CENTER FOR
GLOBAL SUSTAINABILITY

Greenhouse Gas Inventory and Analysis for the United States

1990-2024

Authors

Mausami Desai[1]*, Vincent Camobreco[1], Toby Hedger[1], William Irving[1], Kenna Rewcastle[1], John Steller[1], Lindsay Barbieri[2], Melissa Weitz[1], Tanvi Murumkar[1], Allen Fawcett[1], Jiehong Lou[1], Ryna Cui[1], Nate Hultman[1]

Suggested Citation

Desai, M., Camobreco, V., Hedger, T., Irving, W., Rewcastle, K., Steller, J., Barbieri, L., Weitz, M., Murumkar, T., Fawcett, A., Lou, J., Cui, R., & Hultman, N. (2026). Executive Summary. In Desai et al., *Greenhouse Gas Inventory and Analysis for the United States: 1990-2024* (pp. ES-1 to ES-7). Center for Global Sustainability, University of Maryland, College Park. https://doi.org/10.13016/g1xw-qftw

[1] Center for Global Sustainability, University of Maryland, College Park.
[2] Department of Geographical Sciences, University of Maryland, College Park

Executive Summary

ES.1 Background Information

The *Greenhouse Gas Inventory and Analysis for the United States (GHGIA)* presents a comprehensive picture of greenhouse gas (GHG) sources and sinks covering the geographical region of the United States. The data are presented for each year from 1990 through 2024, the latter being the most recent year comprehensive data are available for the entire economy.

Along with detailed results for single years and analyses of trends over time, this *GHGIA* presents methodological descriptions, data inputs, a characterization of uncertainties, recalculations, and improvements. The following gases are included: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). It also follows the five standard reporting sectors: energy; industrial processes and product use; agriculture; land use, land-use change and forestry (LULUCF); and waste.

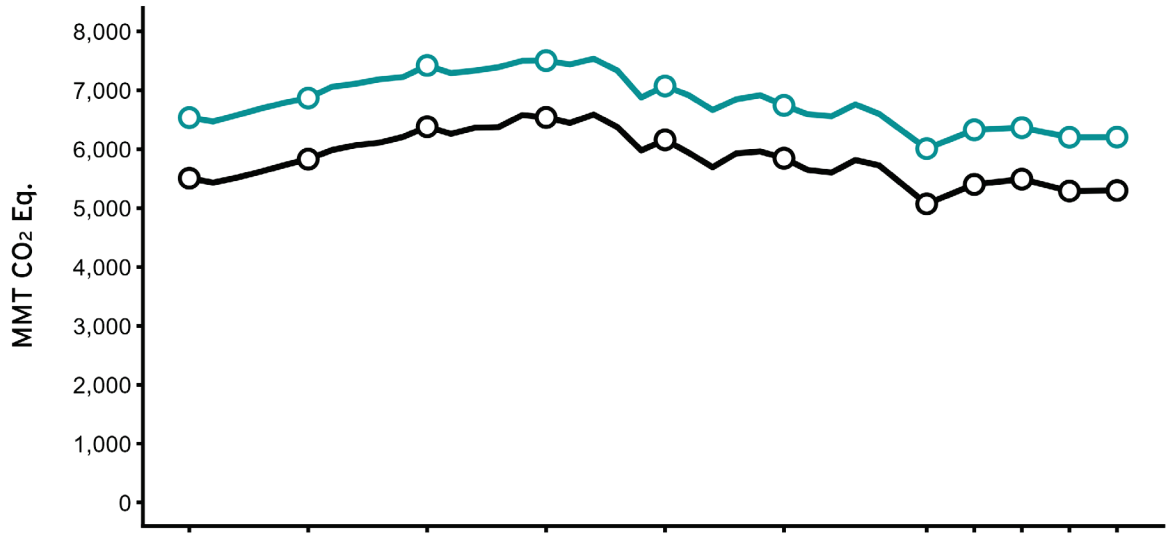
The *GHGIA* adheres to good practice as defined by the Intergovernmental Panel on Climate Change (IPCC) and to international standards for transparency, accuracy, completeness, comparability, and consistency. Users will find it possible to crosswalk the structure of this *GHGIA*, along with the results, with inventories from other countries. The use of established methodologies and data collection practices in this *GHGIA* can support its use by diverse scientific and policy communities. Moreover, this *GHGIA* has been developed in a manner that supports comparability and continuity with past official U.S. inventories prepared by the U.S. Environmental Protection Agency. The *GHGIA* is not an official national inventory produced on behalf of the United States, nor is it an official submission in the context of the United Nations Framework Convention on Climate Change (UNFCCC).

