumulative scales include estimated emissions from total federal onshore mineral production projected for the next 12 months, the life-of-project emission estimates associated with the 12-month projections, and the long-term emissions from the portion of energy demand estimated to be met from the federal mineral estate out to year 2050 using data from the EIA. The estimates provide a baseline to compare emissions from BLM-authorized development with those of the broader economy (national and global) and illustrate the degree to which federal hydrocarbon mineral development contributes to projected GHG emissions.

As part of the full life-cycle assessment, this report also includes projections of emissions on both a short-term and long-term basis: in which the short-term estimates are based on reasonably foreseeable development trends derived from leasing and production statistics, and the long-range estimates are based on the analysis of energy market dynamics developed by the EIA in its Annual Energy Outlook (AEO) report. Together, the estimates are designed to provide relevant, well-supported, and evidence based information that is intended to account for GHG emissions from BLM-approved projects to develop the federal mineral estate.

5.1 Emissions Factors and Production

To characterize direct and certain indirect GHG emission estimates in this report, the BLM applies a combination of published LCA data, other studies and statistics, and assumptions for each hydrocarbon type. The LCA data presented in this report are meant to broaden the analysis of the potential emissions that could result from BLM management of the onshore federal mineral estate. While this approach depicts the energy-in/energy-out emissions calculus, LCA accounting is not accurate in terms of the true GHG burden federal minerals represent. For example, adding all the energy life cycle emissions inventories prepared for hydrocarbon mineral development would result in totals greater than the levels reported at national scales (e.g., EPA's National Emissions Inventory Report). This is because LCA accounting for each mineral can lead to double-counting effects when the results of each separate mineral type are added (Lenzen 2008).[14] Ultimately, a portion of the mineral production will be used to obtain more minerals. For example, petroleum is used and accounted for throughout coal's life cycle in the form of combustion from mining and transportation activities and has thus been double counted relative to estimating total petroleum in its own bin. For any accounting period, there can be no greater sum of emissions than that for which the supply of each mineral type can provide. In general, this means that the total federal GHG burden on the environment is best described by the end use, or downstream combustion portion of the disclosed accounting, plus any fugitive emissions that result from hydrocarbon mineral processes prior to end use. Some of the referenced LCA sources contain estimates for systemic losses of methane (i.e., fugitive emissions), such that when this data is available the BLM back-calculates the fugitive losses from the direct emissions to improve transparency regarding emissions resulting from BLM-authorized development.

The end-use phase emissions for coal, oil, and gas (assumed combustion) are estimated using EPA emissions factors from Tables C-l and C-2 of 40 CFR Part 98, Subpart C, as shown in Tables 5-2, 5-8 and 5-10. The EPA factors were chosen to represent the downstream portion of these life-cycle emissions since they provide a relatively straightforward basis for estimating the consumption of each fuel for which the actual downstream transformation or use is relatively unknown compared to the assumptions and specificity used in the LCA data.

Hydrocarbon production is the primary input used in the LCA methodology, and generally in this report. The BLM uses data and statistics from the EIA and the Office of Natural Resources Revenue (ONRR), both of which provide production accounting services for domestic hydrocarbon minerals to estimate report year emissions on a fiscal year basis (when such data exists).

5.2 Coal

Virtually all coal produced in the U.S is classified as either thermal (steam coal) or metallurgical (met or coking coal). Steam coal has a variety of energy-related uses in several sectors of the economy, including as a primary fuel for baseload electrical generating plants. Met coal is used (indirectly, as coke) as a fuel and reactant in steel production blast furnaces. Regardless of classification, the BLM is unaware of any non-combustion or other de minimis uses for coal stocks and thus assumes 100% combustion for all federal coal produced.

To estimate the LCA emissions associated with federal coal production, this report relies on data obtained from several sources to adequately capture the variability of mine activities occurring at regional scales. The estimates use production metrics representative of operational mines (underground and surface) in each state to evaluate the GHG emissions profiles for extraction. For Wyoming, Montana, and North Dakota, life-cycle emission factors developed by the Department of Energy's National Energy Technology Laboratory (NETL)[15] are used to evaluate emissions from production and the export transport of coal regardless of actual state origin. For New Mexico, Oklahoma, and Alabama, NETL life-cycle emission factors for U.S coal-fired power plants[16] were used for production emissions estimates. For Colorado and Utah, the BLM used detailed internal data from operational mines (both underground and surface) to evaluate LCA GHGs associated with production.

This year's report also incorporates data from a work product developed by the U.S. Geologic Survey (USGS) under an interagency agreement (IAA L21PG00l 34)[17] signed with BLM in 2021. The agreement enlists USGS support for estimating GHG emissions from active and future coal mining operations, by specifically calculating the remaining federal coal resources and reserves at active mines and updating projected future coal mining activities on federal lands. This work was pivotal for allowing the BLM to produce longer term estimates for the federal coal program based on existing and potential coal leases, limited market dynamics, coal plant closure forecasts, and the direct input from mine operators. The USGS projections provide estimates for fugitive methane emissions from mining (direct) and post mining (indirect) activities, transport emissions (indirect) for known coal delivery destinations and methodologies, and sector specific downstream (indirect) estimates for produced coal end-use, based on the type of coal mined (steam or metallurgic) The data shows a nearly 9-fold reduction in emissions resulting from declining coal production from Federal- lease mine plans as coal-burning power plants are retired, with a significant reduction projected around 2032 (assumes the abandonment of multiple Federal-lease mines following coal-fired power plant shutdowns). The BLM is retaining our original methodology of using emissions factors from tables C-1 and C-2 of 40 CFR Part 98, Subpart C, for estimating coal combustion emissions. Calculating sector specific combustion emissions for coal adds little value for reporting purposes since BLM does not provide similar sector specific downstream oil and gas emissions estimates in this report at present. BLM's purpose in this report is to account for and disclose an overall carbon footprint from the federal mineral estate. However, we are incorporating the federal coal ranks from USGS's work (as opposed to the state level EIA coal ranks) to provide for refined emissions factor calculations. Additionally, we note that the BLM's internal analysis of the report year data shows that the USGS and BLM methods deviate in total emissions by about 3.5% after subtracting the extraction emissions, which the USGS data do not account for, but before correcting for the AR6 carbon equivalency factors used in this report (the USGS data is based on AR4 factors). Here, BLMs methodology would be considered more conservative i.e., resulting in higher emissions estimates for the same volumes of coal combusted.

Table 5-1 presents a summary of coal production statistics and the estimated direct emissions factors for activities occurring at active mines for each state. Figure 5-1 shows a U.S Geological Survey[18] map for coal rankings in the U.S that supports the statistics presented in Table 5-1. A summary of the downstream emissions factors derived for each coal type in states where the BLM authorizes coal leasing is presented in Tables 5-2 and 5-3.

Table 5-1. Coal Production Emissions Factors and Statistics

State	Direct EF (kg CO_2e/ton)	Bituminous	Subbituminous	Lignite	Exported	Underground	Surface
Alabama	259.27	100%	0%	0%	74.05%	93.77%	6.23%
Colorado	65.1	100%	0%	0%	0%	58.02%	41.98%
Montana	13.8	99.74%	0%	0.26%	20.35%	26.19%	73.81%
North Dakota	13.8	0%	0%	100%	0%	0%	100%
Utah	27.5	100%	0%	0%	4.98%	100%	0%
Wyoming	138	0%	100%	0%	0.28%	0%	100%

Source USGS (IAA L21PG00734), Annual Coal Reports - U.S. Energy Information Administration (EIA)

Table 5-2. EPA Coal Energy Content and Emissions Factors

Coal Rank	MMbtu/ton	kg CO_2/ MMbtu	kg CO_2/ton	kg CH_4/ MMbtu	kg N_2O/ MMbtu	kg CH_4/ton	kg N_2O/ton	kg CO_2e/ ton
Bituminous	24.93	93.28	2,325.47	0.011	0.0016	0.2742	0.0398	2,344.53
Subbituminous	17.25	97.17	1,676.18	0.011	0.0016	0.1897	0.0276	1,689.37
Lignite	14.21	97.72	1,388.6	0.011	0.0016	0.1563	0.0227	1,399.46

Source: Tables C-1 and C-2 of 40 CFR Part 98, Subpart C.
MMbtu is 1 million British thermal units. No anthracite coal is mined on the federal mineral estate.

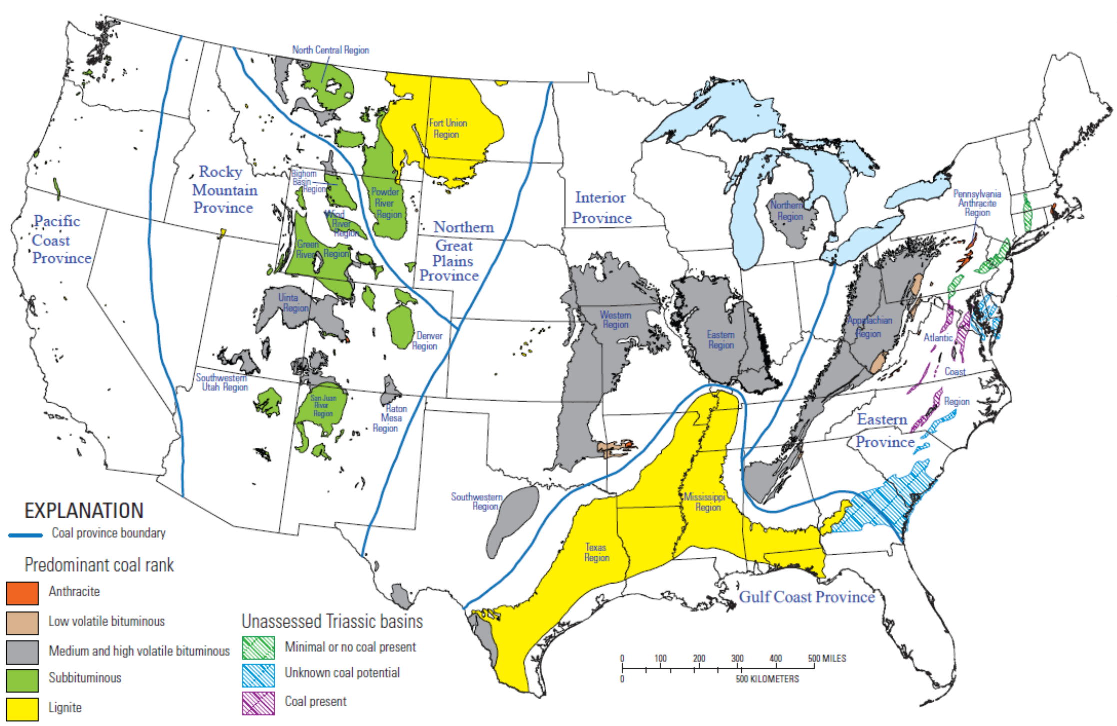


Figure 5-1. 2021 USGS Coal Field Ranks Map

Table 5-3. Derived Downstream Coal Emissions Factors (kg/ton)

State	CO_2	CH_4	N_2O	CO_2e 100
Alabama	2,325	0.274	0.04	2,344
Colorado	2,325	0.274	0.04	2,344
Montana	2,323	0.274	0.04	2,342
North Dakota	1,388	0.156	0.023	1,399
Utah	2,325	0.274	0.04	2,344
Wyoming	1,676	0.19	0.028	1,689

To estimate non-export coal transport emissions where the delivery locations could not be ascertained, the BLM is relying on coal shipping data published by the EIA. The data show the amount of coal shipped per method along with the origin and destination states for the latest available production (2023), which was assumed to be a proxy for the 2024 production data presented in this report. The raw data were scaled to account for the actual production shifts in federal coal producing states relative to the published data. The BLM's estimates assume that all federal coal was transported via rail or truck using the fraction of production shipping methodology obtained from USGS. Reasonable assumptions had to be made for the shipping distance since the actual point of origin, route, and destination data are unknown. Origin to destination state mileage was estimated by using the center points of each state and then adding an additional 20% to the derived length. Intrastate trip length estimates were made using 75% of the square root of each state's total land area divided by two. For both inter- and in-state shipping, the trip lengths were doubled to account for the return trips. Total ton-miles were derived by using USGS supplied rail and truck revenue ton-miles per gallon of fuel (762 and 86, respectively) to estimate the total diesel required to ship the unknown destination quantities of coal. Emissions are calculated by multiplying the estimated fuel use by EPA diesel fuel emissions factors (Table 5-4) for the applicable shipping method. A summary of the analysis data is shown in Table 5-5.

Table 5-4. Coal Transport Emissions Factors

Shipping Method	Units	CO_2	CH_4	N_2O	CO_2e
Railroad	grams/gal	10,210	0.8	0.26	10,304.82
Truck	grams/gal	10,210	0.0665	0.3017	10,294.37
Export	kg CO_2e/ton	NA	NA	NA	107.09

Source: U.S. EPA Emissions Factor Hub
Export: NETL LCA of Coal Exports from the Powder River Basin (cited above), corrected to AR6 GWP.

