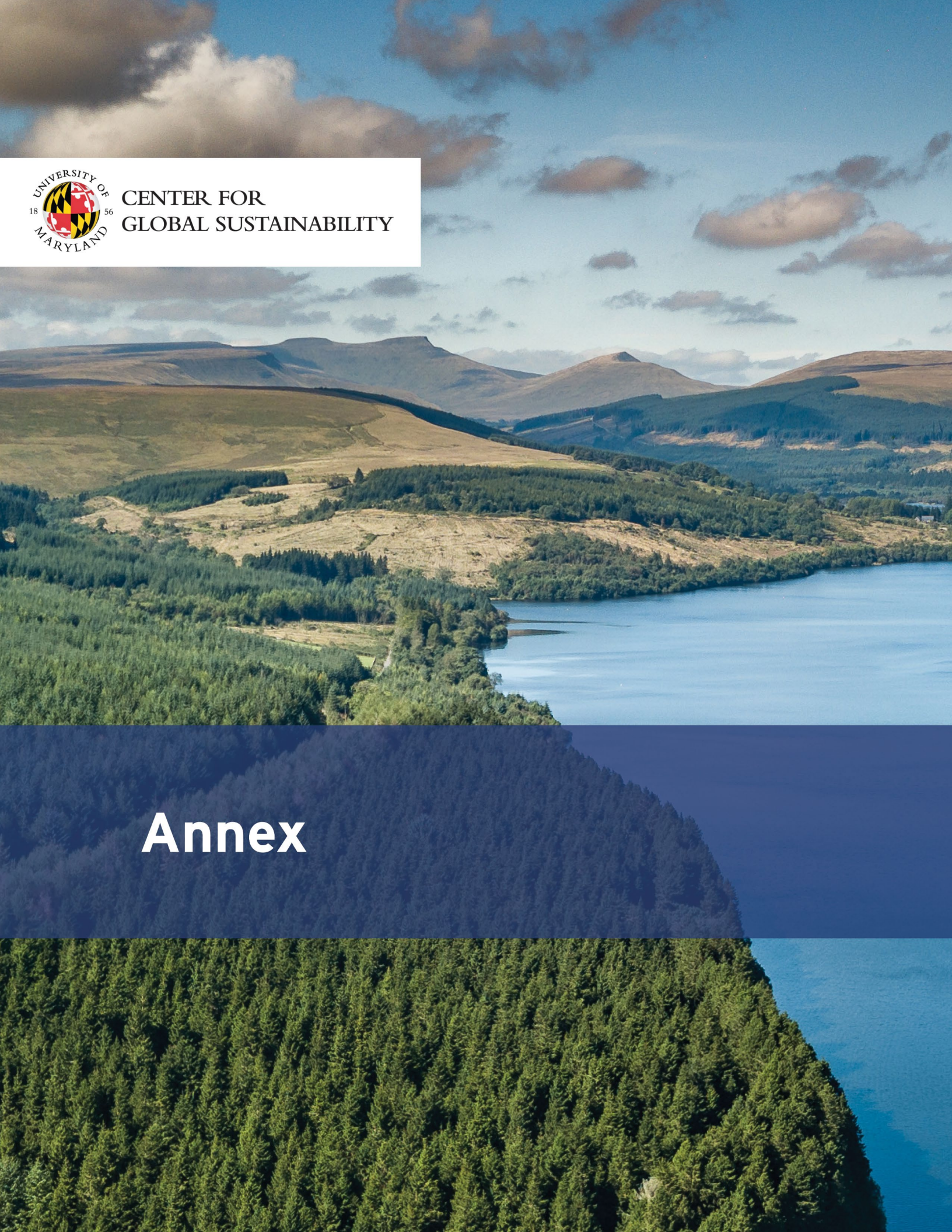

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Guide

This Annex provides additional supporting information for the Greenhouse Gas Inventory and Analysis for the United States: 1990-2024 (GHGIA) (e.g., for the key category analysis), expands on methodologies used to compile specific source and/or sink category estimates and presents other related information (e.g. more information on global warming potentials). For this first GHGIA report, the Annex is intended to be used in conjunction with publicly available information from previous official inventories for the United States. The suggested citation for the Annex is the same as the full GHGIA report.

To facilitate this approach, CGS has prepared a crosswalk file,[1] including an "Annex" tab that maps data tables (e.g. previous CSV data files) in this Annex to the GHGIA to data tables from previous official inventories, i.e., the Annex to EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2023 (EPA, 2025). As noted within specific sub-annexes, methodological information remains unchanged from previous EPA inventories (EPA 2025) or information was not available to update the specific sub-annex for this current GHGIA (e.g., ODS emissions) and may be updated in future inventories. While this annex is mostly complete, some sub-annexes are still undergoing review and will be published when finalized. Other sections will be updated in the next GHGIA. The status is noted within each specific annex. Similarly, where corresponding data tables and associated CSVs are pending, it is noted within the above crosswalk file as pending (P).

[1] The crosswalk file can be downloaded from the GHGIA data web page at https://ghgi.cgs.umd.edu/data.html.

Annex 1. Key Category Analysis

Overview

This Annex details the underlying analysis to identify key categories as summarized in Chapter 1 (Introduction) of the GHGIA. The current key category analysis applied Quantitative Approach 1 level and trend assessments including and excluding LULUCF sector to identify key categories. The Quantitative Approach 2 level and trend assessments including and excluding LULUCF with uncertainty were not updated from EPA (2025) for this GHGIA but will be updated in future GHGIAs. Similarly, the qualitative approach was not applied for this GHGIA but will be reassessed for future inventories.

Disaggregation Level

The source and sink category aggregation level is consistent with EPA (2025). EPA (2025) disaggregated categories consistent with the uncertainty analysis to facilitate application of the Quantitative Approach 2 in future GHGIAs. Consistent with EPA (2025), the aggregation level also reflects some but not all special considerations for disaggregating significant subcategories noted in Table 4.1 in Volume, Chapter 4, of the *2006 IPCC Guidelines* and its *Refinement*. The considerations implemented, or categories disaggregated further include:

- Fuel Combustion and fuel types for the following categories:
    - Fuel Combustion Activities – Electric Power Sector (1.A.1)
    - Fuel Combustion Activities—Other Sectors (1.A.4)
- Enteric Fermentation (3.A)
- Manure management (3.B)
- Land use categories (4.A, 4.B, 4.C, 4.D, 4.E, and 4.F), including disaggregating harvested wood products (HWP) from other forest land remaining forest land carbon stock change
- Solid Waste Disposal (5.A)
- Wastewater (5.D)

Other differences from the default disaggregation approach in the IPCC Guidelines are to align the analysis with country-specific methods and uncertainty analysis, such as:

- Fuel Combustion Activities—Other Sectors
    - Commercial (1.A.4.a)
    - Residential (1.A.4.b)
- Fossil Fuel Combustion
    - Non-Specified Stationary (Incineration of Waste, Non-Energy Use of Fossil Fuels, and U.S. Territories are under 1.A.5.a)
    - Transportation (1.A.5.b Military)
- Biomass Burning (4.(IV). A.1.b Forest Fires and 4.(IV).C.1.b Grass Fires)

- Biological Treatment of Solid Waste (5.B.1 Composting and 5.B.2 Anaerobic Digestion at Biogas Facilities)

A summary of the categories identified as key by sector for this GHGIA are found in Table A1-1, which is included in a downloadable data workbook[2] containing tables for this annex table. The full analysis, including individual and cumulative percent contributions, is found online in the same workbook files included with Annex 1. The electronic data files show the following:

- Key Category Summary by Sector (Table A1-S1)
- Level Analyses for 1990 and 2024, including and excluding LULUCF (Tables A1-S2 to A1-S5)
- Trend Analyses including and excluding LULUCF (Tables A1-S6 and A1-S7)

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Intergovernmental Panel on Climate Change (IPCC) (2006). *2006 IPCC guidelines for national greenhouse gas inventories: Volume 1—General Guidance and Reporting.* IPCC. https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_4_Ch4_MethodChoice.pdf

Intergovernmental Panel on Climate Change. (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 1—General Guidance and Reporting*. IPCC. https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol1.html

[2] Downloadable Annex 1 tables are published under the GHGIA data page at https://ghgi.cgs.umd.edu/data.html.

Annex 2. Uncertainty Assessment

The methodologies and input data are largely consistent with previous EPA reports, so the previous EPA-estimated Monte Carlo results reflect the best available uncertainty assessments and are presented in this GHGIA. See Annex 7 of EPA (2025) for more information on the methods and approach to assessing uncertainties. Uncertainty for the GHGIA is assumed to be consistent with EPA (2025) and this version of the GHGIA does not include new Monte Carlo uncertainty analyses; however, future versions will incorporate this information on a rolling basis, beginning with key categories.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 3. Reference Approach

The CO_2 emissions from fossil fuel combustion discussed in Chater 3 (Energy) are specified for certain energy-consuming end use sectors. For the U.S. this includes the residential, commercial, industrial, transportation, and electric power sectors of the economy. Fuel use in U.S. Territories is also included but not broken out into end use sector detail. This approach to determine and calculate emissions by end use sector is termed the sectoral approach. The sectoral approach entails estimating fuel consumption by specific primary and secondary fuel type by end use sector and applying fuel specific emission factors to determine CO_2 emissions.

The reference approach by comparison, uses a country's high level energy supply data to calculate the emissions of CO_2 from combustion of mainly fossil fuels. The assumption is that carbon is conserved so that, for example, carbon in crude oil is equal to the total carbon content of all the derived products. The reference approach does not distinguish between different end use sectors within the economy and only estimates total CO_2 emissions from one overall energy sector fuel combustion. Emissions derive from where the fuel is used as a heat source in refining or producing power, and from combustion in final consumption of the primary fuel or its secondary products.

Primary energy is energy in the form that it is first accounted for in a statistical energy balance (e.g., coal, crude oil, dry natural gas), before any transformation to secondary or tertiary forms of energy (e.g., petroleum products like gasoline).

As per IPCC guidelines (IPCC, 2006), it is good practice to apply both a sectoral approach and the reference approach to estimate a country's CO_2 emissions from fuel combustion and to compare the results of these two independent estimates.

Method

The methods used to develop the reference approach are consistent with the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

The first step in the process is to collect national energy statistics in physical units from Energy Information Administration (EIA) sources to obtain data on production, imports, exports, and stock changes. Data for solid and gaseous fuels was mainly obtained from the *EIA Monthly Energy Review* (EIA, 2026) and the *EIA Annual Coal Report* (EIA, 2025a). Data for petroleum fuels came mainly from the *EIA Petroleum Supply Annual* (EIA, 2025b).

Production data was obtained for primary energy products while other data was also collected for secondary products. Data are presented in Table A3-1. Note production data for motor gasoline represents an adjustment made to account for supply information on motor gasoline blend components. Data used for the sectoral approach is obtained from supply data while data for the reference approach is obtained mostly from production data.

Several modifications are made to the reference approach data in order to create a more consistent comparison with the sectoral approach data. The first modification is to subtract consumption of fossil fuel accounted for in Chapter 4 (Industrial Processes and Product Use (IPPU)). As discussed in Chapter 3 (Energy) and Chapter 4 (IPPU), several uses of fossil fuels are accounted for under IPPU and subtracted from fossil fuel combustion calculations to avoid double counting, this includes energy used in iron and steel, aluminum, ferroalloys, titanium dioxide, ammonia, silicon carbide and the manufacture of C black. The second modification adjusts motor fuel statistics to exclude the use of biofuels which are not counted as part of the sectoral approach emissions. Both of these modifications are included in the Adjustment column in Table A3-1 below.

The third modification adjusts for consumption of bunker fuels, which are fuels used for international transportation estimated separately from U.S. totals. The fourth modification adds U.S. Territories data that are excluded from the other national aggregate energy statistics but are included in the sectoral approach.

Table A3-1: 2024 U.S. Energy Statistics (Physical Units)

Fuel Category (Units)	Fuel Type	Production	Imports	Exports	Stock Change	Adjustment	Bunkers	U.S. Territories
Solid Fuels (Thousand Short Tons)	Anthracite Coal	3,063	[1]	[1]	[1]			
	Bituminous Coal	247,969	[1]	[1]	[1]			
	Sub-bituminous Coal	221,491	[1]	[1]	[1]	367		
	Lignite	40,017	[1]	[1]	[1]	818		
	Coke		206	1,514	(152)			
	Unspecified Coal		1,998	108,326	(6,672)	18,034		1,239
Gaseous Fuels	Natural Gas (Million Cubic Feet)	38,096,057	3,144,546	7,706,568	(5,613)	442,691		81,770
	Still Gas (Thousand Barrels)		0	0	0			
Liquid Fuels (Thousand Barrels)	Crude Oil	4,843,858	2,411,095	1,498,096	25,773			
	HGL	2,577,038	64,641	1,060,250	2,412			2,522
	Other Liquids	0	390,451	196,936	(5,840)			
	Motor Gasoline	7,724	39,911	291,546	(2,415)	233,958		18,522
	Aviation Gasoline		322	0	259			
	Kerosene		15	1,953	(157)			18
	Jet Fuel		38,442	76,907	3,934		165,705	8,700
	Distillate Fuel		53,868	472,631	-65	51	16,069	13,071
	Residual Fuel		40,046	50,003	(1,353)	6,713	51,963	9,370
	Naphtha for petrochemical feedstocks		3,556	0	(23)			
	Petroleum Coke		2,730	211,131	(979)	8,618		
	Other Oil for petrochemical feedstocks		1,206	3,638	30	7,159		
	Special Naphthas		4,203	0	32			
	Lubricants		16,113	45,968	215			172
	Waxes		1,359	1,543	(34)			
	Asphalt/Road Oil		20,192	8,143	1,723			
	Misc. Products		0	586	94			695

[1] Included in Unspecified Coal Totals
Note: Parentheses indicate negative values.

The detailed fuel production statistics are obtained in physical units (see Table A3-1), similar to the sectoral approach they are converted to units of energy in order to apply carbon contents based on energy units to calculate CO_2 emissions. Energy equivalent conversion factors are shown in Table A3-2, see EPA 2025 for details on sources of conversion factors. The IPCC reference approach calls for estimating apparent fuel consumption before converting to a common energy unit. However, certain fuels in the United States have separate energy conversion factors for different aspects of consumption (i.e., production, imports, exports, and stock changes). Therefore, it is considered appropriate to convert fuel consumption data in Table A3-1 to heat equivalents first before estimating apparent consumption.

Apparent consumption of primary fuels (including crude oil, natural gas liquids, anthracite, bituminous, subbituminous and lignite coal, and natural gas) is first calculated by adding production and imports and subtracting exports and stock changes. The production of secondary fuels is already accounted for in the supply of primary fuels from which they are derived (e.g., secondary petroleum fuels are accounted for in the consumption of crude oil). Apparent consumption of secondary fuels therefore can be accounted for by just adding imports and subtracting exports and stock changes. Note that this calculation can result in negative numbers for apparent consumption of secondary fuels. This result just indicates a net export or stock increase of that particular secondary fuel.

The apparent consumption for primary and secondary fuels is then adjusted as per the modifications discussed above. The adjustments for fuels used in IPPU and biofuels and fuels used for international bunkers are subtracted, while fuel consumption in U.S. Territories is added. Apparent consumption values are shown in Table A3-3.

Table A3-2: 2024 Conversion Factors to Energy Units (Heat Equivalents)

Fuel Category (Units)	Fuel Type	Production	Imports	Exports	Stock Change	Adjustment	Bunkers	U.S. Territories
Solid Fuels (Million Btu/Short Ton)	Anthracite Coal	25.50						
	Bituminous Coal	23.90						
	Sub-bituminous Coal	17.49				25.75		
	Lignite	13.13				12.87		
	Coke		23.45	24.23	23.45			
	Unspecified		25.00	25.97	20.86	24.69		25.14
Gaseous Fuels	Natural Gas (BTU/Cubic Foot)	1,037	1,025	1,009	1,037	1,037		1,037
	Still Gas (Million Btu/Barrel)		6.00	6.00	6.00		6.00	6.00
Liquid Fuels (Million Btu/Barrel)	Crude Oil	5.69	6.06	5.72	5.72		5.72	5.72
	HGL	4.22	4.22	4.22	4.22		4.22	4.22
	Other Liquids	5.83	5.83	5.83	5.83		5.83	5.83
	Motor Gasoline	5.05	5.05	5.05	5.05	5.05	5.05	5.05
	Aviation Gasoline		5.05	5.05	5.05		5.05	5.05
	Kerosene		5.67	5.67	5.67		5.67	5.67
	Jet Fuel[a]		5.67	5.67	5.67		5.68	5.67
	Distillate Fuel		5.83	5.83	5.83	5.83	5.83	5.83
	Residual Oil		6.29	6.29	6.29	6.29	6.29	6.29
	Naphtha for petrochemical feedstocks		5.25	5.25	5.25		5.25	5.25
	Petroleum Coke		6.02	6.02	6.02	6.02	6.02	6.02
	Other Oil for petrochemical feedstocks		5.83	5.83	5.83	5.83	5.83	5.83
	Special Naphthas		5.25	5.25	5.25		5.25	5.25
	Lubricants		6.07	6.07	6.07		6.07	6.07
	Waxes		5.54	5.54	5.54		5.54	5.54
	Asphalt/Road Oil		6.64	6.64	6.64		6.64	6.64
	Misc. Products		5.80	5.80	5.80		5.80	5.80

[a] Jet fuel used in bunkers has a different heating value based on data specific to that source.

Table A3-3: 2024 Apparent Consumption of Fossil Fuels (TBtu)

Fuel Category	Fuel Type	Production	Imports	Exports	Stock Change	Adjustment	Bunkers	U.S. Territories	Apparent Consumption
Solid Fuels	Anthracite Coal	78.1						-	78.1
	Bituminous Coal	5,926.0						-	5,926.0
	Sub-bituminous Coal	3,873.8				9.4		-	3,864.3
	Lignite	525.6				10.5		-	515.0
	Coke	-	4.8	36.7	(3.6)			-	(28.3)
	Unspecified	-	49.9	2,813.5	(139.2)	445.2		31.2	(3,038.4)
Gaseous Fuels	Natural Gas	39,505.6	3,223.2	7,775.9	(5.8)	459.1		84.8	34,584.4
	Still Gas	-	-	-	-		-	-	-
Liquid Fuels	Crude Oil	27,556.7	14,616.1	8,567.6	147.4		-	-	33,457.8
	HGL	10,872.6	272.7	4,473.2	10.2		-	10.6	6,672.5
	Other Liquids	-	2,274.4	1,147.2	(34.0)		-	-	1,161.2
	Motor Gasoline	39.0	201.6	1,472.3	(12.2)		-	93.5	(1,126.0)
	Aviation Gasoline	-	1.6	-	1.3		-	-	0.3
	Kerosene	-	0.1	11.1	(0.9)		-	0.1	(10.0)
	Jet Fuel	-	218.0	436.1	22.3		940.5	49.3	(1,131.6)
	Distillate Fuel	-	313.8	2,753.1	(0.4)	0.3	93.6	76.1	(2,456.7)
	Residual Oil	-	251.8	314.4	(8.5)	42.2	326.7	58.9	(364.1)
	Naphtha for petrochemical feedstocks	-	18.7	-	(0.1)		-	-	18.8
	Petroleum Coke	-	16.4	1,271.9	(5.9)	51.9	-	-	(1,301.4)
	Other Oil for petrochemical feedstocks	-	7.0	21.2	0.2	41.7	-	-	(56.0)
	Special Naphthas	-	22.1	-	0.2		-	-	21.9
	Lubricants	-	97.7	278.8	1.3		-	1.0	(181.3)
	Waxes	-	7.5	8.5	(0.2)		-	-	(0.8)
	Asphalt/Road Oil	-	134.0	54.0	11.4		-	-	68.5
	Misc. Products	-	-	3.4	0.5		-	4.0	0.1
Total		**88,377.4**	**21,731.3**	**31,438.7**	**(15.9)**	**1,060.3**	**1,360.8**	**409.7**	**76,674.4**

Notes: Parentheses indicate negative values. Totals may not sum due to independent rounding.

Potential CO_2 emissions can be estimated by applying fuel-specific carbon coefficients to apparent consumption as shown in Table A3-4. See EPA 2025 for details on sources of carbon contents used.

Table A3-4: 2024 Potential CO_2 Emissions

Fuel Category	Fuel Type	Apparent Consumption (QBtu)	Carbon Coefficients (MMT Carbon/QBtu)	Potential Emissions (MMT CO_2 Eq.)
Solid Fuels	Anthracite Coal	0.08	28.28	8.1
	Bituminous Coal	5.93	25.43	552.5
	Sub-bituminous Coal	3.86	26.48	375.2
	Lignite	0.52	26.85	50.7
	Coke	(0.03)	24.80	(2.6)
	Unspecified	(3.04)	25.34	(282.3)
Gaseous Fuels	Natural Gas	34.58	14.43	1,829.7
	Still Gas	-	18.20	-
Liquid Fuels	Crude Oil	33.46	20.31	2,491.0
	HGL	6.67	18.48	452.1
	Other Liquids	1.16	20.31	86.5
	Motor Gasoline	(1.13)	19.27	(79.6)
	Aviation Gasoline	0.00	18.86	0.0
	Kerosene	(0.01)	19.96	(0.7)
	Jet Fuel	(1.13)	19.70	(81.7)
	Distillate Fuel	(2.46)	20.22	(182.1)
	Residual Oil	(0.36)	20.48	(27.3)
	Naphtha for petrochemical feedstocks	0.02	18.55	1.3
	Petroleum Coke	(1.30)	27.85	(132.9)
	Other Oil for petrochemical feedstocks	(0.06)	20.17	(4.1)
	Special Naphthas	0.02	19.74	1.6
	Lubricants	(0.18)	20.20	(13.4)
	Waxes	(0.00)	19.80	(0.1)
	Asphalt/Road Oil	0.07	20.55	5.2
	Misc. Products	0.00	-	-
Total				**5,047.1**

The calculated apparent consumption values include the amount of fuels used in non-energy uses (e.g., petrochemical feedstocks used to make plastics, asphalt/road oil, etc.) and the potential emissions shown in Table A3-4 assume all the carbon in products from those non-energy uses (NEU) of fossil fuels is emitted. As discussed in Section 3.2, some of the carbon used in NEU is stored and does not get released to the atmosphere. Therefore, carbon stored as part of NEU needs to be calculated and subtracted from potential emissions when calculating reference approach estimates. The calculated carbon stored as part of NEU is shown in Table A3-5 and the adjusted reference approach emissions subtracting NEU storage

is shown in Table A3-6. As with the sectoral approach, the reference approach assumes 100 percent of the carbon in fuels is oxidized to CO_2 to calculate emission estimates.

Table A3-5: 2024 Non-Energy Carbon Stored in Products

Fuel Type	Consumption for Non-Energy Use (TBtu)	Carbon Coefficients (MMT Carbon/QBtu)	Amount of Carbon in Fuel (MMT Carbon)	Fraction Sequestered	Carbon Stored (MMT CO_2 Eq.)
Industrial Coking Coal	57.9	24.80	1.44	0.10	0.5
Industrial Other Coal	9.4	25.34	0.24	0.70	0.6
Natural Gas	400.6	14.43	5.78	0.70	14.8
Asphalt & Road Oil	888.3	20.55	18.26	1.00	66.6
HGL	3,261.0	16.74	54.58	0.70	139.8
Lubricants	91.4	20.20	1.85	0.09	0.6
Natural Gasoline[a]	0.0	18.24	0.00	0.70	0.0
Naphtha (<401 deg. F)	238.5	18.55	4.42	0.70	11.3
Other Oil (>401 deg. F)	102.6	20.17	2.07	0.70	5.3
Still Gas	121.3	18.20	2.21	0.70	5.6
Petroleum Coke	0.0	27.85	0.00	0.30	0.0
Special Naphtha	73.2	19.74	1.45	0.70	3.7
Distillate Fuel Oil	5.2	20.22	0.11	0.50	0.2
Waxes	11.1	19.80	0.22	0.58	0.5
Miscellaneous Products	172.6	0.00	0.00	0.00	0.0
Misc. U.S. Territories Petroleum	4.0	20.00	0.08	0.10	0.0
TOTAL	5,437.2		92.7	0.73	249.6

+ Does not exceed 0.05 MMT CO_2 Eq.

Note: Totals may not sum due to independent rounding.

[a] Formerly referred to as "pentanes plus." this source has been adjusted and is reported separately from HGL to align with historic data and revised EIA terminology.

Table A3-6: 2024 Reference Approach CO_2 Emissions from Fossil Fuel Consumption (MMT CO_2 Eq.)

Fuel Category	Potential Emissions	Carbon Sequestered	Net Emissions
Coal	701.6	1.1	700.5
Petroleum	2,515.7	233.7	2,282.0
Natural Gas	1,829.7	14.8	1,814.9
TOTAL	5,047.1	249.6	4,797.4

Note: Totals may not sum due to independent rounding.

Under the sectoral approach NEU estimates are calculated separate from fossil fuel combustion emissions while under the reference approach they are combined. Therefore, in order to compare the two approaches, sectoral approach estimates need to include fossil fuel combustion emissions (as discussed in Section 3.1) and emissions from NEU (as discussed in Section 3.2). The reference approach also does not include emissions from waste incineration

as it is not directly tracked in national level energy statistics. Under the sectoral approach, waste incineration is also reported separately (see Section 3.3). For completeness, the emissions of waste incineration as calculated in Section 3.3 are added to both the sectoral and reference approach estimates.

Comparison of Results

The comparison of reference and sectoral approach fuel use estimates are shown in Table A3-7 and the comparison of CO_2 estimates are shown in Table A3-8.

Table A3-7: Fuel Consumption in the United States by Estimating Approach (TBtu)[a]

Approach	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Sectoral	**69,697**	**74,607**	**82,491**	**83,639**	**78,461**	**76,973**	**71,140**	**75,323**	**76,615**	**75,445**	**75,776**
Coal	18,098	19,210	21,755	22,213	20,305	15,069	8,815	10,081	9,437	7,741	7,484
Natural Gas	19,147	22,148	23,372	22,267	24,297	27,941	31,300	31,392	33,012	33,339	33,802
Petroleum	32,452	33,249	37,363	39,159	33,859	33,962	31,025	33,851	34,166	34,364	34,490
Reference (Apparent)	**68,865**	**74,182**	**82,005**	**83,979**	**78,276**	**76,439**	**71,005**	**75,280**	**76,258**	**76,218**	**76,674**
Coal	17,723	18,748	21,148	22,211	19,869	14,997	8,754	9,908	9,384	7,802	7,317
Natural Gas	19,255	22,252	23,465	22,334	24,394	28,021	31,480	31,608	33,237	34,099	34,584
Petroleum	31,887	33,182	37,392	39,434	34,012	33,421	30,771	33,765	33,638	34,317	34,773
Difference	**-1.2%**	**-0.6%**	**-0.6%**	**0.4%**	**-0.2%**	**-0.7%**	**-0.2%**	**-0.1%**	**-0.5%**	**1.0%**	**1.2%**
Coal	-2.1%	-2.4%	-2.8%	0.0%	-2.1%	-0.5%	-0.7%	-1.7%	-0.6%	0.8%	-2.2%
Natural Gas	0.6%	0.5%	0.4%	0.3%	0.4%	0.3%	0.6%	0.7%	0.7%	2.3%	2.3%
Petroleum	-1.7%	-0.2%	0.1%	0.7%	0.5%	-1.6%	-0.8%	-0.3%	-1.5%	-0.1%	0.8%

[a] Includes U.S. Territories. Does not include international bunker fuels.
Note: Totals may not sum due to independent rounding.

Table A3-8: CO_2 Emissions from Fossil Fuel Combustion by Estimating Approach (MMT CO_2 Eq.)[a]

Approach	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Sectoral	**4,864**	**5,155**	**5,757**	**5,882**	**5,442**	**5,122**	**4,453**	**4,778**	**4,817**	**4,683**	**4,676**
Coal	1,720	1,824	2,070	2,121	1,937	1,438	843	964	903	740	716
Natural Gas	1,005	1,162	1,226	1,172	1,278	1,463	1,628	1,634	1,720	1,747	1,772
Petroleum	2,126	2,155	2,447	2,576	2,214	2,207	1,969	2,167	2,181	2,183	2,177
MSW	13	14	13	13	13	14	13	12	12	12	12
Reference (Apparent)	**4,828**	**5,171**	**5,745**	**5,955**	**5,469**	**5,147**	**4,517**	**4,852**	**4,875**	**4,815**	**4,809**
Coal	1,668	1,773	2,005	2,108	1,891	1,429	836	945	897	749	701
Natural Gas	1,012	1,169	1,232	1,176	1,284	1,468	1,641	1,649	1,735	1,790	1,815
Petroleum	2,135	2,215	2,494	2,659	2,282	2,237	2,027	2,245	2,229	2,264	2,282
MSW	13	14	13	13	13	14	13	12	12	12	12
Difference	**-0.7%**	**0.3%**	**-0.2%**	**1.2%**	**0.5%**	**0.5%**	**1.4%**	**1.5%**	**1.2%**	**2.8%**	**2.9%**
Coal	-3.0%	-2.8%	-3.1%	-0.6%	-2.4%	-0.6%	-0.8%	-2.0%	-0.6%	1.2%	-2.1%
Natural Gas	0.7%	0.6%	0.5%	0.3%	0.5%	0.3%	0.8%	0.9%	0.9%	2.4%	2.4%
Petroleum	0.4%	2.8%	1.9%	3.2%	3.1%	1.3%	2.9%	3.6%	2.2%	3.7%	4.8%
MSW	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

[a] Includes U.S. Territories. Does not include international bunker fuels.
Note: Totals may not sum due to independent rounding.

The most recent (two to three) inventory years tend to have larger differences in consumption and emissions estimates. This is a likely a result of annual energy consumption data revisions in the EIA energy statistics which tend to have the greatest impact on the most recent years of data. As a result, the differences between the sectoral and reference approach tend to decrease over time.

The differences in coal and natural gas energy use are similar to the differences in the CO_2 emission estimates between the sectoral and reference approaches. This indicates the CO_2 emission factors used for the two approaches are similar. For petroleum, the differences in CO_2 estimates are greater than the differences in energy use estimates and they also generally show the biggest difference in emission estimates.

