

Methodology Report for Greenhouse Gas Inventory and Analysis by U.S. State 1990–2024



UNIVERSITY OF
MARYLAND
SCHOOL OF PUBLIC POLICY

CENTER FOR
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SUSTAINABILITY

Authors

Full report: Mausami Desai^{1*}, Vincent Camobreco¹, Toby Hedger¹, William Irving¹, Kenna Rewcastle¹, John Steller¹, Lindsay Barbieri², Melissa Weitz¹, Tanvi Murumkar¹, Anusha Patel¹, Mollie Averyt³, Katherine Bronstein⁴, Jake Butler³, Leslie Chinery³, Kara Edquist⁵, Rebecca Ferenchiak³, Johanna Garfinkel³, Matt Hakos⁴, Melissa Icenhour⁴, Jeremy Kaelin⁴, Emily Kerr⁴, Brandon Long⁵, Gopi Manne⁵, Tiffany Moore⁴, Ajo Rabemiarisoa³, David Randall⁴, Libby Robinson⁴, Karen Schaffner⁴, Peter Scully³, Sophia Stonebrook³, Tara Stout⁵, Emily Thompson⁴, Riley Vanek⁴, Allen Fawcett¹, Jiehong Lou¹, Ryna Cui¹, Nate Hultman¹ (*corresponding author)

Chapter 1. Introduction: Mausami Desai, William Irving, John Steller, Vincent Camobreco, Jiehong Lou, Ryna Cui, Nate Hultman

Chapter 2. Energy: Vincent Camobreco, Melissa Weitz, Brandon Long, Gopi Manne, Tara Stout, Tanvi Murumkar

Chapter 3. Industrial Processes and Product Use: Toby Hedger, Mollie Averyt, Jake Butler, Leslie Chinery, Rebecca Ferenchiak, Johanna Garfinkel, Matt Hakos, Melissa Icenhour, Jeremy Kaelin, Emily Kerr, Tiffany Moore, Tanvi Murumkar, Ajo Rabemiarisoa, David Randall, Libby Robinson, Karen Schaffner, Peter Scully, Sophia Stonebrook, Tara Stout, Emily Thompson, Riley Vanek

Chapter 4. Agriculture: Kenna Rewcastle, John Steller

Chapter 5. Land Use, Land-Use Change and Forestry: John Steller, Kenna Rewcastle, Lindsay Barbieri, Anusha Patel

Chapter 6. Waste: Mausami Desai, Katherine Bronstein, Kara Edquist, Emily Thompson

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- 1 Center for Global Sustainability, University of Maryland, College Park. A. Fawcett is also affiliated with Pacific Northwest National Laboratory, which did not provide support for this report.
 - 2 Department of Geographical Sciences, University of Maryland, College Park
 - 3 ICF, Reston, VA, United States
 - 4 RTI International, Research Triangle Park, NC, United States
 - 5 Eastern Research Group, Inc. headquartered in Concord, MA

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About the Center for Global Sustainability

Through research, global partnerships, and policy engagement, the Center for Global Sustainability (CGS) at the University of Maryland supports the development and implementation of effective action on climate, energy, and sustainability. CGS works through sustained, collaborative research partnerships in the United States and around the world. Our research programs cover national climate strategies, including national climate targets (NDCs) and long-term strategies; benefits of energy and climate transitions; sub-national climate action; non-CO₂ greenhouse gases; data, inventories, reporting, and transparency; science and scenarios; and more. Our work is also carried out through geographically focused programs focused on the United States, China, Indonesia, Brazil, India, Korea, Japan, Mexico, Canada, Australia, and other countries; and with U.S. subnational governments, including Maryland, other U.S. states, and other subnational actors within the U.S. and other countries. Embedded in the UMD School of Public Policy, we are committed to empowering the next generation of research and policy leaders through our mentoring, research training, and education for students at the undergraduate, master's, and Ph.D. levels.

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Introduction



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1. Introduction

This report describes the methodologies used by the Center for Global Sustainability (CGS) to disaggregate national-level anthropogenic greenhouse gas (GHG) emissions and sinks to the state level while maintaining consistency with the *Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (GHGIA)* (Desai et al., 2026). State-level data is available on the *GHGIA* website (<https://ghgi.cgs.umd.edu>) under the Data and Tools tab. CGS intends to continue publishing the national-level *GHGIA* annually each April, presenting time-series estimates by gas, source or sink, and sector. The complementary state-level estimates, hereafter referred to as the *GHGIA by State*, will also be published annually following the release of the national-level report.

The approaches and specific methods for estimating state-level emissions described in this document are consistent with the national-level *GHGIA*, meaning:

- The methodologies and reporting adhere to good practice as defined by the Intergovernmental Panel on Climate Change and to international standards for transparency, accuracy, completeness, comparability, and consistency.
- The estimates are based on the **same methodologies as the national-level *GHGIA*** and reflect methodological refinements and improvements in the national-level *GHGIA*.
- This report covers the years 1990–2024, consistent with the most recent national-level *GHGIA*.
- The **completeness and geographic disaggregation** of the report are consistent with the national-level *GHGIA*, meaning the state-level estimates cover all anthropogenic sources and sinks, and all seven gases (carbon dioxide [CO₂], methane [CH₄], nitrous oxide [N₂O], hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], sulfur hexafluoride [SF₆], and nitrogen trifluoride [NF₃]). In addition to estimates for states, the report also includes emissions and removals occurring in the District of Columbia, U.S. territories, and tribal lands. See Annex 2 for more information on geographic completeness.
- Estimates are compiled to **avoid double counting** or gaps in GHG emissions coverage between states, ensuring that state totals, when summed, equal totals in the national-level *GHGIA*. This is important for data users, who require consistent, comparable, and complete state data for analyses and other purposes.

Official State Inventories

Many states have compiled or are developing their own state-level GHG inventories on a regular basis (e.g., annual, biennial, etc.). The state inventory data accompanying this methodology report should not be considered the official data of any state government. In addition, for states where an official inventory is available, states may find CGS's *GHGIA by State* useful for comparison and quality assurance and quality control (QA/QC), or as a complement or supplement to existing state efforts. Depending on their circumstances and policy needs, states may also choose to adopt the CGS estimates or activity data as part of their official estimates. See Annex 1 to this report for information on where users can find official state-level data.

This methodology document is organized by inventory reporting sectors⁶ and their respective source and sink categories, consistent with the national-level *GHGIA*. For users seeking a comprehensive technical understanding of the compilation of *GHGIA by State* emission and sink estimates, CGS recommends reading this methodology report in conjunction with the corresponding sections of the three key references listed in Table 1-1. The *GHGIA by State* emission and sink estimates are compiled to be consistent with the latest national-level GHG data and largely apply or extend methodologies and data previously published by the U.S. Environmental Protection Agency (EPA). The first version of the EPA state report underwent formal peer review in 2021, in addition to technical review by state experts.⁷

Methodological detail is only included in this document for new sources that were not included in EPA (2024). Unless otherwise noted, readers should refer to EPA (2024) for detailed descriptions of disaggregation methodologies. Where previously published methods remain unchanged, CGS summarizes the disaggregation approaches rather than repeating information from the latest national-level inventory report or the previous state-level methodology report.

Table 1-1: Key References for Data Users

Geographic Scope	Report	Publication Source	Publication Date	What to Read
State	Methodology Report Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990–2022	U.S. Environmental Protection Agency (EPA) (EPA, 2024)	September 2024	The sector and source-category-level “Background,” “Methods/Approach” and “Uncertainty” sections
National	Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2023	EPA (FOIA Release) (EPA, 2025)	May 2025	The relevant sector/source category-upfront content and “Methodology and Time-Series Consistency” and “Uncertainty” sections as appropriate
National	Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (GHGIA)	Center for Global Sustainability (CGS) (Desai et al., 2026)	April 2026	The source category-level “Methodology,” “Recalculation,” and “Uncertainty” sections

6 The international reporting guidelines require reporting of GHG emissions and removals across five sectors: energy, IPPU, agriculture, LULUCF, and waste. Find international reporting guidelines at <https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review/reporting-and-review-under-the-paris-agreement/national-inventory-reports>

7 See <https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-state-methodology-report-archive> for the peer review and supporting files.

Differences Between CGS and Official State GHG Data

CGS's *GHGIA by State* data may differ from inventories developed independently by state governments. These differences can arise for several reasons and do not necessarily indicate that one set of estimates is more accurate or "correct" than another. Consistent with EPA's state GHG data, CGS clearly describes its coverage, methodologies, and accounting approaches to help users understand these differences. CGS's estimates are intended to complement and supplement existing state data. Potential differences between CGS and official state estimates are summarized in Table 1-2.

Table 1-2: Potential Differences Between Official State GHG Inventories and CGS Estimates

Area	Potential Differences
Organization of sectors	CGS has organized estimates by sector and their respective source and sink categories, consistent with the national-level <i>GHGIA</i> and with international reporting guidelines. Standardization of sectors in international reporting allows countries to compare data and supports cooperation on climate action. States may use alternate organization of data for presenting emissions and sinks, such as economic sectors, rather than IPCC sectors. Some states may use IPCC sectors as the basis of their inventory, but allocate categories differently across sectors, such as reporting some IPPU categories in the energy sector (e.g., SF₆ from electrical transmission and distribution). Comparability also depends on similar coverage. The completeness and geographic disaggregation of the estimates are consistent with the national-level <i>GHGIA</i>, meaning in addition to estimates for states, the methods also address emissions and removals occurring in the District of Columbia, U.S. territories, and tribal lands. Note: The data accompanying this document also presents estimates using economic sectors, consistent with U.S. energy data conventions (electric power industry, industry, agriculture, commercial, and residential sectors).
Methods and data	As a starting point, CGS generally used either the same methods or methods based on those used to compile the national-level estimates. In some cases, CGS used different methodologies, activity and/or proxy data, and emissions factors to disaggregate national emissions to each state. States may apply the same methods but use different sources of activity data. For example, states may have access to the latest facility-level information through state reporting programs.

Area	Potential Differences
Accounting approaches	States may have adopted different accounting decisions that differ from those adopted for international reporting (e.g., use of different category definitions and emission scopes consistent with state laws and regulations). CGS uses geographic state boundaries to allocate emissions consistent with the international methodological framework for national reporting.⁸ This means CGS focuses on emissions that occur within geographic state boundaries (“Scope 1”), whereas some states include emissions that are caused by activity within their borders but which actually occur in other states (“Scope 2 or 3”). In this example, some states include emissions from imported electricity or electricity production that occurs outside state boundaries. States may also use consumption-based accounting approaches, which include emissions resulting from the consumption of goods and services regardless of where they occur. Other possible accounting differences include the approach to estimating transportation, cross-border aviation and marine emissions, or treatment of biogenic CO₂. For example, CGS does not include biogenic CO₂ emissions in state energy sector totals because, in accordance with IPCC methodological guidelines, CO₂ emissions and removals due to the harvesting, combustion, and growth of biomass are included in the carbon stock changes of the relevant land use category of the LULUCF sector where the biomass originates. Including these emissions in both energy sector and LULUCF totals would result in double counting.⁹ Users of <i>GHGIA by State</i> should take care to review and understand differences in accounting approaches to ensure that any comparisons of estimates are based on an equivalent or an apples-to-apples comparison of estimates.
Time series	CGS has developed state-level estimates for 1990–2024 consistent with the national-level <i>GHGIA</i> published in April 2026 and with current international reporting requirements. States may estimate emissions and sinks over a different time period based on state goals, designation of different base years, legislation, and available state data. Some states may not estimate back to 1990 and instead include only more recent years. Other states may have previously published estimates for earlier years but have not recalculated or otherwise updated these estimates in more recent publications despite changes in methods, activity data, or emissions factors. Similarly, new emissions sources may be added in recent years to improve completeness of the inventory, but those sources may be excluded or not estimated in earlier years of the time series (due to lack of data).
Global warming potentials (GWPs)	States may use different metrics for CO₂ equivalency of non-CO₂ gases, such as different values for GWPs. Consistent with the national-level <i>GHGIA</i>, CGS is using 100-year GWPs from IPCC’s Fifth Assessment Report (AR5) to calculate CO₂ equivalency of non-CO₂ state-level emissions, as required for international reporting of annual national inventories (IPCC, 2014). This requirement ensures that national GHG inventories reported across nations are comparable.