Table 5-5. Coal Transport Data (Federal)

State	Unknown Destination Fraction	Truck	Rail	Truck Diesel (gal)	Rail Diesel (gal)	Export Volume (tons)	Total CO2e (Mt)
Alabama	100%	27%	73%	0	89	1,096	1.18E-04
Colorado	42%	23%	77%	1,198,277	2,975,744	0	4.30E-02
Montana	100%	3%	44%	0	28,296,014	1,860,573	4.91E-01
North Dakota	0%	15%	29%	0	0	0	0.00E+00
Utah	45%	72%	23%	0	665,051	313,957	4.05E-02

Wyoming	94%	1%	95%	54,271,928	464,733,869	549,342	5.41E+00

Report year emissions from BLM coal leasing authorizations are based on ONRR records of actual coal production. Table 5-6 shows a summary of the ONRR production data from states that reported federal coal production during the past 5 years. The table also shows total U.S. coal production (federal and nonfederal) to illustrate the percentage of federal coal relative to the U.S. total (% U.S. Total) and the percentage of federal coal that comes from the various federal coal producing states (% Federal). The percent total calculations are based on the 5-year average data column.

Table 5-6. Federal Coal Production (tons)

Area	2021	2022	2023	2024	2025	5-Year Average	% U.S. Total	% Federal
U.S. Total	577,431,278	594,155,282	577,954,017	512,540,324	533,037,529	559,023,686	100%	NA
Federal Total	252,569,978	270,234,600	243,565,832	211,027,558	223,885,134	240,256,620	42.98%	100%
Onshore Total	252,569,978	270,234,600	243,565,832	211,027,558	223,885,134	240,256,620	42.98%	100%
Wyoming	218,113,757	233,022,508	217,517,595	182,665,634	196,193,509	209,502,601	37.48%	87.2%
Montana	10,614,886	12,759,947	9,207,466	9,210,573	9,142,866	10,187,148	1.82%	4.24%
Utah	11,295,467	10,290,260	6,600,106	5,736,031	6,304,358	8,045,244	1.44%	3.35%
Colorado	7,468,159	6,331,968	5,695,953	7,811,188	6,492,919	6,760,037	1.21%	2.81%
North Dakota	4,340,950	5,349,940	4,423,101	5,587,406	5,750,002	5,090,280	0.91%	2.12%
New Mexico	736,759	2,217,007	0	0	0	590,753	0.11%	0.25%
Alabama	0	259,622	121,611	16,726	1,480	79,888	0.01%	0.03%
Oklahoma	0	3,348	0	0	0	670	0%	0%

% U.S. Total and % Federal data are based on the 5-Year Average data column.

5.3 Short-Term Coal Projections

Most of the coal produced from BLM-managed lands comes from the Powder River Basin (PRB) in Wyoming and Montana. According to a recent analysis (Cohn 2021)[19], several PRB mines have closed or are scheduled to close in the next few years, and PRB production has dropped by 50% since its peak in 2010. This includes a nearly 20% decrease experienced between 2019 and 2020 as documented in Table 6-6 and in other reports (West 2021).[20] BLM data indicate that few new coal leases have been sold in recent years, while a somewhat larger number of leases have been terminated, and that less recent leases were purchased to provide reserves for future production at existing mines. The BLM does project some shifts in existing coal production from new leases in the next 12 months. Table 5-7 presents federal coal statistics[21] that are useful to discern leasing trends and to potentially guide future emissions estimates. The data includes the number of leases, leased acres, and lease sales held for each of the past 5 years broken down by leasing region.

Table 5-7. Federal Coal Leasing Statistics

Area	Statistic	2021	2022	2023	2024	2025
Total Federal	Leases	284	283	279	273	ND
	Acres	433,264	427,425	421,903	404,847	ND
	Sales	2	0	0	0	ND
Colorado	Leases	47	47	47	47	ND
	Acres	81,748	81,708	81,708	81,708	ND
	Sales	0	0	0	0	ND
Eastern States	Leases	4	4	4	10	ND
	Acres	9,727	9,727	9,727	18,509	ND
	Sales	0	0	1	0	ND
Montana	Leases	54	54	54	35	ND
	Acres	49,045	49,045	49,045	27,813	ND
	Sales	2	0	0	0	ND
New Mexico	Leases	20	19	18	12	ND
	Acres	41,056	35,257	34,497	25,715	ND
	Sales	0	0	0	0	ND
Utah	Leases	58	58	55	55	ND
	Acres	64,250	64,250	59,488	58,867	ND
	Sales	0	0	0	0	ND
Wyoming	Leases	99	99	99	95	ND
	Acres	186,917	186,917	186,917	179,891	ND
	Sales	0	0	0	0	ND

Source: BLM, Public Land Statistics, Volumes 206-209, FY 2024.

BLM's coal statistics and data are not nearly robust enough to form a short-term (12-month) estimate of potential production from which to estimate emissions. Previous annual reports simply used a two-year average of production as a projection. The BLM is using the EIA's short-term energy outlook (STEO) for coal projections. The STEO forecast is for slightly less volume in 2026, as compared to 2025 due to an imbalance between domestic supply and demand. The short-term life-of-project emissions for this report year are calculated by applying the appropriate life-cycle emissions factors to the aggregated life-of-mine production data supplied by the USGS as noted above. This USGS data has allowed the BLM to extend the short-term emissions estimates for coal as shown in Table 6-3.

5.4 Crude Oil

According to EIA data (2023), approximately 95% of oil stocks in the U.S. are transformed into fuels, while the remainder are refined to produce a range of petrochemical products such as plastics and other consumables. Refining processes require additional feedstocks to meet regulatory requirements or yield the desired products. Because of these feedstocks and the fact that most of the products refineries produce are less dense than the crude oil stock, refined product volume is greater than that of the crude oil feed by approximately 5.9%. This gain, known in the industry as process gain, means that the percentage of crude oil stocks used to produce combustible products is essentially equivalent to the original produced crude oil volumes; and so, for the purposes of this report, the BLM is assuming a

100% combustion rate for crude oil production.

To account for the methods and infrastructure used to produce and market crude oil products, this report relies on published data produced in part by the DOE NETL, which updates its 2005 baseline well-to-wheels life-cycle GHG analysis of petroleum-based fuels consumed in the U.S. (Cooney et al. 2017).[22] The update focuses on three primary products derived from crude oil; gasoline, diesel, and jet fuel, which according to the EIA account for approximately 83% of the crude oil stock use in the U.S. To estimate crude oil life-cycle emissions from the reported production volumes, the BLM calculates a weighted average of NETL's updated modeled LCA emission factors as derived from the EIA product percentages. As part of this year's annual update, the BLM is providing speciated GHG estimates for all crude oil life-cycle stages. The speciated GHG emissions factors are taken from NETL's 2005 Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum-Based Fuels report. The baseline report also provides a CO_2e emissions factor, and here the BLM is applying a ratio of the baseline and update CO_2e emissions to the speciated factors in the baseline to derive update-based speciated factors. The speciated factors are then summed using AR6 CO_2e conversion factors to arrive at a final updated CO_2e factor. Table 5-8 shows the LCA emissions factors as applied in this report.

Table 5-8. GHG Emissions Factors for Federal Oil Production (tonnes/bbl)

Life-Cycle Stage	Type	CO2	CH4	N2O	CO2e
Extraction / Production	Direct	4.60E-02	9.19E-04	1.26E-06	7.38E-02
Crude Transport	Indirect	4.73E-03	3.89E-06	8.00E-08	4.87E-03
Refining	Indirect	4.88E-02	5.97E-05	7.82E-07	5.08E-02
Product Distribution	Indirect	5.08E-03	3.14E-06	9.98E-08	5.20E-03
End Use	Indirect	4.32E-01	1.74E-05	3.48E-06	4.34E-01

End Use Source: 40 CFR Appendix Tables C-1 & C-2 to Subpart C of Part 98 - Default Combustion CO2, CH4, and N20 Emission Factors and High Heat Values for Various Fuels. Emissions factors converted to AR6 GWPs from referenced sources.

Report year emissions and projected emissions from BLM crude oil leasing authorizations and permitting actions are based on ONRR records of actual oil production. Table 5-9 shows a summary of the ONRR production data from states that reported federal oil production during the past 5 years. The table also shows total U.S. oil production (federal and nonfederal) to illustrate the percentage of federal oil relative to the U.S. total (% U.S. Total) and the percentage of federal oil that comes from the various federal oil producing states (% Federal). The U.S. total data includes all oil produced from both onshore and offshore sources. The percent total calculations are based on the 5-year average data column.

Table 5-9. Federal Oil Production (bbl)

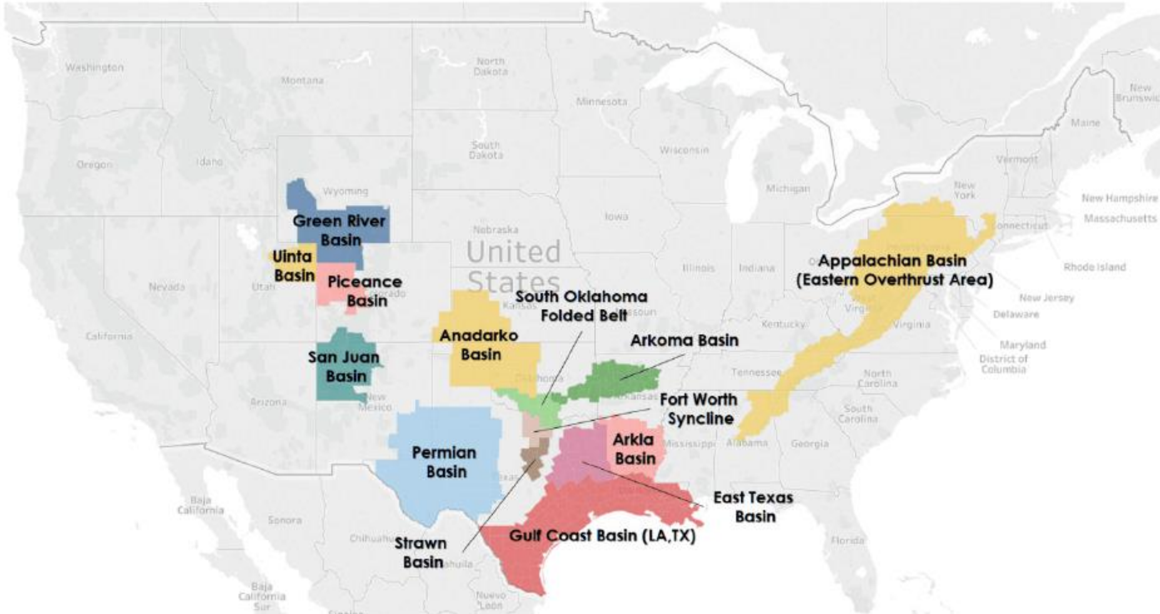
Area	2021	2022	2023	2024	2025	5-Year Average	% U.S. Total	% Federal
U.S. Total	4,128,623,000	4,381,539,000	4,724,335,000	4,843,858,000	4,958,907,000	4,607,452,400	100%	NA
Federal Total	997,523,121	1,107,371,211	1,223,213,721	1,295,861,248	1,341,273,616	1,193,048,583	25.89%	100%
Offshore	611,324,862	628,937,101	675,708,460	668,933,308	686,544,402	654,289,627	14.2%	54.84%
Onshore Total	386,198,259	478,434,110	547,505,261	626,927,940	654,729,214	538,758,956	11.69%	45.16%
New Mexico	263,296,650	352,547,543	420,282,681	489,313,591	520,989,412	409,285,975	8.88%	34.31%
Wyoming	45,296,830	48,355,197	51,170,658	55,931,182	59,497,152	52,050,204	1.13%	4.36%
North Dakota	48,316,218	43,246,847	41,477,449	47,591,435	41,542,236	44,434,837	0.96%	3.72%
Colorado	8,599,847	9,432,908	9,160,447	8,317,612	9,140,058	8,930,174	0.19%	0.75%
California	8,651,099	8,642,624	8,211,924	7,818,947	6,791,855	8,023,290	0.17%	0.67%
Utah	6,432,543	6,603,684	7,054,558	9,315,538	8,228,358	7,526,936	0.16%	0.63%
Alaska	921,641	5,021,631	5,617,470	4,265,156	4,100,888	3,985,357	0.09%	0.33%
Montana	2,844,430	2,744,200	2,555,515	2,550,798	2,698,539	2,678,696	0.06%	0.22%
Oklahoma	429,568	582,409	744,715	556,266	634,482	589,488	0.01%	0.05%
Louisiana	382,113	350,838	262,083	247,662	228,791	294,297	0.01%	0.02%
Nevada	219,674	233,631	227,304	202,692	187,153	214,091	0%	0.02%
Texas	303,817	197,391	299,924	276,806	259,314	267,450	0.01%	0.02%
Mississippi	211,928	184,966	177,884	281,518	188,639	208,987	0%	0.02%
South Dakota	123,025	121,701	107,304	99,981	97,649	109,932	0%	0.01%
Kansas	90,442	90,336	82,453	87,791	88,571	87,919	0%	0.01%
Nebraska	19,738	26,822	25,073	24,794	23,473	23,980	0%	0%
Alabama	17,095	17,358	16,278	14,055	9,170	14,791	0%	0%
Illinois	14,762	14,333	13,147	12,250	9,479	12,794	0%	0%
Michigan	9,614	7,972	8,004	7,965	5,850	7,881	0%	0%
Ohio	9,487	6,649	6,009	7,170	5,346	6,932	0%	0%
Kentucky	6,710	4,459	3,781	4,282	2,415	4,329	0%	0%
Pennsylvania	589	492	475	441	383	476	0%	0%
Idaho	437	117	123	5	0	136	0%	0%
Arkansas	2	2	2	3	1	2	0%	0%

5.5 Natural Gas

Natural gas is used as a combustion energy source in almost every sector of the economy. According to EIA data, approximately 3% of natural gas stocks are used in the industrial sector as a raw material to produce chemicals, fertilizer, and hydrogen. The amount of natural gas diverted into each of the non-combustion product streams is not known. However, the processes[23] that support the chemical transformation of methane (natural gas) into hydrogen is known to generate a stoichiometric amount of CO_2 emissions from the feedstock gas. Thus, for this report year, the BLM is conservatively assuming that any process or product using natural gas as a feedstock would release GHGs at the same rate as combustion.