The main reason for this difference is in product definitions between the two approaches. The fuel categories in the reference approach focus on primary energy use categories which are different from those used in the sectoral approach which are mostly focused on secondary and tertiary fuel types. For example, the reference approach estimates apparent consumption and emissions for crude oil while the sectoral approach estimates the energy content and emissions of the various secondary products resulting from crude oil refining like gasoline and diesel fuel. See EPA 2025 for more detail on comparisons over time.

References

Intergovernmental Panel on Climate Change (IPCC) (2006). *2006 IPCC guidelines for national greenhouse gas inventories: Volume 2—Energy*. IPCC. https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html

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U.S. Energy Information Administration (EIA) (2026). *Monthly Energy Review*, February 2026. Energy Information Administration, U.S. Department of Energy, Washington, DC. DOE/EIA-0035 (2026/02).

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 4. QA/QC Plan

As noted in Chapter 1 (Introduction) and sectoral chapters of the GHGIA (2026), for this first GHGIA report, general QA/QC checks were conducted that were consistent with Volume 1, Chapter 6 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and its 2019 Refinement (IPCC, 2006, 2019). CGS will explore development of a customized QA/QC plan for future reports.

References

Desai, M., Irving, W., Fawcett, A., Lou, J., Cui, R., & Hultman, N. (2026). Chapter 1. Introduction. In Desai et al., *Greenhouse Gas Inventory and Analysis for the United States: 1990-2024* (pp. 1-1 to 1-8). Center for Global Sustainability, University of Maryland, College Park. https://doi.org/10.13016/g1xw-qftw

Intergovernmental Panel on Climate Change (IPCC) (2006). *2006 IPCC guidelines for national greenhouse gas inventories: Volume 1—General Guidance and Reporting*. IPCC. https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_4_Ch4_MethodChoice.pdf

Intergovernmental Panel on Climate Change. (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 1—General Guidance and Reporting*. IPCC. https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol1.html

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Annex 5. Additional Information

Annex 5 contains additional methodological information, information on GWPs, other gases and emissions (e.g. ODS), and information on use of facility level data.

Annex 5.1 Methodology for Estimating CO_2 Emissions from Fossil Fuel Combustion

As discussed in Chapter 3 (Energy), Section 3.1 Fossil Fuel Combustion, there are eight main steps in calculating CO_2 emissions associated with fossil fuel combustion including:

- Step 1: Determine total fuel consumption by fuel type and end use sector
- Step 2: Subtract uses accounted for under industrial processes and product use (IPPU)
- Step 3: Adjust for biofuels and captured and sequestered CO_2 (including CO_2 exported)
- Step 4: Adjust sectoral allocation of distillate fuel oil and motor gasoline
- Step 5: Subtract consumption for non-energy use (NEU)
- Step 6: Subtract consumption of international bunker fuels
- Step 7: Determine carbon emissions factors by fuel type
- Step 8: Calculate CO_2 emissions

The steps and methodology used to estimate CO_2 emissions are consistent with those used in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Table A5.1-1 shows energy consumption data for 2024 by fuel type and end use sector. That data already includes adjustments for biofuels and for sector redistribution of gasoline and diesel fuel (steps 1,3 and 4) in columns 2 through 8. The 2024 adjustments needed for IPPU (column 9), international bunker fuels (column 10) and NEU (columns 11 – 13) are also shown (steps 2,5 and 6).

Table A5.1-2 shows the adjustments needed for IPPU by fuel type and IPPU category for the full time series. Table A5.1-3 shows the adjustments needed for NEU by fuel type and sector for the full time series and Table A5.1-4 shows the adjustments needed for internation bunker fuels by fuel type over the full time series.

Table A5.1-5 shows the adjusted energy consumption and the calculated CO_2 emission estimates per fuel type. The CO_2 estimates also include adjustments for sequestered CO_2, in the electric power sector (See Section 3.9) and exported to Canada (steps 3 and 8).

Table A5.1-6 shows the CO_2 content coefficients by year used to calculate CO_2 emissions from the adjusted energy use values (step 7).

Adjusted energy consumption data and calculated CO_2 emission estimates per fuel type for other years in the time series are available as supplemental data tables along with all the other data tables published with this *Greenhouse Gas Inventory and Analysis for the United States (GHGIA)* for download[3].

Total transportation sector CO_2 emissions are shown in Table A5.1-5 based on fuel use by type and CO_2 emissions factors shown in Table A5.1-6. CO_2 emissions within the transportation sector are also broken out in more detail by mode of transport as shown in Chapter 3 (Energy), Section 3.1.2. This is done using the same methodology described above and requires fuel use by type and by mode of transport as shown in Table A5.1-7 in terms of physical units and in Table A5.1-8 in terms of energy units.

[3] Downloadable Annex tables are published under the GHGIA data page at https://ghgi.cgs.umd.edu/data.html.

Table A5.1-1: 2024 Energy Consumption and Adjustments Data by Fuel Type (TBtu)

	Total Consumption (TBtu)[a]							Adjustments (TBtu)				
										Unadjusted NEU Consumption		
Fuel Type	Res.	Comm.	Ind.	Trans.	Elec.	Terr.	Total	IPPU	Bunker Fuel	Ind.	Trans.	Terr.
Total Coal	NO	10.9	887.1	NO	7,014.3	27.6	7,939.9	445.2		67.3	NO	
Residential Coal	NO						NO					
Commercial Coal		10.9					10.9					
Industrial Coking Coal			448.4				448.4	390.5		57.9		
Industrial Other Coal			438.7				438.7	54.6		9.4		
Transportation Coal				NO			NO					
Electric Power Coal					7,014.3		7,014.3					
U.S. Territory Coal (bit)						27.6	27.6					
Natural Gas	4,545.5	3,436.2	10,913.2	1,393.6	13,889.7	84.8	34,262.9	461.1		437.4		
Total Petroleum	749.4	968.5	8,392.7	25,323.8	165.7	292.8	35,893.0	42.5	1,360.8	5,298.7	90.3	5.1
Asphalt & Road Oil			888.3				888.3			888.3		
Aviation Gasoline				22.8			22.8					
Distillate Fuel Oil	256.7	177.9	642.5	6,759.0	55.9	76.1	7,968.2	0.3	93.6	5.2		
Jet Fuel				3,507.5		49.3	3,556.8		940.5			
Kerosene	11.5	1.7	2.4			0.1	15.7					
LPG (Propane)	481.2	187.5		11.9			680.6					
HGL			3,714.5			9.8	3,724.2			3,515.9		
Lubricants			84.4	90.3		1.0	175.8			84.4	90.3	1.0
Motor Gasoline		598.3	426.9	14,366.2		93.5	15,484.9					
Residual Fuel		2.9	42.2	566.1	62.3	58.9	732.5	42.2	326.7			
Other Petroleum												
AvGas Blend Comp.			(1.0)				(1.0)					
Crude Oil			NO				NO					
MoGas Blend Comp.			NO				NO					
Misc. Products			172.6			4.0	176.6			172.6		4.0
Naphtha (<401 deg. F)			255.1				255.1			255.1		
Other Oil (>401 deg. F)			153.6				153.6			153.6		
Pentanes Plus			NO				NO			NO		
Petroleum Coke		0.2	453.3		47.5		500.9			13.2		
Still Gas			1,468.9				1,468.9			121.3		
Special Naphtha			78.0				78.0			78.0		
Unfinished Oils			NO				NO					

(continued)

Table A5.1-1: 2024 Energy Consumption and Adjustments Data by Fuel Type (TBtu) *(continued)*

	Total Consumption (TBtu)[a]							Adjustments (TBtu)				
										Unadjusted NEU Consumption		
Fuel Type	Res.	Comm.	Ind.	Trans.	Elec.	Terr.	Total	IPPU	Bunker Fuel	Ind.	Trans.	Terr.
Waxes			11.1				11.1			11.1		
Geothermal					52.6		52.6					
Total (All Fuels)	5,294.8	4,415.6	20,193.0	26,717.4	21,122.2	405.3	78,148.3	948.8	1,360.8	5,803.5	90.3	5.1

NO (Not Occurring)

[a] Expressed as gross calorific values (i.e., higher heating values). Adjustments already included for biofuels and for sector distribution of gasoline and diesel fuel.

Notes: Consumption values of select fuels are shown as negative due to differences in EIA energy balancing accounting. These are designated with parentheses.

Totals may not sum due to independent rounding.

Table A5.1-2: Adjustments to Industrial Sector for IPPU (TBtu)

Fuel Type / IPPU Category	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Industrial Coking Coal	**1,041.9**	**846.9**	**740.1**	**535.4**	**489.9**	**439.9**	**334.5**	**426.7**	**412.6**	**392.0**	**390.5**
I&S, lead & zinc	1,041.9	846.9	740.1	535.4	489.9	439.9	334.5	426.7	412.6	392.0	390.5
Industrial Other Coal	**38.4**	**36.1**	**72.0**	**61.5**	**54.5**	**54.4**	**50.4**	**56.3**	**52.9**	**54.6**	**54.6**
Coking coal adj	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I&S	35.5	36.1	72.0	61.5	54.5	54.4	50.4	56.3	52.9	54.6	54.6
Natural Gas	**449.7**	**520.3**	**461.5**	**322.3**	**298.1**	**305.7**	**422.2**	**398.6**	**418.8**	**421.7**	**459.1**
Ammonia	374.9	382.5	346.9	237.2	235.4	249.4	378.5	349.9	373.0	374.4	411.7
I&S	74.9	137.8	114.6	85.1	62.7	56.4	43.7	48.8	45.8	47.3	47.4
Residual Fuel	**108.9**	**134.8**	**147.3**	**137.5**	**108.2**	**33.9**	**32.0**	**45.8**	**47.0**	**39.0**	**42.2**
Carbon Black	108.9	134.8	147.3	137.5	108.2	33.9	32.0	45.8	47.0	39.0	42.2
Diesel Fuel	**22.7**	**15.0**	**16.8**	**2.2**	**3.8**	**1.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
I&S	22.7	15.0	16.8	2.2	3.8	1.3	0.3	0.3	0.3	0.3	0.3
Total	**1,661.5**	**1,553.1**	**1,437.7**	**1,058.9**	**954.4**	**835.1**	**839.4**	**927.8**	**931.6**	**907.7**	**946.8**

Notes: Totals may not sum due to independent rounding.

Table A5.1-3: Unadjusted Non-Energy Fuel Consumption (TBtu)

Sector/Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Industry	**4,417.2**	**4,875.0**	**5,463.1**	**5,352.6**	**4,643.1**	**4,832.7**	**5,191.3**	**5,413.3**	**5,334.1**	**5,523.2**	**5,803.5**
Industrial Coking Coal	0.0	37.8	53.5	80.4	64.8	122.4	79.4	77.5	46.4	65.4	57.9
Industrial Other Coal	7.6	10.5	11.5	11.0	9.6	9.5	9.5	9.5	9.5	9.5	9.4
Natural Gas to Chemical Plants, Other Uses	305.9	374.8	408.0	261.3	312.0	382.3	489.0	462.5	436.0	436.8	437.4
Asphalt & Road Oil	1,170.2	1,178.2	1,275.7	1,323.2	877.8	831.7	832.3	898.1	916.1	891.8	888.3
HGL	1,219.6	1,546.2	1,756.2	1,602.5	1,853.0	2,236.1	2,693.0	2,865.8	3,004.9	3,230.7	3,515.9
Lubricants	186.3	177.8	189.9	160.2	135.9	142.1	111.1	109.2	115.0	88.8	84.4
Pentanes Plus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Naphtha (<401 deg. F)	347.8	373.0	613.5	698.7	490.6	428.1	354.6	354.8	265.5	271.8	255.1
Other Oil (>401 deg. F)	753.9	801.0	722.2	708.0	452.5	229.0	217.0	216.9	127.7	119.6	153.6
Still Gas	21.3	40.1	8.1	67.7	152.5	102.7	97.8	112.1	107.7	114.0	121.3
Petroleum Coke	119.2	120.3	163.4	220.7	86.8	43.4	36.3	37.7	14.2	15.0	13.2
Special Naphtha	107.1	70.8	97.4	62.5	26.1	99.3	86.6	81.2	89.2	89.2	78.0
Other (Wax/Misc.)											
Distillate Fuel Oil	7.1	7.0	11.5	12.2	5.8	4.9	4.9	5.5	5.5	5.4	5.2
Waxes	33.3	40.6	33.1	31.4	17.1	12.4	9.2	11.8	13.0	9.0	11.1
Miscellaneous Products	137.8	97.1	119.2	112.8	158.7	188.9	170.7	170.8	183.4	176.2	172.6
Transportation	**176.0**	**167.9**	**179.4**	**151.3**	**154.8**	**162.8**	**115.6**	**123.3**	**129.9**	**95.0**	**90.3**
Lubricants	176.0	167.9	179.4	151.3	154.8	162.8	115.6	123.3	129.9	95.0	90.3
U.S. Territories	**50.8**	**55.4**	**140.8**	**114.9**	**27.4**	**10.3**	**3.5**	**3.5**	**1.0**	**3.6**	**5.1**
Lubricants	0.7	2.0	3.1	4.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Other Petroleum (Misc. Prod.)	50.1	53.4	137.7	110.3	26.4	9.3	2.5	2.5	0.0	2.5	4.0
Total	**4,644.0**	**5,098.4**	**5,783.3**	**5,618.8**	**4,825.2**	**5,005.9**	**5,310.4**	**5,540.2**	**5,465.1**	**5,621.8**	**5,898.9**

Note: These values are unadjusted non-energy fuel use from EIA. They have not yet been adjusted to remove petroleum feedstock exports and processes accounted for in Chapter 4 (Industrial Processes and Product Use). Totals may not sum due to independent rounding.

Table A5.1-4: International Bunker Fuel Consumption (TBtu)

Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Aviation Jet Fuel	541.8	705.1	881.5	854.4	866.4	1,023.3	563.7	721.5	945.6	943.9	940.5
Marine Residual Fuel Oil	715.7	523.2	444.1	581.0	619.8	406.8	294.0	292.3	325.2	301.8	326.7
Marine Distillate Fuel Oil	158.0	125.7	85.9	126.9	128.2	113.5	105.0	100.1	96.8	94.0	93.6
Total	**1,415.5**	**1,354.0**	**1,411.4**	**1,562.3**	**1,614.4**	**1,543.6**	**962.6**	**1,113.9**	**1,367.5**	**1,339.7**	**1,360.8**

Note: Totals may not sum due to independent rounding

Table A5.1-5: 2024 Adjusted Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

	Adjusted Consumption (TBtu)							Emissions (MMT CO_2 Eq.) from Energy Use						
Fuel Type	Res.	Comm.	Ind.	Trans.	Elec.	Terr.	Total	Res.	Comm.	Ind.	Trans.	Elec.	Terr.	Total
Total Coal		**10.9**	**364.1**		**7,014.3**	**27.6**	**7,416.9**		**1.1**	**34.9**		**672.0**	**2.5**	**710.5**
Residential Coal														
Commercial Coal		10.9					10.9		1.1					1.1
Industrial Coking Coal														
Industrial Other Coal			364.1				364.1			34.9				34.9
Transportation Coal														
Electric Power Coal					7,014.3		7,014.3					672.0		672.0
U.S. Territory Coal (bit)						27.6	27.6						2.5	2.5
Natural Gas	**4,545.5**	**3,436.2**	**10,014.7**	**1,393.6**	**13,889.7**	**84.8**	**33,364.4**	**240.5**	**181.8**	**529.8**	**73.7**	**734.8**	**4.5**	**1,765.1**
Total Petroleum	**749.4**	**968.5**	**3,051.5**	**23,872.6**	**165.7**	**287.8**	**29,095.6**	**50.1**	**67.6**	**225.0**	**1,714.8**	**13.7**	**20.9**	**2,092.1**
Asphalt & Road Oil														
Aviation Gasoline				22.8			22.8				1.6			1.6
Distillate Fuel Oil	256.7	177.9	637.0	6,665.4	55.9	76.1	7,869.0	19.0	13.2	47.2	494.1	4.1	5.6	583.3
Jet Fuel				2,566.9		49.3	2,616.3				185.4		3.6	189.0
Kerosene	11.5	1.7	2.4			0.1	15.7	0.8	0.1	0.2			+	1.2
LPG (Propane)	481.2	187.5		11.9			680.6	30.3	11.8		0.8			42.8
HGL			198.6			9.8	208.4			12.6			0.6	13.3
Lubricants														
Motor Gasoline		598.3	426.9	14,366.2		93.5	15,484.9		42.3	30.2	1,015.0		6.6	1,094.1
Residual Fuel		2.9		239.5	62.3	58.9	363.6		0.2		18.0	4.7	4.4	27.3
Other Petroleum														
AvGas Blend Components			-+				-+			-+				-+
Crude Oil														

(continued)

Table A5.1-5: 2024 Adjusted Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type *(continued)*

Fuel Type	Adjusted Consumption (TBtu)							Emissions (MMT CO_2 Eq.) from Energy Use						
	Res.	Comm.	Ind.	Trans.	Elec.	Terr.	Total	Res.	Comm.	Ind.	Trans.	Elec.	Terr.	Total
MoGas Blend Components														
Misc. Products														
Naphtha (<401 deg. F)														
Other Oil (>401 deg. F)														
Pentanes Plus														
Petroleum Coke		0.2	440.1		47.5		487.7		+	44.9		4.8		49.8
Still Gas			1,347.6				1,347.6			89.9				89.9
Special Naphtha														
Unfinished Oils														
Waxes														
Geothermal					52.6		52.6					0.3		0.3
Total (All Fuels)	5,294.8	4,415.6	13,430.2	25,266.3	21,122.2	400.2	69,929.4	290.6	250.5	789.7	1,788.6	1,420.8	27.9	4,568.1

+ Does not exceed 0.05 TBtu or 0.05 MMT CO_2 Eq.

Note: Energy values are expressed as gross calorific values (i.e., higher heating values). Consumption and/or emissions of select fuels are shown as negative due to differences in EIA energy balancing accounting. Totals may not sum due to independent rounding.

Table A5.1-6: CO_2 Emission Factors by Year (MMT CO_2/QBtu)

Fuel Type[a]	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Coal by Sector											
Residential Coal[c]	96.02	95.79	95.33	95.47	94.42	95.27	96.10	95.90	95.99	96.71	96.73
Commercial Coal[c]	96.02	95.79	95.33	95.47	94.42	95.27	96.10	95.90	95.99	96.71	96.73
Industrial Coking Coal[c]	93.62	93.74	93.97	93.87	93.80	93.75	93.87	93.86	93.89	93.85	93.89
Industrial Other Coal[c]	94.62	94.55	94.37	94.58	94.83	95.35	95.80	95.69	95.72	95.78	95.89
Electric Power Coal[c]	95.11	95.03	95.27	95.61	95.50	95.58	95.78	95.82	95.83	95.89	95.85
U.S. Territory Coal (bit)	92.18	92.18	92.18	92.18	92.18	92.18	92.18	92.18	92.18	92.18	92.18
Coal by Rank											
Anthracite	103.68	103.68	103.68	103.68	103.68	103.68	103.68	103.68	103.68	103.68	103.68
Bituminous[c]	93.08	93.22	93.31	93.31	93.19	93.13	93.24	93.25	93.23	93.19	93.23
Subbituminous[c]	97.00	97.04	97.03	97.08	97.06	97.13	97.12	97.12	97.12	97.09	97.09
Lignite[c]	97.45	97.50	97.57	97.60	97.65	97.74	98.17	98.27	98.28	98.35	98.46
Natural Gas											
Pipeline Natural Gas[c]	53.00	53.04	53.05	53.01	53.08	52.91	52.91	52.91	52.92	52.92	52.91
Petroleum											
Asphalt & Road Oil	75.36	75.36	75.36	75.36	75.36	75.36	75.36	75.36	75.36	75.36	75. 36

(continued)

Table A5.1-6: CO_2 Emission Factors by Year (MMT CO_2/QBtu) *(continued)*

Fuel Type[a]	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Aviation Gasoline	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14
Distillate Fuel Oil No. 2[b,c]	73.96	73.96	74.76	74.69	74.21	74.15	74.13	74.13	74.13	74.13	74.13
Jet Fuel[c]	71.13	70.91	72.22	72.22	72.22	72.22	72.22	72.22	72.22	72.22	72.22
Kerosene	73.20	73.20	73.20	73.20	73.20	73.20	73.20	73.20	73.20	73.20	73.20
LPG (Propane)	62.88	62.88	62.88	62.88	62.88	62.88	62.88	62.88	62.88	62.88	62.88
HGL (Energy Use)[c]	63.07	63.10	63.15	63.07	63.21	63.31	63.33	63.39	63.33	63.50	63.62
HGL (Non-Energy Use)[c]	62.35	62.54	62.62	62.78	62.63	62.41	61.64	61.71	61.46	61.46	61.37
Lubricants	74.06	74.06	74.06	74.06	74.06	74.06	74.06	74.06	74.06	74.06	74.06
Motor Gasoline[c]	71.22	70.98	71.39	70.84	71.10	70.59	70.66	70.66	70.66	70.66	70.66
Residual Fuel Oil No. 6[b,c]	75.09	75.09	75.09	75.09	75.09	75.09	75.09	75.09	75.09	75.09	75.09
Other Petroleum											
AvGas Blend Components	69.19	69.19	69.19	69.19	69.19	69.19	69.19	69.19	69.19	69.19	69.19
Crude Oil[c]	73.87	74.09	74.13	74.49	74.45	74.45	74.45	74.45	74.45	74.45	74.45
MoGas Blend Components[c]	71.22	70.98	70.87	71.00	71.34	71.34	71.34	71.34	71.34	71.34	71.34
Misc. Products[d]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Petroleum Liquids	73.33	73.33	73.33	73.33	73.33	73.33	73.33	73.33	73.33	73.33	73.33
Naphtha (<401 deg. F)	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02	68.02
Other Oil (>401 deg. F)	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96	73.96
Pentanes Plus	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88
Petroleum Coke	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11	102.11
Still Gas	66.72	66.72	66.72	66.72	66.72	66.72	66.72	66.72	66.72	66.72	66.72
Special Naphtha	72.37	72.37	72.37	72.37	72.37	72.37	72.37	72.37	72.37	72.37	72.37
Unfinished Oils[c]	73.87	74.09	74.13	74.49	74.45	74.45	74.45	74.45	74.45	74.45	74.45
Waxes	72.58	72.58	72.58	72.58	72.58	72.58	72.58	72.58	72.58	72.58	72.58
Geothermal[e]											
Flash Steam	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98
Dry Steam	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81

[a] All coefficients based on higher heating value. Higher heating value (gross heating value) is the total amount of heat released when a fuel is burned. Coal, crude oil, and natural gas all include chemical compounds of carbon and hydrogen. When those fuels are burned, the carbon and hydrogen combine with oxygen in the air to produce CO_2 and water. Some of the energy released in burning goes into transforming the water into steam and is usually lost. The amount of heat spent in transforming the water into steam is counted as part of gross heat content. Lower heating value (net heating value), in contrast, does not include the heat spent in transforming the water into steam. Using a simplified methodology based on International Energy Agency defaults, higher heating value can be converted to lower heating value for coal and petroleum products by multiplying by 0.95 and for natural gas by multiplying by 0.90. CO_2 content coefficients are presented in higher heating value because U.S. energy statistics are reported by higher heating value.

[b] Distillate fuel oil No. 2 and residual fuel oil No. 6 are the only fuel oils used in the CO_2 from fossil fuel combustion calculations.

[c] Carbon contents vary annually based on changes in fuel composition.

[d] The miscellaneous products category reported by EIA is assumed to be mostly petroleum refinery sulfur compounds that do not contain carbon.

[e] Carbon contents based on geotype (i.e., flash steam and dry steam). CO_2 contents for binary and binary/flash geotypes are zero and have been excluded from this table.

Notes: CO_2 emission factors are calculated based on carbon content coefficients and assume 100% oxidation of C to CO_2.

Table A5.1-7: Fuel Consumption by Fuel and Vehicle Type (million gallons unless otherwise specified)

Fuel/Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Motor Gasoline[a,b]	**108,134**	**113,626**	**125,015**	**129,237**	**119,740**	**120,544**	**106,560**	**117,011**	**115,389**	**119,447**	**115,545**
Passenger Cars	70,227	64,631	62,120	58,991	52,282	43,734	33,869	35,726	33,737	33,865	31,672
Light-Duty Trucks	30,637	42,161	56,575	64,729	62,618	71,825	67,169	74,944	74,981	78,709	77,083
Motorcycles	368	429	459	533	690	733	689	784	929	987	982
Buses	579	474	366	199	167	268	349	403	445	475	483
Medium- and Heavy-Duty Trucks	4,712	4,340	3,892	3,242	2,670	2,789	3,360	3,947	4,070	4,182	4,092
Recreational Boats	1,611	1,591	1,603	1,543	1,314	1,196	1,125	1,208	1,226	1,230	1,234
Distillate Fuel Oil (Diesel Fuel)[a,b]	**25,621**	**31,475**	**39,084**	**44,593**	**40,877**	**44,086**	**43,862**	**48,627**	**48,725**	**48,508**	**48,059**
Passenger Cars	963	798	562	391	254	285	194	201	194	181	163
Light-Duty Trucks	799	1,234	1,894	2,904	2,679	3,118	2,586	2,799	2,834	2,808	2,725
Buses	759	1,060	1,477	1,435	1,387	1,765	1,594	1,801	1,977	1,968	1,954
Medium- and Heavy-Duty Trucks	18,708	23,108	29,426	34,335	31,752	33,562	35,367	39,191	39,013	38,917	38,510
Recreational Boats	267	268	269	275	260	255	258	284	301	306	318
Ships and Non-Recreational Boats	658	1,159	1,367	814	800	1,270	747	1,042	1,071	1,036	993
Rail[c]	3,467	3,848	4,089	4,439	3,743	3,833	3,116	3,308	3,336	3,293	3,396
Jet Fuel[d]	**19,168**	**17,979**	**19,992**	**19,410**	**15,529**	**16,155**	**12,372**	**15,656**	**16,906**	**18,353**	**19,014**
Commercial Aircraft	11,569	12,136	14,672	13,976	11,931	12,534	9,613	12,527	13,654	13,654	13,654
General Aviation Aircraft	3,940	3,295	3,107	3,534	2,287	2,327	1,659	1,966	2,105	3,599	4,350
Military Aircraft	3,660	2,548	2,213	1,900	1,311	1,294	1,100	1,163	1,147	1,099	1,010
Aviation Gasoline[d]	**374**	**329**	**302**	**294**	**225**	**176**	**168**	**179**	**186**	**176**	**189**
General Aviation Aircraft	374	329	302	294	225	176	168	179	186	176	189
Residual Fuel Oil[d]	**2,006**	**2,587**	**2,963**	**1,713**	**1,818**	**378**	**651**	**2,155**	**2,037**	**1,478**	**1,600**
Ships and Non-Recreational Boats	2,006	2,587	2,963	1,713	1,818	378	651	2,155	2,037	1,478	1,600
Natural Gas[d] (trillion cubic feet)	**0.7**	**0.7**	**0.7**	**0.6**	**0.7**	**0.7**	**1.1**	**1.2**	**1.3**	**1.3**	**1.3**
Passenger Cars	+	+	+	+	+	+	+	+	+	+	+
Light-Duty Trucks	+	+	+	+	+	+	+	+	+	+	+
Medium- and Heavy-Duty Trucks	+	+	+	+	+	+	+	+	+	+	+
Buses	+	+	+	+	+	+	+	+	+	+	+
Pipelines	0.7	0.7	0.7	0.6	0.7	0.7	1.1	1.2	1.3	1.3	1.3
LPG[d]	**251**	**194**	**130**	**309**	**50**	**109**	**95**	**107**	**122**	**128**	**131**
Passenger Cars	1	0.7	0.3	1	+	+	+	+	+	+	+
Light-Duty Trucks	25	20	9	25	2	2	6	7	10	13	13
Medium- and Heavy-Duty Trucks	225	172	84	154	21	31	80	87	94	95	97
Buses	+	1	37	128	27	77	9	12	17	21	21
Electricity[e] (Million kilowatt-hours)	**4,751**	**4,975**	**5,382**	**7,506**	**7,719**	**8,399**	**9,544**	**9,985**	**12,061**	**14,704**	**18,968**
Passenger Cars	+	+	+	+	1	743	2,391	2,438	3,156	4,225	5,819

(continued)

Table A5.1-7: Fuel Consumption by Fuel and Vehicle Type (million gallons unless otherwise specified) *(continued)*

Fuel/Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Light-Duty Trucks	+	+	+	+	2	15	509	1,081	2,095	3,371	5,922
Buses	+	+	+	+	4	4	96	132	210	245	245
Rail	4,751	4,975	5,382	7,506	7,712	7,637	6,548	6,334	6,599	6,864	6,983

+ Does not exceed 0.05 units (trillion cubic feet, million kilowatt-hours, or million gallons, as specified).

[a] Figures do not include ethanol blended in motor gasoline or biodiesel blended into distillate fuel oil. Net carbon fluxes associated with ethanol are accounted for in Chapter 6 (Land Use, Land-Use Change and Forestry).

[b] Gasoline and diesel highway vehicle fuel consumption estimates are based on data from FHWA Highway Statistics Table MF-21 and ratios developed from MOVES5 to apportion FHWA fuel consumption data to vehicle type and fuel type.

[c] Class II and Class III diesel consumption data for 2014-2024 is estimated by applying the historical average fuel usage per carload factor to the annual number of carloads.

[d] Estimated based on EIA transportation sector energy estimates by fuel type, with bottom-up activity data used for apportionment to modes.

[e] Electricity consumption by passenger cars, light-duty trucks (SUVs), and buses is based on plug-in electric vehicle sales data and engine efficiencies, as reported in the *EIA Monthly Energy Review* (EIA, 2026).

Note: Totals may not sum due to independent rounding.