8 See Volume 1, Chapter 8, Section 8.2.1, on Coverage, available online at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_8_Ch8_Reporting_Guidance.pdf. Per the 2006 IPCC Guidelines, national inventories include GHG emissions and removals taking place within national territory and offshore areas over which the country has jurisdiction with some minor exceptions. For example, one exception is “CO₂ emissions from road vehicles should be attributed to the country where the fuel is sold to the end user.”

9 See Q2-10 of Frequently Asked Questions on general guidance and other inventory issues: <https://www.ipcc-nggip.iges.or.jp/faq/faq.html>.

Institutional Arrangements

In preparing the state-level inventory, CGS uses many of the same data arrangements used to compile the national-level *GHGIA* (see Chapter 1. Introduction of the *GHGIA*).

Methodology

Consistent with EPA (2024), three different approaches are applied to disaggregate national estimates to the state level, as described in Table 1-3. CGS ensures consistency with the *GHGIA* by either applying the same methods used to compile national estimates or using methods that are based on those used to compile national estimates.

Within each sector’s documentation, CGS has provided a methodology summary table indicating the approach used to disaggregate national estimates to the state level. CGS has also prepared data appendices to provide underlying data and/or relevant proxy information, where possible, to estimate emissions and sinks.

Table 1-3: Disaggregation Approaches

Disaggregation Approach	Description
Use same method as national-level <i>GHGIA</i>	The national-level <i>GHGIA</i> methods are applied directly at state or finer levels. For example, estimates of forest land remaining forest land and of lands converted to forest land are built from existing data sets that already disaggregate to the state level (see Chapter 5, Table 5.1), and where national estimates reflect aggregation of data estimated at subnational or substate scale. Another example using this approach is state-level fossil fuel combustion estimates, where state energy use data from the U.S. Energy Information Administration (EIA) are used to estimate state-level emissions, i.e., state-level energy use is based on the same basic data sources used to estimate national-level fossil fuel combustion emissions (see Chapter 2, Table 2.1).
Use proxy/indicator data	Estimates are disaggregated from national-level <i>GHGIA</i> estimates using geographic proxies or other indicators (e.g., population, production capacity, GHGRP). This approach is applied for categories where it was not possible to apply the same method used for the national-level <i>GHGIA</i> (i.e., because state-level data were not available or were incomplete). For example, this approach is used to estimate state-level emissions from other process uses of carbonates (see Chapter 3, Table 3.1) where state-level population is used as a proxy to allocate national emissions. A key factor in this approach is evaluating how well emissions correlate with proxies, and where multiple options exist, how to choose among them.

Disaggregation Approach	Description
Hybrid (e.g., combination of both approaches)	Under this approach, state-level estimates apply a combination of approaches over the time series due to limitations or changes in availability of state-specific data for each year. For example, some estimates may use facility-specific data from EPA's GHGRP, which began collecting data in 2010, as a basis for national- and state-level estimates. For these categories, CGS may use the same method for 2010–2024, while using a proxy approach for earlier years of the time series to estimate state-level emissions, employing IPCC good practice guidance techniques to ensure consistency over the time series to the extent possible. ¹⁰ For example, this approach is used to estimate state-level CO ₂ and PFC emissions from aluminum production (see Chapter 3, Table 3.1).

Changes from EPA (2024)

CGS follows IPCC good practice by recalculating and revising national-level estimates as better methods and/or data become available. This approach reduces uncertainties over time and improves inventory quality by increasing transparency, completeness, consistency, and overall usefulness. CGS applies the same good practices to state-level estimates. In general, when methodological changes are implemented, the time series in the previous report (i.e., 1990–2023) is recalculated to reflect the change. Note that the most common reason for recalculating national GHG emissions estimates is to incorporate updated statistical data, and changes may impact only recent years of the time series.

Changes or updates made to state-level data are presented within each sector in upfront tables (e.g., 2-2, 3-2, etc.). Although compiled by different organizations, changes to state GHG data between CGS's *GHGIA* report and the previous estimates published by EPA (2025) covering 1990–2023 are considered recalculations and noted within the methodology summary tables. The "Additional Information" column tables indicate reasons for revisions, e.g., whether changes are due to refinements in the national-level *GHGIA* methods and data, including new categories, and/or due to an update that refined the approach and data used to disaggregate national estimates to the state level.

Quality Assurance/Quality Control (QA/QC)

CGS implemented QC procedures during the compilation process to support quality, transparency, and integrity of the *GHGIA by State*. CGS implemented general QC procedures adapted from the national-level *GHGIA* to ensure that data processing and application of methods could easily identify and correct errors (i.e., data/unit transcription, computation, recalculation, and trend checks). Finally, CGS compared the sum of state GHG emission and sink estimates to national emission and sink estimates by gas, category, IPCC sector, and economic sector, for consistency with the national-level *GHGIA*.

¹⁰ See Volume 1, Chapter 5: Time Series Consistency from 2006 IPCC Guidelines for National Greenhouse Gas Inventories at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_5_Ch5_Timeseries.pdf.

For quality assurance or review, CGS welcomes feedback on this methodology report and the accompanying 1990–2024 state GHG data. Responses to comments received by **November 16, 2026**, will be published with the next methodology report along with an explanation of how CGS addressed comments. Comments received after this date will also be considered as input for preparing future reports. Feedback can be submitted to ghgi@umd.edu. See also Future Areas for Improvement below.

Uncertainty

CGS has not quantified state-specific or category-level uncertainties for the activity data and other parameters used to estimate state-level emissions and removals but has provided qualitative information on how uncertainties compare to those in the national-level *GHGIA*. The uncertainties of state-level emissions estimates are generally expected to be comparable to or higher than the uncertainties of national-level emissions estimates for the reasons listed below. As with the national-level *GHGIA*, the state-level uncertainty estimates for any given source or sink category may change as the understanding of the uncertainty associated with the underlying data parameters and methodologies improves.

- First, where state GHG data is based on the same methodology, uncertainty is expected to be comparable to quantified uncertainty estimates in the national-level *GHGIA*. For example, in the agriculture and LULUCF sectors, uncertainty in state-level emissions estimates is expected to be similar to the uncertainty associated with national estimates since national estimates are developed from emissions estimated at higher resolution spatial scales.
- Second, for cases where proxy approaches are needed to disaggregate national estimates, CGS expects the uncertainty in state-level emissions to be larger than that associated with national estimates as the assumptions involved in the use of proxies contributed additional uncertainty to reported estimates. For example, where total U.S. production is multiplied by an emissions factor to obtain total national-level emissions, but production capacity rather than production is used to allocate the U.S. emissions to facilities and states, variation in each facility's capacity utilization in relation to actual production will not be reflected in the estimates, increasing their uncertainty.
- Third, for some categories where state-level emissions are estimated using the same facility-based methods as are used for national-level emissions (i.e., where same method is used), state-level uncertainties will generally be higher than national-level uncertainties (in percentage terms), assuming the uncertainties in the estimates for each facility and state are independent of each other.
- In instances where hybrid approaches are implemented to disaggregate state-level estimates, uncertainty in reported estimates may be similar or higher in the segments of the time series depending on which portions of the time series employ a proxy and which segments apply the same methods as the national-level *GHGIA*.

For more information on uncertainties with national-level GHG estimates, see Section 1.7 of the Introduction chapter to the national-level *GHGIA*. Category-specific uncertainties for national estimates are discussed qualitatively in the category-specific methodological discussions across the national-level *GHGIA* report, and quantitative estimates are summarized at the end of each sectoral chapter.

Future Areas of Improvement

CGS has outlined areas for improving future annual publications of these data at the sector level. These improvement areas are additional to improvements identified in the national-level *GHGIA*. From a cross-cutting perspective, CGS plans to prioritize the following improvements:

- Publishing key category analyses for each state.
- Implementing additional QA/QC through analysis and comparisons of *GHGIA by State* data with estimates recently published in official state inventories.

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2

Energy



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2. Energy

The energy sector includes state-level emissions estimates from the following source categories consistent with the national-level *GHGIA*:

- Fossil fuel combustion (FFC): emissions associated with fuel use, including combustion and non-energy use (NEU) of fuels
 - Fossil fuel combustion
 - Carbon emitted from non-energy use of fossil fuels
 - Geothermal
 - Incineration of waste
 - International bunker fuels
 - Wood biomass and biofuels consumption
- Fugitive emissions, mainly from fuel production
 - Coal mining
 - Abandoned underground coal mines
 - Petroleum and natural gas systems
 - Abandoned oil and gas wells

More information on national-level energy sector emissions and methods is available in Chapter 3 of the latest national-level *GHGIA*.

Methodology

Table 2-1 summarizes the different approaches used to estimate state-level energy emissions. Overall, the specific methods used to develop state-level estimates for 1990–2024 are the same as EPA (2024a), and any relevant updates are described under “Additional Information”. For users seeking a comprehensive technical understanding of the compilation of *GHGIA by State* emission and sink estimates, this methodology report is best read in conjunction with the corresponding sections of the three references provided in Table 2-2. The *GHGIA by State* emission and sink estimates are compiled to be consistent with the latest national-level *GHGIA* data and largely apply and extend methodologies and data previously published by EPA at the national and state levels. Methodological detail is only included in this document for new sources not included in EPA (2024a). Unless otherwise noted, readers should refer to EPA (2024a) for detailed descriptions of disaggregation methodologies. Where previously published methods remain unchanged, CGS summarizes the disaggregation approaches rather than repeating information from the latest national-level inventory report or the previous state-level methodology report. Recalculations at the national-level *GHGIA* (2026) that affect state-level estimates are discussed in the national-level *GHGIA* Chapter 3. Geographic completeness is consistent with the national-level *GHGIA* and is summarized in Annex 2 by sector and source.

Table 2-1: Methodology Summary for State-Level Energy Sector GHG Emission Estimates

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Fossil fuel combustion (FFC)					
Fossil Fuel Combustion (FFC) (<i>GHGIA</i> Section 3.1)	CO ₂ CH ₄ N ₂ O	For most fuels and sectors, state-level emissions are estimated by allocating national emission estimates to states using the same method as the national-level <i>GHGIA</i> (2026). For some fuels and sectors (e.g., fuel use adjustments in the industrial sector due to emissions being accounted for as part of IPPU), proxy data is used to allocate national totals (e.g., IPPU data on total emissions by state).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the time series are due to use of updated data. Recalculations also reflect updates at the national level. See the <i>GHGIA</i> Section 3.1 for more details.	Includes activity data and information on how data was proxied across states. Appendix A: National 2024 FFC CO₂, State FFC CO₂ (Table A-1), FFC CO₂ Residential (Tables A-2 to A-8), FFC CO₂ Commercial (Tables A-9 to A-18), FFC CO₂ Industrial (Tables A-19 to A-47), FFC CO₂ Transportation (Tables A-48 to A-51), FFC CO₂ Electricity (Tables A-52 to A-58), Stationary non-CO₂ (Tables A-89 to A-104), Mobile non-CO₂ (Tables A-105 to A-116), Ag Stationary (Tables A-130 to A-133), Ag Mobile (Table A-134) & Ag CO₂ (Table A-135) Tabs
NEUs of fossil fuels (<i>GHGIA</i> Section 3.2)	CO ₂	State-level emissions are estimated by allocating national emission estimates to states using proxy approaches (e.g., non-energy use of petrochemical feedstock emissions is allocated to states based on petrochemical production emissions by state from IPPU).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the time series are due to use of updated data. Recalculations also reflect updates at the national level. See the <i>GHGIA</i> Section 3.2 for more details.	Includes activity data and information on how data was proxied across states. Appendix A: National 2024 NEU CO₂, NEU (Tables A-59 to A-77) and NEU Adj (Tables A-82 to A-88)-Tabs

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Geothermal (GHGIA Section 3.1)	CO ₂	State-level emissions are estimated by allocating national-level GHGIA emission estimates to states using geothermal production by state as proxy data.	No	N/A	N/A
Incineration of waste (GHGIA Section 3.3)	CO ₂ CH ₄ N ₂ O	State-level emissions are estimated by allocating national-level GHGIA emission estimates to states using a combination of proxy approaches across the time series. 1990–2010: State-level emissions are estimated by allocating national emission estimates to states using total MSW combusted in each state as proxy data. 2011–2024: State-level emissions are estimated by allocating national emission estimates to states using the same method as the national-level GHGIA.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Updates were made to use EIA data in 2024 instead of GHGRP data at both the national and state level. See the GHGIA Section 3.3 for more details.	Includes activity data and information on how data was proxied across states. Appendix A: Waste Incineration (Table A-117) Tab