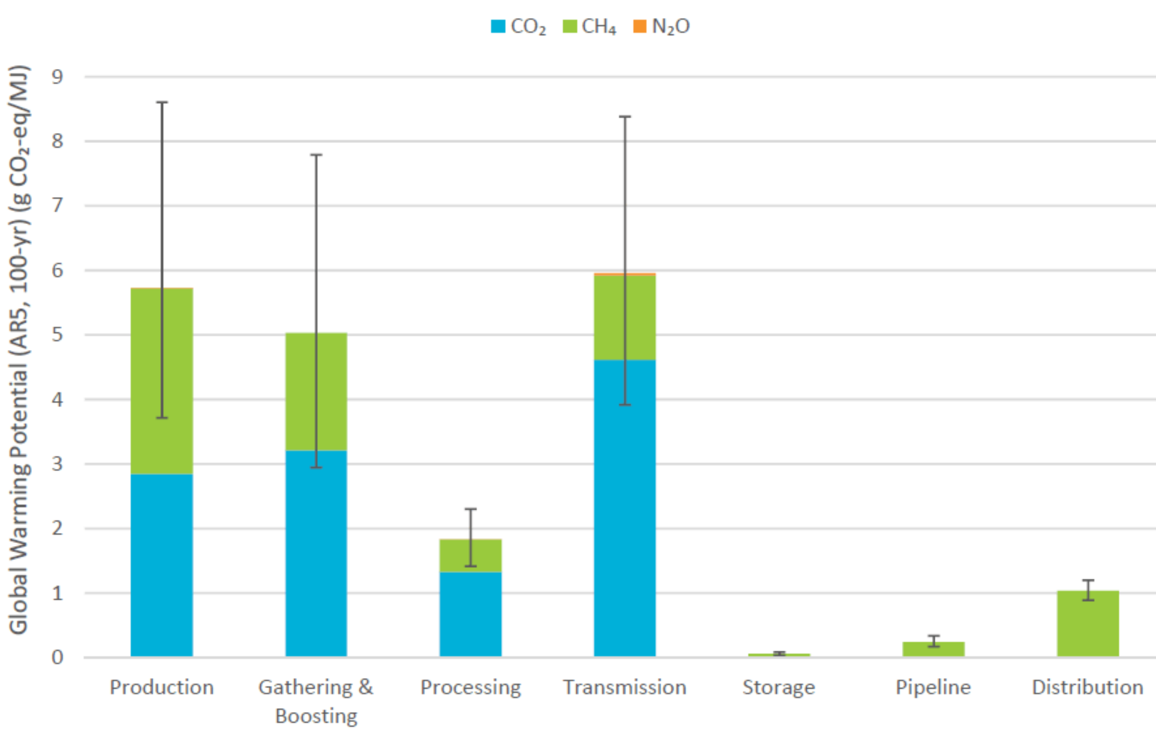
To account for the LCA emissions associated with natural gas production, the BLM is relying on data published by NETL in a 2019 report titled "Life Cycle Analysis of Natural Gas Extraction and Power Generation".[24] The NETL report provides a detailed examination of the natural gas supply chain in the U.S. broken down by basin and resource type. The calculations in this report are based on the national averages published in the NETL report, as these values provide a reasonable estimation of emissions based on the fractions of production the representative federal basins contribute to total U.S. production (see Figure 5-2, which contains the applicable NETL report exhibits). The NETL report concludes that the average life-cycle GHG emissions from the U.S. natural gas supply chain are 18.53 grams (g) of carbon dioxide equivalent per megajoule (MJ) of delivered (i.e., combusted) natural gas. The report also concludes that total methane emissions throughout the supply chain are approximately 1.24% of the production volume (see Figure 5-2, NETL Exhibit 6-2). The loss of gas throughout the supply chain represents a reduction of the available gas that could be combusted by the same fraction, and so for accounting purposes the BLM is assuming a combustion rate of 98.76% of all production volumes. In terms of emissions speciation, methane alone accounts for 6.493 g CO_2e/MJ (0.218 g CH_4/MJ) of the total supply chain CO_2e factor. The BLM is assuming that 100% of the production emissions from the supply chain processes are part of the direct emissions scope from federal production. The direct emissions of CO_2 and CH_4 from the federal production supply chain are estimated to be 2.852 and 0.08 grams per megajoule, respectively. The BLM is using the published energy density of natural gas (1,026 Btu/cf) from Tables C-1 and C-2 at 40 CFR Part 98, Subpart C, to calculate LCA emissions in this report.

Exhibit 2-2. Basins that Account for Majority of U.S. Natural Gas Production



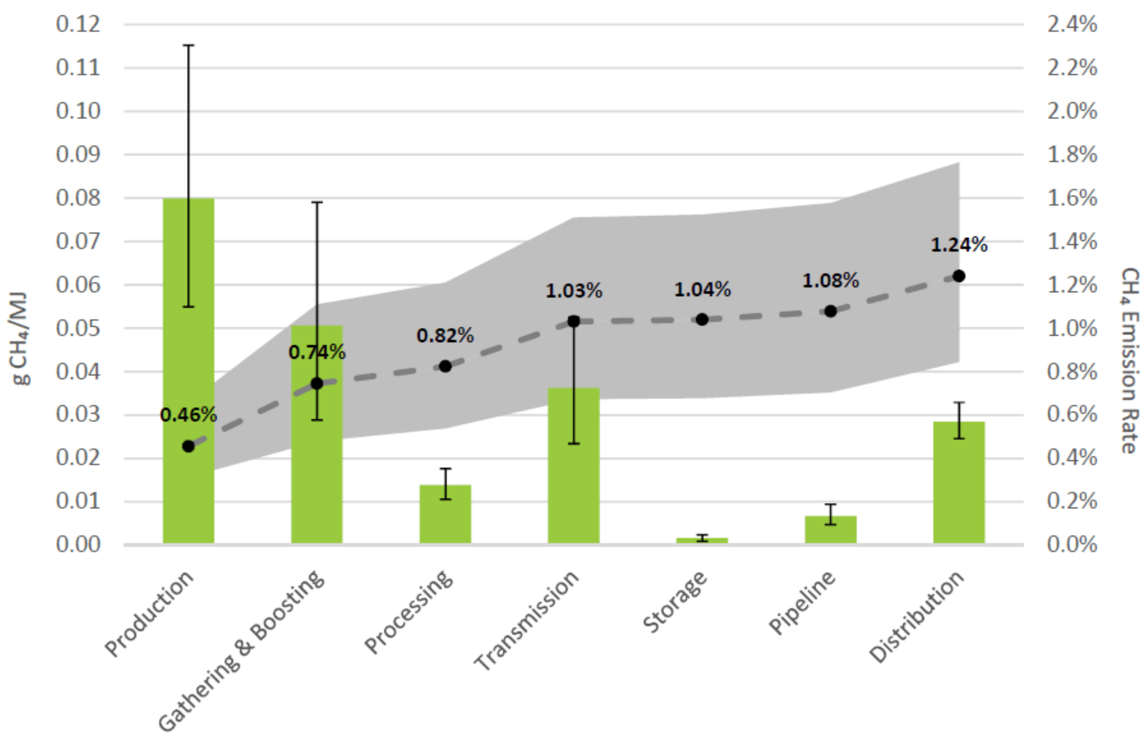
(A)

Exhibit 6-1. Life Cycle GHG Emissions for the U.S. Natural Gas Supply Chain



(B)

Exhibit 6-2. Life Cycle CH_4 Emissions for the U.S. Natural Gas Supply Chain



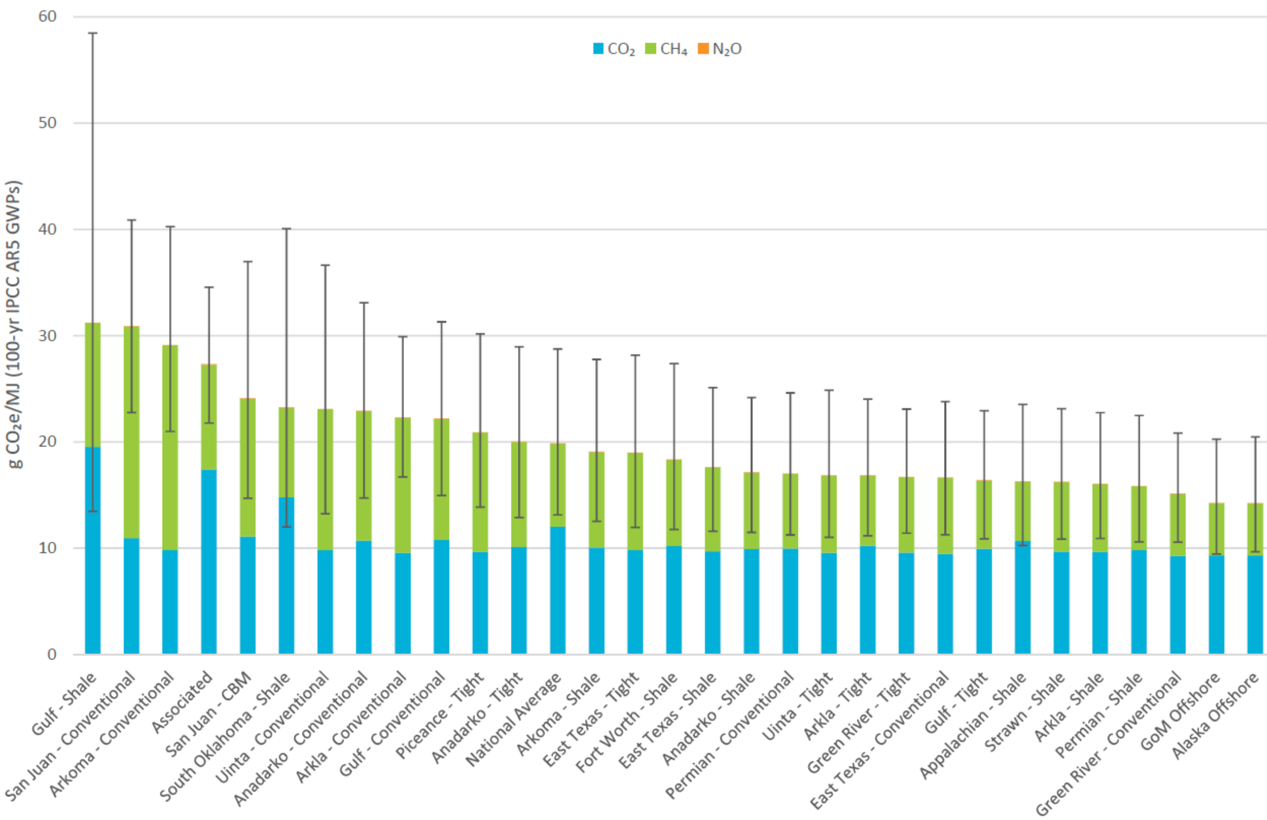
(C)

Exhibit 2-3. Natural Gas Production Shares by Well Type and Geography

Geography	Well Type						
	Conventional	Shale	Tight	CBM	Offshore	Associated	Total
Onshore Production							
Anadarko	2.2%	2.6%	1.7%				6.5%
Appalachian		29.0%					29.0%
Arkla	0.4%	4.2%	1.4%				6.0%
Arkoma	0.3%	0.9%					1.2%
East Texas	1.6%	1.3%	1.3%				4.2%
Fort Worth Syncline		1.8%	0.0%				1.8%
Green River	1.6%		3.9%				5.5%
Gulf Coast	0.8%	6.6%	1.3%				8.7%
Permian	2.3%	5.3%					7.6%
Piceance			0.3%				0.3%
San Juan	1.4%			1.9%			3.3%
South Oklahoma		1.0%					1.0%
Strawn		3.2%					3.2%
Uinta	0.5%		0.8%				1.3%
*Subtotal: Onshore**	*11.0%*	*56.0%*	*10.6%*	*1.9%*			*79.6%*
Offshore Production							
Offshore Gulf of					4.2%		4.2%
Offshore Alaska					0.1%		0.1%
Subtotal: Offshore					*4.3%*		*4.3%*
Associated Gas							
United States						16.1%	16.1%
Total							
*Total**	*11.0%*	*56.0%*	*10.6%*	*1.9%*	*4.3%*	*16.1%*	*100%*

(D)

Exhibit 6-6. Life Cycle GHG Emissions for Natural Gas Scenarios (100-year CO_2e)



(E)

Figure 5-2. NETL Report Exhibits for LCA Estimates

Table 5-10. GHG Emissions Factors for Federal Gas Production (tonnes/Mcf)

Life-Cycle Stage	Type	CO_2	CH_4	N_2O	CO_2e
Extraction / Production	Direct	3.09E-03	8.66E-05	1.55E-12	5.67E-03
Subtotal Transport	Indirect	8.47E-03	1.33E-04	1.31E-07	1.25E-02
Subtotal Process	Indirect	1.44E-03	1.66E-05	5.12E-09	1.94E-03
End Use	Indirect	5.44E-02	1.03E-06	1.03E-07	5.45E-02

Transport subtotal includes gather/boost, station transmission, pipeline transmission, and product distribution emissions.
Processing subtotal includes gas plant processing and storage.
Emissions factors converted/corrected to AR6 GWPs from referenced AR5 sources.