Table A5.1-8: Energy Consumption by Fuel and Vehicle Type (TBtu)

Fuel/Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Motor Gasoline[a]	**13,524**	**14,211**	**15,636**	**16,164**	**14,888**	**14,988**	**13,249**	**14,548**	**14,347**	**14,851**	**14,366**
Passenger Cars	8,783	8,083	7,769	7,378	6,500	5,438	4,211	4,442	4,195	4,211	3,938
Light-Duty Trucks	3,832	5,273	7,076	8,096	7,785	8,930	8,351	9,318	9,323	9,786	9,584
Motorcycles	46	54	57	67	86	91	86	97	115	123	122
Buses	72	59	46	25	21	33	43	50	55	59	60
Medium- and Heavy-Duty Trucks	589	543	487	405	332	347	418	491	506	520	509
Recreational Boats	201	199	200	193	163	149	140	150	152	153	153
Distillate Fuel Oil (Diesel Fuel)	**3,553**	**4,365**	**5,421**	**6,185**	**5,669**	**6,114**	**6,083**	**6,744**	**6,758**	**6,728**	**6,665**
Passenger Cars	134	111	78	54	35	40	27	28	27	25	23
Light-Duty Trucks	111	171	263	403	372	432	359	388	393	389	378
Buses	105	147	205	199	192	245	221	250	274	273	271
Medium- and Heavy-Duty Trucks	2,595	3,205	4,081	4,762	4,404	4,655	4,905	5,435	5,411	5,397	5,341
Recreational Boats	37	37	37	38	36	35	36	39	42	42	44
Ships and Non-Recreational Boats	91	161	190	113	111	176	104	145	148	144	138
Rail	481	534	567	616	519	532	432	459	463	457	471
Jet Fuel	**2,588**	**2,427**	**2,699**	**2,620**	**2,096**	**2,181**	**1,670**	**2,114**	**2,282**	**2,478**	**2,567**
Commercial Aircraft	1,562	1,638	1,981	1,887	1,611	1,692	1,298	1,691	1,843	1,843	1,843
General Aviation Aircraft	532	445	419	477	309	314	224	265	284	486	587

(continued)

Table A5.1-8: Energy Consumption by Fuel and Vehicle Type (TBtu) *(continued)*

Fuel/Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Military Aircraft	494	344	299	257	177	175	149	157	155	148	136
Aviation Gasoline	**45**	**40**	**36**	**35**	**27**	**21**	**20**	**22**	**22**	**21**	**23**
General Aviation Aircraft	45	40	36	35	27	21	20	22	22	21	23
Residual Fuel Oil	**300**	**387**	**443**	**256**	**272**	**57**	**97**	**323**	**305**	**221**	**239**
Ships and Non-Recreational Boats	300	387	443	256	272	57	97	323	305	221	239
Natural Gas	**679**	**724**	**672**	**624**	**719**	**745**	**1,111**	**1,232**	**1,367**	**1,358**	**1,394**
Passenger Cars	+	+	0.1	0.3	0.1	0.1	+	+	+	+	+
Light-Duty Trucks	+	+	0.4	0.6	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Medium- and Heavy-Duty Trucks	+	+	0.2	0.4	0.7	1.1	1.6	1.7	1.7	1.7	1.7
Buses	+	0	3	4	4	5	5	4	5	6	6
Pipelines	679	724	668	619	714	739	1,105	1,226	1,361	1,351	1,386
LPG	**23**	**18**	**12**	**28**	**5**	**10**	**9**	**10**	**11**	**12**	**12**
Passenger Cars	0.1	0.1	+	0.1	+	+	+	+	+	+	+
Light-Duty Trucks	2	2	1	2	0	0	1	1	1	1	1
Medium- and Heavy-Duty Trucks	21	16	8	14	2	3	7	8	9	9	9
Buses	+	0	3.4	12	2	7	1	1	2	2	2
Electricity	**16**	**17**	**18**	**26**	**26**	**29**	**33**	**34**	**41**	**50**	**65**
Passenger Cars	+	+	+	+	+	2.5	8.2	8.3	10.8	14.4	19.9
Light-Duty Trucks	+	+	+	+	+	0.1	1.7	3.7	7.1	11.5	20.2
Buses	+	+	+	+	+	+	0.3	0.4	0.7	0.8	0.8
Rail	16	17	18	26	26	26	22	22	23	23	24
Total	**20,729**	**22,189**	**24,937**	**25,938**	**23,702**	**24,144**	**22,272**	**25,026**	**25,133**	**25,719**	**25,331**

+ Does not exceed 0.05 units (TBtu).

[a] This table is calculated with the heat content for gasoline without ethanol from Table A.1 in the *EIA Monthly Energy Review* (EIA, 2026) rather than the annually variable quantity-weighted heat content for gasoline with ethanol, which varies by year.

Note: Totals may not sum due to independent rounding.

References

U.S. Energy Information Administration (EIA) (2026). *Monthly Energy Review*, February 2026. Energy Information Administration, U.S. Department of Energy, Washington, DC. DOE/EIA-0035 (2026/02).

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.2 Methodology for Estimating Carbon Content of Fossil Fuels

Information on the methodology used to estimate carbon contents of fossil fuels can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on carbon content methodology will be updated and included in the Annex to the GHGIA 2027 as applicable.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990-2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.3 Methodology for Estimating Carbon Emitted from Non-Energy Uses of Fossil Fuels

Information on the methodology used to estimate carbon emitted from non-energy uses of fossil fuels can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate carbon emitted from non-energy uses of fossil fuels will be updated and included in the Annex to the GHGIA 2027 as applicable.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.4 Methodology for Estimating Non-CO_2 Emissions from Fossil Fuel Combustion

Non-CO_2 emissions calculations follow the same basic methodology as for calculating CO_2 emissions except the non-CO_2 calculations require activity data by combustion technology type in order to calculate emissions. The methods used to calculate non-CO_2 emissions are consistent with those used in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

As discussed in Chapter 3 (Energy), for stationary sources Tier 1 factors are used for calculating non-CO_2 emissions from combustion in the residential, commercial and industrial sectors as well as for fuel combustion in territories. For those sectors the only data needed is fuel use by type by sector as shown in Table A5.4-1. The emission factors used for those sectors are shown in Table A5.4-2 and are based on fuel use in energy units by fuel type and sector. Table A5.4-1 also shows the energy used by fuel type in the electric power sector. However, for the electric power sector the non-CO_2 emission estimates are based on more specific Tier 2 emission factors by technology type as shown in Table A5.4-3.

Table A5.4-1: Stationary Fuel Consumption for Calculating Non-CO_2 Emissions (TBtu)

Fuel/End-Use Sector	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Coal	**19,637**	**20,912**	**23,088**	**22,966**	**20,731**	**15,444**	**9,121**	**10,404**	**9,748**	**8,137**	**7,888**
Residential	31	17	11	8	0	0	0	0	0	0	0
Commercial	124	117	92	97	70	31	15	15	14	12	11
Industrial	1,668	1,557	1,362	1,246	993	732	449	450	450	380	364
Electric Power	17,807	19,216	21,618	21,582	19,633	14,645	8,625	9,908	9,252	7,719	7,485
U.S. Territories[a]	5	5	5	33	35	36	33	31	32	28	28
Petroleum	**6,349**	**5,935**	**6,633**	**6,682**	**4,985**	**4,666**	**3,616**	**3,469**	**3,771**	**3,277**	**3,620**
Residential	1,376	1,266	1,433	1,369	1,116	954	853	813	851	786	749
Commercial	1,000	733	777	770	709	954	779	763	887	661	968
Industrial	2,907	2,787	2,662	2,889	2,354	2,290	1,719	1,611	1,736	1,522	1,555
Electric Power	797	860	1,269	1,003	412	173	24	22	48	30	60
U.S. Territories[a]	268	290	491	649	394	296	241	260	249	278	288
Natural Gas	**17,229**	**19,311**	**20,894**	**20,930**	**22,895**	**26,595**	**29,552**	**29,534**	**31,067**	**31,243**	**31,660**
Residential	4,487	4,954	5,105	4,946	4,878	4,777	4,846	4,889	5,140	4,682	4,545
Commercial	2,680	3,096	3,252	3,073	3,165	3,316	3,279	3,409	3,635	3,447	3,436
Industrial	7,687	8,697	8,630	7,324	7,668	8,738	9,484	9,679	9,838	9,912	9,963
Electric Power	2,376	2,564	3,894	5,562	7,157	9,707	11,894	11,484	12,403	13,116	13,630
U.S. Territories[a]	0	0	13	24	28	57	50	74	51	85	85
Wood	**2,216**	**2,370**	**2,262**	**2,137**	**2,217**	**2,305**	**1,960**	**1,992**	**2,135**	**1,969**	**1,920**
Residential	580	520	420	430	541	513	345	357	450	382	358
Commercial	66	72	71	70	72	73	73	73	73	72	72
Industrial	1,442	1,652	1,636	1,452	1,409	1,476	1,356	1,366	1,415	1,341	1,328
Electric Power	129	125	134	185	196	244	185	197	198	174	162
U.S. Territories	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

NE (Not Estimated)

[a] U.S. Territories coal is assumed to be primarily consumed in the electric power sector, natural gas in the industrial sector, and petroleum in the transportation sector.

Note: Totals may not sum due to independent rounding.

Table A5.4-2: CH_4 and N_2O Emission Factors by Fuel Type and Sector (g/GJ)[a]

Fuel/End-Use Sector	CH_4	N_2O
Coal		
Residential	300	1.5
Commercial	10	1.5
Industrial	10	1.5
U.S. Territories	1	1.5
Petroleum		
Residential	10	0.6
Commercial	10	0.6
Industrial	3	0.6
U.S. Territories	5	0.6
Natural Gas		
Residential	5	0.1
Commercial	5	0.1
Industrial	1	0.1
U.S. Territories	1	0.1
Wood		
Residential	300	4.0
Commercial	300	4.0
Industrial	30	4.0
U.S. Territories	NA	NA

NA (Not Applicable)

[a] GJ (Gigajoule) = 10^9 joules. One joule = $9.486 \div 10^{-4}$ Btu.

Table A5.4-3: CH_4 and N_2O Emission Factors by Technology Type and Fuel Type for the Electric Power Sector (g/GJ)[a]

Technology	Configuration	CH_4	N_2O
Liquid Fuels			
Residual Fuel Oil/Shale Oil Boilers	Normal Firing	0.8	0.3
	Tangential Firing	0.8	0.3
Gas/Diesel Oil Boilers	Normal Firing	0.9	0.4
	Tangential Firing	0.9	0.4
Large Diesel Oil Engines >600 hp (447kW)		4.0	NA
Solid Fuels			
Pulverized Bituminous Combination Boilers	Dry Bottom, wall fired	0.7	5.8
	Dry Bottom, tangentially fired	0.7	1.4
	Wet bottom	0.9	1.4
Bituminous Spreader Stoker Boilers	With and without re-injection	1.0	0.7
Bituminous Fluidized Bed Combustor	Circulating Bed	1.0	61
	Bubbling Bed	1.0	61
Bituminous Cyclone Furnace		0.2	0.6
Lignite Atmospheric Fluidized Bed		NA	71
Natural Gas			
Boilers		1.0	0.3
Gas-Fired Gas Turbines >3MW		3.7	1.3
Large Dual-Fuel Engines		258	NA
Combined Cycle		3.7	1.3
Peat			
Peat Fluidized Bed Combustion	Circulating Bed	3.0	7.0
	Bubbling Bed	3.0	3.0
Biomass			

(continued)

Table A5.4-3: CH_4 and N_2O Emission Factors by Technology Type and Fuel Type for the Electric Power Sector (g/GJ) *(continued)*

Technology	Configuration	CH_4	N_2O
Wood/Wood Waste Boilers		11.0	7.0
Wood Recovery Boilers		1.0	1.0

NA (Not Applicable)
[a] GJ (Gigajoule) = 10^9 joules. One joule = 9.486+10^{-4} Btu.

For mobile sources, depending on the category, non-CO_2 emissions are calculated based on activity data including fuel consumption or vehicle miles traveled (VMT). The activity data estimates are multiplied by emission factors, expressed per unit of fuel consumed or per VMT depending on the activity data source. The methods used to calculate non-CO_2 emissions from mobile sources are consistent with those used in the Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023 report (EPA, 2025).

Non-CO_2 emissions from on-road gasoline and diesel fuel vehicles are calculated based on VMT activity data and associated emissions factors as per the following steps.

- Step 1: Determine VMT by vehicle type, fuel type, and model year
- Step 2: Allocate VMT data to control technology type
- Step 3: Determine CH_4 and N_2O factors by vehicle, fuel, and control technology type per VMT
- Step 4: Determine CH_4 and N_2O emitted by vehicle, fuel, and control technology type

As part of step 1, on road gasoline and diesel vehicle VMT is calculated based on FHWA data on total VMT and allocated to vehicle type based on data from the MOVES5 model. See EPA 2025 for more details on the approach. VMT for gasoline vehicles are shown in Table A5.4-4 and VMT for diesel vehicles are shown in Table A5.4-5. Total VMT for each on-road vehicle type for each year in the time series were then distributed across 30 model years to represent the age of vehicles in the on-road fleet. Values for 2024 are shown in Table A5.4-6. This distribution was derived by weighting the age distribution of the U.S. vehicle fleet in each year by the average annual age-specific vehicle mileage accumulation of U.S. vehicles. See EPA 2025 for more details on the approach.

Table A5.4-4: Vehicle Miles Traveled for Gasoline On-Road Vehicles (billion miles)

Year	Passenger Cars	Light-Duty Trucks	Heavy-Duty Vehicles[a]	Motorcycles
1990	1,474.4	409.3	46.6	11.4
1995	1,464.5	650.4	47.4	12.5
2000	1,455.7	939.5	44.8	12.2
2005	1,459.6	1,153.6	37.9	13.8
2010	1,390.6	1,200.4	32.5	18.5
2015	1,225.6	1,489.4	30.7	19.7
2020	991.1	1,518.8	34.2	18.1
2021	1,023.7	1,679.3	39.2	19.9
2022	997.5	1,743.7	41.2	24.0
2023	980.3	1,799.0	41.4	24.6
2024	987.0	1,866.8	44.0	25.3

[a] Heavy-Duty Vehicles includes Medium-Duty Trucks, Heavy-Duty Trucks, and Buses.

Table A5.4-5: Vehicle Miles Traveled for Diesel On-Road Vehicles (billion miles)

Year	Passenger Cars	Light-Duty Trucks	Heavy-Duty Trucks[a]	Heavy-Duty Buses
1990	40.7	18.7	136.7	6.0
1995	33.2	28.6	176.7	8.9
2000	23.2	39.8	219.0	11.9
2005	14.6	49.5	247.5	11.2
2010	9.5	45.9	253.6	11.9
2015	9.1	51.3	241.6	13.6
2020	5.7	45.2	254.1	11.2
2021	5.9	49.1	280.7	12.5
2022	5.7	50.3	283.2	13.7
2023	5.1	49.5	280.6	13.4
2024	5.0	54.0	297.9	14.1

[a] Heavy-Duty Trucks includes Medium-Duty Trucks and Heavy-Duty Trucks.

Table A5.4-6: VMT Distribution by Vehicle Age and Vehicle/Fuel Type[a] in 2024

Vehicle Age	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC	HDDB
0	5.04%	8.02%	9.73%	0.00%	7.01%	9.37%	24.05%	20.29%
1	5.25%	7.97%	9.94%	0.00%	6.57%	7.97%	12.46%	10.17%
2	3.62%	6.76%	12.81%	0.00%	6.53%	9.99%	8.80%	5.49%
3	3.86%	7.10%	9.34%	0.00%	6.58%	7.54%	7.84%	5.76%
4	4.48%	6.48%	9.01%	0.00%	4.39%	9.60%	4.75%	5.85%
5	5.39%	7.31%	7.74%	0.09%	6.36%	8.30%	3.97%	6.09%
6	5.64%	6.59%	5.07%	1.05%	6.52%	5.75%	3.46%	5.35%
7	6.45%	6.18%	6.49%	1.24%	6.17%	6.38%	3.09%	4.90%
8	6.41%	5.33%	5.51%	1.16%	6.37%	6.57%	2.90%	4.59%
9	6.72%	4.93%	4.65%	14.40%	6.32%	5.70%	2.56%	4.00%
10	6.17%	4.05%	2.69%	17.23%	3.66%	3.67%	2.30%	3.37%
11	6.20%	3.41%	2.46%	17.48%	2.57%	2.73%	1.96%	2.62%
12	5.26%	2.82%	2.64%	13.79%	2.93%	2.55%	1.74%	2.45%
13	3.72%	2.73%	1.86%	9.11%	2.54%	1.93%	1.17%	2.39%
14	3.45%	2.06%	0.76%	7.61%	1.07%	0.95%	0.90%	2.39%
15	2.85%	1.45%	0.82%	4.60%	0.99%	0.74%	1.80%	1.91%
16	3.24%	2.29%	1.17%	0.46%	2.77%	1.55%	2.08%	1.69%
17	3.19%	2.23%	0.87%	0.31%	2.44%	1.76%	2.52%	1.53%
18	2.60%	1.99%	1.05%	3.73%	3.47%	1.51%	2.36%	1.42%
19	2.23%	1.85%	0.80%	2.25%	2.61%	1.10%	2.05%	1.01%
20	1.75%	1.75%	0.66%	1.22%	2.77%	0.71%	1.55%	1.03%
21	1.54%	1.41%	0.54%	1.32%	2.12%	0.52%	1.56%	0.90%
22	1.20%	1.19%	0.48%	1.15%	1.61%	0.47%	1.16%	0.91%
23	0.95%	0.97%	0.51%	0.65%	1.55%	0.66%	0.88%	0.82%
24	0.83%	0.82%	0.45%	0.53%	0.96%	0.71%	0.66%	0.73%
25	0.59%	0.66%	0.73%	0.23%	1.02%	0.51%	0.47%	0.68%
26	0.45%	0.48%	0.31%	0.20%	0.25%	0.24%	0.32%	0.54%
27	0.35%	0.43%	0.34%	0.07%	0.76%	0.22%	0.24%	0.41%
28	0.25%	0.28%	0.20%	0.06%	0.47%	0.16%	0.20%	0.34%
29	0.23%	0.27%	0.27%	0.04%	0.42%	0.14%	0.16%	0.29%
30	0.08%	0.18%	0.08%	0.00%	0.23%	0.03%	0.05%	0.08%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

[a] The following abbreviations correspond to vehicle types: LDGV (light-duty gasoline vehicles), LDGT (light-duty gasoline trucks), HDGV (heavy-duty gasoline vehicles), LDDV (light-duty diesel vehicles), LDDT (light-duty diesel trucks), HDDV (heavy-duty diesel vehicles), MC (motorcycles) and HDDB (heavy-duty diesel buses).

As part of step 2, VMT by vehicle type for each model year was distributed across control technologies as shown in Table A-5.2-7, Table A5.4-8 and Table A5.4-9 for gasoline vehicles and Table A5.4-10 for diesel vehicles and motorcycles. Emission control technology assignments were estimated in part based on when control technologies were implemented and for more recent years by confidential engine family sales data and annual certification test results. For 2024 the emission control technology assignments were held constant at the 2023 values. See EPA 2025 for more details on allocation of emission control technologies across the vehicle fleet.

Table A5.4-7: Emissions Control Technology Assignments for Gasoline Passenger Cars (% of VMT)

Model Years	Non-catalyst	Oxidation	EPA Tier 0	EPA Tier 1	CARB LEV	CARB LEV 2	EPA Tier 2	CARB LEV 3	EPA Tier 3
1973-1975	100%	-	-	-	-	-	-	-	-
1976	20%	80%	-	-	-	-	-	-	-
1977-1978	15%	85%	-	-	-	-	-	-	-
1979-1980	10%	90%	-	-	-	-	-	-	-
1981	-	15%	85%	-	-	-	-	-	-
1982	-	14%	86%	-	-	-	-	-	-
1983	-	12%	88%	-	-	-	-	-	-
1984-1993	-	-	100%	-	-	-	-	-	-
1994	-	-	80%	20%	-	-	-	-	-
1995	-	-	60%	40%	-	-	-	-	-
1996	-	-	40%	54%	6%	-	-	-	-
1997	-	-	20%	68%	12%	-	-	-	-
1998	-	-	<1%	82%	18%	-	-	-	-
1999	-	-	<1%	67%	33%	-	-	-	-
2000	-	-	-	44%	56%	-	-	-	-
2001	-	-	-	3%	97%	-	-	-	-
2002	-	-	-	1%	99%	-	-	-	-
2003	-	-	-	<1%	85%	2%	12%	-	-
2004	-	-	-	<1%	24%	16%	60%	-	-
2005	-	-	-	-	13%	27%	60%	-	-
2006	-	-	-	-	18%	35%	47%	-	-
2007	-	-	-	-	4%	43%	53%	-	-
2008	-	-	-	-	2%	42%	56%	-	-
2009	-	-	-	-	<1%	43%	57%	-	-
2010	-	-	-	-	-	44%	56%	-	-
2011	-	-	-	-	-	42%	58%	-	-
2012	-	-	-	-	-	41%	59%	-	-
2013	-	-	-	-	-	40%	60%	-	-
2014	-	-	-	-	-	37%	62%	1%	-
2015	-	-	-	-	-	33%	56%	11%	<1%
2016	-	-	-	-	-	25%	50%	18%	6%
2017	-	-	-	-	-	14%	0%	29%	56%
2018	-	-	-	-	-	7%	0%	42%	52%
2019	-	-	-	-	-	3%	0%	44%	53%
2020	-	-	-	-	-	0%	0%	50%	50%
2021	-	-	-	-	-	2%	0%	48%	50%
2022	-	-	-	-	-	1%	0%	49%	50%
2023	-	-	-	-	-	1%	0%	49%	50%
2024	-	-	-	-	-	1%	0%	49%	50%

- (Not Applicable)

Table A5.4-8: Emissions Control Technology Assignments for Gasoline Light-Duty Trucks (% of VMT)

Model Years	Non-catalyst	Oxidation	EPA Tier 0	EPA Tier 1	CARB LEV	CARB LEV 2	EPA Tier 2	CARB LEV 3	EPA Tier 3
1973-1975	100%	-	-	-	-	-	-	-	-
1976	30%	70%	-	-	-	-	-	-	-
1977	20%	80%	-	-	-	-	-	-	-
1978-1979	25%	75%	-	-	-	-	-	-	-
1980	20%	80%	-	-	-	-	-	-	-
1981	-	95%	5%	-	-	-	-	-	-
1982	-	90%	10%	-	-	-	-	-	-
1983	-	80%	20%	-	-	-	-	-	-
1984	-	70%	30%	-	-	-	-	-	-
1985	-	60%	40%	-	-	-	-	-	-
1986	-	50%	50%	-	-	-	-	-	-
1987-1993	-	5%	95%	-	-	-	-	-	-
1994	-	-	60%	40%	-	-	-	-	-
1995	-	-	20%	80%	-	-	-	-	-
1996 - 1997	-	-	-	100%	-	-	-	-	-
1998	-	-	-	87%	13%	-	-	-	-
1999	-	-	-	61%	39%	-	-	-	-
2000	-	-	-	63%	37%	-	-	-	-
2001	-	-	-	24%	76%	-	-	-	-
2002	-	-	-	31%	69%	-	-	-	-
2003	-	-	-	25%	69%	-	6%	-	-
2004	-	-	-	1%	26%	8%	65%	-	-
2005	-	-	-	-	17%	17%	66%	-	-
2006	-	-	-	-	24%	22%	54%	-	-
2007	-	-	-	-	14%	25%	61%	-	-
2008	-	-	-	-	<1%	34%	66%	-	-
2009	-	-	-	-	-	34%	66%	-	-
2010	-	-	-	-	-	30%	70%	-	-
2011	-	-	-	-	-	27%	73%	-	-
2012	-	-	-	-	-	24%	76%	-	-
2013	-	-	-	-	-	31%	69%	-	-
2014	-	-	-	-	-	26%	73%	1%	-
2015	-	-	-	-	-	22%	72%	6%	-
2016	-	-	-	-	-	20%	62%	16%	2%
2017	-	-	-	-	-	9%	14%	28%	48%
2018	-	-	-	-	-	7%	-	38%	55%
2019	-	-	-	-	-	3%	-	44%	53%
2020 - 2022	-	-	-	-	-	-	-	50%	50%
2023	-	-	-	-	-	<1%	-	50%	50%
2024	-	-	-	-	-	<1%	-	50%	50%

- (Not Applicable)

Table A5.4-9: Emissions Control Technology Assignments for Gasoline Heavy-Duty Vehicles (% of VMT)

Model Years	Uncontrolled	Non-catalyst	Oxidation	EPA Tier 0	EPA Tier 1	CARB LEV	CARB LEV 2	EPA Tier 2	CARB LEV 3	EPA Tier 3
⁜1980	100%	-	-	-	-	-	-	-	-	-
1981-1984	95%	-	5%	-	-	-	-	-	-	-
1985-1986	-	95%	5%	-	-	-	-	-	-	-
1987	-	70%	15%	15%	-	-	-	-	-	-
1988-1989	-	60%	25%	15%	-	-	-	-	-	-
1990-1995	-	45%	30%	25%	-	-	-	-	-	-
1996	-	-	25%	10%	65%	-	-	-	-	-
1997	-	-	10%	5%	85%	-	-	-	-	-
1998	-	-	-	-	100%	-	-	-	-	-
1999	-	-	-	-	98%	2%	-	-	-	-
2000	-	-	-	-	93%	7%	-	-	-	-
2001	-	-	-	-	78%	22%	-	-	-	-
2002	-	-	-	-	94%	6%	-	-	-	-
2003	-	-	-	-	85%	14%	-	1%	-	-
2004	-	-	-	-	-	33%	-	67%	-	-
2005	-	-	-	-	-	15%	-	85%	-	-
2006	-	-	-	-	-	50%	-	50%	-	-
2007	-	-	-	-	-	-	27%	73%	-	-
2008	-	-	-	-	-	-	46%	54%	-	-
2009	-	-	-	-	-	-	45%	55%	-	-
2010	-	-	-	-	-	-	24%	76%	-	-
2011	-	-	-	-	-	-	7%	93%	-	-
2012	-	-	-	-	-	-	17%	83%	-	-
2013	-	-	-	-	-	-	17%	83%	-	-
2014	-	-	-	-	-	-	19%	81%	-	-
2015	-	-	-	-	-	-	31%	64%	5%	-
2016	-	-	-	-	-	-	24%	10%	21%	44%
2017	-	-	-	-	-	-	8%	8%	39%	45%
2018	-	-	-	-	-	-	13%	-	35%	52%
2019	-	-	-	-	-	-	10%	-	40%	50%
2020	-	-	-	-	-	-	-	-	50%	50%
2021	-	-	-	-	-	-	-	-	50%	50%
2022	-	-	-	-	-	-	-	-	50%	50%
2023	-	-	-	-	-	-	-	-	45%	55%
2024	-	-	-	-	-	-	-	-	45%	55%

- (Not Applicable)

Table A5.4-10: Emissions Control Technology Assignments for Diesel On-Road Vehicles and Motorcycles

Vehicle Type/Control Technology	Model Years
Diesel Passenger Cars and Light-Duty Trucks	
Uncontrolled	1960–1982
Moderate Control	1983–1995
Advanced Control	1996–2006
Aftertreatment	2007-2024
Diesel Medium- and Heavy-Duty Trucks and Buses	
Uncontrolled	1960–1989
Moderate Control	1990–2003
Advanced Control	2004–2006
Aftertreatment	2007–2024
Motorcycles	
Uncontrolled	1960–1995
Non-Catalyst Controls	1996–2005
Advanced	2006-2024

For step 3, CH_4 and N_2O emission factors (in grams of CH_4 and N_2O per mile) for gasoline and diesel on-road vehicles were developed, as shown in Table A5.4-11. Values are based on annual certification data and laboratory test results of different vehicles and control technologies. See EPA 2025 for more details.

Table A5.4-11: Non-CO_2 Emission Factors for On-Road Vehicles

Vehicle Type/Control Technology	N_2O (g/mi)	CH_4 (g/mi)
Gasoline Passenger Cars		
EPA Tier 3	0.0015	0.0055
ARB LEV III	0.0012	0.0045
EPA Tier 2	0.0048	0.0072
ARB LEV II	0.0043	0.0070
ARB LEV	0.0205	0.0100
EPA Tier 1	0.0429	0.0271
EPA Tier 0	0.0647	0.0704
Oxidation Catalyst	0.0504	0.1355
Non-Catalyst Control	0.0197	0.1696
Uncontrolled	0.0197	0.1780
Gasoline Light-Duty Trucks		
EPA Tier 3	0.0012	0.0092
ARB LEV III	0.0012	0.0065
EPA Tier 2	0.0025	0.0100
ARB LEV II	0.0057	0.0084
ARB LEV	0.0223	0.0148
EPA Tier 1	0.0871	0.0452
EPA Tier 0	0.1056	0.0776
Oxidation Catalyst	0.0639	0.1516
Non-Catalyst Control	0.0218	0.1908
Uncontrolled	0.0220	0.2024
Gasoline Heavy-Duty Vehicles		
EPA Tier 3	0.0063	0.0252

 (continued)

Table A5.4-11: Non-CO_2 Emission Factors for On-Road Vehicles *(continued)*

Vehicle Type/Control Technology	N_2O (g/mi)	CH_4 (g/mi)
ARB LEV III	0.0136	0.0411
EPA Tier 2	0.0015	0.0297
ARB LEV II	0.0049	0.0391
ARB LEV	0.0466	0.0300
EPA Tier 1	0.1750	0.0655
EPA Tier 0	0.2135	0.2630
Oxidation Catalyst	0.1317	0.2356
Non-Catalyst Control	0.0473	0.4181
Uncontrolled	0.0497	0.4604
Diesel Passenger Cars		
Aftertreatment	0.0192	0.0302
Advanced	0.0010	0.0005
Moderate	0.0010	0.0005
Uncontrolled	0.0012	0.0006
Diesel Light-Duty Trucks		
Aftertreatment	0.0214	0.0290
Advanced	0.0014	0.0009
Moderate	0.0014	0.0009
Uncontrolled	0.0017	0.0011
Diesel Medium- and Heavy-Duty Trucks and Buses		
Aftertreatment	0.0431	0.0095
Advanced	0.0048	0.0051
Moderate	0.0048	0.0051
Uncontrolled	0.0048	0.0051
Motorcycles		
Advanced	0.0179	0.0661
Non-Catalyst Control	0.0069	0.0672
Uncontrolled	0.0087	0.0899

Non-CO_2 emissions from alternative fuel vehicles (AFVs) are calculated based on VMT activity data and associated emissions factors as per the following steps.