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
CO ₂ transport, injection, and geological storage (<i>GHGIA</i> Section 3.9)	CO ₂	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using the same method as the national-level <i>GHGIA</i> .	Yes	New source first added in EPA (2025a). The data used matches the national-level <i>GHGIA</i> approach, proxied for 2024. See the <i>GHGIA</i> Section 3.9 for more details.	N/A
International bunker fuels (IBFs) (memo item) (<i>GHGIA</i> Section 3.10)	CO ₂ CH ₄ N ₂ O	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using proxy data (e.g., total jet fuel used per state is used to allocate jet fuel bunkers).	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Updates were made only to proxy jet fuel bunker data for 2024. See the <i>GHGIA</i> Section 3.10 for more details.	Includes activity data and information on how data was proxied across states. Appendix A: IBF (Tables A-78 to A-81) Tab
Wood biomass and biofuels consumption (memo item) (<i>GHGIA</i> Section 3.11)	CO ₂	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using proxy data (e.g., total gasoline used per state is used to allocate ethanol use).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions were made to the time series based on updated proxy data used. Recalculations also reflect updates at the national level. See the <i>GHGIA</i> Section 3.11 for more details.	Includes activity data and information on how data was proxied across states. Appendix A: Biomass CO ₂ (Tables A-118 to A-129) Tab

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Fugitive Emissions					
Coal mining (<i>GHGIA</i> Section 3.4)	CH ₄	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using the same method as the national <i>GHGIA</i> .	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions were made to the time series based on updated data used. Recalculations also reflect updates at the national level. See the <i>GHGIA</i> Section 3.4 for more details.	N/A
Abandoned underground coal mines (<i>GHGIA</i> Section 3.5)	CH ₄	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using a combination of approaches across the time series. 1990–2019: State-level emissions are estimated by allocating national emission estimates to states using relevant proxy data. 2020–2024: State-level emissions are estimated by allocating national emission estimates to states using the same method as the national-level <i>GHGIA</i>.	No	N/A	See Appendix B (Tables B-1 through B-4) from EPA (2024a) for 1990–2019 data.

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Petroleum and natural gas systems (<i>GHGIA</i> Sections 3.6 & 3.7)	CO ₂ CH ₄ N ₂ O	1990–2023: State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using proxy data (e.g., total gas production, transmission pipeline miles). Where basin-level approaches are used in the <i>GHGIA</i>, those approaches are also applied here. Refinery emissions are based on GHGRP locations. 2024: For each segment, the total national emissions were multiplied by the average fraction of total national emissions in that state for years 2022 and 2023.	No	The disaggregation method and estimates for 1990–2023 remain unchanged.	See Appendix B Energy Sector Fugitive Estimates from EPA (2025a), Tables B-5 to B-12 for 1990–2023 data.
Abandoned Oil and Gas Wells (<i>GHGIA</i> Section 3.8)	CO ₂ CH ₄	1990–2023: Same approach as national-level <i>GHGIA</i>. 2024: For oil and for gas, the total national emissions were multiplied by the average fraction of total national emissions in that state for years 2022 and 2023.	No	The disaggregation method and estimates for 1990–2023 remain unchanged.	See Appendix B - Energy Sector Fugitive Estimates from EPA (2025a), Table B-13 Annual State-Level Abandoned O&G Well Count Estimates (1990–2023).

Table 2-2: Key References for Data Users

Geographic Scope	Report	Publication Source	Publication Date	What to Read
State	Methodology Report Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990–2022	EPA (2024a)	September 2024	Chapter 1 (Introduction) and Chapter 2 (Energy) sector/source-level “Background”, “Methods/ Approach” and “Uncertainty”
National	Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2023	EPA (2025b)	May 2025 (FOIA Release)	Chapter 3 (Energy) source category-level upfront discussion and “Methodology and Time-Series Consistency” and “Uncertainty” sections, as appropriate
National	Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (GHGIA)	CGS (Desai et al., 2026)	April 2026	Chapter 3 (Energy) source category-level “Methods” “Recalculation,” and “Uncertainty” sections as appropriate, and “Future Areas for Improvement”

Methodology for newly added sources

Starting with 1990–2023 data, state-level emissions for CO₂ Transport, Injection, and Geological Storage were added as a new source. The data used matches the national-level *GHGIA* approach, which relies on data from the EPA GHGRP (EPA, 2024b, 2024c). The GHGRP data is at the state level, so the allocation approach uses the same data as the national estimates. For 2024, since GHGRP data was not available at the time estimates were developed, the 2024 values were proxied to 2023 levels. See the *GHGIA* Section 3.9 for more details.

Comparison to national totals

Quality control procedures were implemented to review changes to the time series and confirm that energy source estimates sum to national estimates. Issues identified during these checks were addressed, and errors were corrected (e.g., computational formula errors, transcription errors, etc.).

The state-level energy source calculations resulted in GHG estimates that generally add up to the total estimates in the national-level *GHGIA*, with small differences occurring at the more disaggregated sector level. The differences are due to the vintage of the different data sources used. The national-level *GHGIA* was based on the February 2026 Monthly Energy Review (MER) (EIA, 2026a), while the state-level values were based on the June 2026 State Energy Data System (SEDS) (EIA, 2026b). The SEDS uses updated information on the sector allocation of some fuels (mostly lubricants and liquefied petroleum gas (LPG), as shown in Figure 2-1, which will be reflected in the next national-level *GHGIA* report. There is also a slight difference in total emissions. The percentage differences in the 2024

sector totals are small: a 0.5% difference in the residential sector and -0.2% in the industrial sector. The percentage difference in total emissions is also very minor, a 0.0004% difference.

There are some small differences in the NEU-calculated state-level emissions totals compared with what is reported in the national-level *GHGIA*. As with FFC, these differences represent a very small percentage of total NEU emissions (the maximum percentage difference over time is around 0.015% of total NEU emissions).



Figure 2-1: Sectoral Differences in Select Fuels

Future areas of improvement

Areas for improving the energy sector state-level estimates are the same as those presented in Section 3.1 of the national-level *GHGIA* (Desai et al., 2026). Additional improvements to reduce uncertainty and provide additional detail consistent with the national-level *GHGIA* are outlined below:

- The approach used to allocate bunker fuels by state based on the total amount of jet fuel used by state could potentially lead to an overestimation or underestimation of bunker fuel emissions for some states. Therefore, CGS will look into better ways to allocate jet fuel bunker data across states, such as flight-level data on departures and destinations.
- The national-level *GHGIA* distributes electricity emissions across end-use sectors to present results with electricity distributed by sector. That calculation was not done at the state level. The national-level *GHGIA* also breaks out transportation sector emissions by vehicle type; that calculation was also not done at the state level. CGS will look into reporting these disaggregated data in future state-level reports.

References

The references listed below only include new references used for compiling and updating the current *GHGIA by State*. Full citations for all references relevant to compiling national-level Energy estimates are found at the end of Chapter 3 (Energy) of the national-level *GHGIA* (2026) and its Annexes 5.1 through 5.11. The national-level *GHGIA* is available online at <https://ghgi.cgs.umd.edu/>.

General Energy

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A photograph of industrial cooling equipment, featuring large white rectangular units with circular fans on top and metal pipes connected to the sides. The scene is set outdoors on a dark surface.

3

Industrial Processes and Product Use (IPPU)



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3. Industrial Processes and Product Use

The IPPU sector state-level emissions estimates include the following sources consistent with the national-level *GHGIA*:

- Minerals
 - Cement production
 - Lime production
 - Glass production
 - Other process uses of carbonates
- Chemicals
 - Ammonia production
 - Urea consumption for non-agricultural purposes
 - Nitric acid production
 - Adipic acid production
 - Caprolactam, glyoxal, and glyoxylic acid production
 - Carbide production and consumption
 - Titanium dioxide production
 - Soda ash production
 - Petrochemical production
 - HCFC-22 production
 - Production of fluorochemicals other than HCFC-22
 - Non-EOR carbon dioxide utilization
 - Phosphoric acid production
- Metals
 - Iron and steel production and metallurgical coke production
 - Ferroalloy production
 - Aluminum production
 - Magnesium production
 - Lead production
 - Zinc production
- Product use
 - Electronics industry
 - Substitution of ozone depleting substances
 - Electrical equipment

- SF₆ and PFCs from other product use
- Nitrous oxide from product uses

More information on national-level IPPU sector emissions and methods is available in Chapter 4 of the latest national-level *GHGIA*.

Methodology

Table 3-1 summarizes the different approaches used to estimate state-level IPPU sector emissions and completeness across states. The disaggregation approaches applied in developing the 1990–2024 state-level estimates are generally the same as EPA (2024), and any relevant updates are described under “Additional Information”. For users seeking a comprehensive technical understanding of the compilation of *GHGIA by State* emission and sink estimates, this methodology report is best read in conjunction with the corresponding sections of the three references provided in Table 3-2. The *GHGIA by State* emission and sink estimates are compiled to be consistent with the latest national-level *GHGIA* data and largely apply and extend methodologies and data previously published by EPA at the national and state levels. Methodological detail is only included in this document for new sources not included in EPA (2024). Unless otherwise noted, readers should refer to EPA (2024) for detailed descriptions of disaggregation methodologies. Where previously published methods remain unchanged, CGS summarizes the disaggregation approaches rather than repeating information from the latest national-level inventory report or the previous state-level methodology report. Recalculations at the national-level *GHGIA* that affect state-level estimates are discussed in the national-level *GHGIA* Chapter 4. Geographic completeness is consistent with the national-level *GHGIA* and is summarized in Annex 2 by sector and source.

Table 3-1: Methodology Summary for State-Level IPPU Sector GHG Emission Estimates

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Minerals					
Cement production (<i>GHGIA</i> Section 4.1.1)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National clinker production was apportioned evenly on an annual basis among individual states to estimate GHG emissions. 2010–2024: GHGRP emissions by state were used to apportion clinker production over individual states to estimate their GHG emissions based on the same method as the national-level <i>GHGIA</i>.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	C-1: USGS Clinker Production (000 short tons 1990–1992, 000 metric tons 1993–2009) C-2: Emissions Data by State from GHGRP (2010–2024), CEMS normalized (metric tons)
Lime production (<i>GHGIA</i> Section 4.1.2)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on the estimated number of facilities for 1990–2009.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	C-3: 1990 - 2009 Estimated Facility Count, used to develop 1990 - 2009 Estimated State Percentage C-4: 2010 - 2024 GHGRP CO₂ emissions data (metric tons), used to develop 2010 - 2024 Estimated State Percentage

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		2010–2024: GHGRP emissions data reported by state were used to directly estimate each state's CO ₂ emissions from lime production.			C-5; 1990 - 2009 Count of Facilities where CO ₂ Recovered used to calculate % of States where CO ₂ Recovered C-6: 2010 - 2024 Estimate of State CO ₂ Recovered used to calculate % of States where CO ₂ Recovered
Glass production (GHGIA Section 4.1.3)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level GHGIA emissions estimates were apportioned to each state based on the estimated number of facilities. 2010–2024: GHGRP emissions data reported by state were used to apportion each state's CO₂ emissions from glass production.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to updated Annual Average Glass Production Index for historical series at the national level (see Recalculations discussion in national-level GHGIA section 4.1.3). The state facility count was updated for 2024.	C-7: 1990 - 2009 Facility Count, used to develop 1990 - 2009 Estimated State Percentage C-8: 2010 - 2024 GHGRP CO₂ emissions data (metric tons), used to develop 2010 - 2024 Estimated state Percentage

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Other process uses of carbonates (<i>GHGIA</i> Section 4.1.4)	CO ₂	Facility-level consumption of magnesite for non-metallurgical magnesia production is used to develop state estimates. For all other categories, total national-level <i>GHGIA</i> emissions are allocated to all applicable U.S. states and territories using state-level consumption of limestone and dolomite for other uses of carbonates, state-level consumption of clay for ceramics production, and state population as a proxy for other uses of soda ash, due to limitations in availability of state-specific data.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to updated state-level population data (see references to this chapter).	C-9: 1990 - 2024 - Limestone Consumption Data from USGS Mineral Yearbooks C-10: 1990 - 2024 - Limestone Consumption With Estimated Values for Missing/Withheld Data C-11: 1990 - 2024 - Dolomite Consumption Data from USGS Mineral Yearbooks C-12: 1990 - 2024 - Dolomite Consumption With Estimated Values for Missing/Withheld Data C-13: 1990 - 2024 - Ceramics Production from USGS Mineral Yearbooks C-14 1990 - 2024 - Non-Metallurgical Magnesia Production from USGS Mineral Yearbooks
Non-EOR carbon dioxide utilization (previously named CO ₂ Consumption) (<i>GHGIA</i> Section 4.2.12)	CO ₂	National-level <i>GHGIA</i> emission estimates were allocated to states using U.S. population statistics as a proxy for CO ₂ utilization data.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to updated state-level population data (see references to this chapter).	