ES.2 Summary of Trends

Figure ES-1 shows the trend in both gross and net U.S. GHG emissions and removals since 1990. In 2024, total gross emissions were 6,205.3 million metric tons of carbon dioxide equivalent (MMT CO_2 Eq.). This total is a 5.1 percent decrease from 1990 and a 0.04 percent annual increase from 2023. The decreasing trend from around 2005 is associated primarily with a decrease in CO_2 emissions from fossil fuel combustion. The factors influencing this change, including declining emissions from electricity production, are discussed in more detail in Chapter 2 (Trends) and in Chapter 3 (Energy).

In 2024, total net U.S. GHG emissions, including emissions and sinks from LULUCF, were 5,298.8 MMT CO_2 Eq. This total is a 3.8 percent decrease from 1990 and a 0.2 percent annual increase from 2023. Sequestration of CO_2 in the LULUCF sector offset the equivalent of 14.6 percent of total gross emissions in 2024 (906.5 MMT CO_2 Eq.).

Figure ES-1: U.S. Gross and Net Emissions



	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	90-24
Gross Emissions	6,536	6,868	7,422	7,504	7,073	6,744	6,010	6,328	6,365	6,203	6,205	-5.1%
Net Emissions	5,507	5,831	6,381	6,539	6,159	5,846	5,071	5,402	5,491	5,290	5,299	-3.8%

ES.3 Overview of Source and Sink Categories

Figure ES-2 indicates the largest categories that contributed to overall GHG emissions in 2024, and Figure ES-3 shows categories that have experienced significant changes since 1990. Together, these categories are a subset of the inventory formally defined as "key categories" by the IPCC because they have the most significant impact on overall results.

Figure ES-2: Key Categories for 2024 and Their Emissions (Gross)