Report year emissions and projected emissions from BLM gas leasing authorizations and permitting actions are based on ONRR records of actual gas production. Table 5-11 shows a summary of the ONRR production data from states that reported federal gas production during the past 5 years. The table also shows total U.S. gas production (federal and nonfederal) to illustrate the percentage of federal gas relative to the U.S. total (% U.S. Total) and the percentage of federal gas that comes from the various federal gas producing states (% Federal). The U.S. total data includes all gas produced from both onshore and offshore sources. The percent total calculations are based on the 5-year average data column (see example calculation in table notes).

Table 5-11. Federal Gas Production (Mcf)

Area	2021	2022	2023	2024	2025	5-Year Average	% U.S. Total	% Federal
U.S. Total	41,676,743,000	43,700,928,000	45,399,670,000	45,867,761,000	47,733,473,000	44,875,715,000	100%	NA
Federal Total	4,162,574,989	4,495,923,206	4,810,353,500	5,044,172,072	5,260,582,669	4,754,721,287	10.6%	100%
Onshore Total	3,366,604,184	3,680,621,978	4,013,975,493	4,316,212,503	4,505,696,156	3,976,622,063	8.86%	83.64%
New Mexico	1,360,677,461	1,663,903,614	2,002,324,466	2,320,532,681	2,639,329,138	1,997,353,472	4.45%	42.01%
Wyoming	1,112,043,192	1,048,695,106	1,007,801,290	1,019,830,019	960,086,375	1,029,691,196	2.29%	21.66%
Offshore	795,970,805	815,301,228	796,378,007	727,959,569	754,886,513	778,099,224	1.73%	16.36%
Colorado	531,487,312	528,376,515	515,364,912	475,801,089	473,214,831	504,848,932	1.12%	10.62%
Utah	126,494,054	140,924,454	154,129,115	165,823,173	123,261,856	142,126,530	0.32%	2.99%
North Dakota	114,812,401	119,511,578	126,452,733	147,700,685	143,776,915	130,450,862	0.29%	2.74%
Louisiana	18,991,264	45,490,037	75,570,407	66,236,199	43,620,512	49,981,684	0.11%	1.05%
Texas	32,867,410	44,378,352	42,324,378	37,401,513	50,341,392	41,462,609	0.09%	0.87%
Alaska	14,255,225	33,031,826	34,798,966	29,732,688	27,978,349	27,959,411	0.06%	0.59%
Oklahoma	12,677,135	12,690,530	13,808,533	12,596,523	11,782,786	12,711,101	0.03%	0.27%
Montana	9,860,558	9,454,288	8,837,787	8,651,423	8,250,436	9,010,898	0.02%	0.19%
California	9,326,738	9,053,053	9,384,449	8,867,251	7,471,073	8,820,513	0.02%	0.19%
Arkansas	7,744,326	7,472,860	8,088,341	8,106,160	7,594,553	7,801,248	0.02%	0.16%
Alabama	7,805,455	7,350,519	7,531,731	8,418,610	3,192,284	6,859,720	0.02%	0.14%
Ohio	2,546,214	5,505,072	3,225,609	2,231,441	1,882,161	3,078,099	0.01%	0.06%
Kansas	2,921,668	2,897,888	2,552,558	2,470,441	2,494,978	2,667,507	0.01%	0.06%
Michigan	934,083	876,555	819,593	750,052	622,352	800,527	0%	0.02%
South Dakota	625,957	492,962	473,511	391,663	352,163	467,251	0%	0.01%
Mississippi	167,743	169,037	172,727	393,447	210,432	222,677	0%	0%
Virginia	128,523	122,846	118,369	110,552	113,390	118,736	0%	0%
Kentucky	94,004	90,142	80,481	83,205	73,202	84,207	0%	0%
West Virginia	52,101	63,917	57,043	41,192	18,005	46,452	0%	0%
Pennsylvania	53,644	51,038	45,217	29,914	19,219	39,806	0%	0%
New York	6,838	6,679	3,746	4,271	3,281	4,963	0%	0%
Idaho	23,139	5,529	1,264	1,045	0	6,195	0%	0%
Nevada	5,399	5,220	6,124	5,144	4,842	5,346	0%	0%
Illinois	2,337	2,361	2,143	2,122	1,631	2,119	0%	0%

5.6 Short-Term Oil and Gas Projections

The short-term projections for oil and gas emissions are based on analyses of three authorization scopes that exist for potential oil and gas production. These include (1) leased federal lands that are held-by-production, (2) approved applications for permit to drill (APDs), and (3) leased lands from competitive lease sales expected to occur over the next annual reporting cycle (72 months). As was the case for coal, here too the BLM is assuming that all oil and gas developed is consumed in the same year. When initiating a planning action in an area of potential oil and gas development, the BLM may produce an analysis of the fluid mineral potential known as a reasonably foreseeable development (RFD) scenario for oil and gas development for the specific geographic area. An RFD is typically constructed to support the management actions developed for a field or district office's resource management plan. The RFD provides an estimate of development potential and growth rates within the specified region based on several indicators, including the estimated hydrocarbon potential, operator surveys, existing development trends, various economics forecasts, and basin or geology factors, among others. These documents typically provide 20+ years of oil and gas development estimates and have traditionally been used to inform decisions on areas open and closed for leasing and the need for implementing stipulations, conditions of approval, or mitigation measures. The RFDs that are currently available, although useful for informing management actions and tracking limits of analysis for a particular region, are not useful for estimating GHG emissions across all BLM-managed mineral estate in a particular year because of their differing years of analysis, projection methodologies, and management objectives. The BLM does not currently have an up-to-date RFD that covers the entire federal onshore mineral estate. Due to the inconsistencies among available RFDs and a lack of an RFD for all federal mineral producing regions, the individual RFDs or a summation of all available RFDs may not be used to derive a single replicable methodology from which to make projections, which is one of the goals of this report. For the purposes of this report, a more representative and consistent approach for making projections that captures the implications of different levels of development and production across the entirety of the federal mineral estate was employed.

Each of the authorization scopes previously described relies in part on the most recent 5-year average dataset of federal mineral statistics[25] developed by the BLM in combination with the previously identified external sources of hydrocarbon production data. The development statistics include both internal BLM tracking data, such as annual lease acres and held-by-production rates, APD approval counts, spud rates, and producible well counts, as well as an analysis of external well completion and production rates for individual wells in states reporting federal oil and gas production. Additional parameters are calculated from the internal statistics to aid in the projection calculations and to provide custom metrics for tracking purposes as shown in Table 5-12.

Table 5-12. 5-Year Federal Oil and Gas Statistics

Statistic	2021	2022	2023	2024	2025	5-year Average
Acres Under Lease	24,932,645	23,771,097	23,196,348	22,218,215	21,394,971	23,102,654
Producing Acres	12,607,203	12,429,147	12,446,907	12,425,869	12,346,001	12,451,025

Acres Held by Production (%) *	50.57%	52.29%	53.66%	55.93%	57.71%	53.89%
New Lease Acres (sold)	249,132	74,758	91,712	110,650	132,047	131,660
Number of APDs Approved	4,914	2,852	3,519	3,322	5,740	4,536
Number of Wells Spud	1,630	2,063	2,106	2,383	2,358	2,109
Number of Producible Wells	88,887	89,350	90,298	91,006	91,935	90,294
Federal Wells per Acre *	0.28426	0.28432	0.27582	0.27173	0.24417	0.27208
Total Potential Wells *	164,357	160,997	146,884	140,106	138,611	150,192
Potential New Wells *	75,483	71,659	56,598	49,112	46,688	59,908
Potential Development Years *	881.3	734.7	1,604.3	649	602.2	893
Total CO2e Emissions (Mt) *	465.63	447.77	611.54	686.63	707.9	583.88
CO2e Emissions (tonnes/prod acre) *	522.35	520.55	601.34	531.49	571.68	549.46

***** = calculated parameter

The BLM analyzed 10 years (2013-2022) of external data from the S&P Global Enerdeq Browser database (commercial source) for oil and gas wells in federal mineral producing states. The analysis of the individual wells provided an estimate of the total potential mineral yield, or estimated ultimate recovery (EUR), and the associated decline rates that could be expected from any new wells developed within the authorization scopes analyzed in this report. Producing the EUR and decline estimates was necessary because life-of-project production is a reasonably foreseeable outcome from existing and future authorizations if economic quantities of federal minerals exist within any authorization scope.

Enerdeq provides subscription-based access to more than 5 million completions and 2.5 million production entities and provides an adequate sample size for most regions to apply statistical methods for determining the EUR. Initially, the BLM made queries to obtain the American Petroleum Institute (API) well identifiers for all new wells completed within the last 10 years. The 10-year timeframe was chosen to capture the changes in characteristics for wells developed before and after the advent and widespread adoption of horizontal drilling and hydraulic fracturing completion techniques. The queried data were scrubbed to eliminate nontarget wells (e.g., injection, water) and then organized by state to query 10 years of production data. This query provided the individual well production-by-age data that was necessary to develop the decline curve profiles and provide for cumulative production estimates over the life of a well. Oil and gas wells typically produce high quantities of minerals initially, followed by a period of rapid decline that settles into a very shallow decline over the remainder of their economic life. The BLM applied regression analysis techniques to the production data to generate a typical decline equation for wells in each state. The EUR for each state was calculated for an estimated life span of 30 years. These EUR volumes were then applied to the estimated number of new wells projected for the applicable authorization boundaries in each state to estimate cumulative or life-of-project GHG emissions. The decline curve formulas are also useful for estimating existing held-by-production projections as described later. Table 5-13 presents some of the Enerdeq data highlights that went into the BLM's analysis, and Figure 5-3 shows the results of the decline analysis for the selected state.

Table 5-13. Enerdeq Data as Analyzed by BLM

State	New Wells	Oil Producer	Gas Producer	Counties	Basins	Plays	Vert	Dir	Hor	10 Yr Oil (bbls)	10 Yr Gas (Mcf)
Alabama	244	83	239	10	4	3	196	42	6	13,818,908	54,911,130
Alaska	602	525	602	10	2	1	8	130	464	441,830,777	6,289,990,679
Arkansas	1421	149	1,359	18	2	4	147	59	1,215	5,773,220	2,112,694,264
California	9,729	9,706	7,025	17	5	2	3,546	4,982	1,201	372,870,387	227,212,097
Colorado	12,088	11,833	12,033	31	11	5	247	2,489	9,352	1,178,900,638	8,949,692,008
Florida	8	8	0	3	2	2	1	4	3	1,547,244	3,415,416
Idaho	12	1	11	1	1	1	5	7	0	433,480	15,820,120
Illinois	245	245	0	24	1	1	241	0	4	4,021,040	0
Indiana	30	30	0	6	1	1	25	0	5	425,525	0
Kansas	3123	2,770	703	82	11	3	2,853	12	258	68,510,481	121,551,341
Kentucky	413	11	403	25	3	2	113	1	299	145,485	44,298,349
Louisiana	1207	838	1,031	72	1	6	283	377	547	162,477,224	6,386,661,385
Michigan	113	112	42	20	1	1	28	37	48	8,747,640	6,275,207
Mississippi	277	276	166	28	2	3	124	84	69	36,468,599	79,397,855
Montana	440	434	379	21	10	3	79	4	357	60,178,985	73,710,723
Nebraska	201	201	1	16	6	1	200	0	1	5,994,033	1,575
Nevada	5	5	0	2	1	1	4	0	1	39,118	0
New Mexico	9,865	9,785	9,834	9	5	5	904	245	8,716	2,216,160,877	7,868,969,596
New York	683	663	620	7	1	1	681	0	2	751,031	1,010,953
North Dakota	11,582	11,576	11,524	14	1	2	33	6	11,543	3,000,558,278	6,160,597,262
Ohio	3,341	2,117	3,198	40	2	2	486	19	2,836	164,761,274	15,323,477,760
Oklahoma	11,672	11,201	11,215	64	11	5	899	118	10,655	1,026,032,605	14,044,489,681
Oregon	1	0	1	1	1	1	1	0	0	0	992,360
Pennsylvania	8,814	3,049	8,556	33	1	2	1,732	49	7,033	39,938,010	42,189,187,677
South Dakota	25	25	0	1	3	1	3	0	22	2,590,634	1,057,790
Texas	35,532	34,063	34,448	196	16	5	4,723	480	30,329	8,629,679,751	46,862,505,349
Utah	2,806	2,800	2,791	10	7	4	543	1,839	424	186,860,851	856,392,619
Virginia	897	0	897	5	1	3	754	126	17	0	144,174,602
West Virginia	3,103	2,416	3,095	29	1	3	254	30	2,818	99,369,096	13,844,985,994
Wyoming	5,290	5,107	4,986	19	11	5	731	2,124	2,435	457,018,451	4,470,390,812
Sums	123,769	116,654	122,180	814	125	79	19,844	13,264	90,660	18,185,903,642	176,133,864,604

Data is representative of all wells (federal and nonfederal) drilled and producing within the analyzed period (2013 – 2022).
Active development status (not shown) assigned to states with development rates of approximately 500 or more wells per year.