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Chemicals					
Ammonia production (<i>GHGIA</i> Section 4.2.1)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on ammonia production capacity by state and year. 2010–2024: GHGRP emissions data by state were used as a surrogate for ammonia production data by state to apportion national emissions to each state.	No	No changes were made to the disaggregation methods, and the approach used is consistent with that used in EPA (2024).	D-1: 1990 - 2009 Estimated Capacity (thousand short tons per year of ammonia), used to develop 1990 - 2009 Estimated State Percentage D-2; 2010 - 2024 GHGRP CO₂ emissions data (metric tons), used to develop 2010 - 2024 Estimated State Percentage
Urea consumption for nonagricultural purposes (<i>GHGIA</i> Section 4.2.2)	CO ₂	National-level <i>GHGIA</i> emissions were apportioned to each state using state population as a proxy for urea consumption for nonagricultural purposes.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to incorporation of a new data source to adjust for agricultural uses of urea consistent with Chapter 5 – Agriculture and updated state-level population data (see references to this chapter).	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Nitric acid production (<i>GHGIA</i> Section 4.2.3)	N ₂ O	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on nitric acid production capacity by state and year. 2010–2024: GHGRP emissions data by state were used as a surrogate for nitric acid production data by state to apportion national emissions to each state.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). The facility count was updated for 2024.	D-3: 1990 - 2009 Estimated Capacity (tons/day), used to develop 1990 - 2009 Estimated State Percentage D-4; 2010 - 2024 GHGRP CO₂e emissions data (metric tons CO₂e), used to develop 2010 - 2024 Estimated Emissions by State
Adipic acid production (<i>GHGIA</i> Section 4.2.4)	N ₂ O	National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on facility-level GHGRP process emissions reported by the four U.S. adipic acid facilities (located in Florida, Texas, and Virginia).	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	D-5: 1990 - 2024 GHGRP emissions data (Tg N ₂ O)

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Caprolactam, glyoxal and glyoxylic acid production (<i>GHGIA</i> Section 4.2.5)	N ₂ O	National-level <i>GHGIA</i> emission estimates were apportioned to each state based on caprolactam production capacity by state and year. Emissions from glyoxal and glyoxylic acid production are not currently estimated because of a lack of publicly available data.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	D-6: 1990 - 2024 Estimated Capacity, used to develop 1990 - 2024 Estimated State Percentage
Carbide production and consumption (<i>GHGIA</i> Section 4.2.6)	CO ₂ CH ₄	State-level emissions were estimated using a combination of approaches. Production: National-level <i>GHGIA</i> SiC production data were evenly distributed between Illinois and Kentucky, the two states identified as home to SiC production facilities. Consumption: National-level <i>GHGIA</i> SiC consumption emissions were apportioned to all states using state population as a proxy for SiC consumption data.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions of the time series are due to updated production and consumption data for 2022 and 2023 and updated state-level population data (see references to this chapter).	D-7: Data for Disaggregating Silicon Carbide Production Emissions
Titanium dioxide production (<i>GHGIA</i> Section 4.2.7)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	D-8: 1990 - 2009 Estimated Capacity (metric tons), used to develop 1990 - 2009 Estimated State Percentage

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		were apportioned to each state based on facility production capacity. 2010–2024: GHGRP emissions data by state were used as a surrogate for TiO₂ production data by state to apportion national-level <i>GHGIA</i> emissions to each state.		There were no changes to the 1990–2023 time series.	D-9: 2010 - 2024 GHGRP CO ₂ emissions data (metric tons), used to develop 2010 - 2024 Estimated State Percentage
Soda ash production (<i>GHGIA</i> Section 4.2.8)	CO ₂	All national-level <i>GHGIA</i> emissions were attributed to Wyoming for the entirety of the 1990–2024 time series, because Wyoming is the only state with emissive (trona ore-based) soda ash production; the non-emissive processes used in California and Colorado do not generate emissions.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). There were no changes to the 1990–2023 time series.	D-10: U.S. Emissions from Soda Ash Production, from GHGI: 1990–2019 (Million Metric tons CO ₂ Eq.)
Petrochemical production (<i>GHGIA</i> Section 4.2.9)	CO ₂ CH ₄	National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on facility-level production capacity for acrylonitrile, carbon black, ethylene, ethylene dichloride, ethylene oxide, and methanol production. The emission factor used to calculate CO ₂ emissions for methanol production in 1990–2014 is based on the	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions of the time series are due to an updated data source for petrochemical production and the use of a new implied	D-11: Acrylonitrile production capacity per State per year (kmt) D-12: Carbon Black production capacity per State per year (kmt) D-13: Ethylene production capacity per State per year (kmt) D-14: Ethylene Dichloride production capacity per State per year (kmt)

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		production rate reported by the American Chemistry Council (ACC) in 2015–2024 rather than the total production reported to the GHGRP in those years.		emission factor. The ethylene production capacity for expansion was updated at one facility for RY 2017.	D-15: Ethylene Oxide production capacity per State per year (kmt) D-16: Methanol production capacity per State per year (kmt)
HCFC-22 production (GHGIA Section 4.2.10)	HFC-23	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: Facility-specific information on emissions-control efforts and production capacities, combined with facility-specific GHGRP data for 2010, were used to estimate emissions by state. 2010–2024: Facility-specific GHGRP data on HFC-23 emissions were compiled by state.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	
Production of fluorochemicals other than HCFC-22 (GHGIA Section 4.2.11)	HFCs PFCs SF ₆ NF ₃	State-level emissions were estimated using a combination of approaches across the time series. For a set of 17 facilities, facility-specific estimates were compiled directly by state across the full-time series. For the remaining facilities (five for 1990–2010; five to seven for 2011–2023),	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		the combined national estimate for that group was divided evenly and allocated to each state where those facilities were located.			
Phosphoric acid production (<i>GHGIA</i> Section 4.2.13)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on facility production capacity by state. 2010–2024: GHGRP process emissions data by state were used as a surrogate for phosphoric acid production data by state to apportion national emissions to each state.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	D-17: 2010 - 2024 GHGRP CO₂ emissions data (metric tons) - FL/NC Rock Type, used to develop 2010–2019 Estimated State Percentage D-18: 2010 - 2024 GHGRP CO₂ emissions data (metric tons) - ID/UT Rock Type, used to develop 2010–2019 Estimated State Percentage D-19: 2010 - 2024 GHGRP CO₂ emissions data (metric tons) - Import Rock Type, used to develop 2010–2019 Estimated State Percentage D-20: 1990 - 2009 Phosphoric Plant Capacity (10³ ton/year) - FL/NC Rock Type, used to develop 1990–2009 Estimated State Percentage D-21: 1990 - 2009 Phosphoric Plant Capacity (10³ ton/year) - ID/UT Rock Type, used to develop 1990–2009 Estimated State Percentage

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
					D-22: 1990 - 2009 Phosphoric Plant Capacity (10 ³ ton/year) - Import Rock Type, used to develop 1990–2009 Estimated State Percentage
Metal Production					
I&S production and metallurgical Coke Production (GHGIA Section 4.3.1)	CO ₂ CH ₄	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level GHGIA emissions estimates were apportioned to each state based on a combination of state-level coking coal consumption data and U.S. Census manufacturing data as a proxy for iron and steel production activity. 2010–2024: National-level GHGIA emissions estimates were apportioned for steel, sinter, iron, pellet, and other activities using GHGRP process emissions data by state.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). The raw steel production capacity was updated for 2024.	H-1: 1990 - 2024 Coke Sales from EIA (Tbtu), used to develop 1990 - 2024 Estimated State Percentage H-2: BOF Data used to develop Estimated State Percentage H-3: EAF Data used to develop Estimated State Percentage H-4: Data, used to develop Estimated State Percentage for “Other” Categories

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Ferroalloys production (GHGIA Section 4.3.2)	CO ₂ CH ₄	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level GHGIA emissions estimates were apportioned to each state based on the known ferroalloy production facility locations in each state, with any remaining national emissions not attributable to known facilities allocated evenly across the remaining known facilities. 2010–2024: GHGRP facility process emissions data were used to apportion national emissions to each state, with any remaining national emissions not attributable to known facilities allocated evenly across the remaining known facilities.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	H-5: Emissions by Facility (kt CO₂) H-6: Emissions by Facility (kt CH₄)
Aluminum production (GHGIA Section 4.3.3)	CO ₂ PFCs	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level GHGIA emissions estimates were apportioned to each state based on each state's smelter capacity as a share of total U.S. capacity.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		2010–2024: Facility-specific GHGRP process emissions data were used to apportion national emissions to each state.			
Magnesium Production and Processing (<i>GHGIA</i> Section 4.3.4)	CO ₂ SF ₆ HFCs	State-level emissions were estimated using a combination of approaches across the time series. 1990–1998: National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on a single year (1999) of state- and process-level emissions shares. 1999–2010: Company- and facility-specific cover gas emissions reported through the SF₆ Emission Reduction Partnership for the Magnesium Industry (SF₆ and HFCs) and USGS Minerals Yearbook (CO₂) were used to apportion national emissions to each state. 2011–2024: Facility-specific GHGRP emissions data were used to apportion national emissions to each state, with emissions from non-reporting processes and facilities allocated proportionally to states with reported emissions.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		2023–2024: National-level <i>GHGIA</i> emissions were allocated to states based on reported emissions data from GHGRP and scaling factors by state and gas based on 2022 data.			
Lead Production (<i>GHGIA</i> Section 4.3.5)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates were apportioned to each state based on the estimated number and location of primary and secondary lead production facilities. 2010–2024: GHGRP emissions data by state were used as a surrogate for lead production data by state to apportion national-level <i>GHGIA</i> emissions to each state.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	H-7: 1990 - 2009 Estimated Primary Facility Count, used to develop 1990 - 2009 Estimated State Percentage by Type H-8: 1990 - 2009 Estimated Secondary Facility Count, used to develop 1990 - 2009 Estimated State Percentage by Type H-9: - 2024 GHGRP CO₂ emissions data (metric tons), used to develop 2010 - 2020 Estimated State Percentage
Zinc Production (<i>GHGIA</i> Section 4.3.6)	CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2009: National-level <i>GHGIA</i> emissions estimates were apportioned to each	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	H-10: 1990 - 2009 Estimated Electrothermic Furnace Unit Count, used to develop 1990 - 2009 Estimated State Percentage by Unit Type H-11: 1990 - 2009 Estimated Waelz Kiln Unit Count, used

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		state based on the number of facilities and production processes present in each state. 2010–2024: GHGRP emissions data were used to apportion national-level <i>GHGIA</i> emissions to each state.			develop 1990 - 2009 Estimated State Percentage by Unit Type H-12: 1990 - 2009 Estimated Other Furnace Unit Count, used to develop 1990 - 2009 Estimated State Percentage by Unit Type H-13: 1990 - 2009 Estimated Flame Reactor Unit Count, used to develop 1990 - 2009 Estimated State Percentage by Unit Type H-14: 2010 - 2024 GHGRP CO₂ emissions data (metric tons), used to develop 2010 - 2024 Estimated State Percentage
Product Use					
Electronics industry (<i>GHGIA</i> Section 4.4)	N ₂ O NF ₃ SF ₆ HFCs PFCs	State-level emissions were estimated using a combination of approaches across the time series. <u><i>Semiconductor Manufacturing and MEMS:</i></u> 1990–2007: National-level <i>GHGIA</i> emissions for semiconductor manufacturing were allocated to states based on the 2008 proportion of emissions. Emissions from	Yes	No changes were made to the disaggregation methods for 1990–2022, and the approach is consistent with that used in EPA (2024). Revisions to 2023 are attributable to the modification in disaggregation approach used for 2023 and 2024.	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		MEMs between 1991 and 2010 were interpolated between 1991 emissions and 2011 emissions by state. 2008–2010: Emissions were allocated to states based on the breakdown of TMLA by state applied to national estimates. 2011–2014: National-level <i>GHGIA</i> emissions were allocated based on GHGRP facility locations for reporters. For non-reporters, emissions were allocated based on World Fab Forecast data and the proportion of estimated emissions for non-reporters. For 2013 and 2014, a scaling factor of 0.017% was used for time-series consistency. 2015–2022: National-level <i>GHGIA</i> emissions were allocated to states based on GHGRP facility locations for reporters. For non-reporters, emissions were allocated based on data from the World Fab Forecast dataset and respective emission factors by gas.			