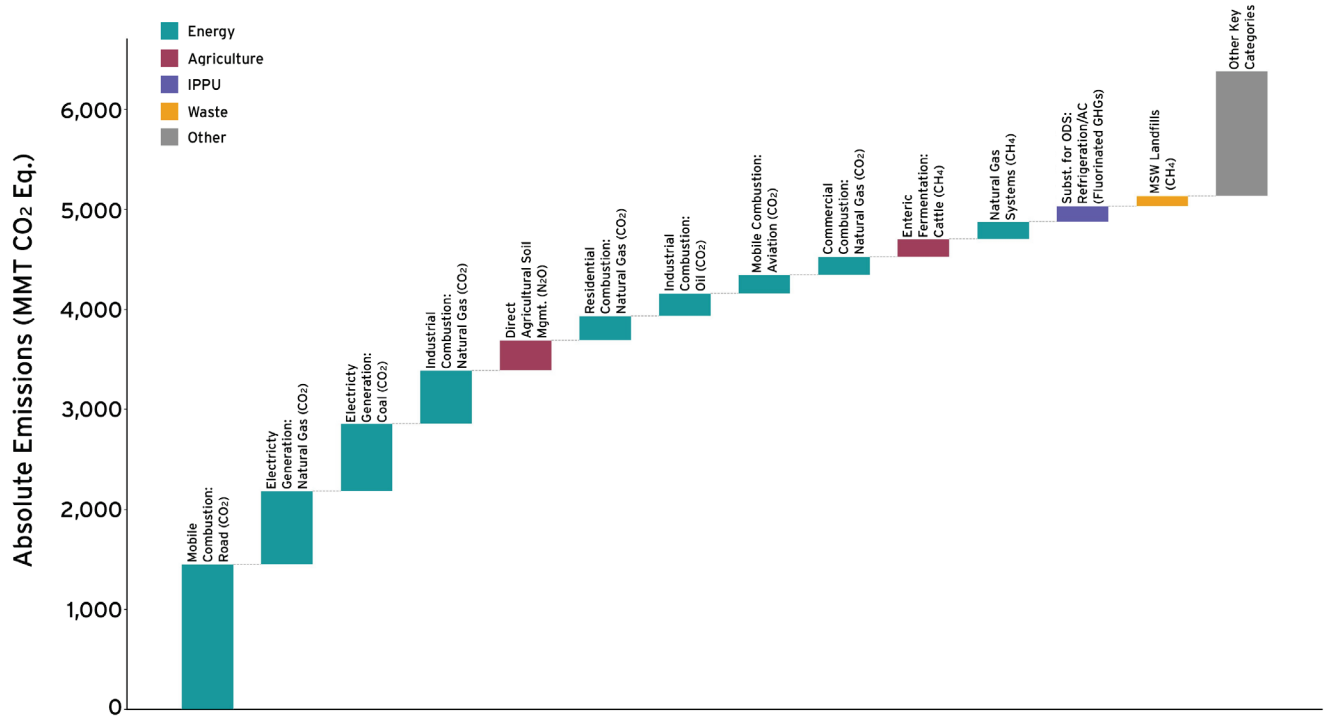
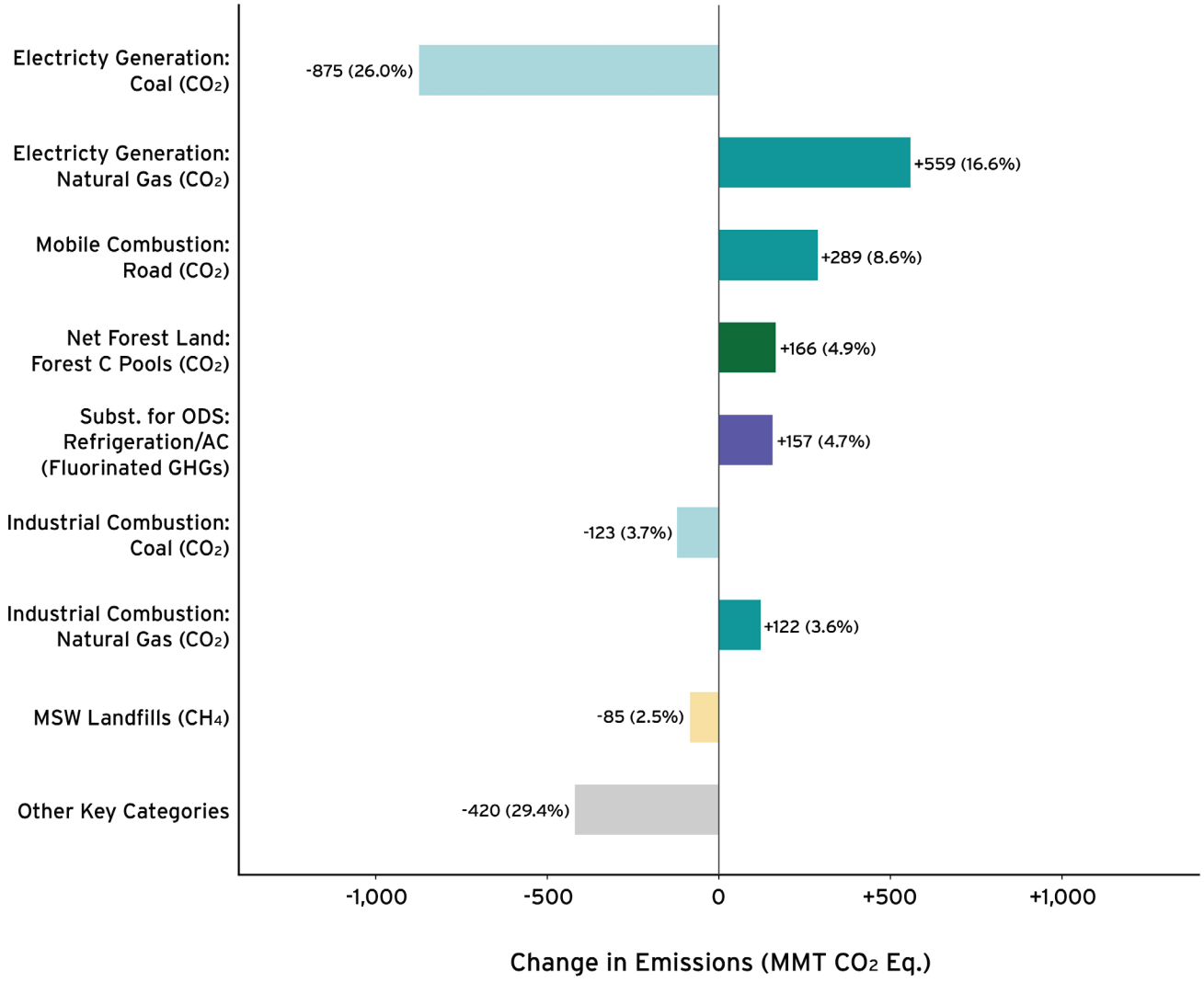