- Step 1: Determine VMT by vehicle and fuel type
- Step 2: Determine N_2O and CH_4 emission factors by vehicle and alternative fuel type
- Step 3: Determine the amount of CH_4 and N_2O emitted by vehicle and fuel type

Alternative fuels include compressed natural gas (CNG), liquid natural gas (LNG), liquefied petroleum gas (LPG), ethanol, methanol, biodiesel, hydrogen, and electricity. As part of step 1, alternative fuel vehicle VMT were calculated using a number of sources over the time period, see EPA 2025 for more details. VMT estimates for AFVs by vehicle category (passenger car, light-duty truck, medium-duty vehicles, heavy-duty vehicles and buses) and fuel type are shown in Table A5.4-12. For 2024, all the VMT values for AFV categories were held constant at 2023 values. As part of step 2, N_2O and CH4 emission factors were developed by vehicle and alternative fuel type. N2O factors are shown in Table A5.4-13 and CH4 factors are shown in Table A5.4-14.

Table A5.4-12: Detailed Vehicle Miles Traveled for Alternative Fuel On-Road Vehicles (Million Miles)

Vehicle Type/Year	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Light-Duty Cars	**3.4**	**12.6**	**82.6**	**124.4**	**246.4**	**2,874.0**	**9,003.1**	**11,302.8**	**14,705.1**	**19,283.1**	**19,283.1**
Methanol-Flex Fuel ICE	+	0.1	+	+	+	+	+	+	+	+	+
Ethanol-Flex Fuel ICE	+	0.3	17.0	42.9	104.4	102.4	61.6	61.2	58.1	54.9	54.9
CNG ICE	+	+	4.5	13.4	9.2	10.0	9.0	9.3	9.1	9.0	9.0
CNG Bi-fuel	+	0.2	14.6	34.1	6.8	1.6	0.2	+	+	+	+
LPG ICE	1.0	1.0	1.0	+	+	0.1	+	+	+	+	+
LPG Bi-fuel	2.4	2.5	2.4	2.8	1.0	0.1	+	+	+	+	+
Biodiesel (BD100)	+	+	1.6	30.4	59.0	339.3	246.3	232.2	208.2	257.6	257.6
NEVs	+	8.4	40.8	+	63.4	155.1	148.7	153.1	157.6	170.7	170.7
Electric Vehicle	+	0.1	0.7	0.9	0.7	1,354.7	6,119.7	8,077.3	11,339.4	15,661.0	15,661.0
SI PHEV - Electricity	+	+	+	+	1.9	910.1	2,369.2	2,698.9	2,845.2	3,023.2	3,023.2
Fuel Cell Hydrogen	+	+	+	+	+	0.7	48.4	70.9	87.4	106.6	106.6
Light-Duty Trucks	**66.4**	**73.7**	**1528**	**559.5**	**2,067.5**	**2,461.7**	**4,125.6**	**6,835.1**	**10,567.1**	**19,503.8**	**19,503.8**
Ethanol-Flex Fuel ICE	+	0.3	17.9	45.9	111.1	195.1	379.3	432.9	484.1	540.0	540.0
CNG ICE	+	+	4.3	12.2	7.3	4.0	2.0	1.7	1.2	0.7	0.7
CNG Bi-fuel	+	0.4	36.2	61.2	17.4	18.2	18.2	19.7	20.9	22.2	22.2
LPG ICE	19.2	20.9	21.1	27.4	8.5	4.9	4.8	5.3	5.8	6.3	6.3
LPG Bi-fuel	47.2	51.3	51.9	56.9	21.7	8.1	7.0	7.6	8.1	8.7	8.7
LNG	+	+	0.1	0.2	+	+	0.1	0.1	0.1	0.1	0.1
Biodiesel (BD100)	+	+	17.2	351.0	1,899.2	2,201.2	2,100.6	2,399.1	2,562.1	3,472.3	3,472.3
Electric Vehicle	+	0.8	4.0	4.6	2.3	21.9	1,220.6	2,952.9	5,610.2	12,096.9	12,096.9
SI PHEV - Electricity	+	+	+	+	+	7.5	381.4	1,000.1	1,855.4	3,335.4	3,335.4
Fuel Cell Hydrogen	+	+	+	+	+	0.7	11.6	15.7	19.0	21.1	21.1
Medium-Duty Trucks	**176.0**	**159.8**	**175.1**	**260.1**	**473.2**	**2,623.3**	**3,514.1**	**3,423.9**	**3,328.0**	**4,112.5**	**4,112.5**
CNG ICE	+	+	0.7	2.6	5.5	11.2	16.2	17.7	18.5	18.8	18.8
CNG Bi-fuel	+	0.1	6.9	9.9	6.2	11.1	15.7	17.1	17.7	18.1	18.1
LPG ICE	142.6	129.8	128.9	76.0	27.9	18.2	7.1	5.1	2.9	0.8	0.8
LPG Bi-fuel	33.5	29.9	31.5	28.5	13.1	19.8	29.2	31.6	32.7	33.2	33.2
LNG	+	+	+	+	+	0.2	0.4	0.5	0.5	0.6	0.6
Biodiesel (BD100)	+	+	7.2	143.0	420.5	2,562.8	3,445.4	3,351.9	3,255.6	4,041.1	4,041.1
Heavy-Duty Trucks	**201.1**	**196.6**	**201.0**	**487.6**	**1,115.2**	**5,510.3**	**7,233.5**	**6,886.5**	**6,573.1**	**7,992.0**	**7,992.0**
Neat Methanol ICE	100.6	98.3	110.3	412.1	1,030.0	5,450.2	7,175.1	6,829.4	6,520.0	7,941.7	7,941.7
Neat Ethanol ICE	+	+	+	+	+	+	+	+	+	+	+
CNG ICE	+	+	+	1.5	+	1.1	3.6	1.7	1.0	0.5	0.5
LPG ICE	+	+	0.8	1.8	13.1	19.9	35.8	39.7	40.8	42.6	42.6
LPG Bi-fuel	94.5	92.4	84.3	67.6	58.5	30.2	12.5	9.3	5.5	2.0	2.0
LNG	6.1	5.9	5.4	4.0	10.1	5.3	4.5	4.4	4.1	3.9	3.9
Biodiesel (BD100)	+	+	+	0.7	3.6	3.6	2.1	1.9	1.6	1.3	1.3
Buses	**31.5**	**54.6**	**209.2**	**318.5**	**379.7**	**923.5**	**1,385.4**	**1,432.4**	**1,610.9**	**1,862.5**	**1,862.5**
Neat Methanol ICE	15.7	27.3	104.6	159.3	189.8	461.9	693.2	717.3	807. 4	934.1	934.1

(continued)

Table A5.4-12: Detailed Vehicle Miles Traveled for Alternative Fuel On-Road Vehicles (Million Miles) *(continued)*

Vehicle Type/Year	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Neat Ethanol ICE	3.6	6.5	+	+	+	+	+	+	+	+	+
CNG ICE	+	4.5	+	+	+	2.8	173.1	196.5	219.1	221.0	221.0
LPG ICE	+	1.0	79.7	110.3	130.6	160.1	4.2	4.8	5.5	5.5	5.5
LNG	12.1	11.8	10.8	12.4	6.7	2.8	0.6	+	+	+	+
Biodiesel (BD100)	+	3.2	11.5	14.7	6.6	4.1	158.9	153.7	161.1	193.6	193.6
Electric	+	+	1.2	14.3	43.5	289.4	310.4	300.2	314.6	378.1	378.1
Fuel Cell Hydrogen	+	0.3	1.3	7.6	2.4	2.3	45.0	59.9	103.3	130.1	130.1
Total VMT	**478.5**	**497.4**	**820.7**	**1,750.1**	**4,281.9**	**14,392.7**	**25,261.8**	**29,880.6**	**36,784.1**	**52,753.9**	**52,753.9**

+ Does not exceed 0.05 million vehicle miles traveled.

Notes: For most calculations, medium-duty trucks are grouped with heavy-duty trucks; they are reported separately here because these two categories may run on a slightly different range of fuel types.

Table A5.4-13: N_2O Emission Factors for Alternative Fuel Vehicles (g/mi)

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Light-Duty Cars											
Methanol-Flex Fuel ICE	0.040	0.040	0.027	0.014	0.006	0.006	0.004	0.004	0.004	0.004	0.004
Ethanol-Flex Fuel ICE	0.040	0.040	0.027	0.014	0.006	0.006	0.004	0.004	0.004	0.004	0.004
CNG ICE	0.024	0.024	0.022	0.014	0.006	0.006	0.004	0.004	0.004	0.004	0.004
CNG Bi-fuel	0.024	0.024	0.022	0.014	0.006	0.006	0.004	0.004	0.004	0.004	0.004
LPG ICE	0.024	0.024	0.022	0.014	0.006	0.006	0.004	0.004	0.004	0.004	0.004
LPG Bi-fuel	0.024	0.024	0.022	0.014	0.006	0.006	0.004	0.004	0.004	0.004	0.004
Biodiesel (BD100)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Light-Duty Trucks											
Ethanol-Flex Fuel ICE	0.077	0.077	0.056	0.035	0.007	0.007	0.005	0.005	0.005	0.005	0.005
CNG ICE	0.046	0.046	0.045	0.035	0.007	0.007	0.005	0.005	0.005	0.005	0.005
CNG Bi-fuel	0.046	0.046	0.045	0.035	0.007	0.007	0.005	0.005	0.005	0.005	0.005
LPG ICE	0.046	0.046	0.045	0.035	0.007	0.007	0.005	0.005	0.005	0.005	0.005
LPG Bi-fuel	0.046	0.046	0.045	0.035	0.007	0.007	0.005	0.005	0.005	0.005	0.005
LNG	0.046	0.046	0.045	0.035	0.007	0.007	0.005	0.005	0.005	0.005	0.005
Biodiesel (BD100)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Medium-Duty Trucks											
CNG ICE	0.127	0.127	0.127	0.127	0.104	0.110	0.034	0.034	0.033	0.033	0.033
CNG Bi-fuel	0.127	0.127	0.127	0.127	0.104	0.110	0.034	0.034	0.033	0.033	0.033
LPG ICE	0.127	0.127	0.127	0.127	0.104	0.110	0.034	0.034	0.033	0.033	0.033
LPG Bi-fuel	0.127	0.127	0.127	0.127	0.104	0.110	0.034	0.034	0.033	0.033	0.033
LNG	0.127	0.127	0.127	0.127	0.104	0.110	0.034	0.034	0.033	0.033	0.033
Biodiesel (BD100)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Heavy-Duty Trucks											
Neat Methanol ICE	0.128	0.128	0.128	0.128	0.114	0.130	0.000	0.027	0.026	0.026	0.026
Neat Ethanol ICE	0.128	0.128	0.128	0.128	0.114	0.130	0.028	0.027	0.026	0.026	0.026

(continued)

Table A5.4-13: N_2O Emission Factors for Alternative Fuel Vehicles (g/mi) *(continued)*

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
CNG ICE	0.077	0.077	0.077	0.077	0.110	0.108	0.017	0.017	0.017	0.017	0.017
LPG ICE	0.077	0.077	0.077	0.077	0.110	0.108	0.017	0.017	0.017	0.017	0.017
LPG Bi-fuel	0.077	0.077	0.077	0.077	0.110	0.108	0.017	0.017	0.017	0.017	0.017
LNG	0.077	0.077	0.077	0.077	0.110	0.108	0.017	0.017	0.017	0.017	0.017
Biodiesel (BD100)	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Buses											
Neat Methanol ICE	0.198	0.198	0.198	0.198	0.144	0.136	0.029	0.029	0.029	0.028	0.028
Neat Ethanol ICE	0.198	0.198	0.198	0.198	0.144	0.136	0.029	0.029	0.029	0.028	0.028
CNG ICE	0.119	0.119	0.119	0.119	0.086	0.081	0.018	0.017	0.017	0.017	0.017
LPG ICE	0.119	0.119	0.119	0.119	0.086	0.081	0.018	0.017	0.017	0.017	0.017
LNG	0.119	0.119	0.119	0.119	0.086	0.081	0.018	0.017	0.017	0.017	0.017
Biodiesel (BD100)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003

Note: When driven in all-electric mode, plug-in electric vehicles have zero tailpipe emissions. Therefore, emissions factors for battery electric vehicles (BEVs) and the electric portion of plug-in hybrid electric vehicles (PHEVs) are not included in this table.

Table A5.4-14: CH_4 Emission Factors for Alternative Fuel Vehicles (g/mi)

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Light-Duty Cars											
Methanol-Flex Fuel ICE	0.126	0.126	0.083	0.033	0.022	0.016	0.015	0.013	0.012	0.011	0.011
Ethanol-Flex Fuel ICE	0.126	0.126	0.083	0.033	0.022	0.016	0.015	0.013	0.012	0.011	0.011
CNG ICE	1.793	1.793	1.103	0.413	0.225	0.158	0.146	0.133	0.120	0.106	0.106
CNG Bi-fuel	1.793	1.793	1.103	0.413	0.225	0.158	0.146	0.133	0.120	0.106	0.106
LPG ICE	0.179	0.179	0.110	0.041	0.022	0.016	0.015	0.013	0.012	0.011	0.011
LPG Bi-fuel	0.179	0.179	0.110	0.041	0.022	0.016	0.015	0.013	0.012	0.011	0.011
Biodiesel (BD100)	-	-	-	-	-	0.030	0.030	0.030	0.030	0.030	0.030
Light-Duty Trucks											
Ethanol-Flex Fuel ICE	0.184	0.184	0.118	0.042	0.024	0.016	0.016	0.014	0.013	0.012	0.012
CNG ICE	2.632	2.631	1.580	0.528	0.242	0.164	0.158	0.144	0.130	0.116	0.116
CNG Bi-fuel	2.632	2.631	1.580	0.528	0.242	0.164	0.158	0.144	0.130	0.116	0.116
LPG ICE	0.263	0.263	0.158	0.053	0.024	0.016	0.016	0.014	0.013	0.012	0.012
LPG Bi-fuel	0.263	0.263	0.158	0.053	0.024	0.016	0.016	0.014	0.013	0.012	0.012
LNG	2.632	2.631	1.580	0.528	0.242	0.164	0.158	0.144	0.130	0.116	0.116
Biodiesel (BD100)	-	-	-	-	-	0.029	0.029	0.029	0.029	0.029	0.029
Medium-Duty Trucks											
CNG ICE	6.800	6.800	6.800	6.800	5.566	5.893	1.829	1.807	1.786	1.764	1.764
CNG Bi-fuel	6.800	6.800	6.800	6.800	5.566	5.893	1.829	1.807	1.786	1.764	1.764
LPG ICE	0.680	0.680	0.680	0.680	0.557	0.589	0.183	0.181	0.179	0.176	0.176
LPG Bi-fuel	0.680	0.680	0.680	0.680	0.557	0.589	0.183	0.181	0.179	0.176	0.176
LNG	6.800	6.800	6.800	6.800	5.566	5.893	1.829	1.807	1.786	1.764	1.764
Biodiesel (BD100)	-	-	-	-	0.052	0.009	0.009	0.009	0.009	0.009	0.009
Heavy-Duty Trucks											
Neat Methanol ICE	0.287	0.287	0.287	0.287	0.256	0.292	0.075	0.000	0.000	0.000	0.000
Neat Ethanol ICE	0.287	0.287	0.287	0.287	0.256	0.292	0.075	0.073	0.072	0.070	0.070
CNG ICE	4.100	4.100	4.100	4.100	5.871	5.761	0.921	0.921	0.921	0.921	0.921
LPG ICE	0.410	0.410	0.410	0.410	0.587	0.576	0.092	0.092	0.092	0.092	0.092
LPG Bi-fuel	0.410	0.410	0.410	0.410	0.587	0.576	0.092	0.076	0.060	0.044	0.044
LNG	4.100	4.100	4.100	4.100	5.871	5.761	0.921	0.921	0.921	0.921	0.921
Biodiesel (BD100)	-	-	-	-	0.061	0.009	0.009	0.009	0.009	0.009	0.009
Buses											
Neat Methanol ICE	1.316	1.316	1.316	1.316	0.960	0.904	0.195	0.000	0.000	0.000	0.000
Neat Ethanol ICE	1.316	1.316	1.316	1.316	0.960	0.904	0.195	0.193	0.190	0.188	0.188
CNG ICE	18.800	18.800	18.800	18.800	13.710	12.908	2.787	2.753	2.719	2.684	2.684
LPG ICE	1.880	1.880	1.880	1.880	1.371	1.291	0.279	0.275	0.272	0.268	0.268
LNG	18.800	18.800	18.800	18.800	13.710	12.908	2.787	2.753	2.719	2.684	2.684
Biodiesel (BD100)	-	-	-	-	0.070	0.009	0.009	0.009	0.009	0.009	0.009

Note: When driven in all-electric mode, plug-in electric vehicles have zero tailpipe emissions. Therefore, emissions factors for battery electric vehicles (BEVs) and the electric portion of plug-in hybrid electric vehicles (PHEVs) are not included in this table.

Non-CO_2 emissions from non-road mobile sources are calculated based on fuel quantity used and associated emissions factors per amount of fuel consumed by fuel type. Activity data for non-road mobile sources include annual fuel consumption statistics by transportation mode and fuel type. Non-road mobile sources include those captured in the transportation sector as well as non-transportation sector mobile sources. Non-transportation sector mobile sources include snowmobiles, golf carts, riding lawn mowers, agricultural equipment, and trucks used for off-road purposes, among others. Total activity data by non-road source category, excluding bunkers, are shown in Table A5.4-15. The CO_2 emissions from these non-transportation sector mobile sources are included in other sectors (e.g., industrial sector). N_2O and CH_4 emission factors were developed for non-road sources by vehicle and fuel type. N_2O factors are shown in Table A5.4-16 and CH_4 factors are shown in Table A5.4-17. Factors are in units of kg of fuel combusted so activity data in gallons and cubic feet are converted to kg based on fuel densities.

Table A5.4-15: Fuel Consumption for Non-Road Sources by Fuel Type (million gallons unless otherwise noted)

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Aircraft[a]	**19,542**	**18,308**	**20,294**	**19,704**	**15,754**	**16,331**	**12,540**	**15,835**	**17,092**	**18,529**	**19,204**
Aviation Gasoline	374	329	302	294	225	176	168	179	186	176	189
Jet Fuel	19,168	17,979	19,992	19,410	15,529	16,155	12,372	15,656	16,906	18,353	19,014
Commercial Aviation	11,569	12,136	14,672	13,976	11,931	12,534	9,613	12,527	13,654	13,654	13,654
Ships and Boats	**4,826**	**5,932**	**6,544**	**4,847**	**4,693**	**3,652**	**3,312**	**5,212**	**5,161**	**4,576**	**4,645**
Diesel	1,156	1,661	1,882	1,468	1,361	1,881	1,342	1,645	1,691	1,661	1,603
Gasoline	1,611	1,626	1,636	1,599	1,446	1,325	1,251	1,345	1,366	1,370	1,374
Residual	2,060	2,646	3,027	1,781	1,886	445	719	2,222	2,104	1,545	1,667
Construction/Mining Equipment[b]											
Diesel	4,317	4,718	5,181	6,667	5,727	5,200	5,966	6,414	6,782	6,829	6,859
Gasoline	472	437	357	746	678	367	389	363	290	387	354
CNG (million cubic feet)	5,082	5,463	6,032	7,341	6,219	5,430	5,834	6,272	6,477	6,499	6,512
LPG	22	24	27	32	26	22	25	27	28	28	28
Agricultural Equipment[c]											
Diesel	3,514	3,400	3,278	3,985	3,942	3,862	3,682	3,741	3,689	3,689	3,689
Gasoline	813	927	652	1,078	692	159	135	147	148	132	198
CNG (million cubic feet)	1,758	1,712	1,678	1,881	1,647	1,561	1,483	1,506	1,485	1,487	1,485
LPG	0	0	0	0	0	0	0	0	0	0	0
Rail	**3,469**	**3,864**	**4,106**	**4,446**	**3,807**	**4,020**	**3,288**	**3,400**	**3,428**	**3,385**	**3,423**
Diesel	3,469	3,864	4,106	4,446	3,807	4,020	3,288	3,400	3,428	3,385	3,423

(continued)

Table A5.4-15: Fuel Consumption for Non-Road Sources by Fuel Type (million gallons unless otherwise noted) *(continued)*

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Other[d]											
Diesel	2,095	2,071	2,047	2,395	2,450	2,832	2,849	3,071	3,348	3,442	3,533
Gasoline	4,371	4,482	4,673	5,743	5,525	5,083	5,041	5,268	5,515	5,476	5,416
CNG (million cubic feet)	20,894	22,584	25,035	26,702	29,891	38,069	38,280	41,151	44,451	45,699	46,890
LPG	1,412	1,809	2,192	2,351	2,165	2,279	2,414	2,596	2,891	3,003	3,112
Total (gallons)	**44,854**	**45,972**	**49,351**	**51,995**	**45,459**	**43,808**	**39,642**	**46,076**	**48,372**	**49,477**	**50,459**
Total (million cubic feet)	**27,735**	**29,759**	**32,745**	**35,925**	**37,757**	**45,060**	**45,597**	**48,929**	**52,413**	**53,684**	**54,887**

[a] For aircraft, this is aviation gasoline. For all other categories, this is motor gasoline.
[b] Includes equipment, such as cranes, dumpers, and excavators, as well as fuel consumption from trucks that are used off-road in construction.
[c] Includes equipment, such as tractors and combines, as well as fuel consumption from trucks that are used off-road in agriculture.
[d] "Other" includes snowmobiles and other recreational equipment, logging equipment, lawn and garden equipment, railroad equipment, airport equipment, commercial equipment, and industrial equipment, as well as fuel consumption from trucks that are used off-road for commercial/industrial purposes.
Note: Totals not provided for source categories that include gallons and cubic feet. Totals may not sum due to independent rounding.

Table A5.4-16: N_2O Emission Factors for Non-Road Mobile Combustion (g/kg fuel)

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Ships and Boats											
Residual Fuel Oil	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088
Gasoline											
2 Stroke	0.021	0.021	0.021	0.022	0.024	0.026	0.027	0.028	0.028	0.028	0.028
4 Stroke	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
Distillate Fuel Oil	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054
Rail											
Diesel	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
Aircraft											
Jet Fuel	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Aviation Gasoline	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Agricultural Equipment											
Gasoline-Equipment											
2 Stroke	0.103	0.110	0.118	0.150	0.170	0.170	0.170	0.170	0.170	0.169	0.169
4 Stroke	0.355	0.360	0.365	0.389	0.409	0.422	0.431	0.433	0.433	0.431	0.431
Gasoline-Off-road Trucks	0.355	0.360	0.365	0.389	0.409	0.422	0.431	0.433	0.433	0.431	0.431
Diesel-Equipment	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.335	0.335
Diesel-Off-Road Trucks	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.175	0.175
CNG	0.061	0.061	0.061	0.065	0.074	0.076	0.076	0.076	0.076	0.076	0.076
LPG	0.389	0.389	0.389	0.409	0.437	0.451	0.460	0.462	0.462	0.460	0.460
Construction/Mining Equipment											
Gasoline-Equipment											
2 Stroke	0.028	0.029	0.030	0.035	0.042	0.042	0.042	0.042	0.042	0.042	0.042
4 Stroke	0.408	0.430	0.450	0.500	0.516	0.525	0.528	0.528	0.528	0.530	0.530
Gasoline-Off-road Trucks	0.408	0.430	0.450	0.500	0.516	0.525	0.528	0.528	0.528	0.530	0.530
Diesel-Equipment	0.295	0.295	0.295	0.295	0.294	0.295	0.295	0.295	0.295	0.296	0.296
Diesel-Off-Road Trucks	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.174	0.175	0.175
CNG	0.367	0.367	0.367	0.381	0.391	0.409	0.442	0.445	0.445	0.446	0.446
LPG	0.197	0.197	0.197	0.208	0.223	0.235	0.243	0.243	0.243	0.244	0.244
Lawn and Garden Equipment											
Gasoline-Residential											
2 Stroke	0.107	0.113	0.120	0.143	0.171	0.172	0.172	0.172	0.172	0.174	0.174
4 Stroke	0.519	0.545	0.578	0.647	0.684	0.694	0.696	0.696	0.696	0.701	0.701
Gasoline-Commercial											
2 Stroke	0.071	0.075	0.079	0.095	0.110	0.110	0.110	0.110	0.110	0.111	0.111
4 Stroke	0.409	0.444	0.476	0.517	0.530	0.534	0.535	0.535	0.535	0.539	0.539
Diesel-Commercial	0.167	0.159	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.154	0.154
LPG	0.245	0.245	0.245	0.261	0.291	0.304	0.306	0.306	0.306	0.308	0.308
Airport Equipment											
Gasoline 4 Stroke	0.299	0.309	0.316	0.340	0.372	0.382	0.383	0.383	0.383	0.400	0.400
Diesel	0.364	0.364	0.364	0.364	0.364	0.364	0.364	0.364	0.364	0.380	0.380
LPG	0.346	0.346	0.346	0.369	0.414	0.430	0.432	0.432	0.432	0.451	0.451
Industrial/Commercial Equipment											
Gasoline											
2 Stroke	0.107	0.116	0.123	0.171	0.177	0.178	0.178	0.178	0.178	0.182	0.182
4 Stroke	0.425	0.450	0.473	0.515	0.542	0.552	0.551	0.550	0.550	0.563	0.563
Diesel	0.183	0.182	0.180	0.182	0.187	0.190	0.189	0.189	0.189	0.195	0.195
CNG	0.034	0.032	0.031	0.034	0.040	0.044	0.043	0.042	0.042	0.043	0.043
LPG	0.250	0.250	0.250	0.263	0.291	0.308	0.311	0.312	0.312	0.324	0.324
Logging Equipment											
Gasoline											
2 Stroke	-	-	-	-	-	-	-	-	-	-	-
4 Stroke	0.579	0.591	0.604	0.657	0.672	0.719	0.736	0.737	0.737	0.733	0.733
Diesel	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.398	0.395	0.395
Railroad Equipment											
Gasoline 4 Stroke	0.498	0.527	0.555	0.617	0.643	0.649	0.650	0.650	0.650	0.665	0.665
Diesel	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.304	0.304

(continued)

Table A5.4-16: N_2O Emission Factors for Non-Road Mobile Combustion (g/kg fuel) *(continued)*

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
LPG	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Recreational Equipment											
Gasoline											
2 Stroke	0.034	0.034	0.034	0.034	0.035	0.037	0.039	0.039	0.039	0.039	0.039
4 Stroke	0.487	0.496	0.503	0.532	0.534	0.536	0.537	0.531	0.531	0.535	0.535
Diesel	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.208	0.208
LPG	0.255	0.255	0.255	0.259	0.270	0.281	0.293	0.295	0.295	0.297	0.297

Table A5.4-17: CH_4 Emission Factors for Non-Road Mobile Combustion (g/kg fuel)

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Ships and Boats											
Residual Fuel Oil	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309
Gasoline											
2 Stroke	1.255	1.259	1.270	1.355	1.465	1.578	1.652	1.661	1.672	1.672	1.672
4 Stroke	0.717	0.720	0.725	0.742	0.760	0.783	0.805	0.808	0.813	0.813	0.813
Distillate Fuel Oil	2.008	2.008	2.008	2.008	2.008	2.008	2.008	2.008	2.039	2.039	2.039
Rail											
Diesel	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
Aircraft											
Jet Fuel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation Gasoline	2.640	2.640	2.640	2.640	2.640	2.640	2.640	2.640	2.640	2.640	2.640
Agricultural Equipment											
Gasoline-Equipment											
2 Stroke	1.500	1.612	1.720	2.186	2.480	2.480	2.480	2.480	2.471	2.471	2.471
4 Stroke	0.570	0.577	0.586	0.624	0.656	0.677	0.692	0.695	0.692	0.692	0.692
Gasoline-Off-road Trucks	0.570	0.577	0.586	0.624	0.656	0.677	0.692	0.695	0.692	0.692	0.692
Diesel-Equipment	0.397	0.397	0.397	0.397	0.397	0.397	0.397	0.397	0.396	0.396	0.396
Diesel-Off-Road Trucks	0.286	0.286	0.286	0.286	0.286	0.286	0.286	0.286	0.287	0.287	0.287
CNG	1.391	1.391	1.391	1.493	1.676	1.731	1.736	1.736	1.730	1.730	1.730
LPG	0.135	0.135	0.135	0.142	0.152	0.157	0.160	0.160	0.160	0.160	0.160
Construction/Mining Equipment											
Gasoline-Equipment											
2 Stroke	1.868	1.939	1.997	2.341	2.857	2.858	2.858	2.858	2.866	2.866	2.866
4 Stroke	0.789	0.832	0.871	0.967	0.999	1.015	1.022	1.022	1.025	1.025	1.025
Gasoline-Off-road Trucks	0.789	0.832	0.871	0.967	0.999	1.015	1.022	1.022	1.025	1.025	1.025
Diesel-Equipment	0.317	0.317	0.317	0.317	0.316	0.316	0.317	0.317	0.318	0.318	0.318
Diesel-Off-Road Trucks	0.286	0.286	0.286	0.286	0.286	0.286	0.286	0.286	0.287	0.287	0.287
CNG	1.322	1.322	1.322	1.372	1.409	1.473	1.595	1.605	1.609	1.609	1.609
LPG	0.233	0.233	0.233	0.246	0.264	0.278	0.287	0.288	0.289	0.289	0.289
Lawn and Garden Equipment											
Gasoline-Residential											
2 Stroke	1.489	1.567	1.666	1.981	2.361	2.382	2.383	2.384	2.403	2.403	2.403
4 Stroke	0.803	0.842	0.894	1.001	1.058	1.073	1.076	1.076	1.084	1.084	1.084
Gasoline-Commercial											
2 Stroke	1.685	1.778	1.859	2.237	2.609	2.609	2.611	2.611	2.631	2.631	2.631
4 Stroke	0.821	0.891	0.956	1.037	1.064	1.072	1.073	1.074	1.082	1.082	1.082
Diesel-Commercial	0.236	0.220	0.208	0.208	0.208	0.208	0.208	0.208	0.209	0.209	0.209
LPG	0.137	0.137	0.137	0.146	0.164	0.171	0.171	0.171	0.179	0.179	0.179
Airport Equipment											
Gasoline 4 Stroke	0.287	0.296	0.303	0.325	0.356	0.366	0.367	0.367	0.383	0.383	0.383
Diesel	0.593	0.593	0.593	0.593	0.593	0.593	0.593	0.593	0.619	0.619	0.619
LPG	0.137	0.137	0.137	0.146	0.164	0.171	0.171	0.171	0.179	0.179	0.179
Industrial/Commercial Equipment											
Gasoline											
2 Stroke	1.541	1.670	1.774	2.450	2.545	2.552	2.554	2.555	2.617	2.617	2.617
4 Stroke	0.758	0.798	0.837	0.912	0.965	0.987	0.984	0.983	1.006	1.006	1.006

(continued)

Table A5.4-17: CH_4 Emission Factors for Non-Road Mobile Combustion (g/kg fuel) *(continued)*

Vehicle / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Diesel	0.120	0.112	0.106	0.113	0.127	0.141	0.133	0.132	0.135	0.135	0.135
CNG	2.334	2.385	2.420	2.676	2.824	2.854	2.897	2.904	2.986	2.986	2.986
LPG	0.174	0.174	0.174	0.183	0.203	0.214	0.216	0.216	0.225	0.225	0.225
Logging Equipment											
Gasoline											
2 Stroke	2.289	2.364	2.423	2.799	3.468	3.468	3.468	3.468	3.446	3.446	3.446
4 Stroke	0.914	0.931	0.950	1.034	1.072	1.137	1.159	1.161	1.153	1.153	1.153
Diesel	0.153	0.153	0.153	0.153	0.154	0.153	0.153	0.153	0.152	0.152	0.152
Railroad Equipment											
Gasoline 4 Stroke	0.897	0.945	0.990	1.102	1.147	1.158	1.160	1.160	1.187	1.187	1.187
Diesel	0.125	0.125	0.125	0.125	0.126	0.125	0.125	0.125	0.128	0.128	0.128
LPG	0.784	0.786	0.787	0.812	0.870	0.936	0.970	0.973	0.995	0.995	0.995
Recreational Equipment											
Gasoline											
2 Stroke	5.170	5.214	5.252	5.326	5.553	5.944	6.310	3.510	3.534	3.534	3.534
4 Stroke	0.935	0.951	0.965	1.022	1.026	1.030	1.032	0.975	0.982	0.982	0.982
Diesel	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.230	0.230	0.230
LPG	0.182	0.182	0.182	0.185	0.193	0.201	0.209	0.211	0.213	0.213	0.213

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990-2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.5 Supplemental Information on Greenhouse Gas Emissions from Transportation and Other Mobile Sources, by Mode/Vehicle Type/Fuel Type

This Annex provides supplemental information on the contribution by greenhouse gas, mode, vehicle type, and fuel type of transportation and other (non-transportation) mobile sources on U.S. greenhouse gas emissions.