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		2023–2024: National-level <i>GHGIA</i> emissions were allocated to states based on the distribution of emissions in 2022. <i>Heat Transfer Fluids:</i> 1990–1999: Emissions did not occur. 2000–2010: National-level <i>GHGIA</i> emissions were allocated to states based on the breakdown of TMLA by state applied to national estimates. 2011–2022: National-level <i>GHGIA</i> emissions were allocated to states based on facility location for GHGRP reporters and based on the percentage of non-reporters in the national inventory. 2023–2024: National-level <i>GHGIA</i> emissions were allocated to states based on the distribution of emissions in 2022. <i>Photovoltaics:</i> 1998–2010: National-level <i>GHGIA</i> emissions were allocated to states based on facility manufacturing capacity and interpolated			

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		for years in which capacity data was unavailable. 2011–2022: National-level <i>GHGIA</i> emissions were allocated to states based on a combination of state-level manufacturing capacity and reported facility data. 2023–2024: National-level <i>GHGIA</i> emissions were allocated to states based on the distribution of emissions in 2022.			
Substitution of ozone-depleting substances (<i>GHGIA</i> Section 4.5)	HFCs PFCs CO ₂	State-level emissions were estimated using a combination of approaches across the time series. 1990–2008: National-level <i>GHGIA</i> emissions were allocated to states based on a combination of Census population data and a 2008 ratio of regional HFC emissions from NOAA derived from atmospheric measurements at sites across the United States. 2009–2023: National-level <i>GHGIA</i> emissions were allocated to states based on a combination of Census population data and regional HFC emission estimates from NOAA derived from	No	No changes were made to the disaggregation methods for 1990–2023, and the approach is consistent with that used in EPA (2024).	

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		atmospheric measurements at sites across the United States. 2024: National-level <i>GHGIA</i> emissions were allocated to states based on Census population data.			
Electrical Equipment (<i>GHGIA</i> Section 4.6.1)	SF ₆	State-level emissions were estimated using a combination of approaches across the time series. 1990–2010: National-level <i>GHGIA</i> emissions were allocated to states based on the proportion of transmission miles by state using Homeland Infrastructure Foundation-Level Data. 2011–2022: National-level <i>GHGIA</i> emissions were allocated to states based on a combination of facility-reported emissions and the proportion of transmission miles by state for reporters. For non-reporters, emissions were estimated based on the proportion of transmission miles by state using HIFLD data. Emissions for California were obtained from CARB's GHG emissions inventory for 2011–2021.	No	No changes were made to the disaggregation methods for 1990–2022, and the approach is consistent with that used in EPA (2024).	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
		2023–2024: National-level <i>GHGIA</i> emissions were allocated to states based on the distribution of emissions in 2022.			
SF ₆ and PFCs from other product use (<i>GHGIA</i> Section 4.6.2)	SF ₆ PFCs	State-level emissions were estimated using a combination of approaches across the time series. 1990–2022: National-level <i>GHGIA</i> emissions were allocated to states based on DOD and DOE data and assumptions regarding the facilities at which these emissions occur. 2023–2024: National-level <i>GHGIA</i> emissions were allocated to states based on the distribution of emissions in 2022 for military applications and particle accelerators, and from 2016 for other scientific applications (the last year with significant emissions from this source).	No	No changes were made to the disaggregation methods for 1990–2022, and the approach is consistent with that used in EPA (2024).	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Nitrous oxide from product uses (<i>GHGIA</i> Section 4.6.3)	N ₂ O	National-level <i>GHGIA</i> emissions estimates were apportioned to each state using state population as a proxy for state-specific N ₂ O usage.	Yes	No changes were made to the disaggregation methods for 1990–2022, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to updated state-level population data (see references to this chapter).	I-1: N ₂ O Product Usage and Emission Factor by End-Use

Table 3-2: Key References for Data Users

Geographic Scope	Report	Publication Source	Publication Date	What to Read
State	Methodology Report Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990–2022	EPA (2024)	September 2024	Chapter 1 (Introduction) and Chapter 3 (IPPU) sector/ source-level “Background”, “Methods/Approach” and “Uncertainty”
National	Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2023	EPA (2025c)	May 2025 (FOIA Release)	Chapter 4 (IPPU) source category-level upfront discussion and “Methodology and Time-Series Consistency” and “Uncertainty” sections as appropriate
National	Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (<i>GHGIA</i>)	Center for Global Sustainability (Desai et al., 2026)	April 2026	Chapter 4 (Industrial Process and Product Use) source category-level “Methodology and Time Series Consistency,” “Recalculation,” and “Uncertainty” sections as appropriate, and “Future Areas for Improvement”

Methodology for newly added sources

No new sources were added to the IPPU sector for this current report.

Comparison to national totals

The sum of state totals aligns with the national-level *GHGIA*. Quality control procedures were implemented to review changes to the time series and confirm that IPPU source estimates sum to national estimates. Issues identified during these checks were addressed, and errors were corrected (e.g., computational formula errors, transcription errors, etc.).

Future areas of improvement

Areas for improving the IPPU sector state-level estimates are the same as those presented in Section 4.1 of the national-level *GHGIA* (Desai et al., 2026), including improvement of geographic completeness, given that many state-level IPPU category estimates utilize the same methodological approach as the national-level *GHGIA*. Some state-level planned improvements for IPPU include:

- Identifying state-specific data that could allow application of the same methods applied at the national level.
- Identifying other types of proxy data for more significant sources that have stronger correlation to emissions where state-specific data is unavailable to apply the same method applied at the national level.
- Improving time series consistency where hybrid approaches have been applied.

References

The references listed below only include new references used for compiling and updating the current *GHGIA by State*. Full citations for all references relevant to compiling national-level IPPU estimates are found at the end of Chapter 4 (IPPU) of the national-level *GHGIA* (2026). The national-level *GHGIA* is available online at <https://ghgi.cgs.umd.edu/>.

General Industrial Process and Product Use

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). *Greenhouse gas inventory and analysis for the united states: 1990-2024*. Center for Global Sustainability, University of Maryland, College Park. <https://doi.org/10.13016/g1xw-qftw>

U.S. Census Bureau. (2025). *International data base (IDB): population in U.S. territories 1990-2024*. Retrieved March 4, 2026, from <https://www.census.gov/data-tools/demo/idb>

U.S. Census Bureau. (2024). *Annual Estimates of Resident Population Change for the United States, States, District of Columbia, and Puerto Rico and State Rankings: April 1, 2020 to July 1, 2024*. <https://www.census.gov/data/tables/time-series/demo/popest/2020s-national-total.html>

U.S. Environmental Protection Agency. (2025a). *2024 greenhouse gas reporting program data: EF_Views_20251027*. [Unpublished annual data released via Freedom of Information Act Request]

U.S. Environmental Protection Agency. (2025b). *Consolidated data for all states and Appendices A-I*. [Unpublished consolidated state data and associated data appendices released via Freedom of Information Act Request]

U.S. Environmental Protection Agency. (2025c). *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]

U.S. Environmental Protection Agency. (2024). *Methodology report for inventory of U.S. greenhouse gas emissions and sinks by state: 1990-2022* (EPA-430-R-24-006). <https://www.epa.gov/ghgemissions/methodology-report-inventory-us-greenhouse-gas-emissions-and-sinks-state-1990-2022>



4

Agriculture



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4. Agriculture

The agriculture sector includes the following source categories consistent with the national-level *GHGIA*:

- Enteric fermentation
- Manure management
- Rice cultivation
- Agricultural soil management
- Liming
- Urea fertilization
- Field burning of agricultural residues (FBAR)

More information on national-level emissions and methods is available in Chapter 5 of the latest national-level *GHGIA*.

Methodology

Table 4-1 summarizes the different approaches used to estimate state-level agriculture emissions. Overall, the specific methods used to develop state-level emission estimates for 1990–2024 are consistent with those used in EPA (2024a). For some agriculture categories including livestock enteric fermentation and manure management, rice cultivation, agricultural soil management, and field burning of agricultural residues (FBAR), *GHGIA* state and national-level emission estimates are developed using the same underlying data and methods for portions or all of the time series. In these cases, state-level estimates are not derived by “disaggregating” the national-level *GHGIA* estimate and allocating emissions to individual states. Rather, the national-level *GHGIA* methodology uses geographically-specific activity data to develop estimates that can be aggregated to both the state and national levels as part of the same calculation framework. These instances are noted in Table 4-1 as using the same methods as the national-level *GHGIA* (e.g., see the enteric fermentation cattle disaggregation approach for 1990–2022). This designation indicates that state and national estimates are developed using the same underlying methods. For other categories, national-level *GHGIA* estimates are disaggregated or allocated to individual states using proxy data that are available at subnational spatial scales. Geographic completeness is consistent with the national-level *GHGIA* (see Annex 1).

For users seeking a comprehensive technical understanding of the compilation of *GHGIA by State* emission and sink estimates, this methodology report is best read in conjunction with the corresponding sections of the three references provided in Table 4-2. The *GHGIA by State* emission and sink estimates are compiled to be consistent with the latest national-level *GHGIA* data and largely apply methodologies and data previously published by EPA at the national and state levels. Methodological detail is only included in this document for new sources not included in EPA (2024a). Unless otherwise noted, readers should refer to EPA (2024a) for detailed descriptions of disaggregation methodologies. Where previously published methods remain unchanged, CGS summarizes the disaggregation approaches rather than repeating information from the latest national-level inventory report or the previous state-level methodology report. Recalculations at the national-level *GHGIA* that impact state-level estimates are discussed in the national-level *GHGIA* Chapter 5.

Table 4-1: Methodology Summary for State-Level Agriculture Sector GHG Emissions Estimates

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
Enteric fermentation (GHGIA Section 5.1)	CH ₄	<u>Cattle, swine, sheep:</u> Enteric fermentation state-level emissions are estimated using a combination of approaches across the time series. 1990–2022: State-level estimates are developed using the same methods as the national-level GHGIA. This approach is consistent with the approach previously applied in EPA (2024a). 2023–2024: Proxy approach; state-level proportions of national livestock populations are applied to national emissions estimates to disaggregate state emissions estimates. This approach is consistent with the approach used to estimate 2021 state-level emissions applied by EPA (2023). <u>Goats, mules & asses, American bison, horses:</u> Enteric fermentation state-level emissions are estimated using a	<u>Cattle, swine, sheep:</u> 1990–2023: No <u>Goats, mules & asses, American bison:</u> 1990–2017: No 2018–2023: Yes <u>Horses:</u> 1990–1991: Yes 1992–2017: No 2018–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Additional details on changes to emissions data are included below: <u>Cattle, swine, sheep:</u> 2023–2024: National emissions are estimated with the “Simplified Approach” described in GHGIA Section 5.1. <u>Goats, mules & asses, American bison:</u> 2018–2023: Revisions to the time series are due to integration of 2022 USDA Census of Agriculture data (USDA NASS, 2024) into the national-level GHGIA. State emissions estimates reflect this change in national emissions estimates. <u>Horses:</u> 1990–1991: Revisions to the time series are due to correcting a national-level GHGIA error in the	E-1: State Non-Cattle Populations E-2: State Cattle Populations

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
		combination of approaches across the time series. 1990–2017: State-level emissions estimates are developed using the same methods as the national-level <i>GHGIA</i>. This approach is consistent with the approach previously applied in EPA (2024a). 2018–2022: Proxy approach; state-level proportions of national emissions previously reported in EPA (2024a) are applied to the national-level <i>GHGIA</i> emissions to compile state estimates. 2023–2024: Proxy approach; state-level proportions of national livestock emissions are applied to national-level <i>GHGIA</i> estimates to derive state estimates, consistent with the approach used in EPA (2023).		extrapolation method used to back cast populations from the 1992 USDA Census of Agriculture data. State emissions estimates reflect this change in the national emissions estimates. 2018–2023: Revisions to the time series are due to integration of 2022 USDA Census of Agriculture data (USDA NASS, 2024) into the national-level <i>GHGIA</i>. State emissions estimates reflect this change in national emissions estimates.	