Leased Lands

To estimate the potential GHG emissions resulting from leased lands held-by-production, the BLM applies the derived decline curves on a relative basis to the report year production levels and projects out for an additional 30 years (the assumed life-of-project period) for each applicable state. The decline curves for any state are statistically valid for an average "new" well; however, the held-by- production data is representative of wells at various ages. Therefore, applying the decline curve to existing field-wide production would most likely underrepresent future cumulative emissions. The decline data show that newer wells are far more productive in their first few years of life than over the entire life of the project period, and thus it is generally assumed that for any state with active development, the newer wells are driving production. For these states, the BLM assumed a field-wide decline age of 5 years. For a majority of the decline data, the 5-year mark lands squarely at the heel of the harmonic shaped curves (see Figure 5-3, year 5) and should correspond with a moderate gradual decline that could be expected at field-wide scales with active development. For all other states, the decline age was assumed to be 10 years (very shallow decline, leading to sustained production over the projection period). Additionally, this analysis conservatively assumes that all existing wells on leases held-by-production will continue to produce for another 30 years, even though it is highly likely that some will be plugged and abandoned. This fact can be clearly seen in the data contained in Table 5-12; even though the BLM recorded 1,857 well spuds per year on average over the 5-year period, the producible well counts are relatively flat over the entire 5-year period. It is likely that some of the recorded spuds came up dry leading to a smaller increment in the producible well counts, just as it is likely that some of the producible wells on record reached the end of their economic lives (i.e., no longer considered producible), and were thus subtracted from this count.

Approved Applications for Permit to Drill

To estimate the potential GHG emissions resulting from approved APDs, the BLM uses the last 2 years of approved APD counts minus the spuds recorded for the same period. Here the BLM is breaking from the general approach in this report of using 5-year average data for making projections in acknowledgement that APDs are only valid for 2 years (absent extensions that can be granted for an additional 2 years with appropriate justification). In general, the BLM statistics show that spud counts lag APD approvals across the states, and therefore it is reasonable to assume that the delta between the two metrics is enough to cover any potential extensions and subsequent development that may arise during the reporting period (i.e., the next 12 months). The remaining APD counts are multiplied by the corresponding decline curve equation that was derived for each state.

Potential Future Leasing

Estimates of potential GHG emissions resulting from any future leasing are relatively speculative. In terms of emissions, the BLM is assuming that full development of the leased parcels would occur concurrently within the same sale (report) year. While this assumption does not reflect a typical timeline for oil and gas development, it is simplifying for projection purposes and allows the BLM to evaluate the potential emissions for any authorizations made. Here, the BLM relies on the 5-year average of the acres held by production, the annual total leased acres, and the calculated well density (wells per acre) on the federal mineral estate. Additionally, for some states with leased lands where the 5-year average statistics fall below a threshold minimum, the BLM assumes a minimum leased acreage to conservatively estimate potential emissions. The minimum thresholds are 100 acres leased for states with less than 4,000 acres currently leased, and 2,560 acres leased for states with more than 4,000 acres currently leased for which the 5-year leasing average is less than the minimum itself. The statistical annual lease acres data (5-year average) or the alternative minimum lease acres is used to estimate the number of wells for potentially leased lands which is then multiplied by the corresponding decline curve data for each state to obtain the estimated life-of-project production and emissions.

5.7 Long-Term Federal Hydrocarbon Mineral Emissions Projections

The emission estimates from the federal mineral estate authorization boundaries previously outlined present current emissions and projected emissions based on potential development and production volumes over the short term. As discussed at the beginning of this section, the BLM is using data from EIA's most current AEO report to estimate potential long-term emissions (to year 2050). The AEO is developed using the National Energy Modeling System (NEMS), an integrated model that captures interactions of economic changes and energy supply, demand, and prices. The AEO is published to satisfy the Department of Energy Organization Act of 1977, which requires EIA's Administrator to prepare annual reports on trends and projections for energy use and supply. The AEO explores several scenarios that capture alternative policy-based cases that can be compared to a “reference case”, which represents EIA's best assessment of how U.S. and world energy markets will operate through 2050. The reference case examines a future characterized by slower growth in energy consumption (due to energy efficiency increases) and by increasing energy supply due to technological progress in the renewable, oil, and natural gas energy sectors. For the 2026 AEO, the reference case has been renamed as the counterfactual case. Projections in the AEO are not predictions of what will happen, but rather, they are modeled projections of what may happen given certain assumptions. The major underlying assumption for the application of any AEO scenario data in this report is that the ratio of federal and nonfederal mineral production is fixed at the current annual average for each state going forward. For each year of AEO data, which is inclusive of total (federal and nonfederal) production, the BLM is applying the current (report year) federal fraction for each mineral type to derive a forecast of long-term federal mineral production from which to estimate emissions. Overall, this forecast method is useful for analyzing long-term trends in GHGs.

5.8 Long-Term Federal Hydrocarbon Mineral Emissions Projections

This report relies on life-cycle emissions estimates produced in part by the DOE NETL (as previously cited). The life-cycle estimates cover broad activities used to represent recovery and processing of federal minerals, including lease exploration, construction, well drilling and completion, production, processing, transportation, and end use. The BLM acknowledges that operational diversity, product variations, and broad geographic distribution of the federal mineral estate introduces some uncertainty into the simplifying assumptions and approximation methodologies used to estimate emissions in this report. For some of the current estimates, such as CO_2 emissions from energy-related combustion activities, the impact of uncertainties on overall emission estimates is believed to be relatively small. For some other limited categories of emissions, including the assumptions used to estimate production and project future emissions, the following are some uncertainties that could have a larger impact on the estimates:

- The uncertainties inherent to the LCA data, which are unavoidably propagated in the BLM estimates.
- Unknowable factors about actual or future development localities, methodologies, and production rates.
- The exact nature of energy sources and amounts used in production, transportation, and processing systems.
- How the produced federal minerals are ultimately transformed and used.
- The overall energy density of the produced federal mineral estate (used in emissions calculations).
- The exact nature of any control technology that may be utilized at direct or indirect activity locations.
- How regulations and market forces or the lack thereof may influence development and production dynamics.

The BLM is making a broad but concerted effort to use and present the best data available for the emissions estimates in this report. As new information becomes available, the BLM will continue to improve and revise its emission estimates, methodologies, and assumptions as appropriate. Ultimately, whether these estimates are realized is subject to many influences that are largely beyond the BLM's control. Unforeseen changes in several factors such as geologic conditions, drilling technology, global and national economics, energy demand, geopolitical strife, and laws and policies enacted at the federal, state, and local level could result in different outcomes than those projected in this assessment.

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6.0 GHG Emissions and Projections from BLM-Authorized Actions

This chapter provides estimates of direct and reasonably foreseeable indirect GHG emissions for both existing and projected federal hydrocarbon production. Estimates of existing emissions show the GHGs emitted from the assumed consumption of each hydrocarbon based on production statistics from the previous fiscal year for all producing wells and mines. Estimates of emissions from projected hydrocarbon production include both short- and long-term estimates based on the methodologies discussed in the previous chapter.

6.1 Short-Term Coal Emissions

Table 6-1 presents the emissions from coal production on the federal mineral estate in FY 2025, which were calculated by multiplying the representative emission factors from Tables 5-1, 5-3, and 5-4 by the state-specific shipping and production data contained in Tables 5-5 and 5-6. The estimates presented here include emissions from the typical coal lifecycle, including emissions arising from activities outside of the BLM's jurisdiction (such as emissions associated with coal exports). Table 6-2 and 6-3 show the short-term emissions projections (12-month and life-of-project) from reasonably foreseeable coal production in the 8 states where federal coal is presently being produced.

Table 6-1. Federal Coal Emissions - 2025 (Mt)

Area	Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
U.S. Total	533,037,529	10.5541	NA	31.9332	1,046.85	1,089.34
BLM Total	223,885,134	3.5094	1.0861	5.2177	390.91	400.72
Alabama	1,480	0.0004	0.0001	0.0005	0	0
Colorado	6,492,919	0.4227	0.1958	0.218	15.22	16.06
Montana	9,142,866	0.1262	0.0342	0.1496	21.41	21.72
North Dakota	5,750,002	0.0794	0.006	0.006	8.05	8.14
Utah	6,304,358	0.1734	0.1163	0.2312	14.78	15.3
Wyoming	196,193,509	2.7075	0.7337	4.6125	331.44	339.5

Production units = short tons.
U.S. Total is both federal and nonfederal data, shown for illustration purposes.

Table 6-2. Federal Coal Emissions - Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	222,989,594	9.2465	1.0818	5.1968	389.35	404.87
Wyoming	195,408,735	6.0683	0.7308	4.594	330.12	341.51
Montana	9,106,295	0.2829	0.034	0.149	21.33	21.79
Colorado	6,466,947	0.7292	0.195	0.2171	15.16	16.3
Utah	6,279,141	0.117	0.1158	0.2302	14.72	15.18
North Dakota	5,727,002	2.0485	0.006	0.006	8.01	10.08
Alabama	1,474	0.0008	0.0001	0.0005	0	0

12-Month production units = short tons.
Projected emissions prepared from 2023 USGS IAA deliverable.

Table 6-3. Federal Coal Emissions - Projected Short-Term Life-of-Project (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	3,625,086,464	111.7851	16.5136	84.924	6,164.62	6,377.84
Wyoming	3,241,778,000	100.6708	12.1239	109.5768	5,476.57	5,698.94
Utah	145,949,040	2.7192	2.6922	6.2055	342.18	353.8
Montana	104,800,024	3.2553	0.3918	4.728	245.45	253.82
North Dakota	89,730,000	0	0	0	0	0
Colorado	42,108,500	4.7478	1.2698	0.7957	98.72	105.54
Alabama	720,900	0.3919	0.0359	0.4935	1.69	2.61

Life-of-Project (LOP) production units = short tons.
Projected emissions prepared from 2023 USGS IAA deliverable.

6.2 Short-Term Oil Emissions

Tables 6-4 through 6-10 show the FY 2024 held-by-production emissions from oil production on the federal mineral estate, as well as the emissions from projected APD approvals and leasing within the next 12 months on both a maximum annual and life-of-project basis. The emissions were calculated by multiplying the emission factors from Tables 5-8 by the state-specific production amounts from Table 5-9, or by the projection metrics (APD or lease wells and the associated production). The estimates presented here include emissions from the full oil lifecycle, including emissions arising from activities outside of the BLM's jurisdiction (such as emissions associated with refining and processing).

Table 6-4. Federal Oil Emissions - Held-By-Production Lands 2025 (Mt)

Area	Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
U.S. Total	4,958,907,000	365.8043	251.898	49.9014	2,149.69	2,817.3
Federal Total	1,341,273,616	70.6456	68.1328	13.4972	581.44	733.72
Onshore	654,729,214	48.2975	33.2583	6.5885	283.83	371.97
Alabama	9,170	0.0007	0.0005	0.0001	0	0.01
Alaska	4,100,888	0.3025	0.2083	0.0413	1.78	2.33
Arkansas	1	0	0	0	0	0
California	6,791,855	0.501	0.345	0.0683	2.94	3.86
Colorado	9,140,058	0.6742	0.4643	0.092	3.96	5.19
Illinois	9,479	0.0007	0.0005	0.0001	0	0.01
Kansas	88,571	0.0065	0.0045	0.0009	0.04	0.05
Kentucky	2,415	0.0002	0.0001	0	0	0
Louisiana	228,791	0.0169	0.0116	0.0023	0.1	0.13
Michigan	5,850	0.0004	0.0003	0.0001	0	0
Mississippi	188,639	0.0139	0.0096	0.0019	0.08	0.11
Montana	2,698,539	0.1991	0.1371	0.0272	1.17	1.53
Nebraska	23,473	0.0017	0.0012	0.0002	0.01	0.01
Nevada	187,153	0.0138	0.0095	0.0019	0.08	0.11
New Mexico	520,989,412	38.4319	26.4647	5.2427	225.85	295.99
North Dakota	41,542,236	3.0645	2.1102	0.418	18.01	23.6
Offshore	686,544,402	22.3481	34.8745	6.9087	297.62	361.75
Ohio	5,346	0.0004	0.0003	0.0001	0	0

Oklahoma	634,482	0.0468	0.0322	0.0064	0.28	0.36
Pennsylvania	383	0	0	0	0	0
South Dakota	97,649	0.0072	0.005	0.001	0.04	0.06
Texas	259,314	0.0191	0.0132	0.0026	0.11	0.15
Utah	8,228,358	0.607	0.418	0.0828	3.57	4.67
Wyoming	59,497,152	4.3889	3.0223	0.5987	25.79	33.8