As discussed previously, other non-transportation mobile sources include construction/mining equipment, agricultural equipment, vehicles used off-road, and other sources that have utility associated with their movement but do not have a primary purpose of transporting people or goods (e.g., snowmobiles, riding lawnmowers, etc.). Estimates of CO_2 from these other non-transportation mobile sources are based on EIA fuel consumption estimates and are included as part of fossil fuel combustion emissions in the industrial and commercial sectors as shown in Chapter 3 (Energy), Section 3.1. The EIA data does not specifically break out fuel use estimates for these other non-transportation mobile sources and it is rather just included as part of total sector fuel use.

In order to provide additional information on transportation and other non-transportation mobile sources, estimates of CO_2 from these other non-transportation mobile sources are developed in this Annex using the same fuel consumption data utilized in developing the N_2O and CH_4 estimates for these sources. Note that this estimate of fuel consumption volumes for these other non-transportation mobile sources could differ from the EIA estimated fuel consumption volumes used for CO_2 estimates in the industrial and commercial sectors reported in Chapter 3 (Energy), Section 3.1 and is estimated in this Annex as supplemental informational data for comparative reasons only. CO_2 emissions from these other non-transportation mobile sources are provided in Table A5.5-1.

Table A5.5-1: CO_2 Emissions from Other Non-Transportation Mobile Sources (MMT CO_2 Eq.)

Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Agricultural Equipment	43.4	43.1	39.9	50.8	46.6	41.1	39.1	39.8	39.3	39.1	39.7
Construction/Mining Equipment	48.9	52.7	57.4	76.2	65.3	57.0	65.1	69.5	72.7	74.0	74.0
Other Sources	69.6	72.2	76.3	89.9	86.6	87.4	88.0	93.4	100.2	101.6	102.7
Total	**161.9**	**168.0**	**173.6**	**216.9**	**198.4**	**185.6**	**192.2**	**202.8**	**212.2**	**214.7**	**216.4**

Transportation sources also result in emissions of HFCs from the following three categories (as shown in Table A5.5-2): mobile air-conditioning units in passenger cars, light-duty trucks, and heavy-duty vehicles; comfort cooling from air conditioning units in passenger trains and buses; and refrigerated transport from units used to cool freight during transportation.

Table A5.5-2: HFC Emissions from Transportation Sources (MMT CO_2 Eq.)

HFC Category/Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Mobile AC	**0.0**	**17.7**	**50.2**	**61.3**	**58.8**	**36.8**	**24.2**	**22.4**	**20.4**	**18.4**	**16.2**
Passenger Cars	0.0	10.2	25.5	28.8	25.0	13.3	7.6	7.0	6.6	5.7	5.1
Light-Duty Trucks	0.0	7.1	23.3	30.2	31.0	20.9	14.2	13.0	11.4	10.4	8.9
Heavy-Duty Vehicles	0.0	0.4	1.5	2.2	2.8	2.6	2.4	2.4	2.4	2.3	2.2
Comfort Cooling for Trains and Buses	**0.0**	**+**	**0.1**	**0.3**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.5**	**0.5**
School and Tour Buses	0.0	+	0.1	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.4
Transit Buses	0.0	+	+	+	+	+	0.1	0.1	0.1	0.1	0.1
Rail	0.0	0.0	0.0	+	+	+	+	+	+	+	+
Refrigerated Transport	**0.0**	**0.2**	**0.8**	**1.6**	**2.9**	**5.4**	**7.9**	**8.4**	**8.8**	**9.0**	**9.3**
Medium- and Heavy-Duty Trucks	0.0	0.1	0.4	1.0	1.6	2.6	3.6	3.8	3.9	3.9	3.8
Rail	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ships and Boats	0.0	+	0.3	0.5	1.2	2.6	4.2	4.5	4.8	5.1	5.4
Total	**0.0**	**17.8**	**51.1**	**63.1**	**62.1**	**42.6**	**32.5**	**31.2**	**29.6**	**27.9**	**26.0**

+ Does not exceed 0.05 MMT CO_2 Eq.
Note: Totals may not sum due to independent rounding.

Estimates of greenhouse gas emissions from an expanded analysis including all transportation sector and other non-transportation mobile sources is shown in Table A5.5-3. These estimates include CO_2 emissions from transportation sources and CH_4 and N_2O emissions from transportation and other non-transportation mobile sources as reported in Section 3.1. The estimates also include information on CO_2 emitted from other non-transportation mobile sources and HFC emissions as shown in Table A5.5-1 and Table A5.5-2 above. Some additional analysis was performed to provide a detailed breakdown of emissions by mode, vehicle category and fuel type as outlined in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025). The results are also shown in Figure A5.5-1.

Figure A5.5-1: Total U.S. Greenhouse Gas Emissions from Transportation and Mobile Sources (MMT CO_2 Eq.)

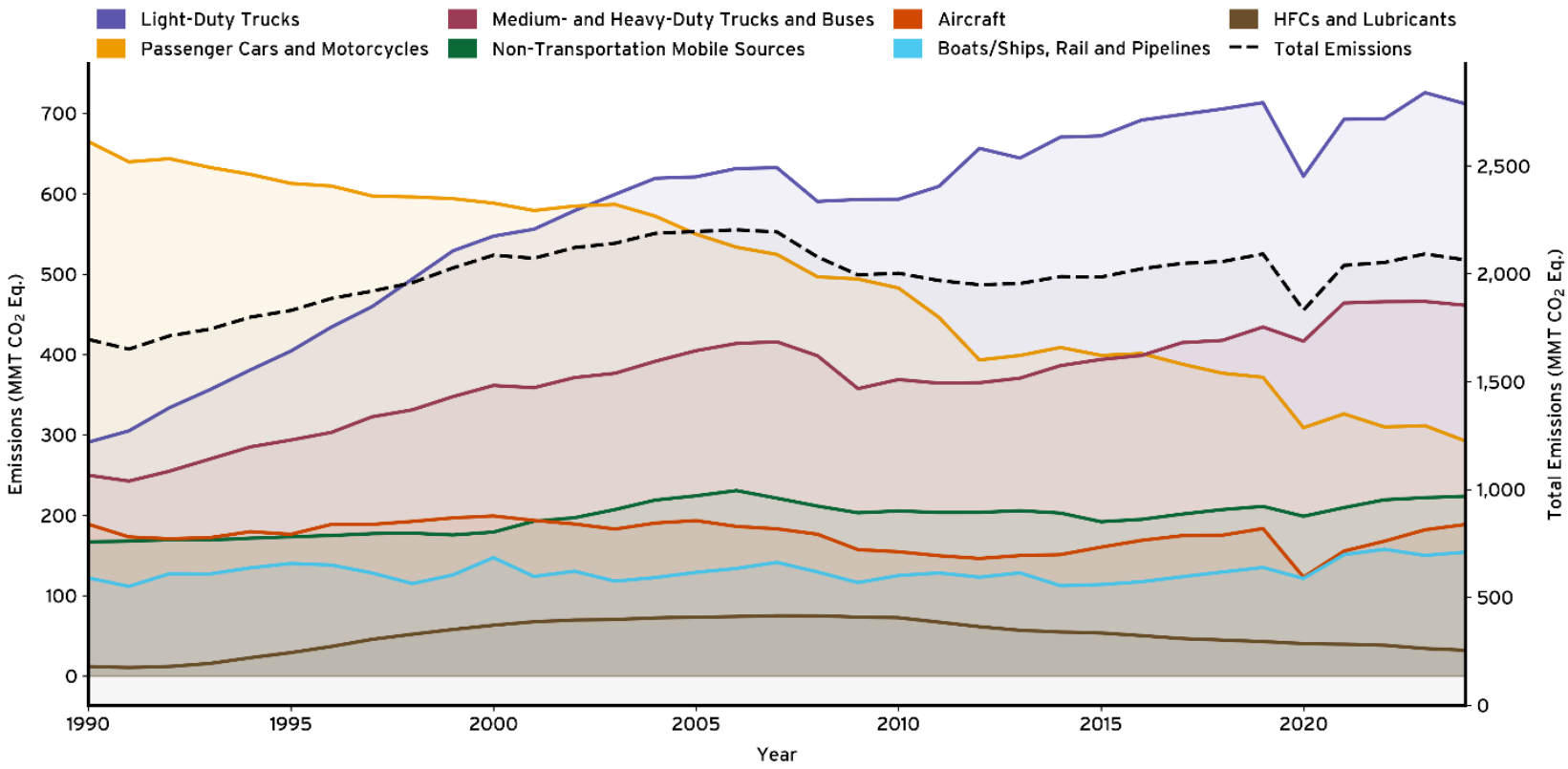


Table A5.5-4 presents total estimates of greenhouse gas emissions from transportation and other non-transportation mobile sources broken out by greenhouse gas.

Table A5.5-3: Total U.S. Greenhouse Gas Emissions from Transportation and Mobile Sources (MMT CO_2 Eq.)

Mode / Vehicle Type / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	% of total	Change 90-24
Transportation Total	**1,528.1**	**1,656.1**	**1,906.4**	**1,970.8**	**1,796.6**	**1,792.1**	**1,631.9**	**1,828.6**	**1,832.5**	**1,869.3**	**1,839.9**	**89.2%**	**20%**
On-Road Vehicles	**1,205.4**	**1,328.4**	**1,547.6**	**1,637.8**	**1,505.3**	**1,504.4**	**1,375.4**	**1,509.3**	**1,493.4**	**1,525.7**	**1,485.8**	**72.0%**	**23%**
Passenger Cars	**661.5**	**619.1**	**609.6**	**573.8**	**501.4**	**405.7**	**310.3**	**326.1**	**308.1**	**308.3**	**288.6**	**14.0%**	**-56%**
Gasoline	651.6	600.7	578.3	540.9	473.8	389.0	299.8	316.0	298.3	299.2	279.7	13.6%	-57%
Diesel	9.9	8.2	5.8	4.1	2.6	3.0	2.0	2.1	2.0	1.9	1.7	0.1%	-83%
AFVs	+	+	+	+	+	+	+	+	+	+	+	0.0%	-42%
Electricity	0.0	0.0	0.0	0.0	+	0.4	0.9	1.0	1.2	1.5	2.1	0.1%	NA
HFCs from Mobile AC	0.0	10.2	25.5	28.8	25.0	13.3	7.6	7.0	6.6	5.7	5.1	0.2%	NA
Light-Duty Trucks	**290.9**	**411.3**	**570.5**	**651.2**	**624.1**	**692.8**	**636.0**	**705.5**	**704.6**	**736.1**	**720.7**	**34.9%**	**148%**
Gasoline	282.6	391.4	527.4	590.6	565.4	639.6	594.8	663.0	662.9	695.3	681.3	33.0%	141%
Diesel	8.2	12.7	19.7	30.1	27.7	32.2	26.8	29.0	29.4	29.1	28.3	1.4%	245%
AFVs	0.1	0.1	0.1	0.2	+	+	+	0.1	0.1	0.1	0.1	0.0%	-40%
Electricity	0.0	0.0	0.0	0.0	+	+	0.2	0.4	0.8	1.2	2.1	0.1%	NA
HFCs from Mobile AC	0.0	7.1	23.3	30.2	31.0	20.9	14.2	13.0	11.4	10.4	8.9	0.4%	NA
Medium- and Heavy-Duty Trucks	**236.6**	**278.9**	**344.2**	**390.2**	**356.9**	**377.6**	**402.6**	**447.7**	**447.1**	**447.0**	**442.2**	**21.4%**	**87%**
Gasoline	43.2	40.0	36.4	30.0	24.4	24.8	29.7	34.9	36.0	36.9	36.1	1.8%	-16%
Diesel	192.1	237.3	305.4	356.0	328.0	347.1	366.3	405.9	404.2	403.2	399.3	19.3%	108%
AFVs	1.3	1.0	0.5	0.9	0.2	0.5	0.6	0.6	0.7	0.7	0.7	0.0%	-46%
HFCs from Refrigerated Transport & Mobile AC	0.0	0.5	1.9	3.2	4.4	5.2	6.1	6.3	6.3	6.1	6.0	0.3%	NA
Buses	**13.1**	**15.3**	**19.3**	**17.9**	**16.6**	**21.8**	**20.3**	**23.0**	**25.3**	**25.5**	**25.5**	**1.2%**	**94%**
Gasoline	5.3	4.4	3.4	1.8	1.5	2.4	3.1	3.6	3.9	4.2	4.3	0.2%	-20%
Diesel	7.8	10.9	15.3	14.9	14.3	18.2	16.5	18.7	20.5	20.4	20.3	1.0%	160%
AFVs	+	+	0.4	1.0	0.4	0.7	0.3	0.3	0.4	0.4	0.4	0.0%	5065%
Electricity	0.0	0.0	0.0	0.0	+	+	+	0.1	0.1	0.1	0.1	0.0%	NA
HFCs from Comfort Cooling	0.0	+	0.1	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0%	NA
Motorcycles	**3.3**	**3.9**	**4.1**	**4.8**	**6.2**	**6.5**	**6.2**	**7.0**	**8.3**	**8.8**	**8.8**	**0.4%**	**163%**
Gasoline	3.3	3.9	4.1	4.8	6.2	6.5	6.2	7.0	8.3	8.8	8.8	0.4%	163%
Aircraft	**188.8**	**176.4**	**199.1**	**193.3**	**154.6**	**160.3**	**123.0**	**155.4**	**167.8**	**181.9**	**188.5**	**9.1%**	**0%**
General Aviation Aircraft	**42.0**	**35.1**	**35.3**	**39.6**	**26.3**	**26.5**	**19.2**	**22.8**	**24.5**	**39.5**	**47.2**	**2.3%**	**12%**
Jet Fuel	38.8	32.3	32.7	37.1	24.4	25.0	17.8	21.3	22.9	38.0	45.6	2.2%	17%
Aviation Gasoline	3.2	2.8	2.6	2.5	1.9	1.5	1.4	1.5	1.6	1.5	1.6	0.1%	-49%
Commercial Aircraft	**110.8**	**116.2**	**140.5**	**133.8**	**114.2**	**120.0**	**92.0**	**120.0**	**130.8**	**130.8**	**130.8**	**6.3%**	**18%**
Jet Fuel	110.8	116.2	140.5	133.8	114.2	120.0	92.0	120.0	130.8	130.8	130.8	6.3%	18%
Military Aircraft	**36.0**	**25.0**	**23.3**	**19.9**	**14.0**	**13.9**	**11.8**	**12.6**	**12.5**	**11.6**	**10.6**	**0.5%**	**-71%**
Jet Fuel	36.0	25.0	23.3	19.9	14.0	13.9	11.8	12.6	12.5	11.6	10.6	0.5%	-71%
Ships and Boats	**47.0**	**58.7**	**65.8**	**45.4**	**44.8**	**33.7**	**32.2**	**53.7**	**53.4**	**47.0**	**48.4**	**2.3%**	**3%**
Gasoline	14.5	14.3	14.5	13.8	11.8	10.7	10.0	10.8	10.9	11.0	11.0	0.5%	-24%
Distillate Fuel	9.7	15.0	17.4	11.6	11.2	16.1	10.6	14.0	14.5	14.2	13.8	0.7%	42%

(continued)

Table A5.5-3: Total U.S. Greenhouse Gas Emissions from Transportation and Mobile Sources (MMT CO_2 Eq.) *(continued)*

Mode / Vehicle Type / Fuel Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	% of total	Change 90-24
Residual Fuel	22.8	29.4	33.6	19.5	20.7	4.3	7.4	24.5	23.1	16.8	18.2	0.9%	-20%
HFCs from Refrigerated Transport	0.0	+	0.3	0.5	1.2	2.6	4.2	4.5	4.8	5.1	5.4	0.3%	NA
Rail	**39.0**	**43.0**	**46.4**	**51.4**	**43.6**	**43.7**	**35.0**	**37.0**	**37.3**	**36.8**	**37.8**	**1.8%**	**-3%**
Distillate Fuel	35.9	39.8	42.8	46.4	38.9	39.8	32.3	34.3	34.6	34.2	35.2	1.7%	-2%
Electricity	3.2	3.2	3.5	4.8	4.6	3.8	2.5	2.5	2.6	2.5	2.5	0.1%	-21%
HFCs from Comfort Cooling & Refrigerated Transport	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0%	NA
Pipelines	**36.0**	**38.4**	**35.5**	**32.8**	**37.9**	**39.1**	**58.5**	**64.9**	**72.0**	**71.5**	**73.3**	**3.6%**	**104%**
Natural Gas	36.0	38.4	35.5	32.8	37.9	39.1	58.5	64.9	72.0	71.5	73.3	3.6%	104%
Other Transportation	**11.8**	**11.3**	**12.1**	**10.2**	**10.4**	**11.0**	**7.8**	**8.3**	**8.7**	**6.4**	**6.1**	**0.3%**	**-49%**
Lubricants	11.8	11.3	12.1	10.2	10.4	11.0	7.8	8.3	8.7	6.4	6.1	0.3%	-49%
Non-Transportation Mobile Total	166.9	173.3	179.1	224.2	205.3	192.0	198.7	209.5	219.2	221.9	223.6	10.8%	34%
Agricultural Equipment	**44.7**	**44.5**	**41.1**	**52.5**	**48.1**	**42.4**	**40.3**	**41.0**	**40.5**	**40.3**	**40.9**	**2.0%**	**-9%**
Gasoline	7.5	8.4	6.0	9.8	6.2	1.4	1.2	1.3	1.3	1.2	1.8	0.1%	-77%
Diesel	37.2	36.0	35.0	42.5	41.8	40.9	39.0	39.6	39.1	39.1	39.1	1.9%	5%
CNG	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0%	-15%
LPG	+	+	+	+	+	+	+	+	+	+	+	0.0%	-12%
Construction/Mining Equipment	**50.2**	**54.1**	**58.9**	**78.3**	**67.1**	**58.6**	**66.9**	**71.4**	**74.6**	**76.0**	**76.0**	**3.7%**	**51%**
Gasoline	4.4	4.0	3.3	6.9	6.1	3.3	3.5	3.3	2.6	3.5	3.2	0.2%	-28%
Diesel	45.4	49.6	55.1	70.8	60.5	54.8	62.9	67.6	71.5	72.0	72.3	3.5%	59%
CNG	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.0%	30%
LPG	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.0%	27%
Other Equipment	**71.9**	**74.7**	**79.1**	**93.4**	**90.1**	**90.9**	**91.6**	**97.0**	**104.1**	**105.5**	**106.6**	**5.2%**	**48%**
Gasoline	40.5	41.1	43.2	52.8	50.0	45.6	45.3	47.2	49.4	49.1	48.5	2.4%	20%
Diesel	21.9	21.6	21.6	25.3	25.7	29.6	29.8	32.1	35.0	36.0	37.0	1.8%	69%
CNG	1.2	1.3	1.4	1.5	1.7	2.2	2.2	2.3	2.5	2.6	2.7	0.1%	128%
LPG	8.3	10.7	12.9	13.9	12.8	13.5	14.3	15.4	17.1	17.8	18.4	0.9%	122%
Transportation and Non-Transportation Mobile Total	**1,695.0**	**1,829.4**	**2,085.5**	**2,195.0**	**2,001.9**	**1,984.1**	**1,830.7**	**2,038.0**	**2,051.7**	**2,091.2**	**2,063.6**	**100%**	**22%**

+ Does not exceed 0.05 MMT CO_2 Eq.

NA (Not Applicable) there were no HFC emissions or electricity use for on road vehicles allocated to the transport sector in 1990, therefore, a growth rate cannot be calculated.

Notes: The method used to estimate CO_2 emissions from non-transportation mobile sources in this supplementary information table differs from the method used to estimate CO_2 in the industrial and commercial sectors in Section 3.1, which include CO_2 emissions from all non-transportation mobile sources. Emissions from international bunker fuels are not included in this supplemental table. Emissions from electricity use include combustion emissions and other emissions from electricity production including from waste incineration, electrical transmission and distribution, and a portion of other process uses of carbonates (from pollution control equipment installed in electricity generation plants). Totals may not sum due to independent rounding.

Table A5.5-4: Transportation and Mobile Source Emissions by Gas (MMT CO_2 Eq.)

Year	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	Change 1990-2024
CO_2	1,649.9	1,757.3	1,977.7	2,084.6	1,904.7	1,915.3	1,779.3	1,987.0	2,002.4	2,044.0	2,017.6	22%
N_2O	37.8	47.2	49.9	42.0	31.2	22.9	16.2	17.1	16.9	16.6	17.1	-55%
CH_4	7.2	7.0	6.7	5.2	3.9	3.2	2.6	2.7	2.7	2.7	2.7	-62%
HFC	0.0	17.8	51.1	63.1	62.1	42.6	32.5	31.2	29.6	27.9	26.0	NA
Total	**1,694.9**	**1,829.3**	**2,085.4**	**2,195.0**	**2,001.9**	**1,984.0**	**1,830.6**	**2,038.0**	**2,051.7**	**2,091.1**	**2,063.5**	**22%**

NA (Not Applicable) there were no HFC emissions allocated to the transport sector in 1990, therefore a growth rate cannot be calculated.
Notes: The method used to estimate CO_2 emissions from non-transportation mobile sources in this supplementary information table differs from the method used to estimate CO_2 in the industrial and commercial sectors in Section 3.1, which include CO_2 emissions from all non-transportation mobile sources. Emissions from international bunker fuels are not included in this supplemental table. Other emissions from electricity production are not included in this table. Totals may not sum due to independent rounding.

Another way to present greenhouse gas emissions from the transportation sector is by passenger and freight categories. Passenger modes include light-duty vehicles, buses, passenger rail, aircraft (general aviation and commercial aircraft), recreational boats, and mobile air conditioners, and are shown in Table A5.5-5. Freight modes include medium- and heavy-duty trucks, freight rail, refrigerated transport, waterborne freight vessels, pipelines, and commercial aircraft and are shown in Table A5.5-6.

Commercial aircraft do carry some freight, in addition to passengers, and emissions have been split between passenger and freight transportation. In addition, rail emissions also need to be split between passenger and freight categories. See EPA 2025 for more details.

The remaining transportation and other non-transportation mobile emissions were from sources not considered to be either freight or passenger modes (e.g., construction/mining and agricultural equipment, lubricants).

Table A5.5-5: Greenhouse Gas Emissions from Domestic Passenger Transportation (MMT CO_2 Eq.)

Vehicle Type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	Change 90-24
On-Road Vehicles	**968.8**	**1,049.5**	**1,203.5**	**1,247.7**	**1,148.4**	**1,126.4**	**971.6**	**1,060.1**	**1,044.2**	**1,075.9**	**1,039.3**	**7%**
Passenger Cars	661.5	619.1	609.6	573.8	501.4	405.3	309.4	325.1	306.9	306.8	286.6	-57%
Light-Duty Trucks	290.9	411.3	570.5	651.2	624.1	692.8	635.8	705.1	703.8	734.9	718.6	147%
Buses	13.1	15.3	19.3	17.9	16.6	21.8	20.3	22.9	25.2	25.4	25.4	94%
Motorcycles	3.3	3.9	4.1	4.8	6.2	6.5	6.2	7.0	8.3	8.8	8.8	163%
Aircraft	**133.6**	**131.2**	**151.5**	**152.0**	**124.3**	**130.0**	**83.4**	**118.6**	**134.0**	**152.1**	**159.0**	**19%**
General Aviation	42.0	35.1	35.3	39.6	26.3	26.5	19.2	22.8	24.5	39.5	47.2	12%
Commercial Aircraft	91.6	96.1	116.1	112.4	97.9	103.5	64.2	95.8	109.5	112.6	111.8	22%
Recreational Boats	**17.2**	**17.0**	**17.3**	**16.7**	**14.5**	**13.3**	**12.7**	**13.7**	**14.0**	**14.1**	**14.3**	**-17%**
Passenger Rail	**4.5**	**4.5**	**5.2**	**6.3**	**6.2**	**5.4**	**4.2**	**4.1**	**4.1**	**4.1**	**4.1**	**-8%**
Total	**1,124.1**	**1,202.3**	**1,377.4**	**1,422.7**	**1,293.3**	**1,275.0**	**1,072.0**	**1,196.5**	**1,196.3**	**1,246.2**	**1,216.7**	**8%**

Note: Totals may not sum due to independent rounding.

Table A5.5-6: Greenhouse Gas Emissions from Domestic Freight Transportation (MMT CO_2 Eq.)

By Mode	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	Change 90-24
Trucking	236.6	278.4	342.7	388.0	354.1	375.0	400.2	445.3	444.8	444.7	440.0	86%
Freight Rail	34.5	38.4	41.2	45.0	37.4	38.3	30.7	32.9	33.2	32.7	33.7	-2%
Ships and Non-Recreational Boats	29.8	41.7	48.5	28.7	30.4	20.4	19.6	40.0	39.3	32.9	34.2	15%
Pipelines	36.0	38.4	35.5	32.8	37.9	39.1	58.5	64.9	72.0	71.5	73.3	104%
Commercial Aircraft	19.2	20.1	24.3	21.4	16.3	16.5	27.8	24.2	21.2	18.2	19.0	-1%
Total	**356.1**	**417.1**	**492.2**	**515.8**	**476.1**	**489.3**	**536.7**	**607.3**	**610.5**	**600.0**	**600.1**	**69%**

Note: Totals may not sum due to independent rounding.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.6 Methodology for Estimating GHG Emissions from Commercial Aircraft Jet Fuel Consumption

Information on the methodology used to estimate GHG emissions from commercial aircraft can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from commercial aircraft will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.7 Methodology for Estimating GHG Emissions from Coal Mining

Information on the methodology used to estimate GHG emissions from coal mining can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from coal mining will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.8 Methodology for Estimating GHG Emissions from Petroleum Systems

Information on the methodology used to estimate CH_4, CO_2, and N_2O emissions from petroleum systems can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from petroleum systems will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.9 Methodology for Estimating GHG Emissions from Natural Gas Systems

Information on the methodology used to estimate CH_4, CO_2, and N_2O emissions from natural gas systems can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from natural gas systems will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.10 Methodology for Estimating GHG Emissions from the Incineration of Waste

Information on the methodology used to estimate CO_2, CH_4, and N_2O emissions from waste incineration can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from waste incineration will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.11 Methodology for Estimating Emissions from International Bunker Fuels used by the U.S. Military

Information on the methodology used to estimate emissions from military bunker fuels can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from military bunker fuels will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.12 Methodology for Estimating Emissions from Other Fluorochemical Production

Information on the methodology used to estimate emissions from fluorochemical production can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from fluorochemical production will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.13 Methodology and QA/QC and Verification Details for Estimating GHG Emissions from Substitution of Ozone Depleting Substances

Information on the methodology used to estimate, QA/QC and verify HFC, PFC, and CO_2 emissions from substitution of ozone depleting substances in previous EPA inventory report can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate emissions from substitution of ozone depleting substances will be updated and included, if applicable, in the Annex to the GHGIA 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.14 Methodology for Estimating GHG Emissions from Enteric Fermentation

Livestock enteric fermentation CH_4 emissions are estimated using a Tier 2 approach for cattle and a Tier 1 approach for non-cattle livestock types as discussed in Chapter 5 (Agriculture) of the GHGIA 2026 report.

Cattle Enteric Fermentation CH_4 Emission Estimates

For the 1990-2023 years of the time series, cattle enteric fermentation estimates are consistent with those presented in EPA (2025). In the 1990 through 2023 GHG inventory prepared by EPA (2025), 1990-2022 emissions were calculated using input data on cattle populations from the USDA Census of Agriculture and annual survey data and then leveraging the Cattle Enteric Fermentation Model (CEFM) (ICF 2006) to estimate state-level and national CH_4 emissions from enteric fermentation. The CEFM model uses population transition matrices coupled with diet data and energy expenditure data specific to cattle geographic locations, cattle subcategories and age class, and management systems, to model sub-annual population changes as cattle grow and are transitioned to new management systems within dairy and beef production systems. The CEFM is developed to implement Tier 2 methodology presented in the IPCC Guidelines (IPCC 2006) using country-specific data in line with reporting requirements and good practice guidance. See Annex 3.11 of EPA (2025) for information regarding the CEFM and activity data used to parameterize the model.