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
Manure management (GHGIA Section 5.2)	CH ₄ N ₂ O	<u>Cattle, swine, sheep:</u> Manure management state-level emissions are estimated using a combination of approaches across the time series. 1990–2022: State-level estimates are developed using the same methods as the national-level GHGIA. 2023–2024: Proxy approach; state-level proportions of national livestock manure management emissions applied to 2023–2024 national emission estimates to disaggregate state estimates, consistent with approach used in EPA (2023). <u>Goats, mules & asses, American bison, horses:</u> Manure management state-level emissions are estimated using a combination of approaches across the time series.	<u>Cattle, swine, sheep:</u> 1990–2023: No <u>Goats, mules & asses, American bison, horses:</u> 1990–2017: No 2018–2023: Yes <u>Horses:</u> 1990–1991: Yes 1992–2017: No 2018–2023: Yes <u>Poultry:</u> 1990–2023: No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). See enteric fermentation row above for details regarding revisions to livestock population data for goats, mules & asses, American bison, and horses. State manure management emissions estimates reflect changes in the enteric fermentation estimates for these livestock categories given shared activity data between enteric fermentation and manure management.	

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
		1990–2017: State-level emissions estimates are developed using the same methods as the national-level <i>GHGIA</i>. 2018–2022: Proxy approach; state-level proportions of national emissions previously reported in EPA (2024a) are applied to national-level <i>GHGIA</i> emissions to compile state-level estimates. 2023–2024: Proxy approach; state-level proportions of national livestock manure management emissions applied to 2023–2024 national emission estimates to disaggregate state estimates, consistent with the approach used in EPA (2023). <u>Poultry:</u> Manure management state-level emissions are estimated using a combination of approaches across the time series.			

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
		1990–2022: State-level estimates are developed using the same methods as the national-level <i>GHGIA</i>. 2023–2024: State-level proportions of national poultry populations are applied to national emissions estimates to disaggregate state estimates, consistent with the approach used in EPA (2023).			
Rice cultivation (<i>GHGIA</i> Section 5.3)	CH ₄	State-level emissions are estimated using a combination of approaches across the time series. 1990–2020: State-level emissions are estimated using the same method as the national-level <i>GHGIA</i>, utilizing prior runs of the Daycent model. 2021–2024: Proxy approach; national-level <i>GHGIA</i> estimates are allocated to states based on each state's average share of national rice cultivation CH₄ emissions over the last three years for which state-level Daycent outputs were available (2018–2020).	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). 2021–2023: Revisions to the time series are due to updates to the national <i>GHGIA</i> forecasting approach for the years beyond the available Daycent model outputs (see <i>GHGIA</i> Box 5-1 and Section 5.3). These national-level changes are reflected in state-level emissions estimates.	E-3 Rice Area Planted Data

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
Agricultural soil management (<i>GHGIA</i> Section 5.4)	N ₂ O	State-level emissions are estimated using a combination of approaches across the time series. 1990–2020: State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i>, utilizing prior runs of the Daycent model. 2021–2024: National-level <i>GHGIA</i> emissions estimates were allocated to states based on each state’s average share of national agricultural soil N₂O emissions over the last three years for which state-level Daycent outputs were available (2018–2020).	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). 2021–2023: Revisions to the time-series are due to updates to the national <i>GHGIA</i> forecasting approach for the years beyond the available Daycent model outputs (see <i>GHGIA</i> Box 5-1 and Section 5.4). These national-level changes are reflected in state-level emissions estimates.	
Liming (<i>GHGIA</i> Section 5.5)	CO ₂	State-level emissions are estimated using a combination of approaches across the time series. 1990–2023: State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i>, utilizing state-level crushed stone data from the U.S. Geological Survey (USGS).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). 2022–2023: Revisions to the time series are due to integration of updated USGS data for the years 2022 and 2023 into the national-level <i>GHGIA</i>	E-4: Crushed Limestone/ Dolomite Used for Agricultural Purposes

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
		2024: State-level emissions are estimated based on each state's share of national limestone and dolomite consumption for agricultural purposes for the year 2023.		(see <i>GHGIA</i> Section 5.5). These national-level changes are reflected in state-level emissions estimates.	
Urea (<i>GHGIA</i> Section 5.6)	CO ₂	National-level <i>GHGIA</i> emissions estimates were disaggregated to the state level based on each state's share of national urea consumption. The national-level <i>GHGIA</i> incorporated a new source of activity data from the International Fertilizer Association (IFA) for the 1990–2024 time series. State-level urea consumption was estimated by applying state shares calculated from the previously reported activity data to the updated national activity data.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). 1990–2023: Revisions to the time series are due to integration of updated IFA fertilizer activity data to the national-level <i>GHGIA</i> . This change is reflected in state-level emissions estimates.	E-5: Urea Fertilizer Consumption Data

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
FBAR (<i>GHGIA</i> Section 5.7)	CH ₄ N ₂ O	State-level emissions are estimated using a combination of approaches across the time series. <u>Sugarcane:</u> 1990–2020: State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i>, utilizing state-level crop data. 2021–2024: National-level <i>GHGIA</i> sugarcane estimates were allocated to states based on each state’s average share of national sugarcane emissions over the last three years for which state-level estimates were available (2018–2020). <u>All other crops:</u> 1990–2014: State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i>, utilizing state-level crop data.	<u>Sugarcane:</u> 1990–2020: No 2021–2023: Yes <u>All other crops:</u> 1990–2014: No 2015–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). <u>Sugarcane:</u> 2021–2023: Revisions to the time series are due to updates to the national <i>GHGIA</i> forecasting approach for the years beyond the available state-level outputs (see <i>GHGIA</i> Box 5-1 and Section 5.7). These national-level changes are reflected in state-level emissions estimates. <u>All other crops:</u> 2015–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i>	

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state	Additional Information	Data Appendices
		2015–2024: National-level <i>GHGIA</i> emissions estimates were allocated to states based on each state’s average share of national emissions over the last three years for which state-level estimates were available (2018–2020), by crop type and gas.		forecasting approach for the years beyond the available state-level outputs (see <i>GHGIA</i> Box 5-1 and Section 5.7). These national-level changes are reflected in state-level emissions estimates.	

Table 4-2: Key References for Data Users

Geographic Scope	Report	Publication Source	Publication Date	What to Read
State	Methodology Report Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990–2022	EPA (2024a)	September 2024	Chapter 1 (Introduction) and Chapter 4 (Agriculture) sector/ source-level “Background”, “Methods/Approach” and “Uncertainty”
National	Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2023	EPA (2025)	May 2025 (FOIA Release)	Chapter 5 (Agriculture) <i>source category-level upfront discussion and “Methodology and Time-Series Consistency”</i> and “Uncertainty” sections as appropriate
National	Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (GHGIA)	CGS (Desai et al., 2026)	April 2026	Chapter 5 (Agriculture) <i>source category-level “Methods,” “Recalculation,” and “Uncertainty”</i> sections as appropriate, and “Future Areas for Improvement”

Methodology for newly added sources

No new sources were added to the agriculture sector for this current report.

Comparison to national totals

The sum of state totals aligns with the national-level *GHGIA*. Quality control procedures were implemented to review changes to the time series and confirm that agriculture source estimates sum to national estimates. Issues identified during these checks were addressed, and errors were corrected (e.g., computational formula errors, transcription errors, etc.).

Future areas of improvement

Areas for improving state-level agriculture emissions estimates are the same as those presented in Section 5.1 of the national-level *GHGIA* (Desai et al., 2026), including improvement of geographic completeness, given that many state-level agriculture category estimates utilize the same methodological approach as the national-level *GHGIA*. Some state-level planned improvements for agriculture include:

- Revising proxied state-level enteric fermentation and manure management estimates in the latter part of the time series to be consistent with the national estimation methodologies for the entire time series.
- Consider a new agricultural soil management modeling framework that leverages publicly available cropland spatial data and management information.

- Updating the FBAR methodology to incorporate a more comprehensive burned area estimation framework coupled with crop yield information provided by USDA NASS.

References

The references listed below only include new references used for compiling and updating the current *GHGIA by State*. Full citations for all references relevant to compiling national-level Agriculture estimates are found at the end of Chapter 5 (Agriculture) of the national-level *GHGIA* (2026) and its Annexes 5.14–5.16. The national-level *GHGIA* is available online at <https://ghgi.cgs.umd.edu/>.

General

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). *Greenhouse gas inventory and analysis for the united states: 1990-2024*. Center for Global Sustainability, University of Maryland, College Park. <https://doi.org/10.13016/g1xw-qftw>

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]

U.S. Environmental Protection Agency. (2024a). *Methodology report for inventory of U.S. greenhouse gas emissions and sinks by state: 1990–2022* (EPA-430-R-24-006). <https://www.epa.gov/ghgemissions/methodology-report-inventory-us-greenhouse-gas-emissions-and-sinks-state-1990-2022>

Enteric Fermentation and Manure Management

EPA (U.S. Environmental Protection Agency). (2024b). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2022* (EPA 430-R-24-004). <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022>

EPA (U.S. Environmental Protection Agency). (2023). *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2021* (EPA 430-R-23-002). <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021>

U.S. Department of Agriculture National Agricultural Statistics Service. (2024). *2022 Census of agriculture*. U.S. Department of Agriculture. <https://www.nass.usda.gov/Publications/AgCensus/2022/index.php>



5

Land Use, Land-Use Change, and Forestry (LULUCF)



UNIVERSITY OF
MARYLAND
SCHOOL OF PUBLIC POLICY

CENTER FOR
GLOBAL
SUSTAINABILITY

5. Land Use, Land-Use Change, and Forestry

This chapter describes the methods applied to estimate state-level GHG fluxes resulting from land use and land-use change within states according to changes within and conversions between all land use types, including:

- Forest land,¹¹
- Cropland,
- Grassland,
- Wetlands,
- Settlements, and
- Other land.

More information on national-level emissions and removals and associated methods is available in Chapter 6 of the national-level *GHGIA*.

Methodology

Table 5-1 summarizes the different approaches used to estimate state-level LULUCF emissions and removals. Overall, the methods used to develop state-level estimates are consistent with those used in EPA (2024). For some categories, including forest carbon, cropland, grassland and some settlements categories, state and national estimates are both developed using the same underlying data and methods for portions or all of the time series. In these cases, state-level estimates are not derived by disaggregating the national-level *GHGIA* estimate to individual states. Rather, the national-level *GHGIA* methodology uses geographically detailed data to develop estimates that can be aggregated to both the state and national levels. These instances are noted in Table 5-1 as using the same methods as the national-level *GHGIA*. This designation indicates that state and national estimates are developed using the same underlying methods. For other categories, national-level *GHGIA* estimates are disaggregated or allocated to the state level using activity data or geographic proxies. State completeness is consistent with the national-level *GHGIA*; see Annex 1.

For users seeking a comprehensive technical understanding of the compilation of the *GHGIA by State* data, this methodology report is best read in conjunction with the corresponding sections of the three references provided in Table 5-2. The *GHGIA by State* emission and sink estimates are compiled to be consistent with the latest national-level *GHGIA* data and largely apply and extend methodologies and data previously published by EPA at the national and state levels. Methodological detail is only included in this document for new sources not included in EPA (2024). Unless otherwise noted, readers should refer to EPA (2024) for detailed descriptions of disaggregation methodologies. Where previously published methods remain unchanged, CGS summarizes the disaggregation approaches rather than repeating information from the latest national-level inventory report or the previous state-level methodology report. Recalculations at the national-level *GHGIA* that impact state-level estimates are discussed in the national-level *GHGIA* Chapter 6.

11 U.S. Forest Service develops state-level estimates for the forest land as part of their U.S. Forest Service Resource Bulletin (Domke et al., 2026 published online at <https://doi.org/10.2737/WO-RB-103>), including state-level data (Walters et al., 2026): <https://www.fs.usda.gov/rds/archive/catalog/RDS-2026-0032>. This dataset also includes state-level uncertainty estimates for forest ecosystem carbon stock changes (fluxes) and non-CO₂ emissions from forest fires under the Forest Land Remaining Forest Land category.