Production units (bbl). U.S. Total is both federal and nonfederal data, shown for illustration purposes. "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-5. Federal Oil Emissions - Held-By-Production Lands Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	531,582,148	39.2133	27.0028	5.3493	230.44	302.01
New Mexico	420,188,279	30.9961	21.3443	4.2284	182.15	238.72
Wyoming	48,568,635	3.5828	2.4671	0.4887	21.05	27.59
North Dakota	34,600,472	2.5524	1.7576	0.3482	15	19.66
Colorado	7,294,701	0.5381	0.3705	0.0734	3.16	4.14
Utah	7,238,597	0.534	0.3677	0.0728	3.14	4.11
California	6,096,032	0.4497	0.3097	0.0613	2.64	3.46
Alaska	3,737,326	0.2757	0.1898	0.0376	1.62	2.12
Montana	2,311,923	0.1705	0.1174	0.0233	1	1.31
Oklahoma	538,096	0.0397	0.0273	0.0054	0.23	0.31
Texas	235,387	0.0174	0.012	0.0024	0.1	0.13
Louisiana	220,740	0.0163	0.0112	0.0022	0.1	0.13
Mississippi	171,140	0.0126	0.0087	0.0017	0.07	0.1
Nevada	156,723	0.0116	0.008	0.0016	0.07	0.09
South Dakota	92,048	0.0068	0.0047	0.0009	0.04	0.05
Kansas	80,711	0.006	0.0041	0.0008	0.03	0.05
Nebraska	21,563	0.0016	0.0011	0.0002	0.01	0.01
Illinois	8,626	0.0006	0.0004	0.0001	0	0
Alabama	8,446	0.0006	0.0004	0.0001	0	0
Michigan	5,576	0.0004	0.0003	0.0001	0	0
Ohio	4,581	0.0003	0.0002	0	0	0
Kentucky	2,196	0.0002	0.0001	0	0	0
Pennsylvania	349	0	0	0	0	0
Arkansas	1	0	0	0	0	0

Production units (bbl). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-6. Federal Oil Emissions - Held-By-Production Lands Projected Life-of-Project (Mt)

Area	LOP Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	4,703,578,648	346.9694	238.9281	47.3321	2,039.01	2,672.24
New Mexico	3,579,691,070	264.0635	181.8379	36.0224	1,551.8	2,033.72
Wyoming	437,683,855	32.2867	22.2331	4.4044	189.74	248.66
North Dakota	343,680,817	25.3523	17.458	3.4585	148.99	195.25
California	90,706,281	6.6911	4.6076	0.9128	39.32	51.53
Utah	87,298,310	6.4397	4.4345	0.8785	37.84	49.6

Colorado	59,265,002	4.3718	3.0105	0.5964	25.69	33.67
Alaska	56,398,977	4.1604	2.8649	0.5675	24.45	32.04
Montana	26,537,520	1.9576	1.348	0.267	11.5	15.08
Oklahoma	5,857,254	0.4321	0.2975	0.0589	2.54	3.33
Louisiana	4,996,575	0.3686	0.2538	0.0503	2.17	2.84
Texas	3,744,358	0.2762	0.1902	0.0377	1.62	2.13
Mississippi	2,506,690	0.1849	0.1273	0.0252	1.09	1.42
South Dakota	1,754,729	0.1294	0.0891	0.0177	0.76	1
Nevada	1,430,470	0.1055	0.0727	0.0144	0.62	0.81
Kansas	1,217,224	0.0898	0.0618	0.0122	0.53	0.69
Nebraska	343,261	0.0253	0.0174	0.0035	0.15	0.2
Alabama	136,859	0.0101	0.007	0.0014	0.06	0.08
Illinois	128,868	0.0095	0.0065	0.0013	0.06	0.07
Michigan	115,169	0.0085	0.0059	0.0012	0.05	0.07
Ohio	47,372	0.0035	0.0024	0.0005	0.02	0.03
Kentucky	32,674	0.0024	0.0017	0.0003	0.01	0.02
Pennsylvania	5,295	0.0004	0.0003	0.0001	0	0
Arkansas	18	0	0	0	0	0

Production units (bbl). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-7. Federal Oil Emissions - Approved APDs Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	516,465,839	38.0982	26.235	5.1972	223.89	293.42
New Mexico	442,292,404	32.6266	22.4672	4.4508	191.73	251.28
Wyoming	29,904,150	2.2059	1.519	0.3009	12.96	16.99
North Dakota	20,164,329	1.4875	1.0243	0.2029	8.74	11.46
Colorado	9,626,430	0.7101	0.489	0.0969	4.17	5.47
Utah	6,250,365	0.4611	0.3175	0.0629	2.71	3.55
Alaska	2,906,469	0.2144	0.1476	0.0292	1.26	1.65
Texas	1,940,775	0.1432	0.0986	0.0195	0.84	1.1
Louisiana	1,584,108	0.1169	0.0805	0.0159	0.69	0.9
Oklahoma	707,820	0.0522	0.036	0.0071	0.31	0.4
California	521,808	0.0385	0.0265	0.0053	0.23	0.3
Montana	437,836	0.0323	0.0222	0.0044	0.19	0.25
Mississippi	50,201	0.0037	0.0026	0.0005	0.02	0.03
Arkansas	30,420	0.0022	0.0015	0.0003	0.01	0.02
South Dakota	25,714	0.0019	0.0013	0.0003	0.01	0.01
Nevada	11,907	0.0009	0.0006	0.0001	0.01	0.01
Kansas	11,103	0.0008	0.0006	0.0001	0	0.01

Production units (bbl). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-8. Federal Oil Emissions - Approved APDs Projected Life-of-Project (Mt)

Area	LOP Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	1,587,550,818	117.109	80.643	15.9755	688.21	901.93
New Mexico	1,356,815,356	100.0884	68.9223	13.6536	588.18	770.85

Wyoming	96,126,316	7.091	4.8829	0.9673	41.67	54.61
North Dakota	51,315,662	3.7854	2.6067	0.5164	22.25	29.15
Colorado	18,663,647	1.3768	0.9481	0.1878	8.09	10.6
Louisiana	16,367,303	1.2074	0.8314	0.1647	7.1	9.3
Utah	16,312,227	1.2033	0.8286	0.1641	7.07	9.27
Alaska	12,843,596	0.9474	0.6524	0.1292	5.57	7.3
Texas	12,087,926	0.8917	0.614	0.1216	5.24	6.87
California	2,822,235	0.2082	0.1434	0.0284	1.22	1.6
Oklahoma	2,085,932	0.1539	0.106	0.021	0.9	1.19
Montana	1,413,956	0.1043	0.0718	0.0142	0.61	0.8
Arkansas	236,791	0.0175	0.012	0.0024	0.1	0.13
Mississippi	217,844	0.0161	0.0111	0.0022	0.09	0.12
South Dakota	173,262	0.0128	0.0088	0.0017	0.08	0.1
Kansas	46,004	0.0034	0.0023	0.0005	0.02	0.03
Nevada	22,761	0.0017	0.0012	0.0002	0.01	0.01

Production units (bbl). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-9. Federal Oil Emissions - Potential Lease Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	43,351,447	3.1979	2.2021	0.4362	18.79	24.63
New Mexico	21,010,236	1.5499	1.0673	0.2114	9.11	11.94
Wyoming	10,013,775	0.7387	0.5087	0.1008	4.34	5.69
Colorado	5,092,692	0.3757	0.2587	0.0512	2.21	2.89
North Dakota	4,612,755	0.3403	0.2343	0.0464	2	2.62
California	521,808	0.0385	0.0265	0.0053	0.23	0.3
Montana	437,836	0.0323	0.0222	0.0044	0.19	0.25
Texas	388,155	0.0286	0.0197	0.0039	0.17	0.22
Alaska	322,941	0.0238	0.0164	0.0032	0.14	0.18
Utah	239,085	0.0176	0.0121	0.0024	0.1	0.14
Ohio	142,731	0.0105	0.0073	0.0014	0.06	0.08
Louisiana	132,009	0.0097	0.0067	0.0013	0.06	0.07
Oklahoma	94,376	0.007	0.0048	0.0009	0.04	0.05
Kansas	55,515	0.0041	0.0028	0.0006	0.02	0.03
Mississippi	50,201	0.0037	0.0026	0.0005	0.02	0.03
Alabama	49,578	0.0037	0.0025	0.0005	0.02	0.03
Michigan	42,582	0.0031	0.0022	0.0004	0.02	0.02
Idaho	27,996	0.0021	0.0014	0.0003	0.01	0.02
West Virginia	27,815	0.0021	0.0014	0.0003	0.01	0.02
South Dakota	25,714	0.0019	0.0013	0.0003	0.01	0.01
Nevada	23,814	0.0018	0.0012	0.0002	0.01	0.01
Nebraska	11,368	0.0008	0.0006	0.0001	0	0.01
Arkansas	10,140	0.0007	0.0005	0.0001	0	0.01
Illinois	6,590	0.0005	0.0003	0.0001	0	0
Pennsylvania	5,737	0.0004	0.0003	0.0001	0	0
Kentucky	5,357	0.0004	0.0003	0.0001	0	0
New York	641	0	0	0	0	0

Production units (bbl). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-10. Federal Oil Emissions - Potential Lease Projected Life-of-Project (Mt)

Area	LOP Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	130,549,500	9.6303	6.6315	1.3137	56.59	74.17
New Mexico	64,452,861	4.7545	3.274	0.6486	27.94	36.62
Wyoming	32,189,087	2.3745	1.6351	0.3239	13.95	18.29
North Dakota	11,738,877	0.8659	0.5963	0.1181	5.09	6.67
Colorado	9,873,671	0.7284	0.5016	0.0994	4.28	5.61
California	2,822,235	0.2082	0.1434	0.0284	1.22	1.6
Texas	2,417,585	0.1783	0.1228	0.0243	1.05	1.37
Alaska	1,427,066	0.1053	0.0725	0.0144	0.62	0.81
Montana	1,413,956	0.1043	0.0718	0.0142	0.61	0.8
Louisiana	1,363,942	0.1006	0.0693	0.0137	0.59	0.77
Utah	623,965	0.046	0.0317	0.0063	0.27	0.35
Michigan	404,647	0.0298	0.0206	0.0041	0.18	0.23
Ohio	290,898	0.0215	0.0148	0.0029	0.13	0.17
Oklahoma	278,124	0.0205	0.0141	0.0028	0.12	0.16
Alabama	254,046	0.0187	0.0129	0.0026	0.11	0.14
Kansas	230,020	0.017	0.0117	0.0023	0.1	0.13
Mississippi	217,844	0.0161	0.0111	0.0022	0.09	0.12
South Dakota	173,262	0.0128	0.0088	0.0017	0.08	0.1
Arkansas	78,930	0.0058	0.004	0.0008	0.03	0.04
Idaho	75,664	0.0056	0.0038	0.0008	0.03	0.04
Nebraska	53,599	0.004	0.0027	0.0005	0.02	0.03
West Virginia	49,315	0.0036	0.0025	0.0005	0.02	0.03
Nevada	45,522	0.0034	0.0023	0.0005	0.02	0.03
Illinois	26,716	0.002	0.0014	0.0003	0.01	0.02
Pennsylvania	24,062	0.0018	0.0012	0.0002	0.01	0.01
Kentucky	21,509	0.0016	0.0011	0.0002	0.01	0.01
New York	2,097	0.0002	0.0001	0	0	0

Production units (bbl). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

6.3 Short-Term Gas Emissions

Tables 6-11 through 6-17 show the FY 2024 held-by-production emissions from gas production on the federal mineral estate, as well as the emissions from projected APD approvals and leasing within the next 12 months on both a maximum annual and life-of-project basis. The emissions are calculated by multiplying the emission factors from Tables 5-10 by the state-specific production amounts from Table 5-11, or by the projection metrics (APD or lease wells and the associated production). The estimates presented here include emissions from the full gas lifecycle, including emissions arising from activities outside of the BLM's jurisdiction (such as emissions associated with refining and processing).