In EPA (2025), cattle enteric fermentation emissions for 2023 were estimated using a "Simplified Approach" where national cattle population data from USDA annual surveys coupled with national-scale implied emission factors for 2022 calculated using CEFM outputs. This same "Simplified Approach" was applied to estimate 2024 cattle enteric fermentation estimates presented in the *GHGIA* report (Desai et al., 2026). Population estimates for dairy cows, bulls, and beef cows are taken directly from the USDA NASS Annual Survey for 2024 and, for all other cattle types, national population estimates were taken from the first of January annual survey results for 2022 and 2024 (USDA, 2022a, 2022b, 2024a, 2024b, 2024c), and the percent change in population numbers from 2022 to 2024 was calculated. These percent changes were then applied to national-level population estimates for each cattle subcategory derived from CEFM output for 2022 to extrapolate 2024 populations based on national-level changes in populations reflected in annual surveys over this two-year period. See Chapter 5 (Agriculture) of the 2026 GHGIA report for additional details on the crosswalk between CEFM cattle livestock types and USDA QuickStats livestock categories (Table 5-4).

For consistency, state-level cattle populations for 2024 (Table A5.14-1) as well as national cattle populations by animal type for the 1990 through 2024 time series (Table A5.14-2) are provided below; state-level population estimates were disaggregated from national populations by multiplying each state's proportional share of the national population for each cattle

subcategory in 2022 by the national population estimate for 2024. This approach assumes that states' relative contributions to overall national-level populations remained stable from

2022 to 2024 but ensures that state-level population estimates sum to the national total used in the 2026 GHGIA report. Future inventory reports will present recalculated national- and state-level cattle enteric fermentation estimates using the full-complexity estimation framework described in Annex 3.11 of EPA (2025). Table 5.14-3 provides the national-level implied emission factors derived from CEFM output from 1990 to 2024 consistent with EPA (2025), where the emission factor for the most recent year (2022) was used to estimate cattle enteric fermentation CH_4 emissions for 2023 and 2024. See Table A-142 in Annex 3.11 of EPA (2025) for estimated state-level implied emission factors for enteric fermentation emissions by animal type for 2022.

Table A5.14-1: 2024 Cattle Population Estimates, by Animal Type and State (1,000 head)

State	Dairy Calves	Dairy Cows	Dairy Repl. Heif. 7-11 Months	Dairy Repl. Heif. 12-23 Month	Bulls	Beef Calves	Beef Cows	Beef Repl. Heif. 7-11 Months	Beef Repl. Heif. 12-23 Months	Steer Stockers	Heifer Stockers	Feedlot
AK	0	0	0	0	4	4	7	0	1	0	0	0
AL	1	3	1	1	41	330	628	22	54	21	22	7
AR	2	5	1	2	53	444	846	27	67	51	31	14
AZ	97	193	33	79	19	84	160	5	12	127	11	282
CA	859	1714	206	497	58	334	635	23	57	281	98	575
CO	101	201	31	75	43	313	596	27	67	352	258	1196
CT	9	18	3	6	0	2	4	0	1	0	1	0
DE	1	3	0	1	0	1	2	0	0	1	0	0
FL	52	105	8	20	53	439	836	25	62	11	11	4
GA	41	83	7	16	29	239	455	20	50	18	11	5
HI	0	1	0	1	4	39	74	2	5	4	2	1
IA	112	224	33	79	58	444	846	32	80	567	258	1211
ID	326	650	95	229	39	244	465	19	47	141	98	327
IL	40	81	11	27	17	166	317	11	27	86	39	222
IN	93	185	16	39	15	90	172	7	17	42	20	111
KS	84	168	43	105	82	697	1328	54	135	897	747	2714
KY	22	44	10	23	58	474	903	25	62	97	48	19
LA	4	9	1	2	29	221	421	16	40	10	8	3
MA	5	9	1	4	1	4	7	1	1	1	0	0
MD	20	41	7	17	3	21	39	2	4	5	3	8
ME	13	26	4	9	1	5	9	1	2	2	1	1

(continued)

Table A5.14-1: 2024 Cattle Population Estimates, by Animal Type and State (1,000 head) *(continued)*

State	Dairy Calves	Dairy Cows	Dairy Repl. Heif. 7-11 Months	Dairy Repl. Heif. 12-23 Month	Bulls	Beef Calves	Beef Cows	Beef Repl. Heif. 7-11 Months	Beef Repl. Heif. 12-23 Months	Steer Stockers	Heifer Stockers	Feedlot
MI	217	433	41	99	14	47	90	5	11	76	20	170
MN	230	459	57	137	29	177	336	17	42	215	63	398
MO	34	69	8	20	106	952	1813	61	150	185	100	88
MS	3	7	1	3	38	234	447	18	45	23	17	7
MT	5	11	1	3	91	637	1214	65	160	92	81	47
NC	19	39	4	9	30	177	337	13	31	18	11	5
ND	7	15	2	5	58	459	874	37	91	136	100	43
NE	29	58	8	20	106	884	1684	71	175	1121	690	2892
NH	5	10	2	4	0	2	4	0	1	1	0	0
NJ	2	4	1	2	1	4	7	0	1	1	1	0
NM	146	291	34	82	24	222	423	14	35	44	31	13
NV	15	31	2	6	13	120	228	8	19	15	12	3
NY	310	618	90	216	19	49	93	8	20	20	17	23
OH	124	247	33	79	29	153	291	13	32	97	26	155
OK	19	39	5	13	164	1040	1982	81	199	444	236	331
OR	62	125	15	36	39	248	472	20	50	75	52	129
PA	235	468	53	128	19	93	178	10	25	62	21	72
RI	0	0	0	0	0	1	1	0	0	0	0	0
SC	4	9	1	3	12	78	148	6	14	5	4	2
SD	85	169	11	26	101	785	1495	75	184	330	216	464
TN	13	27	5	13	58	438	834	24	60	59	37	17
TX	312	623	65	157	318	2171	4134	143	354	1156	738	3025
UT	47	95	15	36	22	162	308	14	35	40	26	22
VA	35	71	10	23	37	294	560	18	44	65	30	17
VT	60	120	14	34	3	7	14	1	2	2	3	1
WA	130	260	35	85	17	110	209	11	27	84	57	232
WI	637	1271	179	432	29	145	276	17	42	176	37	275
WV	2	5	1	1	13	92	176	6	15	17	10	4
WY	4	9	1	3	34	334	636	29	72	70	59	72

Table A5.14-2: Cattle Population Estimates from the CEFM Transition Matrix for 1990 – 2024 (1,000 head)

Livestock Type	1990	1995	2000	2005	2010	2020	2021	2022	2023[a]	2024[a]
Dairy										
Dairy Calves (0–6 months)	5,369	5,091	4,951	4,628	4,666	4,813	4,876	4,855	4,744	4,685
Dairy Cows	10,015	9,482	9,183	9,004	9,087	9,343	9,442	9,377	9,398	9,347
Dairy Replacements 7–11 months	1,214	1,216	1,196	1,257	1,351	1,365	1,326	1,289	1,244	1,206
Dairy Replacements 12–23 months	2,915	2,892	2,812	2,905	3,194	3,272	3,216	3,105	2,995	2,905
Beef										
Beef Calves (0–6 months)	16,909	18,177	17,431	16,918	16,067	15,830	15,602	15,244	14,893	14,707
Bulls	2,160	2,385	2,293	2,214	2,190	2,237	2,211	2,110	2,029	2,031
Beef Cows	32,455	35,190	33,575	32,674	31,440	31,339	30,844	29,983	28,939	28,013
Beef Replacements 7–11 months	1,269	1,493	1,313	1,363	1,238	1,367	1,321	1,242	1,155	1,106
Beef Replacements 12–23 months	2,967	3,637	3,097	3,171	3,050	3,253	3,255	3,070	2,856	2,733
Steer Stockers	10,321	11,716	8,724	8,185	8,234	7,614	7,686	7,682	7,387	7,343
Heifer Stockers	5,946	6,699	5,371	5,015	5,061	4,472	4,629	4,584	4,413	4,365
Feedlot Cattle	9,549	11,064	13,006	12,652	13,204	14,949	15,554	15,474	14,966	15,209

[a] Population estimates for 2023 and 2024 are based on a simplified calculation approach as explained in the Enteric Fermentation section of Chapter 5 (Agriculture) of the GHGIA. Population estimates from 1990-2022 are derived from CEFM output as described in EPA (2025).

Table A5.14-3: Calculated Annual National Enteric Fermentation Emission Factors for Cattle by Animal Type (kg CH_4/head/year)

Cattle Type	1990	1995	2000	2005	2010	2018	2019	2020	2021	2022
Dairy										
Calves	12	12	12	12	12	12	12	12	12	12
Cows	121	122	129	130	138	147	148	150	151	151
Replacements 7–11 months	48	46	46	45	46	46	45	45	45	45
Replacements 12–23 months	73	69	70	67	69	69	69	69	69	68
Beef										
Calves	11	11	11	11	11	11	11	11	11	11
Bulls	91	94	94	97	98	98	98	98	98	98
Cows	88	91	90	93	94	94	94	95	95	95
Replacements 7–11 months	54	57	56	59	60	60	60	60	60	60
Replacements 12–23 months	63	66	66	68	70	70	70	70	70	70
Steer Stockers	55	57	58	58	58	58	58	58	58	58
Heifer Stockers	52	56	60	60	60	60	60	60	60	60
Feedlot Cattle	39	38	39	39	42	43	43	43	44	44

Note: Implied emission factors reported in this table are derived from Table A-141 in Annex 3.11 of EPA (2025). These estimates have not been updated for the 2023 to 2024 portion of the time series, with plans to update these estimates in a future GHGIA report.

Table A5.14-4: Enteric Fermentation CH_4 Emissions from Cattle (kt)

Cattle Type	1990	1995	2000	2005	2010	2020	2021	2022	2023	2024
Dairy	**1,547**	**1,471**	**1,492**	**1,473**	**1,594**	**1,743**	**1,764**	**1,748**	**1,740**	**1,724**
Calves (4-6 months)	62	59	59	54	57	59	60	60	58	58
Cows	1,214	1,156	1,182	1,167	1,253	1,398	1,424	1,417	1,421	1,413
Replacements 7-11 months	58	56	55	56	62	62	60	58	56	55
Replacements 12-23 months	212	201	196	196	222	225	221	212	205	199
Beef	**4,742**	**5,396**	**5,050**	**4,986**	**4,963**	**5,018**	**5,010**	**4,891**	**4,704**	**4,608**
Calves (4-6 months)	182	193	186	179	169	167	165	161	158	156
Bulls	196	225	215	214	215	219	217	207	199	199
Cows	2,862	3,199	3,037	3,035	2,955	2,963	2,919	2,383	2,739	2,651
Replacements 7-11 months	69	85	74	80	75	82	80	75	70	67
Replacements 12-23 months	188	241	204	217	213	227	227	214	199	191
Steer Stockers	563	662	509	473	476	440	445	445	428	425
Heifer Stockers	306	375	323	299	302	269	278	275	265	262
Feedlot Cattle	375	416	502	488	560	649	679	676	647	657
Total	**6,289**	**6,866**	**6,541**	**6,460**	**6,557**	**6,761**	**6,774**	**6,639**	**6,444**	**6,332**

Note: Totals may not sum due to independent rounding.

Table A5.14-5: Enteric Fermentation CH_4 Emissions from Cattle (MMT CO_2 Eq.)

Cattle Type	1990	1995	2000	2005	2010	2020	2021	2022	2023	2024
Dairy	**43.3**	**41.2**	**41.8**	**41.3**	**44.6**	**48.8**	**49.4**	**48.9**	**48.7**	**48.3**
Calves (4-6 months)	1.7	1.6	1.6	1.5	1.6	1.7	1.7	1.7	1.6	1.6
Cows	34.0	32.4	33.1	32.7	35.1	39.1	39.9	39.7	39.8	39.6
Replacements 7-11 months	1.6	1.6	1.5	1.6	1.7	1.7	1.7	1.6	1.6	1.5
Replacements 12-23 months	5.9	5.6	5.5	5.5	6.2	6.3	6.2	5.9	5.7	5.6
Beef	**132.8**	**151.1**	**141.4**	**139.6**	**139.0**	**140.5**	**140.3**	**137.0**	**131.7**	**129.0**
Calves (4-6 months)	5.1	5.4	5.2	5.0	4.7	4.7	4.6	4.5	4.4	4.4
Bulls	5.5	6.3	6.0	6.0	6.0	6.1	6.1	5.8	5.6	5.6
Cows	80.1	89.6	85.0	85.0	82.8	83.0	81.7	79.5	76.7	74.2
Replacements 7-11 months	1.9	2.4	2.1	2.3	2.1	2.3	2.2	2.1	2.0	1.9
Replacements 12-23 months	5.3	6.7	5.7	6.1	6.0	6.4	6.4	6.0	5.6	5.3
Steer Stockers	15.8	18.5	14.2	13.2	13.3	12.3	12.5	12.5	12.0	11.9
Heifer Stockers	8.6	10.5	9.1	8.4	8.4	7.5	7.8	7.7	7.4	7.3
Feedlot Cattle	10.5	11.6	14.0	13.7	15.7	18.2	19.0	18.9	18.1	18.4
Total	**176.1**	**192.3**	**183.2**	**180.9**	**183.6**	**189.3**	**189.7**	**185.9**	**180.4**	**177.3**

Note: Totals may not sum due to independent rounding.

Other Livestock (Non-Cattle) Enteric Fermentation CH_4 Emission Estimates

To estimate non-cattle livestock populations using Tier 1 methodology consistent with the 2006 IPCC Guidelines, livestock population estimates are derived from USDA Census of

Agriculture and USDA Annual Survey statistics. State-level livestock population data were directly sourced from the USDA Census of Agriculture for horses, goats, American bison, and mules & asses. To estimate enteric fermentation emissions from swine and sheep, national population data were derived from USDA-NASS Quarterly and Annual Surveys, respectively, for 2023 and 2024. Population estimates were then multiplied by default emission factors from IPCC (2006). See Chapter 5 (Agriculture) of the *GHGIA* report (Desai et al., 2026), specifically Table 5-5, for more information on specific sources of population activity data for each animal type. State-level swine and sheep population estimates were calculated using a simplified approach in 2024, consistent with the methodology employed by EPA (2025) to estimate state-level other cattle population estimates in 2023. Each state's share of the national population total for each animal type in 2022, when the last full-complexity enteric fermentation methodology was conducted, was calculated, and these state-level population proportions were then multiplied by the national population total to estimate state-level non-cattle livestock populations. National non-cattle livestock populations for the full time series (1990 to 2024) are provided in Table A5.14-6, and state-level non-cattle livestock populations for the year 2024 are provided in Table A5.14-7. While the in-text version of Table A5.14-7 only provides state-level non-cattle livestock populations associated with enteric fermentation emissions estimates, the accompanying CSV file included with this Annex release provides state-level livestock populations for the full time series.

Table A5.14-6: National Non-Cattle Livestock Population Estimates for 1990 - 2004 (1,000 head)

Livestock Type	1990	1995	2000	2005	2010	2020	2021	2022	2023	2024
Swine	53,941.4	58,899.3	58,864.1	61,072.8	64,722.5	76,984.5	74,103.6	73,361.8	74,820.0	75037.1
Sheep	11,358.3	8,989.3	7,036.0	6,135.0	5,620.0	5,200.0	5,170.0	5,065.0	5,130.0	5030.0
Horses	1,661.3	2,631.9	3,394.6	3,875.0	3,784.3	2,585.7	2,498.4	2,411.2	2,324.0	2236.8
Goats	2,515.5	2,357.2	2,418.9	2,896.5	2,829.1	2,597.2	2,563.4	2,529.6	2,520.0	2525.9
American Bison	46.6	104.1	194.1	211.7	176.6	189.0	190.7	192.5	192.1	191.1
Mules & Asses	63.3	101.0	112.5	212.4	289.1	281.7	269.8	257.8	252.0	250.5

Table A5.14-7: 2024 Non-Cattle Livestock Population Estimates by Animal Type and State (head)

State	Swine	Sheep	Horses	Goats	American Bison	Mules
AK	1,629	611	1,148	926	1,478	33
AL	26,698	18,071	26,445	42,638	309	7,205
AR	148,539	16,583	34,842	40,832	271	6,594
AZ	150,288	99,309	55,376	45,321	111	2,191
CA	86,961	571,027	90,115	126,677	591	5,448
CO	542,318	427,029	67,364	42,677	9,487	5,153
CT	2,856	5,787	8,931	4,351	90	686
DE	2,894	1,289	3,676	1,050	0	143
FL	7,210	17,964	80,105	53,716	204	8,442
GA	40,312	18,185	31,651	54,640	232	7,796
HI	7,087	19,926	4,223	12,260	187	271
IA	24,014,368	158,894	42,720	86,725	1,327	3,044
ID	24,310	228,411	38,589	24,744	5,323	2,639
IL	5,424,514	52,634	29,307	31,896	945	2,773
IN	4,442,453	59,585	76,252	48,230	2,018	3,428
KS	1,949,816	64,551	37,920	55,433	8,610	3,586
KY	459,940	58,592	108,129	58,608	4,830	10,464
LA	5,089	9,648	31,039	18,030	187	4,802
MA	7,623	12,733	13,006	7,327	0	806
MD	24,478	17,154	25,507	12,811	158	1,211
ME	4,579	12,904	6,022	6,554	245	425
MI	1,231,950	86,399	50,636	29,984	2,769	2,964
MN	8,829,379	111,226	37,432	50,617	3,087	2,973
MO	3,370,799	96,330	71,134	74,030	1,965	9,216
MS	182,197	12,199	28,157	30,109	52	5,717
MT	228,519	188,687	57,791	16,427	20,320	2,733
NC	8,356,049	28,800	35,624	42,722	272	9,143
ND	157,060	61,572	22,388	8,718	12,398	661
NE	3,639,138	72,496	34,444	35,314	31,977	2,181
NH	4,182	7,857	4,011	3,086	92	257
NJ	7,643	13,043	19,745	10,310	187	1,506
NM	1,513	89,378	31,515	27,883	4,381	1,711
NV	98	59,585	11,226	11,280	54	501
NY	37,868	79,447	59,926	29,629	3,207	2,714
OH	2,725,210	126,122	89,113	66,955	1,441	7,063
OK	2,166,874	51,641	91,067	97,487	7,086	14,255
OR	9,133	143,998	58,568	43,798	1,478	3,361
PA	1,379,906	95,337	77,880	56,968	1,674	7,093
RI	1,430	1,704	705	660	0	55
SC	161,986	9,257	26,070	36,828	371	4,754
SD	2,123,692	233,376	37,392	20,048	33,753	1,214
TN	286,074	48,661	64,516	70,395	532	14,199
TX	1,154,126	695,163	250,707	751,341	8,129	57,935
UT	823,802	268,134	48,454	18,957	799	3,157
VA	297,510	71,502	51,126	40,892	1,356	6,277

(continued)

Table A5.14-7: 2024 Non-Cattle Livestock Population Estimates by Animal Type and State (head) *(continued)*

State	Swine	Sheep	Horses	Goats	American Bison	Mules
VT	4,069	16,614	7,277	10,230	217	310
WA	17,305	49,654	41,877	26,603	1,030	1,962
WI	352,071	81,433	54,962	108,078	6,706	3,909
WV	5,058	31,779	14,893	19,087	517	3,181
WY	108,474	327,720	45,806	11,998	8,653	2,356

Default enteric fermentation CH_4 emission factors for swine, horses, and mules and asses for developed countries were taken from IPCC (2006). Default emission factors for sheep and goats were taken from the *2019 Refinement to the IPCC Guidelines* (IPCC, 2019). An adjustment was made to the default developed country emission factor from IPCC (2006) to reflect the much larger size of American Bison (513 kg; National Bison Association, 2011) relative to the average live weight for buffalo described in the IPCC 2006 Guidelines (300 kg). Table A5.14-8 provides the national emission factors used to estimate non-cattle livestock enteric fermentation CH_4 emissions.

Table A5.14-8: Enteric Fermentation Emission Factors for Other Livestock (kg CH_4/head/year)

Livestock Type	Emission Factor
Swine	1.5
Horses	18
Sheep	9
Goats	9
American Bison	82.2
Mules & Asses	10.0

Source: IPCC (2006), IPCC (2019), and adjustments to IPCC (2006) buffalo emission factor scaled to account for larger average live weight of American Bison.

Table A5.14-9: CH_4 Emissions from Enteric Fermentation from Cattle (MT), by State, for 2024

State	Dairy Calves	Dairy Cows	Dairy Replacement Heifers 7-11 Months	Dairy Replacement Heifers 12-23 Months	Bulls	Beef Calves	Beef Cows	Beef Replacement Heifers 7-11 Months	Beef Replacement Heifers 12-23 Months	Steer Stockers	Heifer Stockers	Feedlot
AK	1	30	1	4	424	41	690	18	52	13	10	3
AL	18	452	25	90	4,054	3,489	59,427	1,314	3,754	1,197	1,311	322
AR	31	753	37	134	5,186	4,699	80,032	1,643	4,692	2,928	1,887	625
AZ	1,193	29,232	1,478	5,373	1,886	888	15,122	304	869	7,384	655	12,170
CA	10,580	259,170	9,358	34,026	5,657	3,531	60,134	1,400	3,997	16,295	5,898	24,834
CO	1,243	30,437	1,416	5,149	4,243	3,313	56,420	1,643	4,692	20,369	15,465	51,705
CT	114	2,788	117	425	47	23	398	24	70	25	39	8
DE	17	422	15	54	28	9	150	7	21	69	8	10
FL	646	15,821	369	1,343	5,186	4,647	79,147	1,521	4,344	637	655	172
GA	511	12,506	308	1,119	2,828	2,529	43,067	1,217	3,476	1,018	655	216
HI	5	121	12	45	377	411	7,004	134	382	229	131	47
IA	1,384	33,903	1,478	5,373	5,657	4,699	80,032	1,947	5,561	32,845	15,465	52,353
ID	4,011	98,243	4,310	15,670	3,771	2,586	44,040	1,156	3,302	8,148	5,898	14,118
IL	498	12,205	505	1,836	1,697	1,760	29,979	669	1,912	4,990	2,359	9,598
IN	1,144	28,026	739	2,686	1,509	955	16,272	426	1,216	2,444	1,180	4,799
KS	1,040	25,465	1,970	7,163	8,014	7,378	125,663	3,286	9,384	51,941	44,823	117,291
KY	271	6,630	431	1,567	5,657	5,016	85,426	1,521	4,344	5,601	2,883	815
LA	55	1,356	37	134	2,828	2,342	39,883	974	2,780	586	498	143
MA	58	1,431	68	246	94	42	707	37	104	64	26	11
MD	252	6,178	320	1,164	330	218	3,714	110	313	318	157	348
ME	160	3,918	160	582	141	52	884	49	139	115	79	25
MI	2,670	65,395	1,872	6,805	1,414	498	8,490	280	799	4,405	1,180	7,360
MN	2,830	69,313	2,586	9,402	2,828	1,869	31,836	1,035	2,954	12,476	3,801	17,205
MO	424	10,397	369	1,343	10,371	10,078	171,648	3,651	10,427	10,694	6,029	3,781
MS	43	1,055	62	224	3,677	2,482	42,271	1,108	3,163	1,324	996	300
MT	68	1,657	49	179	8,957	6,745	114,874	3,895	11,122	5,347	4,876	2,025
NC	240	5,877	172	627	2,923	1,874	31,924	755	2,155	1,069	682	224
ND	92	2,260	99	358	5,657	4,855	82,685	2,215	6,326	7,893	6,029	1,846
NE	357	8,739	369	1,343	10,371	9,357	159,356	4,260	12,165	64,926	41,416	124,980
NH	65	1,582	74	269	47	21	354	15	42	38	21	7
NJ	26	633	34	125	66	41	690	18	52	56	31	11
NM	1,796	43,999	1,539	5,596	2,357	2,352	40,060	852	2,433	2,546	1,835	556

(continued)

Table A5.14-9: CH_4 Emissions from Enteric Fermentation from Cattle (MT), by State, for 2024 *(continued)*

State	Dairy Calves	Dairy Cows	Dairy Replace-ment Heifers 7-11 Months	Dairy Replace-ment Heifers 12-23 Months	Bulls	Beef Calves	Beef Cows	Beef Replace-ment Heifers 7-11 Months	Beef Replace-ment Heifers 12-23 Months	Steer Stockers	Heifer Stockers	Feedlot
NV	191	4,671	111	403	1,226	1,267	21,578	463	1,321	891	734	134
NY	3,814	93,422	4,063	14,775	1,886	519	8,843	487	1,390	1,146	1,049	984
OH	1,526	37,369	1,478	5,373	2,828	1,620	27,591	791	2,259	5,601	1,573	6,712
OK	240	5,877	246	895	16,028	11,013	187,566	4,868	13,902	25,716	14,155	14,296
OR	769	18,835	677	2,462	3,771	2,622	44,659	1,217	3,476	4,328	3,146	5,566
PA	2,891	70,820	2,401	8,730	1,886	987	16,802	621	1,773	3,565	1,284	3,132
RI	3	75	6	22	9	6	97	2	7	8	5	2
SC	55	1,356	62	224	1,131	820	13,972	353	1,008	280	236	67
SD	1,046	25,616	493	1,791	9,900	8,308	141,493	4,503	12,860	19,096	12,975	20,063
TN	166	4,068	246	895	5,657	4,637	78,971	1,461	4,171	3,437	2,228	729
TX	3,845	94,175	2,955	10,745	31,113	22,976	391,315	8,642	24,677	66,963	44,299	130,706
UT	584	14,315	677	2,462	2,169	1,713	29,183	852	2,433	2,292	1,573	960
VA	437	10,698	431	1,567	3,583	3,110	52,971	1,083	3,093	3,794	1,809	751
VT	738	18,082	640	2,328	283	78	1,326	55	156	127	170	37
WA	1,606	39,328	1,601	5,820	1,697	1,163	19,809	669	1,912	4,838	3,408	10,045
WI	7,843	192,117	8,127	29,549	2,828	1,532	26,088	1,035	2,954	10,184	2,228	11,881
WV	31	753	25	90	1,320	976	16,625	365	1,043	993	577	189
WY	55	1,356	62	224	3,300	3,536	60,223	1,765	5,040	4,074	3,539	3,098

Note: 2024 cattle enteric fermentation estimates were calculated using a Simplified Approach to disaggregate state-level populations and emissions estimates from national totals based on each state's proportion of national population for each cattle type in 2022, the last year a full-complexity analysis was conducted using the CEFM model.
See text preceding and following this table within this Annex 5.14 for more information.