Table 5-1: Methodology Summary for Estimating State-Level LULUCF Sector GHG Emissions and Sinks

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
Forest land						
Forest land and lands converted to forest land (<i>GHGIA</i> Sections 6.2.1 and 6.2.2)	Forest ecosystem carbon stock change	CO ₂	State-level carbon stock change estimates are developed using the same method as the national-level <i>GHGIA</i> , which is consistent with U.S. Forest Service Forest Inventory and Analysis (FIA) data (Walters et al., 2026).	Yes	Revisions to the time series are due to the incorporation of updated FIA data. In addition, a consistent methodology was utilized for all of CONUS (see national-level <i>GHGIA</i> for more details). These changes are reflected in the 1990–2023 time series.	See Walters et al., 2026
	Harvested wood products carbon stock change	CO ₂	State-level carbon stock change estimates are developed using a proxy approach based on methodology from the SIT to disaggregate the national HWP estimate (see methodological description following this table).	Newly added	This is a newly added state-level estimate. Previously, it was only estimated at the national level. This is an area of active research and we expect estimates to change over time with methodological refinements.	N/A
	Non-CO ₂ emissions from forest fires	CH ₄ N ₂ O	State-level emissions are estimated using the same method as the national-level <i>GHGIA</i> , which is consistent with U.S. Forest Service data (Walters et al., 2026).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to	See Walters et al., 2026

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
					incorporation of updated FIA data. These changes are reflected in the 1990–2023 time series.	
	Nitrogen additions to forest soils	N ₂ O	Proxy approach. National-level <i>GHGIA</i> emissions were evenly distributed to the states included in the national nitrogen additions to forest soils analysis (see methodological description below).	Newly added	This is a newly added state-level estimate. Previously, it was only estimated at the national level.	N/A
	Non-CO ₂ drained organic soils	CH ₄ N ₂ O	State-level emissions are estimated using the same method as the national-level <i>GHGIA</i> , which is consistent with U.S. Forest Service data (Walters et al., 2026).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to incorporation of updated FIA data. These changes are reflected in the 1990–2023 time series.	See Walters et al., 2026

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
Cropland						
Cropland and lands converted to cropland (<i>GHGIA</i> Sections 6.3.1 and 6.3.2)	Biomass carbon stock change	CO ₂	State-level carbon stock change estimates are developed based on a combination of approaches across the time series. 1990–2017: State-level stock change estimates are developed using the same methods as the national-level <i>GHGIA</i>. 2018–2024: National-level <i>GHGIA</i> stock change estimates were allocated to states based on each state's average share of national cropland biomass carbon stock changes over the last three years for which state-level estimates were available (2015–2017).	1990–2017: No 2018–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2018–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> (2026) forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.3). These national-level changes are reflected in the state-level estimates.	N/A
	Dead organic matter (DOM) carbon stock change	CO ₂	State-level carbon stock change estimates are developed based on a combination of approaches across the time series.	1990–2017: No 2018–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
			same methods as the national-level <i>GHGIA</i>. 2018–2024: National-level <i>GHGIA</i> stock change estimates were allocated to states based on each state's average share of national cropland DOM carbon stock changes over the last three years for which state-level estimates were available (2015–2017).		2018–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.3). These national-level changes are reflected in state-level estimates.	
	Soils carbon stock change	CO ₂	State-level carbon stock changes are estimated using a combination of methods across the time series. 1990–2020: State-level stock changes are estimated using the same methods as the national-level <i>GHGIA</i>, utilizing prior runs of the Daycent model. 2021–2024: National-level <i>GHGIA</i> stock change estimates were allocated to states based on each state's average share	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2021–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach for the years beyond the available Daycent model outputs (see <i>GHGIA</i> Box 5-1 and Section 6.3). These national-level changes are reflected in state-level estimates.	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
			of national cropland soil carbon stock changes over the last three years for which state-level Daycent outputs were available (2018–2020).			
Grassland						
Grassland and lands converted to grassland (<i>GHGIA</i> Sections 6.4.1 and 6.4.2)	Biomass carbon stock change	CO ₂	State-level carbon stock changes are estimated based on a combination of approaches over the time series. 1990–2017: State-level stock change estimates are developed using the same methods as the national-level <i>GHGIA</i>. This approach is consistent with the approach previously applied in EPA (2024). 2018–2024: National-level <i>GHGIA</i> stock change estimates were allocated to states based on each state's average share of national grassland biomass carbon stock changes over the last three years for which state-level estimates were available (2015–2017).	1990–2017: No 2018–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2018–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.4.1 and 6.4.2). These national-level changes are reflected in state-level estimates.	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
	Dead organic matter (DOM) carbon stock change	CO ₂	State-level carbon stock changes are estimated based on a combination of approaches across the time series. 1990–2017: State-level stock changes are estimated using the same methods as the national-level <i>GHGIA</i>. 2018–2024: National-level <i>GHGIA</i> stock change estimates were allocated to states based on each state's average share of national grassland DOM carbon stock changes over the last three years for which state-level estimates were available (2015–2017).	1990–2017: No 2018–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2018–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.4.1 and 6.4.2). These national-level changes are reflected in state-level estimates.	N/A
	Soils carbon stock change	CO ₂	State-level carbon stock changes are estimated based on a combination of approaches across the time series. 1990–2020: State-level stock change estimates are developed using the same methods as the national-level <i>GHGIA</i>, utilizing prior runs of the Daycent model.	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2021–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach for the years beyond the available Daycent model	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
			2021–2024: National-level <i>GHGIA</i> stock change estimates were allocated to states based on each state's average share of national grassland soil carbon stock changes over the last three years for which state-level Daycent outputs were available (2018–2020).		outputs (see <i>GHGIA</i> Box 5-1 and Section 6.4.1 and 6.4.2). These national-level changes are reflected in state-level estimates.	
Grassland remaining grassland (<i>GHGIA</i> Section 6.4.1)	Non-CO ₂ emissions from grassland fires	CH ₄ N ₂ O	State-level emissions are estimated based on a combination of approaches across the time series. 1990–2020: State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i>. This approach is consistent with the approach previously applied in EPA (2024). 2021–2024: National-level <i>GHGIA</i> emissions estimates were allocated to states based on each state's average share of national grassland fire emissions over the last three years for which state-level emissions estimates were available (2018–2020).	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2021–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.4.1). These national-level changes are reflected in state-level emissions estimates.	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
Wetlands						
Wetlands and lands converted to wetlands (<i>GHGIA</i> Sections 6.5.1 and 6.5.2)	Coastal wetlands	CO ₂ CH ₄	State-level emissions and removals are estimated using the same methods as the national-level <i>GHGIA</i> for the whole 1990–2024 time series, utilizing geospatial data from NOAA Coastal Change Analysis Program (C-CAP).	1990–2016: No 2017–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2017–2023: Revisions to the time series are due to the incorporation of the latest 2021 NOAA C-CAP data and interpolations between available NOAA data years in the national-level <i>GHGIA</i> . This resulted in recalculations to the previously reported 2017–2023 estimate. These changes are reflected in the state-level estimates.	
Wetlands remaining wetlands (<i>GHGIA</i> Section 6.5.1)	Aquaculture	N ₂ O	State-level emissions are estimated based on a proxy approach. The 1990–2024 state-level estimates are allocated to states using state-level aquaculture sales data from USDA and aquaculture production data from NOAA (see methodological description below).	Newly added	This is a newly added state-level emission estimate. Previously, it was only estimated at the national level.	E-6: Aquaculture Production Data

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
Wetlands remaining wetlands (<i>GHGIA</i> Section 6.5.1)	Peatlands	CO ₂ CH ₄ N ₂ O	State-level emissions are estimated using a hybrid approach across the 1990–2024 time series. The 1990–2024 state-level emissions estimates were developed using a combination of state-level peat production and state population data.	1990–2021: No 2022–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2022–2023: Revisions to the time series are due to incorporation of updated USGS peat production activity data and updates to Census Bureau population data into the national-level <i>GHGIA</i> . These changes are reflected in the state-level estimates.	E-7: Peat Production Data
Wetlands and lands converted to wetlands (<i>GHGIA</i> Sections 6.5.1 and 6.5.2)	Flooded Lands	CO ₂ CH ₄	State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i> , utilizing geospatial data from various data sources.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). Revisions to the time series are due to a re-run of the national-level <i>GHGIA</i> flooded lands analysis to reflect waterbody ages. This analysis resulted in minimal recalculations. This is reflected in the state-level emissions estimates.	See national-level <i>GHGIA</i> CSV tables 6-29, 6-30, 6-38, and 6-39.

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
Settlements						
Settlements and lands converted to settlements (<i>GHGIA</i> Sections 6.6.1 and 6.6.2)	Soil carbon stock change	CO ₂	State-level carbon stock changes are estimated based on a combination of approaches across the time series. 1990–2020: State-level stock changes are estimated using the same methods as the national-level <i>GHGIA</i>. 2021–2024: National-level <i>GHGIA</i> stock changes were allocated to states based on each state's average share of national settlements soil carbon stock changes over the last three years for which state-level estimates were available (2018–2020).	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2021–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.6.1 and 6.6.2). These national-level changes are reflected in the state-level estimates.	N/A
Settlement remaining settlements (<i>GHGIA</i> Section 6.6.1)	Settlement trees carbon stock change	CO ₂	State-level carbon stock changes are estimated using the same methods as the national-level <i>GHGIA</i> for the whole 1990–2024 time series, utilizing FIA, National Land Cover Database (NLCD) tree cover, and settlement area data.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). For 2024, area estimates by state were updated to calculate percent settlement tree cover	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
					area by state and estimate net CO ₂ fluxes (carbon stock changes).	
Settlements remaining settlements (<i>GHGIA</i> Section 6.6.1)	Soil N ₂ O	N ₂ O	State-level emissions are estimated based on a combination of approaches across the time series. 1990–2020: State-level emissions are estimated using the same methods as the national-level <i>GHGIA</i>. 2021–2024: National <i>GHGIA</i> emissions estimates were allocated to states based on each state's average share of national settlement soil N₂O emissions over the last three years for which state-level estimates were available (2018–2020).	1990–2020: No 2021–2023: Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024). 2021–2023: Revisions to the time series are due to updates to the national-level <i>GHGIA</i> forecasting approach (see <i>GHGIA</i> Box 5-1 and Section 6.6.1). These national-level changes are reflected in the state-level emissions estimates.	N/A

Category	Subcategory/ Carbon Pool	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by state?	Additional Information	Data Appendices
Settlements remaining settlements (<i>GHGIA</i> Section 6.6.1)	Landfilled yard trimmings and food scraps carbon stock change	CO ₂	Proxy approach. State-level carbon stock changes are estimated by disaggregating national-level <i>GHGIA</i> stock change estimates using each state's share of national "settlement" area.	No	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024).	N/A

Note: LULUCF CO₂ estimates ("Gas" column in Table 5-1) reflect carbon stock changes when described in the "Subcategory/Carbon Pool" column and may therefore be emissions of CO₂ or removals (i.e., sequestration) of CO₂.

Table 5-2: Key References for Data Users

Geographic Scope	Report	Publication Source	Publication Date	What to Read
State	Methodology Report Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990–2022	EPA (2024)	September 2024	Chapter 1 (Introduction) and Chapter 5 (LULUCF) <i>sector/source-level</i> “Background”, “Methods/Approach” and “Uncertainty”
National	Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2023	EPA (2025)	May 2025 (FOIA Release)	Chapter 6 (LULUCF) source category-level upfront discussion and “Methodology and Time-Series Consistency” and “Uncertainty” sections as appropriate
National	Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (GHGIA)	CGS (Desai et al, 2026)	April 2026	Chapter 6 (LULUCF) source category-level “Methods,” “Recalculation,” and “Uncertainty” sections as appropriate, and “Future Areas for Improvement”

Methodology for newly added sources

This section elaborates on methods for calculating sources and/or sinks included in the LULUCF sector that were not included or estimated in previous disaggregated data published by EPA (2024). For information on disaggregation methods for all other sources, the methodology outlined by EPA (2024) still applies, but in some cases were updated for different portions of the 1990–2024 time series, as described in Table 5-1.

Forest Land Remaining Forest Land, Harvested Wood Products. The methods to compile state-level carbon stock change estimates for harvested wood products (HWP) are based on the default data from the State Inventory Tool (SIT) (CGS, 2026) and then scaled to match the national HWP carbon flux totals in the national-level *GHGIA* (Desai et al., 2026), consistent with data from Walters et al. (2026). The default data from SIT come from 1987, 1992, and 1997 Forest Service data to estimate average annual stock change for the time period between 1990–1992, 1993–1997, and 1998 to present. These average annual stock change estimates by state were then scaled to the national estimates from the national-level *GHGIA* based on the relative proportion of those state SIT estimates to total aggregated (national-level) SIT estimates. SIT only provides total wood products estimates and does not disaggregate by HWP as products in use and products in solid waste disposal sites (SWDS). To disaggregate HWP to these two subcategories, the proportion of these two categories to the national HWP total from the national-level *GHGIA* was applied equally across all states; changes to the relative proportion of HWP products in use and products in SWDS are reflected at the state level across the 1990 through present time series.