Table 6-11. Federal Gas Emissions - Held-By-Production Lands 2025 (Mt)

Area	Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
U.S. Total	47,733,473,000	270.5487	92.463	594.4307	2,601.39	3,558.83
Federal Total	5,260,582,669	29.8877	10.1901	65.5107	286.69	392.28
Onshore	4,505,696,156	25.5379	8.7278	56.11	245.55	335.93
Alabama	3,192,284	0.0181	0.0062	0.0398	0.17	0.24
Alaska	27,978,349	0.1586	0.0542	0.3484	1.52	2.09
Arkansas	7,594,553	0.043	0.0147	0.0946	0.41	0.57
California	7,471,073	0.0423	0.0145	0.093	0.41	0.56
Colorado	473,214,831	2.6821	0.9166	5.893	25.79	35.28
Illinois	1,631	0	0	0	0	0
Kansas	2,494,978	0.0141	0.0048	0.0311	0.14	0.19
Kentucky	73,202	0.0004	0.0001	0.0009	0	0.01
Louisiana	43,620,512	0.2472	0.0845	0.5432	2.38	3.25
Michigan	622,352	0.0035	0.0012	0.0078	0.03	0.05
Mississippi	210,432	0.0012	0.0004	0.0026	0.01	0.02
Montana	8,250,436	0.0468	0.016	0.1027	0.45	0.62
Nevada	4,842	0	0	0.0001	0	0
New Mexico	2,639,329,138	14.9595	5.1126	32.8679	143.84	196.78
New York	3,281	0	0	0	0	0
North Dakota	143,776,915	0.8149	0.2785	1.7905	7.84	10.72
Offshore	754,886,513	4.3498	1.4623	9.4007	41.14	56.35
Ohio	1,882,161	0.0107	0.0036	0.0234	0.1	0.14
Oklahoma	11,782,786	0.0668	0.0228	0.1467	0.64	0.88
Pennsylvania	19,219	0.0001	0	0.0002	0	0
South Dakota	352,163	0.002	0.0007	0.0044	0.02	0.03
Texas	50,341,392	0.2853	0.0975	0.6269	2.74	3.75
Utah	123,261,856	0.6986	0.2388	1.535	6.72	9.19
Virginia	113,390	0.0006	0.0002	0.0014	0.01	0.01
West Virginia	18,005	0.0001	0	0.0002	0	0
Wyoming	960,086,375	5.4417	1.8598	11.9561	52.32	71.58

Production units (bbl). U.S. Total is both federal and nonfederal data, shown for illustration purposes. "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-12. Federal Gas Emissions - Held-By-Production Lands Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	3,633,310,481	20.5933	7.038	45.2461	198.01	270.89
New Mexico	1,949,527,369	11.0497	3.7764	24.2777	106.25	145.35
Wyoming	852,670,472	4.8329	1.6517	10.6184	46.47	63.57
Colorado	411,745,965	2.3337	0.7976	5.1275	22.44	30.7
Utah	151,139,477	0.8566	0.2928	1.8822	8.24	11.27
North Dakota	124,551,042	0.7059	0.2413	1.551	6.79	9.29
Louisiana	55,847,951	0.3165	0.1082	0.6955	3.04	4.16
Texas	30,657,486	0.1738	0.0594	0.3818	1.67	2.29
Alaska	10,778,305	0.0611	0.0209	0.1342	0.59	0.8
Oklahoma	9,533,282	0.054	0.0185	0.1187	0.52	0.71

California	8,229,135	0.0466	0.0159	0.1025	0.45	0.61
Alabama	7,753,726	0.0439	0.015	0.0966	0.42	0.58
Arkansas	7,580,685	0.043	0.0147	0.0944	0.41	0.57
Montana	7,544,199	0.0428	0.0146	0.0939	0.41	0.56
Kansas	2,252,458	0.0128	0.0044	0.0281	0.12	0.17
Ohio	1,917,216	0.0109	0.0037	0.0239	0.1	0.14
Michigan	645,307	0.0037	0.0013	0.008	0.04	0.05
Mississippi	364,409	0.0021	0.0007	0.0045	0.02	0.03
South Dakota	333,683	0.0019	0.0006	0.0042	0.02	0.02
Virginia	102,371	0.0006	0.0002	0.0013	0.01	0.01
Kentucky	67,351	0.0004	0.0001	0.0008	0	0.01
West Virginia	33,211	0.0002	0.0001	0.0004	0	0
Pennsylvania	27,228	0.0002	0.0001	0.0003	0	0
Nevada	3,437	0	0	0	0	0
New York	2,694	0	0	0	0	0
Illinois	2,022	0	0	0	0	0

Production units (Mcf). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-13. Federal Gas Emissions - Held-By-Production Lands Projected Life-of-Project (Mt)

Area	LOP Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	38,169,223,814	216.3395	73.9364	475.326	2,080.15	2,845.75
New Mexico	19,803,748,923	112.2457	38.3612	246.6185	1,079.27	1,476.49
Wyoming	9,115,056,231	51.6633	17.6565	113.5109	496.75	679.58
Colorado	4,256,890,987	24.1276	8.2459	53.0116	231.99	317.38
Utah	1,644,477,540	9.3207	3.1855	20.4789	89.62	122.61
North Dakota	1,243,539,931	7.0483	2.4088	15.486	67.77	92.71
Texas	550,013,553	3.1174	1.0654	6.8494	29.97	41.01
Louisiana	529,270,197	2.9999	1.0252	6.5911	28.84	39.46
Alaska	436,728,909	2.4753	0.846	5.4386	23.8	32.56
California	132,893,147	0.7532	0.2574	1.6549	7.24	9.91
Arkansas	119,999,513	0.6801	0.2324	1.4944	6.54	8.95
Oklahoma	118,991,195	0.6744	0.2305	1.4818	6.48	8.87
Montana	91,217,351	0.517	0.1767	1.1359	4.97	6.8
Alabama	47,636,756	0.27	0.0923	0.5932	2.6	3.55
Kansas	37,460,659	0.2123	0.0726	0.4665	2.04	2.79
Ohio	17,823,088	0.101	0.0345	0.222	0.97	1.33
Michigan	12,127,851	0.0687	0.0235	0.151	0.66	0.9
South Dakota	5,114,912	0.029	0.0099	0.0637	0.28	0.38
Mississippi	3,293,577	0.0187	0.0064	0.041	0.18	0.25
Virginia	1,765,268	0.01	0.0034	0.022	0.1	0.13
Kentucky	489,629	0.0028	0.0009	0.0061	0.03	0.04
Pennsylvania	261,816	0.0015	0.0005	0.0033	0.01	0.02
West Virginia	233,143	0.0013	0.0005	0.0029	0.01	0.02
Nevada	95,115	0.0005	0.0002	0.0012	0.01	0.01
New York	62,484	0.0004	0.0001	0.0008	0	0
Illinois	32,039	0.0002	0.0001	0.0004	0	0

Production units (Mcf). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-14. Federal Gas Emissions - Approved APDs Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	2,005,519,014	11.3671	3.8848	24.975	109.3	149.52
New Mexico	1,545,437,264	8.7594	2.9936	19.2455	84.22	115.22
Wyoming	249,965,340	1.4168	0.4842	3.1128	13.62	18.64
Colorado	53,860,795	0.3053	0.1043	0.6707	2.94	4.02
Louisiana	43,496,592	0.2465	0.0843	0.5417	2.37	3.24
North Dakota	37,392,129	0.2119	0.0724	0.4656	2.04	2.79
Alaska	33,356,232	0.1891	0.0646	0.4154	1.82	2.49
Utah	22,771,422	0.1291	0.0441	0.2836	1.24	1.7
Texas	8,919,585	0.0506	0.0173	0.1111	0.49	0.67
Oklahoma	7,739,340	0.0439	0.015	0.0964	0.42	0.58
Arkansas	1,378,926	0.0078	0.0027	0.0172	0.08	0.1
Montana	516,719	0.0029	0.001	0.0064	0.03	0.04
California	423,570	0.0024	0.0008	0.0053	0.02	0.03
Mississippi	163,298	0.0009	0.0003	0.002	0.01	0.01
Kansas	75,491	0.0004	0.0001	0.0009	0	0.01
South Dakota	22,311	0.0001	0	0.0003	0	0
Nevada	0	0	0	0	0	0

Production units (Mcf). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-15. Federal Gas Emissions - Approved APDs Projected Life-of-Project (Mt)

Area	LOP Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	6,733,444,155	38.1645	13.0431	83.8524	366.96	502.02
New Mexico	4,913,944,122	27.8518	9.5186	61.1939	267.8	366.37
Wyoming	956,985,519	5.4241	1.8537	11.9175	52.15	71.35
Colorado	196,539,373	1.114	0.3807	2.4475	10.71	14.65
Alaska	181,394,589	1.0281	0.3514	2.2589	9.89	13.52
Louisiana	176,753,201	1.0018	0.3424	2.2011	9.63	13.18
North Dakota	132,190,159	0.7492	0.2561	1.6462	7.2	9.86
Utah	88,918,942	0.504	0.1722	1.1073	4.85	6.63
Texas	39,678,569	0.2249	0.0769	0.4941	2.16	2.96
Oklahoma	31,724,023	0.1798	0.0615	0.3951	1.73	2.37
Arkansas	7,706,938	0.0437	0.0149	0.096	0.42	0.57
California	4,002,557	0.0227	0.0078	0.0498	0.22	0.3
Montana	2,261,231	0.0128	0.0044	0.0282	0.12	0.17
Mississippi	864,502	0.0049	0.0017	0.0108	0.05	0.06
Kansas	376,751	0.0021	0.0007	0.0047	0.02	0.03
South Dakota	103,679	0.0006	0.0002	0.0013	0.01	0.01
Nevada	0	0	0	0	0	0

Production units (Mcf). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-16. Federal Gas Emissions - Potential Lease Projected 12-Months (Mt)

Area	12-Month Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	221,555,043	1.2558	0.4292	2.7591	12.07	16.52
Wyoming	83,703,990	0.4744	0.1621	1.0424	4.56	6.24
New Mexico	73,412,976	0.4161	0.1422	0.9142	4	5.47
Colorado	28,494,098	0.1615	0.0552	0.3548	1.55	2.12
North Dakota	8,553,755	0.0485	0.0166	0.1065	0.47	0.64
Ohio	7,569,084	0.0429	0.0147	0.0943	0.41	0.56
Alaska	3,706,248	0.021	0.0072	0.0462	0.2	0.28
Louisiana	3,624,716	0.0205	0.007	0.0451	0.2	0.27
Pennsylvania	2,154,202	0.0122	0.0042	0.0268	0.12	0.16
West Virginia	2,043,655	0.0116	0.004	0.0254	0.11	0.15
Texas	1,783,917	0.0101	0.0035	0.0222	0.1	0.13
Idaho	1,603,346	0.0091	0.0031	0.02	0.09	0.12
Oklahoma	1,031,912	0.0058	0.002	0.0129	0.06	0.08
Utah	871,038	0.0049	0.0017	0.0108	0.05	0.06
Oregon	665,954	0.0038	0.0013	0.0083	0.04	0.05
Montana	516,719	0.0029	0.001	0.0064	0.03	0.04
Arkansas	459,642	0.0026	0.0009	0.0057	0.03	0.03
California	423,570	0.0024	0.0008	0.0053	0.02	0.03
Kansas	377,455	0.0021	0.0007	0.0047	0.02	0.03
Mississippi	163,298	0.0009	0.0003	0.002	0.01	0.01
Kentucky	109,826	0.0006	0.0002	0.0014	0.01	0.01
Michigan	106,277	0.0006	0.0002	0.0013	0.01	0.01
Alabama	94,002	0.0005	0.0002	0.0012	0.01	0.01
Virginia	62,370	0.0004	0.0001	0.0008	0	0
South Dakota	22,311	0.0001	0	0.0003	0	0
New York	682	0	0	0	0	0

Production units (Mcf). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Table 6-17. Federal Gas Emissions - Potential Lease Projected Life-of-Project (Mt)

Area	LOP Production	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
BLM Total	797,893,947	4.5224	1.5456	9.9363	43.48	59.49
Wyoming	320,458,454	1.8163	0.6207	3.9907	17.46	23.89
New Mexico	233,427,309	1.323	0.4522	2.9069	12.72	17.4
Colorado	103,975,668	0.5893	0.2014	1.2948	5.67	7.75
North Dakota	30,239,579	0.1714	0.0586	0.3766	1.65	2.25
Ohio	24,475,651	0.1387	0.0474	0.3048	1.33	1.82
Alaska	20,154,954	0.1142	0.039	0.251	1.1	1.5
Louisiana	14,729,433	0.0835	0.0285	0.1834	0.8	1.1
Pennsylvania	8,768,943	0.0497	0.017	0.1092	0.48	0.65
Texas	7,935,714	0.045	0.0154	0.0988	0.43	0.59
West Virginia	7,529,708	0.0427	0.0146	0.0938	0.41	0.56
Oklahoma	4,229,870	0.024	0.0082	0.0527	0.23	0.32
California	4,002,557	0.0227	0.0078	0.0498	0.22	0.3
Utah	3,401,271	0.0193	0.0066	0.0424	0.19	0.25

Idaho	3,375,274	0.0191	0.0065	0.042	0.18	0.25
Arkansas	2,568,979	0.0146	0.005	0.032	0.14	0.19
Montana	2,261,231	0.0128	0.0044	0.0282	0.12	0.17
Kansas	1,883,757	0.0107	0.0036	0.0235	0.1	0.14
Oregon	1,675,879	0.0095	0.0032	0.0209	0.09	0.12
Mississippi	864,502	0.0049	0.0017	0.0108	0.05	0.06
Michigan	776,819	0.0044	0.0015	0.0097	0.04	0.06
Alabama	462,915	0.0026	0.0009	0.0058	0.03	0.03
Virginia	337,163	0.0019	0.0007	0.0042	0.02	0.03
Kentucky	248,680	0.0014	0.0005	0.0031	0.01	0.02
South Dakota	103,679	0.0006	0.0002	0.0013	0.01	0.01
New York	5,958	0	0	0.0001	0	0

Production units (Mcf). "0" values are the result of rounding to a defined number of significant digits (Ex: 0.0000), which are then truncated. These values are less than the significant digits provided for (Ex: 0 00004).

Figure 6-1 shows an annualized timeline of the projected short-term life-of-project CO_2e emissions from the previous tables (existing producing wells and projected wells from new APDs and Leasing (12-months)) for all of BLM. Figure 6-1 only shows 25 years to remain consistent with the long-term projections shown in Figure 6-2. The cumulative 30-year sum of all the series (i.e. the federal sum) is displayed in Table 6-18.