Table A5.14-10: CH_4 Emissions from Enteric Fermentation from Cattle (MMT CO_2 Eq.), by State, for 2024

State	Dairy Calves	Dairy Cows	Dairy Replace-ment Heifers 7-11 Months	Dairy Replace-ment Heifers 12-23 Months	Bulls	Beef Calves	Beef Cows	Beef Replac e-ment Heifers 7-11 Months	Beef Replace -ment Heifers 12-23 Months	Steer Stockers	Heifer Stocker s	Feedlot
AK	0.000	0.001	0.000	0.000	0.012	0.001	0.019	0.001	0.001	0.000	0.000	0.000
AL	0.001	0.013	0.001	0.003	0.114	0.098	1.664	0.037	0.105	0.034	0.037	0.009
AR	0.001	0.021	0.001	0.004	0.145	0.132	2.241	0.046	0.131	0.082	0.053	0.018
AZ	0.033	0.818	0.041	0.150	0.053	0.025	0.423	0.009	0.024	0.207	0.018	0.341
CA	0.296	7.257	0.262	0.953	0.158	0.099	1.684	0.039	0.112	0.456	0.165	0.695
CO	0.035	0.852	0.040	0.144	0.119	0.093	1.580	0.046	0.131	0.570	0.433	1.448
CT	0.003	0.078	0.003	0.012	0.001	0.001	0.011	0.001	0.002	0.001	0.001	0.000
DE	0.000	0.012	0.000	0.002	0.001	0.000	0.004	0.000	0.001	0.002	0.000	0.000
FL	0.018	0.443	0.010	0.038	0.145	0.130	2.216	0.043	0.122	0.018	0.018	0.005
GA	0.014	0.350	0.009	0.031	0.079	0.071	1.206	0.034	0.097	0.029	0.018	0.006
HI	0.000	0.003	0.000	0.001	0.011	0.012	0.196	0.004	0.011	0.006	0.004	0.001
IA	0.039	0.949	0.041	0.150	0.158	0.132	2.241	0.055	0.156	0.920	0.433	1.466
ID	0.112	2.751	0.121	0.439	0.106	0.072	1.233	0.032	0.092	0.228	0.165	0.395
IL	0.014	0.342	0.014	0.051	0.048	0.049	0.839	0.019	0.054	0.140	0.066	0.269
IN	0.032	0.785	0.021	0.075	0.042	0.027	0.456	0.012	0.034	0.068	0.033	0.134
KS	0.029	0.713	0.055	0.201	0.224	0.207	3.519	0.092	0.263	1.454	1.255	3.284
KY	0.008	0.186	0.012	0.044	0.158	0.140	2.392	0.043	0.122	0.157	0.081	0.023
LA	0.002	0.038	0.001	0.004	0.079	0.066	1.117	0.027	0.078	0.016	0.014	0.004
MA	0.002	0.040	0.002	0.007	0.003	0.001	0.020	0.001	0.003	0.002	0.001	0.000
MD	0.007	0.173	0.009	0.033	0.009	0.006	0.104	0.003	0.009	0.009	0.004	0.010
ME	0.004	0.110	0.004	0.016	0.004	0.001	0.025	0.001	0.004	0.003	0.002	0.001
MI	0.075	1.831	0.052	0.191	0.040	0.014	0.238	0.008	0.022	0.123	0.033	0.206
MN	0.079	1.941	0.072	0.263	0.079	0.052	0.891	0.029	0.083	0.349	0.106	0.482
MO	0.012	0.291	0.010	0.038	0.290	0.282	4.806	0.102	0.292	0.299	0.169	0.106
MS	0.001	0.030	0.002	0.006	0.103	0.069	1.184	0.031	0.089	0.037	0.028	0.008
MT	0.002	0.046	0.001	0.005	0.251	0.189	3.216	0.109	0.311	0.150	0.137	0.057
NC	0.007	0.165	0.005	0.018	0.082	0.052	0.894	0.021	0.060	0.030	0.019	0.006
ND	0.003	0.063	0.003	0.010	0.158	0.136	2.315	0.062	0.177	0.221	0.169	0.052
NE	0.010	0.245	0.010	0.038	0.290	0.262	4.462	0.119	0.341	1.818	1.160	3.499
NH	0.002	0.044	0.002	0.008	0.001	0.001	0.010	0.000	0.001	0.001	0.001	0.000

(continued)

Table A5.14-10: CH_4 Emissions from Enteric Fermentation from Cattle (MMT CO_2 Eq.), by State, for 2024 *(continued)*

State	Dairy Calves	Dairy Cows	Dairy Replace-ment Heifers 7-11 Months	Dairy Replace-ment Heifers 12-23 Months	Bulls	Beef Calves	Beef Cows	Beef Replac e-ment Heifers 7-11 Months	Beef Replace -ment Heifers 12-23 Months	Steer Stockers	Heifer Stocker s	Feedlot
NJ	0.001	0.018	0.001	0.004	0.002	0.001	0.019	0.001	0.001	0.002	0.001	0.000
NM	0.050	1.232	0.043	0.157	0.066	0.066	1.122	0.024	0.068	0.071	0.051	0.016
NV	0.005	0.131	0.003	0.011	0.034	0.035	0.604	0.013	0.037	0.025	0.021	0.004
NY	0.107	2.616	0.114	0.414	0.053	0.015	0.248	0.014	0.039	0.032	0.029	0.028
OH	0.043	1.046	0.041	0.150	0.079	0.045	0.773	0.022	0.063	0.157	0.044	0.188
OK	0.007	0.165	0.007	0.025	0.449	0.308	5.252	0.136	0.389	0.720	0.396	0.400
OR	0.022	0.527	0.019	0.069	0.106	0.073	1.250	0.034	0.097	0.121	0.088	0.156
PA	0.081	1.983	0.067	0.244	0.053	0.028	0.470	0.017	0.050	0.100	0.036	0.088
RI	0.000	0.002	0.000	0.001	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000
SC	0.002	0.038	0.002	0.006	0.032	0.023	0.391	0.010	0.028	0.008	0.007	0.002
SD	0.029	0.717	0.014	0.050	0.277	0.233	3.962	0.126	0.360	0.535	0.363	0.562
TN	0.005	0.114	0.007	0.025	0.158	0.130	2.211	0.041	0.117	0.096	0.062	0.020
TX	0.108	2.637	0.083	0.301	0.871	0.643	10.957	0.242	0.691	1.875	1.240	3.660
UT	0.016	0.401	0.019	0.069	0.061	0.048	0.817	0.024	0.068	0.064	0.044	0.027
VA	0.012	0.300	0.012	0.044	0.100	0.087	1.483	0.030	0.087	0.106	0.051	0.021
VT	0.021	0.506	0.018	0.065	0.008	0.002	0.037	0.002	0.004	0.004	0.005	0.001
WA	0.045	1.101	0.045	0.163	0.048	0.033	0.555	0.019	0.054	0.135	0.095	0.281
WI	0.220	5.379	0.228	0.827	0.079	0.043	0.730	0.029	0.083	0.285	0.062	0.333
WV	0.001	0.021	0.001	0.003	0.037	0.027	0.466	0.010	0.029	0.028	0.016	0.005
WY	0.002	0.038	0.002	0.006	0.092	0.099	1.686	0.049	0.141	0.114	0.099	0.087

Note: 2024 cattle enteric fermentation estimates were calculated using a Simplified Approach to disaggregate state-level populations and emissions estimates from national totals based on each state's proportion of national population for each cattle type in 2022, the last year a full-complexity analysis was conducted using the CEFM model. See text for more information.

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Annex 5.15 Methodology for Estimating Non-CO_2 Emissions from Manure Management

Livestock manure management CH_4 and N_2O emissions for 2024 were calculated using the "Simplified Approach" methodology implemented in the calculation of enteric fermentation estimates for the national-level *GHGIA* report (Desai et al., 2026). Except where population data were updated to integrate the latest USDA Census of Agriculture data (see Chapter 5: Agriculture in the *GHGIA* for more information), 1990-2023 manure management GHG emissions estimates remain consistent with those presented by EPA (2025). Annex 3.12 of EPA (2025) contains additional information, including state-level parameters, on the full-complexity approach used to estimate livestock manure management emissions for the 1990-2023 portion of the time series.

Livestock population data are consistent with the activity data used to estimate enteric fermentation emissions estimates, with a re-categorization of total dairy and beef cattle populations to align with subcategories that differ significantly in the manure management systems used to manage manure from these cattle types. Swine populations are also further disaggregated in the estimation of manure management GHG emissions by weight class and breeding vs. market swine populations. Finally, manure management GHG emissions estimates also include estimates from the management of poultry manure, though poultry populations are a negligible source of enteric fermentation CH_4 emissions and are not currently included in national GHG inventories per guidance from IPCC (2006). See Chapter 5: Agriculture in the *GHGIA* 2026 report for more information on the sources of poultry population activity data leveraged in this report.

For consistency, national livestock populations used to estimate manure management CH_4 and N_2O emissions are provided in table A5.15-1. Additionally, national-scale implied emission factors used to estimate manure management CH_4 and N_2O in a "Simplified Approach" framework are provided in table A5.15-S1 by livestock type. Additional manure management emissions estimates at the state-level are provided in subsequent tables.

Table A5.15-1: Livestock Populations for Manure Management CH_4 and N_2O Emissions Estimates (1,000 Head)

Animal Type	1990	2005	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dairy Cattle	**19,512**	**17,793**	**18,517**	**18,812**	**18,857**	**18,923**	**19,006**	**18,882**	**18,792**	**18,859**	**18,626**	**18,380**	**18,143**
Dairy Cows	*10,015*	*9,004*	9,209	9,312	9,312	9,369	9,432	9,353	9,343	9,442	9,377	9,398	9,347
Dairy Heifer	*4,129*	*4,162*	4,571	4,727	4,785	4,757	4,741	4,695	4,637	4,541	4,394	4,239	4,112
Dairy Calves	*5,369*	*4,628*	4,737	4,774	4,760	4,797	4,833	4,834	4,813	4,876	4,855	4,744	4,685
Swine[a]	**53,941**	**61,073**	**64,195**	**68,178**	**70,065**	**72,125**	**73,430**	**76,523**	**76,985**	**74,104**	**73,362**	**74,820**	**75,037**
Market <50 lb.	*18,359*	*20,228*	18,939	19,843	20,572	20,973	21,359	21,853	22,423	21,182	21,086	21,460	21,622
Market 50-119 lb.	*11,734*	*13,519*	16,559	17,577	18,175	18,767	19,039	20,210	19,888	19,359	19,085	19,422	19,452
Market 120-179 lb.	*9,440*	*11,336*	12,281	13,225	13,575	13,982	14,311	14,852	14850.15	14,463	14,405	14,873	15,044
Market >180 lb.	*7,510*	*9,997*	10,525	11,555	11,714	12,282	12,418	13,153	13,490	12,909	12,638	12,932	12,902
Breeding	*6,899*	*5,993*	5,892	5,978	6,030	6,122	6,303	6,455	6,333	6,191	6,147	6,132	6,018
Beef Cattle[b]	**81,576**	**82,193**	**74,966**	**76,149**	**79,323**	**81,385**	**81,722**	**81,699**	**81,060**	**81,102**	**79,389**	**76,640**	**75,507**
Feedlot Steers	*6,357*	*8,116*	8,696	8,594	9,017	9,560	9,605	9,714	9,698	10,071	9,960	9,633	9,789
Feedlot Heifers	*3,192*	*4,536*	4,518	4,334	4,433	4,786	5,085	5,203	5,251	5,483	5,514	5,333	5,420
NOF Bulls	*2,160*	*2,214*	2,038	2,109	2,137	2,244	2,252	2,253	2,237	2,211	2,110	2,029	2,031
Beef Calves	*16,909*	*16,918*	14,737	14,998	15,546	15,931	16,221	15,892	15,830	15,602	15,244	14,893	14,707
NOF Heifers	*10,182*	*9,550*	8,730	9,291	9,892	9,790	9,460	9,201	9,091	9,205	8,896	8,425	8,204
NOF Steers	*10,321*	*8,185*	7,291	7,491	8,133	7,904	7,633	7,745	7,614	7,686	7,682	7,387	7,343
NOF Cows	*32,455*	*32,674*	28,956	29,332	30,164	31,171	31,466	31,691	31,339	30,844	29,983	28,939	28,013
Sheep	**11,358**	**6,135**	**5,235**	**5,270**	**5,295**	**5,270**	**5,265**	**5,230**	**5,200**	**5,170**	**5,065**	**5,130**	**5,030**
Sheep On Feed	*1,180*	*2,976*	2,588	2,587	2,624	2,618	2,623	2,616	2,611	2,596	2,550	2,583	2,533
Sheep NOF	*10,178*	*3,159*	2,647	2,683	2,671	2,652	2,642	2,614	2,589	2,574	2,515	2,547	2,497
Goats	**2,516**	**2,897**	2,652	2,668	2,683	2,699	2,665	2,631	2,597	2,563	2,530	2,520	2,526
Poultry[c]	**1,537,074**	**2,150,410**	**2,116,333**	**2,134,445**	**2,173,216**	**2,214,462**	**2,256,552**	**2,276,951**	**2,270,602**	**2,258,352**	**2,249,441**	**2,259,790**	**2,276,370**
Hens >1 yr.	*273,467*	*348,203*	370,637	351,656	377,299	388,006	402,536	403,102	391,526	396,147	377,606	386,408	376,893
Pullets	*73,167*	*96,809*	106,490	118,114	112,061	117,173	124,729	121,971	121,171	123,481	128,590	128,488	129,133
Chickens	*6,545*	*8,289*	6,403	7,211	6,759	6,859	6,626	7,130	6,826	6,430	6,809	7,682	7,568
Broilers	*1,066,209*	*1,613,091*	1,553,636	1,579,764	1,595,764	1,620,691	1,643,327	1,668,582	1,676,745	1,660,127	1,666,436	1,664,545	1,696,109
Turkeys	*117,685*	*84,018*	79,167	77,700	81,333	81,733	79,333	76,167	74,333	72,167	70,000	72,667	66,667
Horses	**1,661**	**3,875**	**3,312**	**3,157**	**3,002**	**2,847**	**2,760**	**2,673**	**2,586**	**2,498**	**2,411**	**2,324**	**2,237**
Mules and Asses	**63**	**212**	**303**	**308**	**313**	**318**	**306**	**294**	**282**	**270**	**258**	**252**	**250**
American Bison	**47**	**212**	**171**	**175**	**179**	**184**	**186**	**187**	**189**	**191**	**192**	**192**	**191**

[a] Prior to 2008, the threshold between the smallest two market swine weight classes was 60 lbs. From 2008 onwards, USDA revised this threshold to be more consistent with international swine statistics, updating the swine categories from Market <60 lbs. to Market <50 lbs. and Market 60-119 lbs. to Market 50-119 lbs.

[b] NOF - Not on Feed

[c] Pullets includes laying pullets, and pullets older and younger than 3 months.

Note: Totals may not sum due to independent rounding.

References

Intergovernmental Panel on Climate Change (IPCC). (2006). *2006 IPCC guidelines for national greenhouse gas inventories*. IPCC. https://www.ipcc-nggip.iges.or.jp/public/2006gl/.

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.16 Methodologies for Estimating Soil Organic Carbon Stock Changes, Soil N_2O Emissions, and CH_4 Emissions and from Agricultural Lands (Cropland and Grassland)

The methods used to estimate emissions and removals associated with agricultural lands and soils, including rice cultivation, agricultural soils management, and cropland and grasslands, are consistent with the Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023 (EPA, 2025). See Annex 3.13 of EPA 2025 for more details.

For this GHGIA, a forecasting approach was used, consistent with prior EPA analyses and in line with IPCC guidance, to extrapolate emission estimate given a lack of data in the most recent years of the time series. See Box 5-1 of Chapter 5 (Desai et al., 2026) for more details. The information provided in this Annex 5.16 is intended to clarify and provide surrogate data used as part of those statistical extrapolation techniques.

Rice Cultivation

As described in Chapter 5.3 of Desai et al. (2026), estimates of CH_4 from rice production from 1990 to 2020 are consistent with estimates from EPA (2025), which was the last time a full complexity rice CH_4 emissions analysis was conducted using the Daycent model. In prior EPA analyses, a combination of IPCC Tier 1 and Tier 3 methods were used across the time series to estimate rice CH_4 depending on soil type and if rice is grown in rotation with other crops. For the majority of CH_4 emissions from rice cultivation, the Tier 3 method involved estimating CH_4 emissions using the Daycent processes-based model, simulating hydrologic conditions, plant growth, methane transport, among others, and also captured amendments and ratooning practices. For a smaller subset rice cultivation conditions where Daycent was not parametrized, the IPCC Tier 1 method was used.

For this GHGIA, to estimate emissions for those years beyond 2020 where Daycent results were not available, a linear regression model with autoregressive integrated moving average (ARIMA) errors was used to forecast emissions estimates from 2021 to 2024. Estimates for 2021 to 2024 were calculated as an estimate of total national emissions across all areas cultivated for rice production, such that single linear extrapolation model was used instead of forecasting Tier 1 rice CH_4 emissions separately from Tier 3 rice CH_4 emissions. Rice area planted, rice area harvested and rice yield per acre data were each evaluated to assess correlation with total methane emissions to serve as surrogate data. Planted rice area, as shown in Table 5-9 (USDA-NASS, 2026), was ultimately used.

Agricultural Soil Management

As described in chapter 5.4 of Desai et al. (2026), agricultural soil management N2O emissions are rooted in the same methodologies leveraged in EPA (2025). For the 1990-2022 portion of the time series, this GHGIA retains the estimates reported in EPA (2025) which were developed

using a combination of Tier 3 methodology implemented with the Daycent process-based model and coupled with Tier 1 methodology to estimate emissions in soil types or specialty crop systems which the Daycent model has not been parameterized to simulate accurately. The Daycent model estimates N_2O emissions occurring on croplands and grasslands from the following nitrogen inputs:

- Synthetic nitrogen fertilizer
- Managed livestock manure
- Other organic materials (e.g., application of treated sewage sludge or other biosolids)
- Manure deposited directly on pasture, rangeland, or paddock soils by grazing livestock (i.e., unmanaged manure; see GHGIA Section 5.2 and Annex 5.15)
- Crop residue retention on crop fields
- Mineralization of soil organic matter
- Asymbiotic nitrogen fixation

The Daycent model incorporates detailed information on soil management, crop cultivation practices, land-use history, and daily meteorological data, and integrates simulation of N_2O emissions with soil carbon stock change fluxes to more accurately model these intricately coupled biogeochemical cycles when estimating carbon and nitrogen fluxes in agricultural soils.

To estimate direct N_2O emissions from agricultural soils for the years 2021-2024, a simplified linear extrapolation model was applied to estimate emissions for this segment of the time series based on correlations between crop production and climate surrogate data and historical Daycent estimates. As described in GHGIA Chapter 5.4, total nitrogen applied to agricultural soils from synthetic fertilizer data was collected from national nitrogen fertilizer consumption data reported by the International Fertilizer Association (IFA, 2026; Table 5.16-1). Nitrogen fertilizer consumption data was only available for 1990 – 2023 at the time of report preparation. Synthetic fertilizer consumption for 2024 was estimated using a linear model correlating total national planted corn and soy acreage (USDA, 2024a, 2024b) with total nitrogen applied as fertilizer as reported in IFA statistics across the time series (Figure 5.16-1). Fertilizer consumption data together with a national average annual precipitation statistic calculated by weighting state annual precipitation data (PRISM, n.d.) by each state's share of national planted corn and soy acreage were then used to estimate direct N_2O emissions from agricultural soil management for 2021-2024. This simplified relationship adequately predicted total direct N_2O emissions across grassland and cropland ecosystems and all nitrogen inputs across the time series ($R^2 = 0.48$, $p < 0.001$) and was therefore used to extrapolate direct N_2O emissions using surrogate data for the latter portion of the time series for which Daycent estimates were not available. Planted acreage of corn and soy across and national annual precipitation weighted as described above is available in Table 5.16-2. Indirect N_2O emissions from 2021-2024 across all nitrogen inputs and cropland and grassland ecosystems were estimated using an ARMA extrapolation with no linear proxy data component.

Figure A5.16-1: Linear Forecast to Estimate Synthetic Nitrogen Fertilizer Application Using Planted Corn and Soy Acreage

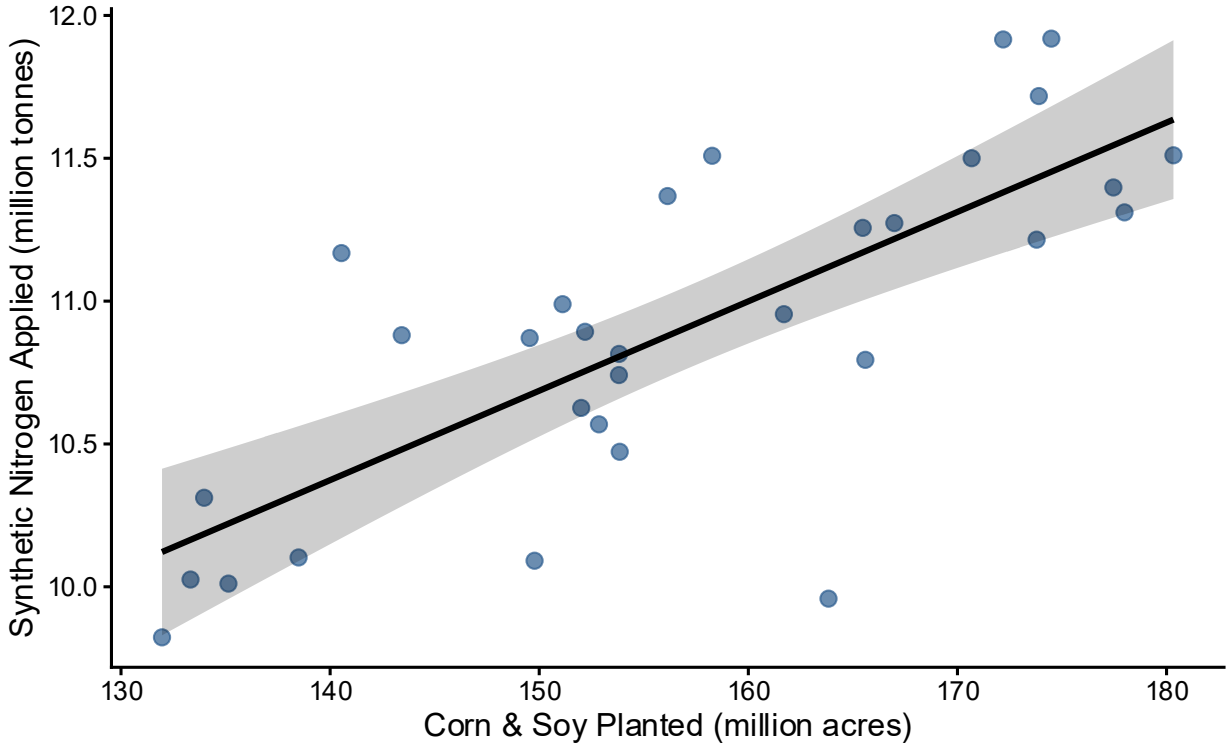


Table A5.16-1: Synthetic Fertilizer Nitrogen Consumption (1,000 metric tons)

Year	Ammonia	Ammonium Nitrate	Ammonium Phosphate	Ammonium Sulphate	Urea	Urea Ammonium Nitrate	NK	NP	NPK	Other	Total Nitrogen Consumption
1990	3815.9	569	653.3	157	1432.1	2145.9	--	--	1329.7	136.5	**10239.4**
1991	3723.5	587.8	651.1	171.7	1476.2	2252.1	--	--	1378.4	144.3	**10385.1**
1992	3255.7	590.2	721.4	166.4	1633.1	2429.1	--	--	1394.5	144.9	**10335.3**
1993	4116.3	606.9	736.2	180.5	1677.1	2543	--	--	1425.7	183.7	**11469.4**
1994	3308.7	581.1	711.7	191.3	1679.4	2514	--	--	1424.6	221.3	**10632.1**
1995	3693.6	646	733.1	200.1	1631.4	2642.8	--	--	1435.6	178.9	**11161.5**
1996	3651.2	597.5	738.3	233.5	1597.2	2782.7	--	--	1449.8	155.5	**11205.7**
1997	3350.5	599.2	743.6	211	1843.4	2807.4	--	--	1424.3	190.5	**11169.9**
1998	3539	577.7	644.6	206	1926.7	2847.8	--	--	1447.7	106.8	**11296.3**
1999	3370.5	523	670.7	212.9	1954.6	2721.7	--	--	1463.5	272.2	**11189.1**
2000	2759.8	480.4	664.8	211.5	2085.1	2500.5	--	--	1474.1	290.7	**10466.9**

2001	2932.7	483.2	740.1	200.8	2211.3	2466.3	--	--	1527.9	332.4	**10894.7**
2002	2926.6	472.8	706.5	219.2	2282.3	2684.8	--	--	1295.8	381.8	**10969.8**
2003	3123.5	469.9	801.3	234.2	2350.4	3076.9	--	--	1447.7	314.8	**11818.7**
2004	2948.2	437.4	773	224.9	2170.7	2772.4	--	--	1548.6	315.6	**11190.8**
2005	2943.8	296.4	719.1	232.2	2236	2786.6	--	122.4	1396.9	192.6	**10926**
2006	3231.1	324.8	730	263.3	2388.1	3301.3	--	123.1	1384.9	219.5	**11966.1**
2007	3518.7	267.2	698.9	250.8	2263.5	2803	--	201.2	1037.5	354.7	**11395.5**
2008	3062.5	232.8	516.8	229.4	2182	2776.3	--	156.4	866.5	375	**10397.7**
2009	3086.6	220.9	640.5	221.2	2299.9	3039.7	0	228.4	931.7	448	**11116.9**
2010	3191.8	232.6	665.9	284.4	2539.4	3163.8	0	240.3	980.5	438.3	**11737**
2011	3468.9	265.5	674	289.3	2627.5	3349.1	76	222	865.6	393.5	**12231.4**
2012	3172.9	282.5	733	289.7	2766.4	3143.5	83	263	884.6	569.3	**12187.9**
2013	3467.6	259.3	748.5	290.2	2629.6	3393.5	254.5	184.4	779.5	53.6	**12060.7**
2014	3088.2	275.7	707	282.7	2694.7	3096.8	259.1	185.6	742.1	484.8	**11816.7**
2015	2856.3	213.5	666.2	353.3	2893.7	3159.4	217.4	253.2	635.8	434.3	**11683.1**
2016	2872.9	214.8	670.1	355.4	2910.6	3177.9	218.7	254.7	639.5	436.8	**11751.4**
2017	2888.6	215.9	673.7	357.3	2926.4	3195.2	219.9	256.1	643	439.2	**11815.3**
2018	2817.7	213.9	637.2	346.9	2808.5	3030.9	161	321.7	704.4	559.8	**11602**
2019	2902	220.3	691.3	357.3	2892.5	3121.5	168.3	349	736	510.8	**11949**
2020	2857.4	205.1	630.9	363	2976.8	3115.2	163.3	324.6	710.2	516.1	**11862.6**
2021	2642.2	206.8	579.2	332.1	2828.3	3093.7	202.1	357	541.2	381.5	**11164.1**
2022	2840.3	222.3	640.5	357	3040.3	3325.5	174.1	394.7	466.2	540	**12000.8**
2023	2750.2	215.2	639	345.7	2943.8	3220	188.2	393.8	504.2	420	**11620.1**

Table A5.16-2: National Planted Corn and Soy Acreage (1,000 acres) and National Weighted Annual Precipitation (mm)

Year	National Corn Planted Acres (1,000 acres)	National Soy Planted Acres (1,000 acres)	Total Corn + Soy Planted Acres (1,000 acres)	National Weighted Average Annual Precipitation (mm)
1990	74,166	83,354	157,520	1,034.3
1991	75,957	76,100	152,057	907.5
1992	79,311	89,167	168,478	894.8
1993	73,239	90,162	163,401	1,069.9
1994	78,921	83,453	162,374	851.0
1995	71,479	82,660	154,139	888.4
1996	79,229	83,296	162,525	945.5
1997	79,537	76,820	156,357	846.9
1998	80,165	77,198	157,363	963.0
1999	77,386	75,046	152,432	821.0
2000	79,551	77,404	156,955	824.6
2001	75,702	77,451	153,153	876.6

2002	78,894	75,718	154,612	863.2
2003	78,603	64,741	143,344	878.5
2004	80,929	75,522	156,451	950.0
2005	81,779	72,032	153,811	833.2
2006	78,327	75,208	153,535	863.8
2007	93,527	73,404	166,931	916.0
2008	85,982	73,963	159,945	1,033.6
2009	86,382	74,075	160,457	1,014.5
2010	88,192	74,266	162,458	947.1
2011	91,936	73,730	165,666	965.2
2012	97,291	72,025	169,316	726.7
2013	95,365	70,005	165,370	968.0
2014	90,597	64,195	154,792	933.3
2015	88,019	62,495	150,514	1,048.6
2016	94,004	61,620	155,624	953.1
2017	90,167	60,085	150,252	903.6
2018	88,821	59,180	148,001	1,093.2
2019	89,370	59,180	148,550	1,141.9
2020	90,432	57,795	148,227	913.7
2021	92,901	87,195	180,096	901.4
2022	88,162	87,450	175,612	842.8
2023	94,641	83,600	178,241	833.8
2024	90,909	87,260	178,169	943.5

Cropland Remaining Cropland

In EPA (2025), both IPCC Tier 2 and Tier 3 methods were used across the time series to estimate soil organic carbon stock changes. As described in Chapter 6.3.1 of Desai et al. (2026), estimates of carbon stock changes from cropland remaining cropland are consistent with estimates from EPA (2025) for the segment of the time series covered by the most recent Daycent simulations, with exact years varying depending on carbon pool.

For biomass (non-woodland herbaceous biomass), estimates from 1990 to 2017 are consistent with estimates from prior analysis (EPA, 2025) where an IPCC Tier 1 method was used. The linear regression model with autoregressive integrated moving average (ARIMA) errors approach was used to forecast the net carbon stock changes for cropland remaining cropland from 2018 to 2024. For organic soils and mineral soils where an IPCC Tier 2 method was used, estimates from 1990 to 2020 are consistent with estimates from EPA (2025) and the same ARIMA approach was used.

In EPA (2025), mineral soils on non-federal lands that have less than 35 percent coarse fragments by volume and are used to produce a variety of crops such as alfalfa hay, barley,

corn, cotton, oats, rice, sorghum, soybeans, sugar beets, tobacco, and wheat, used an IPCC Tier 3 method. For this GHGIA, the ARIMA approach also used USDA soybean and corn crop yield surrogate data (USDA-NASS, 2026a, 2026b) to forecast net carbon stock change from 2021 to 2024; these values are presented in Table 5.16-3.

Table A5.16-3: National Corn and Soybean Yield (bushel/acre)

Year	Corn grain, yield (bushel/acre)	Soybeans, yield (bushel/acre)
1990	118.5	34.1
1991	108.6	34.2
1992	131.5	37.6
1993	100.7	32.6
1994	138.6	41.4
1995	113.5	35.3
1996	127.1	37.6
1997	126.7	38.9
1998	134.4	38.9
1999	133.8	36.6
2000	136.9	38.1
2001	138.2	39.6
2002	129.3	38
2003	142.2	33.9
2004	160.3	42.2
2005	147.9	43.1
2006	149.1	42.9
2007	150.7	41.7
2008	153.3	39.7
2009	164.4	44
2010	152.6	43.5
2011	146.8	42
2012	123.1	40
2013	158.1	44
2014	171	47.5
2015	168.4	48
2016	174.6	51.9
2017	176.6	49.3
2018	176.4	50.6
2019	167.5	47.4
2020	171.4	51
2021	176.7	51.7
2022	173.4	49.6
2023	177.3	50.6
2024	179.3	50.7

Land Converted to Cropland

In prior EPA analysis, both IPCC Tier 2 and Tier 3 methods were used across the time series to estimate soil organic carbon stock changes. As described in Chapter 6.3.2 of Desai et al. (2026), estimates of carbon stock changes from land converted to cropland are consistent with estimates from EPA (2025) for the segment of the time series covered by the most recent Daycent simulations, with exact years varying depending on carbon pool.

For estimating biomass (aboveground and belowground) and DOM (dead wood and litter), estimates from 1990 to 2017 are consistent with estimates from prior analysis (EPA, 2025). For woodlands (under the grassland land-use category) and forest land converted to cropland, both aboveground and belowground biomass were estimated using the IPCC Tier 2 method. For all other land-use conversions to cropland, including other non-woodland grassland, total live biomass carbon stock changes were estimated using the IPCC Tier 1 method. For dead organic matter, a Tier 2 method was used to estimate carbon stock changes through 2017. For this GHGIA, the ARIMA approach was used to forecast the net carbon stock change for land converted to cropland from 2018 to 2024.

Estimates of soil carbon stock changes from 1990 to 2020 are consistent with estimates from prior analysis (EPA, 2025). For organic soils, EPA (2025) used an IPCC Tier 2 method to estimate carbon stock changes through 2020 for all land conversions to cropland. For mineral soils, Tier 2 and Tier 3 methods were used across this same time series; the Tier 3 method was used to estimate mineral soil carbon stock changes for grassland converted to cropland for soil and crop types for which Daycent was parameterized. For this GHGIA, the ARMA approach was used to forecast net carbon stock changes of land converted to cropland from 2021 to 2024. No surrogate data was used to forecast estimates in the ARIMA model, with the model forecasting estimates from 2021 to 2024 based on historical trends.

Grassland Remaining Grassland

In the prior EPA (2025) analysis, both IPCC Tier 2 and Tier 3 methods were used across the time series to estimate grassland remaining grassland carbon stock changes. As described in Chapter 6.4.1 of Desai et al. (2026), estimates of carbon stock changes from grassland remaining grassland are consistent with estimates from EPA (2025) for the segment of the time series covered by the most recent Daycent simulations, with exact years varying depending on carbon pool.