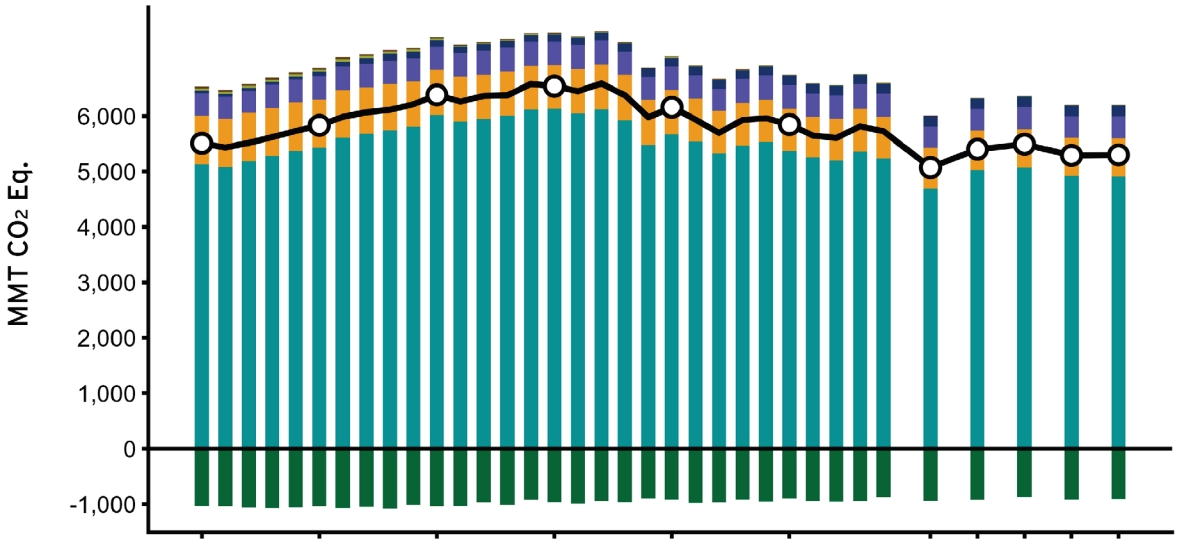
Figure ES-3: Key Categories with the Largest Changes Since 1990



ES.4 Emissions and Removals by Gas

Figure ES-4 shows the trend in emissions and removals since 1990 by GHG. CO_2 makes up the largest share of emissions in each year, and the 4.3 percent decline since 1990 is also the largest contributor to the overall reduction in emissions. On a percentage basis, CH_4, PFCs, and SF_6 also declined significantly since 1990, while HFCs experienced the largest growth. N_2O emissions did not change significantly in aggregate, but category level changes (e.g., in mobile combustion) are discussed more in Chapter 2 (Trends) and Chapter 3 (Energy).