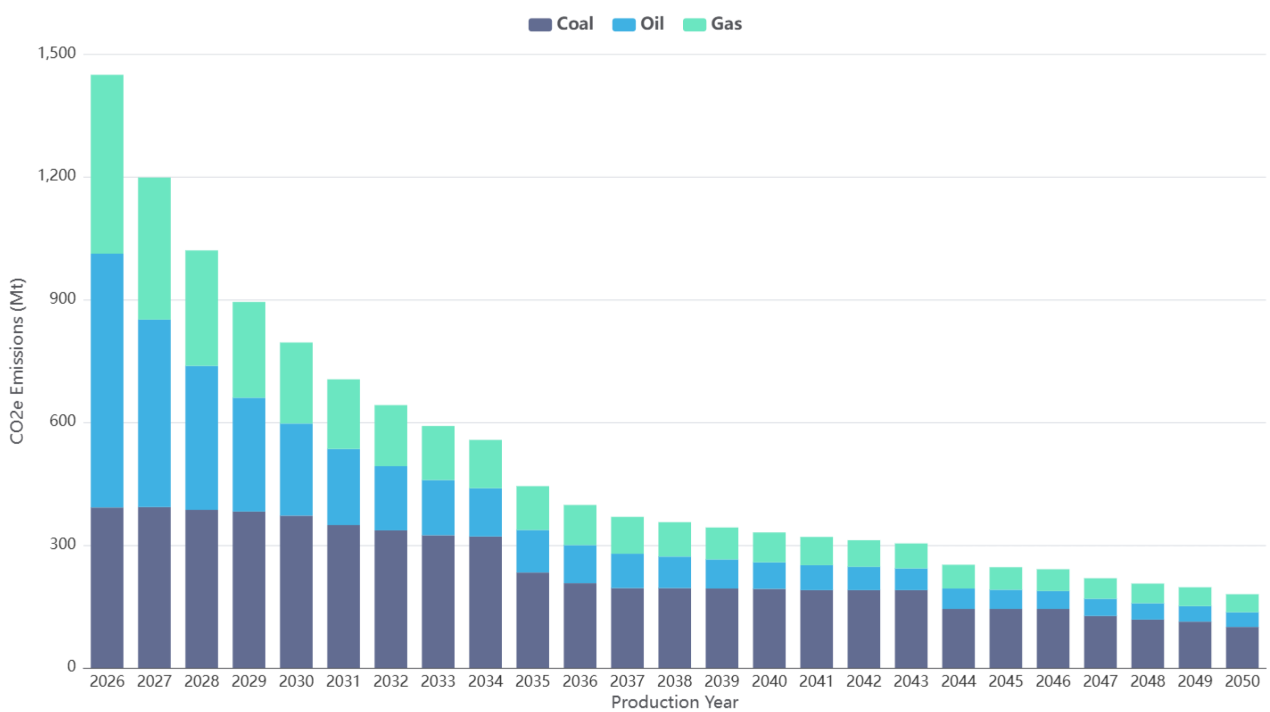

Figure 6-1. Projected Short-Term Oil, Gas, and Coal CO_2e Emissions (tonnes)

Table 6-18. Federal Summary - Projected Short-Term Life-of-Project Emissions (Mt)

Mineral	Extraction CO_2e	Processing CO_2e	Transport CO_2e	Combustion CO_2e	Total CO_2e
Coal	111.79	16.51	85.00	6,164.62	6,377.91
Oil	473.71	326.20	64.62	2,783.81	3,648.34
Gas	259.03	88.53	569.11	2,490.60	3,407.26
Totals	**845**	**431**	**719**	**11,439**	**13,434**

6.4 Long-Term Federal Hydrocarbon Mineral Emissions Projections

The long-term emissions estimates presented in Figure 6-2 and Table 6-19 are based on EIA's AEO counterfactual case data. For the 2025 AEO, the high oil price scenario produces the highest emissions. This should also be true at subnational scales depending on the production resource mix of the individual region. The low oil and gas supply case produced the lowest projected emissions, which is slightly counterintuitive considering that the low renewables cost case would be expected to produce fewer emissions overall (second lowest scenario). Areas with higher levels of coal production could see higher emissions in a low oil and gas supply scenario, as increased coal production takes up the energy slack from lower available oil and gas supplies.

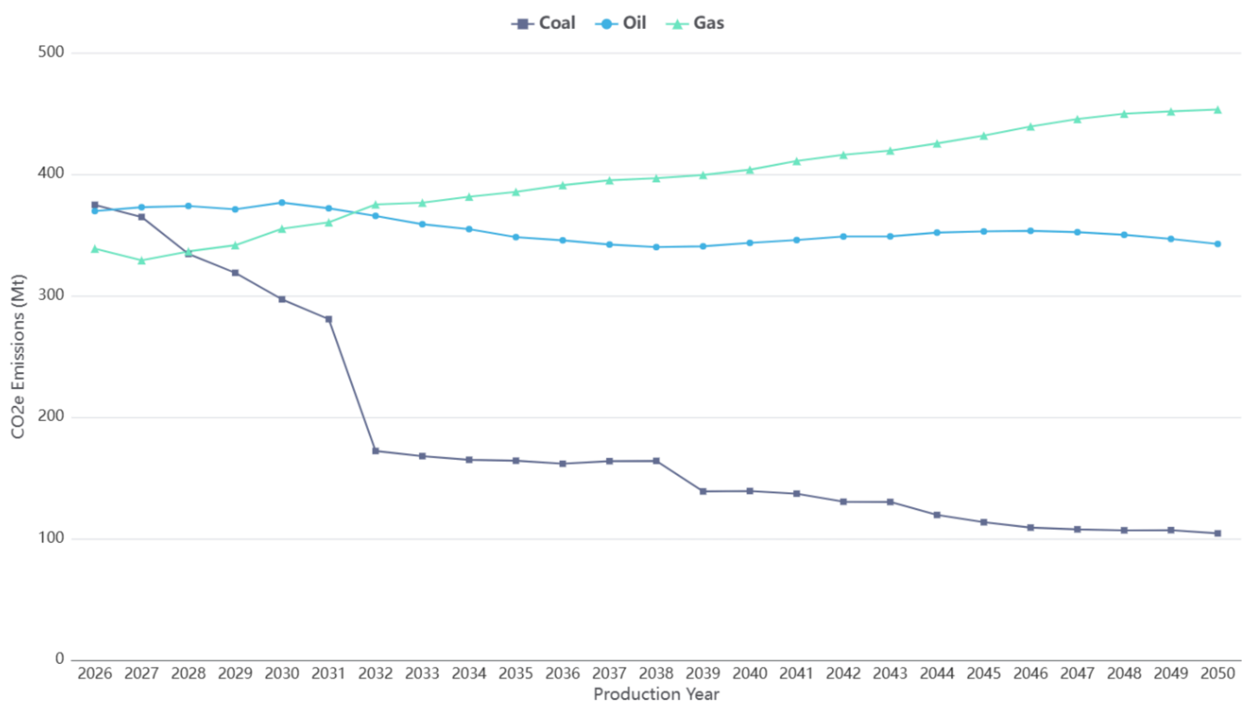

Figure 6-2. Long-Term Onshore Federal Mineral Emissions (Mt CO_2e)

Table 6-19. Long-Term Federal Mineral Projections - AEO Counterfactual Case

Federal Mineral	Production	Energy Content (Quads)	Total CO2e (Mt)
Coal (MM Short Tons)	2,556	4.58E+01	4,574
Oil (MM bbl)	15,612	9.05E+01	8,870
Gas (Bcf)	132,914	1.36E+02	9,910
Totals	**NA**	**2.73E+02**	**23,353**

In 2024, the EIA made substantial changes to the underlying National Energy Modeling System (NEMS) to provide enhanced modeling of hydrogen, carbon capture, oil and gas resources, and other emerging technologies. The projections made from the 2025 data show that hydrocarbon mineral development from the federal onshore mineral estate could account for approximately 12.65% of total U.S. coal, oil, and gas GHG emissions by 2050. The difference (or delta) between the cumulative short-term emissions previously described and the long-term emissions estimates can be thought of as the level of additional development that could be authorized to sustain the existing federal fraction of production over the longer term. Similarly, if the short-term emissions exceed a longer-term scenario, then the delta can be thought of as the amount of reduction required to attain the outlook forecast. The difference in federal emissions on an absolute basis between the high (high oil price) and low (low oil and gas supply) AEO projection scenarios is approximately 8,684 Mt of CO_2e over the entirety of the projection period, or about 347.36 Mt of CO_2e on an annual average basis. In all cases, the EIA clearly explains that the AEO scenario projections are not predictions of what will happen, but rather, they are modeled projections of what may happen given certain assumptions.

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Glossary

abandoned - An oil or gas well is considered abandoned when it has been permanently taken out of production.

actual hydrocarbon production - federal oil and gas lease that is considered to be in an "actual production" status whenever it contains one or more wells drilled on a lease or agreement (communitization or unitization) basis which are producing oil and/or gas in paying quantities. A lease is also considered to be in "actual production" status whenever it contains one or more wells drilled on a lease or agreement basis, which are capable of producing oil and/or gas in paying quantities even though production is not then occurring (BLM Handbook H-3100-1, "Oil and Gas Leasing").

anthropogenic - relating to, or resulting from, the influence of human beings on nature.

applications for permit to drill (APDs) - A revocable authorization to use public land for a specified purpose.

carbon dioxide equivalents (CO2e) - A method to convert the emissions of each different greenhouse gas (methane, nitrous oxide, etc.) to an equivalent amount of CO_2 emissions. The BLM acknowledges the uncertainty in this methodology and has not independently verified its accuracy.

completions - Well completion is the process of making a well ready for production (or injection) after drilling operations are completed. This may include hydraulic fracturing.

decline - Once an oil and gas well has been completed (the process of making a well ready for production), its maximum production level can be attained within days or weeks. After this level has been reached (transient flow period), there is a decline in production usually caused by loss of reservoir pressure or changing volumes of produced fluid. The rate of production decline is depicted by a decline curve. Decline curves generally show the amount of oil or gas produced per unit of time, for many successive periods.

direct emissions - GHG emissions that are emitted from the development of coal, oil, and gas on the federal mineral estate (ie., onsite mining or upstream operations).

downstream - Includes GHG emissions from refining, distributing, and retail of extracted minerals. This includes oil refineries, gas processing plants, products distributors, and natural gas distribution companies. Downstream emissions also include end uses such as combustion of fuels (gasoline, diesel, etc.), plastics, pharmaceuticals, natural gas, and propane.

estimated ultimate recovery (EUR) - The estimated quantity of expected total production from an oil or gas reserve or well. The EUR for a well is calculated as the sum of the observed monthly production values plus the sum of the monthly production values estimated using the decline curve, starting the month after the last observed production month through month 360 (30 years in total).

federal lands - All lands and interests in lands owned by the United States which are subject to the mineral leasing laws, including mineral resources or mineral estates reserved to the United States in the conveyance of a surface or nonmineral estate (43 CFR §3160.0-5).

federal mineral estate - The onshore subsurface mineral estate owned by the Federal Government and managed by the BLM, regardless of surface ownership.

fiscal year **-** A one-year period that companies and governments use for financial reporting and budgeting. The Federal Government defines a fiscal year as the period between October 1st to September 30th.

fugitive emissions - Emissions of greenhouse gases that are not produced intentionally by a stack or vent and may include leaks from industrial sources and pipelines (IPCC 2006).

held-by-production - A provision in an oil or natural gas property lease that allows the lessee, generally an energy company, to continue drilling activities on the property as long as it is economically producing a minimum amount of oil or gas. The held-by- production provision thereby extends the lessee's right to operate the property beyond the initial lease term.

indirect emissions - GHG emissions that are a consequence of the produced hydrocarbons but occur downstream from the point of production on federal lands and/or are outside of BLM's approval authority.

leases - An authorization to possess and use public land for a period of time sufficient to amortize capital investments in the land.

life-cycle assessment **-** A methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service. For instance, in the case of a manufactured product, environmental impacts are assessed from raw material extraction and processing (cradle), through the product's manufacture, distribution and use, to the recycling or final disposal of the materials composing it (grave).

Megatonne - A tonne (symbol t) is a metric unit of mass equal to 1,000 kilograms. It is also referred to as a metric ton. It is equivalent to approximately 2,204.6 pounds, or 1.102 short tons (US). Mega is a multiple of 1 X 106, and thus a Megatonne (symbol Mt), is equal to one million metric tons.

multiple use and sustained yield - A combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources, including recreation, range, timber, minerals, watershed, and wildlife and fish, along with natural scenic, scientific, and historical values.

operators - Any person or entity including but not limited to the lessee or operating rights owner, who has stated in writing to the authorized officer that it is responsible under the terms and conditions of the lease for the operations conducted on the leased lands or a portion thereof (43 CFR §37 60.0-5).

parcels - The name given to an area of land made available for competitive or noncompetitive leasing (BLM Handbook H-3100-1, "Oil and Gas Leasing").

producible well **-** A well producing oil or gas, or if not producing oil or gas, a well either declared or capable of being declared producing.

public lands - Any land and interest in land owned by the United States within the several States and administered by the Secretary of the Interior through the Bureau of Land Management, without regard to how the United States acquired ownership, except (7) lands located on the Outer Continental Shelf; and (2) lands held for the benefit of Indians, Aleuts, and Eskimos (43 U.S.C §1702, Federal Land Policy and Management Act of 1976, Sec. 103(e)).

reasonably foreseeable development (RFD) **-** A technical report containing a long-term projection (scenario) of a particular use of the public lands, in this case oil and gas exploration, development, production, and reclamation activity (BLM Handbook H-1624-1, "Planning for Fluid Mineral Resources").

spud - Spudding is the process of beginning to drill a well in the oil and gas industry.

stoichiometric - Stoichiometry is the study of the quantitative relationships or ratios between two or more substances undergoing a physical change or chemical change (chemical reaction).

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Appendix

2025 Report Year Database (spreadsheet)

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