For estimating grassland remaining grassland biomass (i.e., aboveground and belowground live biomass from woodlands) and DOM (dead wood and litter), estimates from 1990 to 2017 are consistent with estimates from prior analysis (EPA, 2025). These are estimated using an IPCC Tier 2 method. For this GHGIA, an ARIMA approach was used to forecast the net carbon stock change for grassland remaining grassland from 2018 to 2024.

Estimates of grassland remaining grassland organic and mineral soils from 1990 to 2020 are consistent with estimates from prior analysis (EPA, 2025). For organic soils, EPA (2025) used

an IPCC Tier 2 method to estimate carbon stock changes through 2020. For mineral soils, IPCC Tier 2 and Tier 3 methods were used across this same time-series. Additions of biosolids to mineral soils were also estimated using the IPCC Tier 2 method; as described in Chapter 6.4.1, 2023 biosolid activity data values were held constant for 2024 due to lack of data availability. For this GHGIA, an ARIMA approach was used to forecast net carbon stock changes from grassland remaining grassland from 2021 to 2024. No surrogate data was used.

Non-CO_2 Emissions from Grassland Fires

Estimates of non-CO_2 emissions from grassland fires provided in this GHGIA (Desai et al., 2026) from 1990 to 2020 are consistent with estimates from prior analysis (EPA, 2025). Emissions are estimated using an IPCC Tier 1 method which requires data on the area of U.S. managed grassland and data on what portion of the managed grassland area that is burned each year which has been previously based on the Monitoring Trends in Burn Severity (MTBS) program. For the GHGIA, the ARMA extrapolation was applied to extrapolate CH_4 and N_2O emissions for 2021–2024.

Land Converted to Grassland

In the prior EPA (2025) analysis, IPCC Tiers 1, 2, and 3 methods were used across the time series to estimate land converted to grassland carbon stock changes. As described in Chapter 6.4.2 of Desai et al. (2026), estimates of carbon stock changes from land converted to grassland are consistent with estimates from EPA (2025) for the segment of the time series covered by the most recent Daycent simulations, with exact years varying depending on carbon pool.

For estimating land converted to grassland biomass (i.e., aboveground and belowground live biomass from woodland conversion) and DOM (dead wood and litter), estimates from 1990 to 2017 are consistent with estimates from prior analysis (EPA, 2025); these are estimated using an IPCC Tier 2 method. For conversion of total live biomass from land to other grassland (non-woodland), an IPCC Tier 1 method was used. For this GHGIA, the ARIMA approach was used to forecast the net carbon stock change for land converted to grassland from 2018 to 2024.

Estimates of land converted to grassland organic and mineral soils from 1990 to 2020 are consistent with estimates from prior analysis (EPA, 2025). For organic soils, EPA (2025) used an IPCC Tier 2 method to estimate carbon stock changes through 2020. For mineral soils, IPCC Tier 2 and Tier 3 methods were used across this same time-series; the Tier 3 method was used for conversions of cropland to grassland mineral soils for which Daycent was parameterized. For this GHGIA, the ARIMA approach was used to forecast net carbon stock changes from land converted to grassland from 2021 to 2024. No surrogate data was used.

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Annex 5.17 Methodology for Estimating Net Carbon Stock Changes in Forest Ecosystems and Harvested Wood Products for Forest Land Remaining Forest Land and Land Converted to Forest Land as well as Non-CO_2 Emissions from Forest Fires

Methods are consistent with the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* (EPA, 2025). See Annex 3.14 of EPA 2025 for details on the methodologies for estimating emissions and removals associated with forest lands, including details on the recent implementation of the U.S. Forest Service National Scale Volume and Biomass (NSVB) model framework (Westfall, 2024). Both the IPCC (2006) stock-difference and gain-loss methods were utilized. The stock-difference was used for the conterminous United States (CONUS) and coastal southeast and southcentral Alaska, and the gain-loss method was used to estimate carbon stock changes in interior Alaska, Hawaii, and the U.S. Territories.

The methods used to estimate forest carbon stock and stock changes within this GHGIA (Desai et al, 2026) are now consistent across CONUS, as well as southeast Alaska. Estimates are presented in Tables A5.17-1 through A5.17-3; supplemental tables for factors that are consistent with EPA 2025 are available as CSVs.

Table A5.17-1: Net Carbon Flux from Forest Pools in Forest Land Remaining Forest Land and Harvested Wood Pools (MMT C)

Carbon Pool	1990	1995	2000	2005	2010	2020	2021	2022	2023	2024
Forest	**-252.333**	**-250.928**	**-243.725**	**-229.884**	**-225.783**	**-224.315**	**-220.651**	**-203.545**	**-212.847**	**-207.055**
Aboveground Biomass	-165.428	-161.964	-157.965	-151.564	-145.635	-141.16	-139.105	-133.404	-134.134	-130.902
Belowground Biomass	-32.4843	-31.7347	-30.982	-29.8569	-28.7095	-27.9311	-27.568	-26.5636	-26.5673	-25.9265
Dead Wood	-54.9474	-54.974	-54.4632	-53.0033	-52.6053	-52.601	-52.1148	-50.5495	-50.8636	-50.1146
Litter	-0.98605	-3.60072	-1.36888	3.903163	1.055653	-1.62612	-0.8852	8.069843	-0.20502	0.924704
Soil (Mineral)	1.661386	1.492769	1.192447	0.738657	0.168157	-1.04167	-1.02068	-1.13883	-1.11697	-1.07512
Soil (Organic)	-0.14875	-0.14759	-0.13842	-0.10164	-0.05722	0.045157	0.043254	0.041491	0.039729	0.037966
Harvested Wood	**-33.7517**	**-30.6049**	**-25.4852**	**-28.9216**	**-18.84**	**-26.4123**	**-25.824**	**-25.2963**	**-24.7922**	**-27.3991**
Products in Use	-14.9398	-14.0921	-8.7107	-11.6278	-2.01339	-8.81705	-8.29938	-7.86552	-7.47499	-9.68937
SWDS	-18.8119	-16.5127	-16.7745	-17.2938	-16.8266	-17.5952	-17.5247	-17.4307	-17.3172	-17.7097
Total Net Flux	**-286.085**	**-281.533**	**-269.21**	**-258.806**	**-244.623**	**-250.727**	**-246.475**	**-228.841**	**-237.639**	**-234.455**

Notes: Negative sign indicates net C sequestration (i.e., a net removal of C from the atmosphere). Totals may not sum due to independent rounding.

Table A5.17-2: Forest area (1,000 ha) and Carbon Stocks in Forest Land Remaining Forest Land and Harvested Wood Pools (MMT C)

	1990	2005	2020	2021	2022	2023	2024	2025
Forest Area (1,000 ha)	*281,454.87*	*281,926.50*	*282,624.25*	*282,618.61*	*282,619.90*	*282,632.18*	*282,639.95*	*282,647.71*
Carbon Pools								
Forest Ecosystem	**55,517.95**	**59,200.19**	**62,585.75**	**62,810.13**	**63,030.76**	**63,234.31**	**63,447.14**	**63,654.21**
Aboveground Biomass	12,574.76	14,973.38	17,149.11	17,290.27	17,429.38	17,562.78	17,696.92	17,827.82
Belowground Biomass	2,219.04	2,689.77	3,119.40	3,147.34	3,174.90	3,201.47	3,228.03	3,253.96
Dead Wood	2,798.35	3,614.92	4,408.35	4,460.95	4,513.06	4,563.61	4,614.48	4,664.59
Litter	3,777.49	3,791.51	3,776.46	3,778.09	3,778.97	3,770.90	3,771.11	3,770.18
Soil (Mineral)	28,303.21	28,283.43	28,284.76	28,285.80	28,286.82	28,287.96	28,289.08	28,290.15
Soil (Organic)	5,845.08	5,847.16	5,847.68	5,847.63	5,847.59	5,847.55	5,847.51	5,847.47
Harvested Wood	**1,895.18**	**2,353.25**	**2,694.33**	**2,720.74**	**2,746.57**	**2,771.86**	**2,796.65**	**2,824.05**
Products in Use	1,248.79	1,447.37	1,529.52	1,538.34	1,546.64	1,554.51	1,561.98	1,571.67
SWDS	646.39	905.88	1,164.81	1,182.40	1,199.93	1,217.36	1,234.67	1,252.38
Total Stock	**57,413.11**	**61,553.42**	**65,280.09**	**65,530.82**	**65,777.29**	**66,006.14**	**66,243.78**	**66,478.23**

Notes: Totals may not sum due to independent rounding.

Table A5.17-3: Harvested Wood Products from Wood Harvested in the United States—Annual Additions of Carbon to Stocks and Total Stocks under the Production Approach

	Net C additions per year (MMT C per year)			Total C stocks (MMT C)		
Year	Total	Products in use	Products in SWDS			
		Total	Total	Total	Products in use	Products in SWDS
1990	-33.7517	-14.9398	-18.8119	1,895.18	1,248.79	646.3895
1991	-33.7606	-16.3344	-17.4262	1,928.93	1,263.73	665.2014
1992	-32.9198	-14.9712	-17.9486	1,962.69	1,280.06	682.6276
1993	-33.4082	-15.9296	-17.4787	1,995.61	1,295.03	700.5762
1994	-32.2936	-15.0649	-17.2286	2,029.02	1,310.96	718.0548
1995	-30.6049	-14.0921	-16.5127	2,061.31	1,326.03	735.2835
1996	-32.0025	-14.7401	-17.2624	2,091.92	1,340.12	751.7962
1997	-31.142	-13.4039	-17.7381	2,123.92	1,354.86	769.0586
1998	-32.4657	-14.1114	-18.3542	2,155.06	1,368.26	786.7967
1999	-30.78	-12.8173	-17.9627	2,187.53	1,382.38	805.1509
2000	-25.4852	-8.7107	-16.7745	2,218.31	1,395.19	823.1136
2001	-26.7774	-9.57045	-17.207	2,243.79	1,403.90	839.8881
2002	-25.5624	-9.39833	-16.164	2,270.57	1,413.47	857.0951
2003	-28.382	-12.1141	-16.2679	2,296.13	1,422.87	873.2591
2004	-28.7376	-12.3837	-16.3538	2,324.51	1,434.99	889.527
2005	-28.9216	-11.6278	-17.2938	2,353.25	1,447.37	905.8809
2006	-27.349	-9.97168	-17.3773	2,382.17	1,459.00	923.1747
2007	-20.7581	-3.67193	-17.0861	2,409.52	1,468.97	940.552
2008	-14.8436	1.809482	-16.6531	2,430.28	1,472.64	957.6382
2009	-16.6036	-0.01275	-16.5909	2,445.12	1,470.83	974.2913
2010	-18.84	-2.01339	-16.8266	2,461.73	1,470.84	990.8821
2011	-19.3571	-2.3774	-16.9797	2,480.57	1,472.86	1,007.71
2012	-20.8491	-3.71518	-17.1339	2,499.92	1,475.24	1,024.69
2013	-22.5421	-5.27533	-17.2667	2,520.77	1,478.95	1,041.82
2014	-23.4324	-6.0588	-17.3736	2,543.31	1,484.23	1,059.09
2015	-24.9379	-7.39852	-17.5394	2,566.75	1,490.28	1,076.46
2016	-26.0564	-8.38256	-17.6739	2,591.68	1,497.68	1,094.00
2017	-27.2734	-9.44692	-17.8265	2,617.74	1,506.07	1,111.68
2018	-25.6042	-7.84263	-17.7615	2,645.01	1,515.51	1,129.50
2019	-23.7111	-6.16849	-17.5426	2,670.62	1,523.35	1,147.26
2020	-26.4123	-8.81705	-17.5952	2,694.33	1,529.52	1,164.81
2021	-25.824	-8.29938	-17.5247	2,720.74	1,538.34	1,182.40
2022	-25.2963	-7.86552	-17.4307	2,746.57	1,546.64	1,199.93
2023	-24.7922	-7.47499	-17.3172	2,771.86	1,554.51	1,217.36
2024	-27.3991	-9.68937	-17.7097	2,796.65	1,561.98	1,234.67

Notes: Negative sign indicates net C sequestration (i.e., a net removal of C from the atmosphere).

Updates to this GHGIA based on FIA data (Walters et al, 2026) include:

Forest ecosystem carbon stock changes

Previously, the state of Wyoming had a lack of remeasurement data within the national forest inventory (NFI) as noted in EPA 2025; therefore, theoretical age transition matrices were developed. This is further described in Annex 3.14 (starting on page A-453) of EPA 2025.

For this GHGIA, U.S. Forest Service had remeasurement data for the state of Wyoming, allowing for use of a consistent approach across CONUS including use of an empirical age class transition matrix (Walters et al, 2026). This also means that it is now possible to separate forest land remaining forest land from land converted to forest land in Wyoming, allowing harmonization with the NRI/NLCD process described in Chapter 6.1 (U.S. Land Representation) of the GHGIA.

Non-CO_2 emissions from forest fires

While the method for estimating non-CO2 emissions from forest fires did not change compared to EPA 2025, in April 2025, the MTBS program released fire maps for 399 fires from the 2023 and 2024 fire seasons. This included products from 295 fires during 2023 and initial data for 104 fires during 2024 (MTBS, 2025). As noted in Chapter 6.2.1 (Forest Land Remaining Forest Land (Source Category 4A1), this resulted in time-series recalculations.

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Annex 5.18 Methodology for Estimating GHG Emissions from Landfills

Information on the methodology used to estimate CH_4 emissions from landfills can be found in Annex 3.15 to the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Information on the methodology used to estimate CH_4 emissions from landfills will be updated and included, if applicable, in the Annex to the GHGIA for 2027.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.19 Methodology for Estimating GHG Emissions from Wastewater Treatment and Discharge

Information on the methodology used to estimate CH_4 and N2O emissions from Wastewater Treatment and Discharge can be found in Annex 3.16 to the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

Supplemental annex CSVs consistent with tables in Annexes 3.16 are available where information and/or data was updated for this GHGIA. See supplemental CSVs A-5.19-S1 through S17 published under Annex 5.

Annex 5.20 Emissions and Sinks Not Estimated

Consistent with international standards for greenhouse gas inventory completeness, and with reports previously published by U.S. EPA, the GHGIA is intended to be a comprehensive assessment of anthropogenic sources and sinks of greenhouse gas emissions for the United States. Note that natural or non-anthropogenic sources and sinks of greenhouse gas emissions, as defined by the IPCC, are intentionally excluded from the GHGIA.[4]

Some anthropogenic source and sink categories, described in this annex, are not included in the GHGIA. The reasons why an estimate for source or sink category is not reflected in the GHGIA include one or more of the following:

- Emissions and/or removals do not occur within the United States.
- A methodology for estimating emissions and/or removals from a source and/or sink does not currently exist.
- While a methodology is available from IPCC guidelines, data is insufficient to develop an emissions and/or removal estimate over the time series.
- Preliminary estimates based on proxy data suggest emissions and/or removals are likely to be insignificant in terms of overall national emissions, as defined by national inventory reporting guidelines.

For IPCC categories that occur in the United States, but which are nevertheless excluded, the main constraint to estimating and including is data availability. Many of these categories are insignificant in terms of overall national emissions based on available proxy information, qualitative information on activity levels per national circumstances, and/or expert judgment, and not including them introduces a very minor bias. The GHGIA inventory team annually assesses feasibility to estimate and include such sources or sink categories, including reviewing available data required to estimate those emissions and/or sinks, prioritizing resources for categories that may be significant.

Source and Sink Categories Not Estimated

The list of categories not estimated in the GHGIA is the same as presented and quantified in Table A-263 of EPA (2025). In addition, the total level of emission excluded from this report is expected to be identical to the estimate of 1.9 CO_2 Eq. (1,898 kt CO_2 Eq.) presented in EPA (2025). International reporting standards recommend that collectively exclusions should not exceed 0.1 percent of total gross emissions, or in the case of the United States 6.2 MMT CO_2 Eq. (6,205.3 kt CO_2 Eq.).

Geographic Completeness

Some categories are largely complete, but geographic coverage has some minor gaps, and higher levels of aggregation, particularly with respect to certain emissions and removals from

[4] See Section 1.1 of Volume 1, Chapter 1 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_1_Ch1_Introduction.pdf).

U.S. Territories, Alaska, Hawaii, the District of Columbia, and tribal lands. Further details by sector (and GHGIA chapter) are as follows:

- **Energy:** Chapter 3 includes emissions from all 50 states, the District of Columbia, U.S. Territories and tribal lands to the extent they are known to occur (e.g., coal mining does not occur in U.S. Territories). For some small sources there is a lack of detailed information on U.S. Territories, including non-CO_2 emissions from biomass combustion, so emissions estimates may not be available at same levels of disaggregation as those covering the states and District of Columbia.
- **IPPU:** Chapter 4 includes emissions from all 50 states, as well as from the District of Columbia U.S. Territories and tribal lands. While most IPPU sources do not occur in U.S. Territories (e.g., electronics manufacturing does not occur in U.S. Territories), they are estimated and accounted for where they are known to occur (e.g., substitutes from ozone depleting substance substitutes, cement production, lime production, and electrical transmission and distribution).
- **Agriculture:** Chapter 5 includes emissions from all 50 states and tribal lands; however, for Hawaii and Alaska field burning of agricultural residues and agricultural soil management are not estimated except for managed manure and pasture, range and paddock (PRP) nitrogen, and biosolid additions for Alaska, and managed manure and PRP nitrogen, biosolids additions, and crop residue for Hawaii. In addition, U.S. Territories and the District of Columbia are not estimated due to incomplete data, except for urea fertilization in Puerto Rico. Emissions currently not estimated for other U.S. Territories have not been approximated for significance. Other minor outlying U.S. territories in the Pacific Islands have no permanent populations (e.g., Baker Island) and therefore GHGIA assumes no agriculture activities are occurring.
- **LULUCF:** Emissions and removals reported in Chapter 6 include those from all 50 states and tribal lands, however, for Hawaii and Alaska some emissions and removals from land use and land use change are not included. Specifically for Alaska, carbon stock changes from coastal wetlands, cropland and lands converted to cropland, grasslands and lands converted to grassland, settlements and lands converted to settlements, N_2O from settlement soils, and non-CO_2 emission from grassfires, are not estimated. For Hawaii, all wetlands are not estimated except for flooded lands. In addition, U.S. Territories are not included (see Box 6) with the exception of forest carbon stocks. Emissions currently not estimated for U.S. Territories have not yet been approximated for significance.
- **Waste:** Emissions reported in Chapter 7 for landfills, wastewater treatment, and anaerobic digestion at biogas facilities include those from all 50 states, including the District of Columbia. as well as from U.S. Territories and tribal lands. Emissions from landfills include modern, managed sites in most U.S. Territories except for outlying Pacific Islands. Emissions from domestic wastewater treatment include most U.S. Territories except for outlying Pacific Islands. Those emissions are likely insignificant or not occurring given those outlying Pacific Islands (e.g., Baker Island) have no

permanent population. No industrial wastewater treatment emissions are estimated for U.S. Territories, due to lack of data availability. However, industrial wastewater treatment emissions are assumed to be small for other U.S. Territories and are not expected for outlying Pacific Islands. Emissions for composting include all states and Puerto Rico, except Alaska. Some composting operations in Alaska are known, but these consist of aerated composting facilities. Composting emissions are not included from the remaining U.S. Territories, and these are assumed to be small and have not yet been approximated. Similarly, the GHGIA team is not aware of any anaerobic digestion at biogas facilities in U.S. Territories but will review this on an ongoing basis to include these emissions if they are occurring.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request]

Annex 5.21 Global Warming Potential Values

Consistent with GHG inventories from other countries, this GHGIA uses 100-year GWP (GWP100) values from Table 8.A.1 in Appendix 8.A of the IPCC Fifth Assessment Report (AR5) for calculating CO_2 Eq. emissions (IPCC, 2013; Myhre et al., 2013). Information on the global warming potentials from IPCC's Fifth Assessment Report can be found in Annex 6.1 of the Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023 report and the IPCC's Fifth Assessment Report (AR5) as noted in the first sentence of this paragraph (EPA, 2025; (Myhre et al., 2013). The GHGIA uses agreed-upon GWP values for international consistency, but also published unweighted gas emissions and sinks in kilotons (kt) as supplemental CSV data files so those using GHGIA data can apply different metrics and different time horizons to compare the impacts for different greenhouse gases.

Information on the GWP values applied and comparisons of inventory estimates applying additional 100-year GWP values such as those from IPCC's Sixth Assessment Report will be updated and included, in future Annexes to the GHGIA.

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Annex 5.22 Ozone Depleting Substances Emissions

This first edition of GHGIA does not include estimates of emissions of Ozone Depleting Substances. Information on the methodology used to estimate emissions from ozone depleting substances in previous EPA inventory reports can be found in the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025).

For additional information on ODS in the United States, see the Montreal Protocol profile page for the USA[5], and the NOAA website for information on top-down data on fluorinated gases.[6]

The GHGIA is assessing options for developing ODS emission estimates for future reports, as a supplement to gases typically covered under international greenhouse gas reporting requirements.[7] Information on the methodology used to estimate emissions from ozone depleting substances will be updated and included, if applicable, in the Annex to future reports.

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U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

[5] https://ozone.unep.org/countries/profile/usa

[6] https://gml.noaa.gov/hats/US_emissiontracker/emission.html

[7] See Paragraph 48 of the Annex to Decision 18/CMA.1.

Annex 5.23 Greenhouse Gas Precursors: Mapping of U.S. EPA's National Emission Inventory (NEI) Categories to the Greenhouse Gas Inventory and Analysis (GHGIA) Categories

Emissions of precursor gases (CO, NOx, NMVOC, and SO_2) occur in all sectors and information on those emissions can be found in previous EPA GHG Inventory reports (see Chapter 2.3 and Annex 6.3 of the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025). The mapping table included in EPA (2025) explains how EPA's NEI source categories are assigned to those more closely aligned with the categories in the GHGIA Precursor emissions from Agriculture and LULUCF categories are estimated separately and therefore are not taken from the NEI.

Information on the mapping will be updated and included in the Annex to future GHGIAs when new NEI information is published. The publication of the 2023 NEI was pending when this annex was being finalized.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.24 Units, Constants, and Conversions

Consistent with Annex 6.4 EPA (2025) and international reporting standards, GHGIA data and estimates are reported in metric units. Most input data collected for the GHGIA, however, is typically in U.S. Customary units (e.g. short tons, etc.). This annex provides information on units, constants, and conversions used in compiling GHGIA information.

Units and Conversions

Table A5.24-1 provides a list of the common metric prefixes used and the magnitude they represent. Table A5.24-2 provides a list of common unit conversions.

Table A5.24-1: Metric Prefixes and Magnitude

Prefix/Symbol	Factor
atto (a)	10^{-18}
femto (f)	10^{-15}
pico (p)	10^{-12}
nano (n)	10^{-9}
micro (u)	10^{-6}
milli (m)	10^{-3}
centi (c)	10^{-2}
deci (d)	10^{-1}
deca (da)	10
hecto (h)	10^{2}
kilo (k)	10^{3}
mega (M)	10^{6}
giga (G)	10^{9}
tera (T)	10^{12}
peta (P)	10^{15}
exa (E)	10^{18}

Table A5.24-2: Unit Conversions

Starting Unit		Conversion1		Conversion2	Conversion3
Mass					
1 kilogram	=	2.205 pounds			
1 pound	=	0.454 kilograms			
1 short ton	=	2,000 pounds	=	0.9072 metric tons	
1 metric ton	=	1,000 kilograms	=	1.1023 short tons	
Volume					
1 cubic meter	=	35.315 cubic feet			
1 cubic foot	=	0.02832 cubic meters			
1 U.S. gallon	=	3.785412 liters			
1 barrel (bbl)	=	0.159 cubic meters			
1 barrel (bbl)	=	42 U.S. gallons			
1 liter	=	0.001 cubic meters			
Distance					
1 foot	=	0.3048 meters			
Starting Unit		Conversion1		Conversion2	Conversion3
1 meter	=	3.28 feet			

(continued)

Table A5.24-2: Unit Conversions *(continued)*

Starting Unit		Conversion1		Conversion2		Conversion3
1 mile	=	1.609 kilometers				
1 kilometer	=	0.621 miles				
Area						
1 acre	=	43,560 square feet	=	0.4047 hectares	=	4,047 square meters
1 square mile	=	2.589988 square kilometers				
Temperature						
Degrees Celsius	=	(Degrees Fahrenheit – 32)*5/9				
Degrees Kelvin	=	Degrees Celsius + 273.15				

Density Conversions

For calculation purposes fuel use data will sometimes need to be converted from mass to volume or vice versa depending on how data is collected and the units of emission factors used. Table A5.24-3 provides a list of commonly used density values (EIA, 2007).

Table A5.24-3: Density Conversions

Gas/Fuel	Mass		Volume		
Gas					
Methane	0.67606 kilograms	=	1 cubic meter		
Carbon dioxide	1.85387 kilograms	=	1 cubic meter		
Fuel					
Natural gas liquids	1 metric ton	=	11.6 barrels	=	1,844.2 liters
Unfinished oils	1 metric ton	=	7.46 barrels	=	1,186.04 liters
Alcohol	1 metric ton	=	7.94 barrels	=	1,262.36 liters
Liquefied petroleum gas	1 metric ton	=	11.6 barrels	=	1,844.2 liters
Aviation gasoline	1 metric ton	=	8.9 barrels	=	1,415.0 liters
Naphtha jet fuel	1 metric ton	=	8.27 barrels	=	1,314.82 liters
Kerosene jet fuel	1 metric ton	=	7.93 barrels	=	1,260.72 liters
Motor gasoline	1 metric ton	=	8.53 barrels	=	1,356.16 liters
Kerosene	1 metric ton	=	7.73 barrels	=	1,228.97 liters
Naphtha	1 metric ton	=	8.22 barrels	=	1,306.87 liters
Distillate	1 metric ton	=	7.46 barrels	=	1,186.04 liters
Residual oil	1 metric ton	=	6.66 barrels	=	1,058.85 liters
Lubricants	1 metric ton	=	7.06 barrels	=	1,122.45 liters
Bitumen	1 metric ton	=	6.06 barrels	=	963.46 liters
Waxes	1 metric ton	=	7.87 barrels	=	1,251.23 liters
Petroleum coke	1 metric ton	=	5.51 barrels	=	876.02 liters
Petrochemical feedstocks	1 metric ton	=	7.46 barrels	=	1,186.04 liters
Special naphtha	1 metric ton	=	8.53 barrels	=	1,356.16 liters
Miscellaneous products	1 metric ton	=	8.00 barrels	=	1,271.90 liters

Energy Conversions

As per international reporting standards, the common energy unit used in international GHG reporting is the joule. A joule is the energy required to push with a force of one Newton for one meter. A terajoule (TJ) is one trillion (10^{12}) joules. Data for this report is collected in British thermal units (Btu), the customary U.S. energy unit. A Btu is the quantity of heat required to

raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 degrees Fahrenheit. The conversion of TJ to other energy units is shown below.

1 TJ =	2.388×10^{11} calories
	23.88 metric tons of crude oil equivalent
	947.8 million Btus
	277,800 kilowatt-hours

Data on the production and consumption of fuels are typically first gathered in physical units. These units are converted to their energy equivalents for emission calculations. The conversion factors in Table 5.24-4 can be used as default factors if more specific data are not available. See Appendix A of EIA's Monthly Energy Review (EIA 2026) for more detailed information on the energy content of various fuels. Data for coal ranks are from EIA (1993). All values are given in higher heating values (gross calorific values).

Table A5.24-4: Conversion Factors to Energy Units (Heat Equivalents)

Fuel Type (Units)	Factor
Solid Fuels (Million Btu/Short ton)	
Anthracite coal	22.57
Bituminous coal	23.89
Sub-bituminous coal	17.14
Lignite	12.87
Coal Coke	24.80
Natural Gas (Btu/Cubic foot)	
Pipeline natural gas	1,037
Liquid Fuels (Million Btu/Barrel)	
Motor gasoline (includes ethanol)	5.050
Aviation gasoline	5.048
Kerosene	5.670
Jet fuel, kerosene-type	5.670
Distillate fuel (excludes biofuels)	5.770
Residual oil	6.287
Naphtha for petrochemicals	5.248
Petroleum coke	6.219
Other oil for petrochemicals	5.825
Special naphthas	5.248
Lubricants	6.065
Waxes	5.537
Asphalt	6.636
Still gas	6.287
Misc. products	5.796

References

U.S. Energy Information Administration (EIA) (2026). *Monthly Energy Review*, February 2026. Energy Information Administration, U.S. Department of Energy, Washington, DC. DOE/EIA-0035 (2026/02).

U.S. Energy Information Administration (EIA) (2007) *Emissions of Greenhouse Gases in the United States 2006, Draft Report*. Office of Integrated Analysis and Forecasting, Energy Information Administration, U.S. Department of Energy, Washington, DC. DOE-EIA-0573 (2006).

U.S. Energy Information Administration (EIA) (1993) *State Energy Data Report 1992*, Energy Information Administration, U.S. Department of Energy. Washington, DC. DOE/EIA-0214(93).

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

Annex 5.25 Use of Facility-Level Data

The GHGIA team is reviewing 2024 facility-level data from U.S. EPA's Greenhouse Gas Reporting Program (GHGRP) data released through a freedom of information act[8] requests for updating the next GHGIA. Uses of GHGRP from 1990-2023 remain consistent with Table A-283 of Annex 9 of the *Inventory of Greenhouse Gas Emissions and Sinks: 1990–2023* report (EPA, 2025). In addition, the GHGIA team is exploring availability and use of other facility-level data (e.g. from state reporting programs). Information on uses of GHGRP and other facility-level data will be updated and included in the Annex to the next GHGIA. Where data are used, CGS will recalculate 2024 emissions and document those updates within the recalculation discussions within the GHGIA.

References

U.S. Environmental Protection Agency. (2025). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023* (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request].

[8] https://environmentalintegrity.org/2024-greenhouse-gas-reporting-program-data/

Annex 6. Common Reporting Tables

This GHGIA is not an official national inventory nor is it an official inventory submission in the context of the UNFCCC and Paris Agreement. This annex includes a supplementary table indicating where to find equivalent or similar relevant data corresponding to data typically submitted in common reporting tables (CRTs) (i.e., cross walking CRT tables with published report or supplemental CSV data tables from the GHGIA main report or its annexes). See CSV Tables 6S-1 through 6S-6 under Annex 6.