Figure ES-4: Trends in Greenhouse Gas Emissions and Sinks by Gas

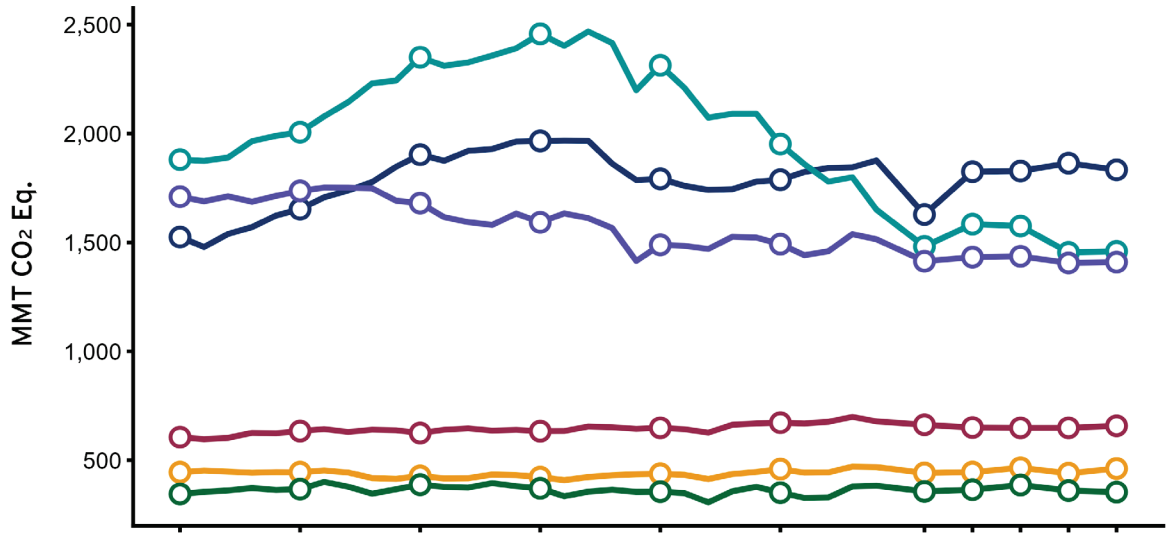


	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	90-24
CO_2	5,130	5,431	6,019	6,125	5,664	5,366	4,694	5,018	5,066	4,924	4,912	-4.3%
CH_4	873	867	818	797	810	764	731	715	696	685	687	-21.3%
N_2O	408	423	413	425	421	429	391	396	399	388	398	-2.4%
HFCs	48	74	116	125	159	168	178	184	190	191	194	306.9%
SF_6	38	35	27	20	12	8	8	8	7	8	8	-79.6%
PFCs	40	37	29	10	7	7	7	6	7	6	6	-85.6%
NF_3	+	+	1	1	1	1	1	1	1	1	1	335.8%
LULUCF Net	(1,029)	(1,037)	(1,040)	(965)	(914)	(898)	(939)	(927)	(874)	(913)	(907)	11.9%
Net Emissions	**5,507**	**5,831**	**6,381**	**6,539**	**6,159**	**5,846**	**5,071**	**5,402**	**5,491**	**5,290**	**5,299**	**-3.8%**

ES.5 Emissions by Economic Sector

GHG emissions can also be categorized according to commonly used economic sectors. One of the benefits of this approach is that it shows how economic activities consume fossil fuels for energy, which is by far the largest category of emissions. Figure ES-5 shows the relative contribution of these sectors and their emission changes over time. Electric power was the largest economic sector in 1990 but was overtaken by transportation in 2017. Electric power emissions can be assigned to the economic sectors that consume electricity to provide an additional characterization of U.S. emissions. Please see Chapter 2 (Trends) and Chapter 3 (Energy) for more information.

Figure ES-5: Trends by Economic Sector



	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	90-24
Transportation	1,525	1,653	1,903	1,966	1,792	1,788	1,628	1,825	1,828	1,864	1,833	20.2%
Electric Power	1,880	2,006	2,350	2,457	2,313	1,952	1,482	1,584	1,575	1,454	1,459	-22.4%
Industry	1,710	1,737	1,681	1,592	1,489	1,492	1,414	1,433	1,436	1,406	1,410	-17.6%
Agriculture	606	634	625	634	649	673	663	650	649	649	658	8.6%
Commercial	445	445	428	423	438	460	442	446	466	441	462	3.8%
Residential	346	368	388	371	356	351	357	365	387	361	354	2.5%
Total Gross Emissions	**6,513**	**6,843**	**7,375**	**7,444**	**7,038**	**6,716**	**5,986**	**6,302**	**6,341**	**6,175**	**6,177**	**-5.2%**

Note: Figure ES-5 excludes emissions from U.S. Territories and excludes emissions and removals from LULUCF sector.

ES.6 Improvements

This is the first *GHGIA* for the United States published by the Center for Global Sustainability. Future versions of the *GHGIA* will benefit from improvements consistent with IPCC good practice, including the refinement of existing methods, engagement with the larger scientific community to integrate new methods and analytical approaches, and innovations in data presentation and the online user experience.

Future versions may also reflect methodological evolution due in part to changes in availability of official data, such as facility-level GHG reporting and federal statistics, as well as opportunities to benefit from new nongovernmental initiatives.