Forest Land Remaining Forest Land, Nitrogen Additions to Forest Soils. Nitrogen additions to forest soils are estimated by taking the total from the national-level *GHGIA* and allocating those emissions evenly to states in the Southeastern U.S., Washington, and Oregon. These are the states included in the nitrogen additions estimates from EPA (2025), reflecting those southeastern states with pine plantations and states with commercial Douglas-fir stands in the Pacific Northwest.

Coastal Wetlands Remaining Coastal Wetlands, N₂O Emissions from Aquaculture. Estimates were disaggregated from the national-level *GHGIA* total using a proxy approach. State-level aquaculture production was estimated using the USDA Census of Aquaculture for the five available census years (USDA, 1998; 2005; 2013; 2018; and 2023). Food-size aquaculture sales data were extracted for the ten highest-volume aquaculture species reported in NOAA's annual national production summaries (see national-level *GHGIA* methodology for more information on the use of NOAA for national activity data): catfish, trout, tilapia, striped bass, oysters, clams, shrimp, mussels, crawfish and salmon. For states where sales data were withheld, state-level sales were estimated by applying the state's farm proportion of national farms to the reported national sales for that species. Once all state sales values were either reported or estimated, each state's proportion of the national sales total was calculated and multiplied by the corresponding national annual production (in pounds) for that species to estimate state-level production. The remaining years in the time series, for which USDA Census of Aquaculture data were not available, were estimated by applying each state's proportion of national production from the more recent available census year to the corresponding national annual production estimates.

Comparison to national totals

Quality control procedures were implemented to review changes to the time series and confirm state-level LULUCF estimates. Issues identified during these checks were addressed, and errors were corrected (e.g., computational formula errors, transcription errors, etc.).

The state-level LULUCF calculations include estimates of CO₂ emissions from drained organic soils, which resulted in GHG estimates that generally align with total estimates in the national-level *GHGIA* but present small differences. Furthermore, independent rounding of the state-level estimates also presents small differences between the total state-level estimates and the national-level *GHGIA*.

Future areas for improvement

Areas for improving state-level estimates are the same as those presented in Section 6.1 of the national-level *GHGIA* (Desai et al., 2026), including improvement of geographic completeness, given that many state-level LULUCF category estimates utilize the same methodological approach as the national-level *GHGIA*. Some state-level planned improvements for LULUCF include:

- Improving state-level estimates to HWP based on ongoing research.
- Refining the coastal wetlands aquaculture approach to reflect only coastal states, which requires revisiting USDA and NOAA data, as well as the national aquaculture N₂O estimation approach.
- Better integrating data between waste sector landfills and LULUCF sector landfilled yard trimming and food scraps, to potentially leverage activity data and ensure consistency across sectors.
- Implementing a new cropland and grassland soil carbon stock change modeling framework, leveraging publicly available cropland and grassland spatial extent and management information.

- Revising the grassland fire non-CO₂ emission estimation framework by leveraging the [Wildland Fire Emissions Inventory System \(v2.2025.10\)](#).

References

The references listed below only include new references used for compiling and updating the current *GHGIA by State*. Full citations for all references relevant to compiling national-level LULUCF estimates are found at the end of Chapter 6 (LULUCF) of the national-level *GHGIA* (Desai et al., 2026) and its Annexes 5.16 to 5.17. The national-level *GHGIA* is available online at <https://ghgi.cgs.umd.edu/>.

General

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). *Greenhouse gas inventory and analysis for the united states: 1990-2024*. Center for Global Sustainability, University of Maryland, College Park. <https://doi.org/10.13016/g1xw-qftw>

U.S. Environmental Protection Agency. (2024). *Methodology report for inventory of U.S. greenhouse gas emissions and sinks by state: 1990–2022* (EPA-430-R-24-006). <https://www.epa.gov/ghgemissions/methodology-report-inventory-us-greenhouse-gas-emissions-and-sinks-state-1990-2022>

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]

Forest Land Remaining Forest Land and Land Converted to Forest Land

Center for Global Sustainability. (2026). *State Inventory Tool: Land use, land-use change, and forestry* [Microsoft Excel workbook]. University of Maryland. <https://ghgi.cgs.umd.edu/data-tools.html>

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Coastal Wetlands Remaining Coastal Wetlands

U.S. Department of Agriculture. (2024). *2023 Census of aquaculture*. AC-22-SS-2. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Census_of_Aquaculture/index.php

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U.S. Department of Agriculture. (2014). *2013 Census of aquaculture*. AC-12-SS-2. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Census_of_Aquaculture/index.php

U.S. Department of Agriculture. (2006). *2005 Census of aquaculture*. AC-02-SP-2. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Census_of_Aquaculture/index.php

U.S. Department of Agriculture. (n.d.). *1998 Census of aquaculture*. https://www.nass.usda.gov/AgCensus/archive/census_parts/1997-aquaculture/index.html



6

Waste



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6. Waste

The waste sector state-level estimates include the following sources consistent with the national-level *GHGIA*:

- Solid waste disposal
 - Municipal solid waste landfills
 - Industrial landfills
- Biological treatment of solid waste
 - Anaerobic digestion at (stand-alone) biogas facilities
 - Composting
- Wastewater treatment and discharge
 - Domestic wastewater treatment
 - Industrial wastewater treatment

More information on national-level emissions and methods is available in Chapter 7 (Waste) of the national-level *GHGIA*. Note that emissions from waste incineration are discussed in Chapter 2 of this methodology report.

Methodology

Table 6-1 summarizes the different approaches used to estimate state-level waste emissions. Overall, the specific methods used to develop state-level estimates for 1990–2024 are the same as EPA (2024), and any relevant updates are described under “Additional Information”. For users seeking a comprehensive technical understanding of the compilation of *GHGIA by State* emission and sink estimates, this methodology report is best read in conjunction with the corresponding sections of the three references provided in Table 6-2. The *GHGIA by State* emission and sink estimates are compiled to be consistent with the latest national-level *GHGIA* data and largely apply and extend methodologies and data previously published by EPA at the national and state level. Methodological detail is only included in this document for new sources not included in EPA (2024a). Unless otherwise noted, readers should refer to EPA (2024a) for detailed descriptions of disaggregation methodologies. Where previously published methods remain unchanged, CGS summarizes the disaggregation approaches rather than repeating information from the latest national-level inventory report or the previous state-level methodology report. Recalculations at the national-level *GHGIA* that affect state-level estimates are discussed in the national-level *GHGIA* Chapter 7. Geographic completeness is consistent with the national-level *GHGIA* and is summarized in Annex 2 by sector and source.

Table 6-1: Methodology Summary for State-Level Waste Sector GHG Emission Estimates

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Landfills					
MSW landfills (<i>GHGIA</i> Section 7.1)	CH ₄	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using a combination of proxy approaches across the time series. 1990–2009: National-level <i>GHGIA</i> CH₄ net emissions are allocated to each state based on each state's share of waste landfilled (as reported by landfills in each state to GHGRP's Subpart HH for historical years) for each year. 2010–2024: National-level <i>GHGIA</i> CH₄ net emissions are allocated to each state by applying each state's share to national net CH₄ emissions (as reported by landfills in each state to Subpart HH) for each year.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the state emissions (primarily for 2016–2023) are due to recalculations of national estimates (see Recalculations discussed in national-level <i>GHGIA</i>, Section 7.1), incorporation of latest GHGRP data impacting state shares, and correction of minor computational errors.	N/A

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Industrial landfills (<i>GHGIA</i> Section 7.1)	CH ₄	State-level emissions from pulp, paper, food, and beverage industrial landfills are estimated by allocating national-level <i>GHGIA</i> emission estimates to states using source-specific state proxies, including pulp and paper mill counts and relevant food and beverage manufacturing data.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the state emissions time series are due to recalculations of national estimates (see Recalculations discussed in national-level <i>GHGIA</i> , Section 7.1), incorporation of latest GHGRP data impacting state shares, and correction of minor computational errors.	F-1: Mills by State F-2: Food and Beverage Manufacturing NAICS Codes Assumed to Generate Waste that May Be Disposed in an Industrial Waste Landfill F-3: Percentage of Waste Disposed of by State for the Selected NAICS Codes
Biological Treatment of Solid Waste					
Composting (<i>GHGIA</i> Section 7.3)	CH ₄ N ₂ O	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emissions to each state based on a combination of approaches across the time series. 1990–1999: National-level <i>GHGIA</i> emissions are allocated to each state using the share of material composted by state in 2000. 2000–2024: National-level <i>GHGIA</i> emissions are allocated to each state based on the state's share of material composted.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the state emissions (primarily for 2019–2023) are due to incorporation of updated activity data at the national and state level. See Recalculations discussion in national-level <i>GHGIA</i> section 7.3. These national-level changes are reflected in the state-level emissions estimates.	F-4: Percentage of Material Composted by State, Calculated Using Available State Data (%)

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Anaerobic digestion at (stand-alone) biogas facilities (<i>GHGIA</i> Section 7.4)	CH ₄	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emissions to each state based on each state's share of operational facilities.	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the state emissions for 2022 and 2023 are due to incorporation of the latest facility data collection project by EPA's Office of Resource Recovery and Conservation (ORCR). See Recalculations discussion in national-level <i>GHGIA</i> Section 7.4. These national-level changes are reflected in the state-level emissions estimates.	F-5: Count of Operational and Shutdown [Standalone] Biogas Facilities by State
Wastewater Treatment and Discharge					
Domestic wastewater (<i>GHGIA</i> Section 7.2)	CH ₄ N ₂ O	State-level emissions are estimated by allocating national-level <i>GHGIA</i> emission estimates to each state based on population share and state-level septic system use (from periodic census surveys).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revisions to the state emissions across the time series are due to incorporation of updated activity data at the national and state level (e.g., state-level population). See Recalculations discussion in national-level <i>GHGIA</i> Section 7.2. These national-level changes are reflected in the state-level emission estimates.	F-6: Share of population with septic systems

Category	Gas	Disaggregation Approach	Changes to 1990–2023 estimates from previously published EPA GHGI by State	Additional Information	Data Appendices
Industrial wastewater (GHGIA Section 7.2)	CH ₄	State-level emissions are estimated by allocating national-level GHGIA emissions to each state based on industrial-source specific proxy data (e.g., state-specific wastewater outflows from pulp and paper facilities, state-level production of meat/poultry processing, fruits and vegetables processing, beer, ethanol, and/or petroleum).	Yes	No changes were made to the disaggregation methods, and the approach is consistent with that used in EPA (2024a). Revision to state emissions across the time series are due to incorporation of updated activity data at the national level (see Recalculations in national-level GHGIA Section 7.2). These national-level changes are reflected in the state-level emissions estimates. Revisions are also due to incorporation of updated state-level production for pulp and paper, beer, ethanol, and petroleum with latest data from ECHO (EPA 2026), EIA (2026a; 2026b), EIA SEDS (2025c), and TTB (2026a; 2026b).	F-7: State Percentages based on Total Wastewater Flow from Pulp and Paper Facilities F-8: List of NPDES pulp and paper permits removed from the analysis F-9: State-level Meat and Poultry Production by State F-10: – State-level Fruits and Vegetables Production Data F-11: – State-level Petroleum Production Data F-12: – State-level Ethanol Production Data F-13: – State-level Breweries Production Data

Table 6-2: Key References for Data Users

Geographic Scope	Report	Publication Source	Publication Date	What to Read
State	Methodology Report Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990–2022	EPA (2024a)	September 2024	Chapter 1 (Introduction) and Chapter 6 (Waste) sector/ source-level “Background”, “Methods/Approach” and “Uncertainty”
National	Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2023	EPA (2025a)	May 2025 (FOIA Release)	Read the Chapter 7 (Waste) source category-level upfront discussion and “Methodology and Time-Series Consistency” and “Uncertainty” sections
National	Greenhouse Gas Inventory and Analysis for the United States: 1990–2024 (<i>GHGIA</i>)	Center for Global Sustainability (Desai et al., 2026)	April 2026	Read the Chapter 7 (Waste) source category-level “Methodology,” “Recalculation,” and “Uncertainty” sections as appropriate, and “Future Areas for Improvement”

Methodology for newly added sources

No new sources were added to the waste sector for this current report.

Comparison to national totals

The sum of state totals aligns with the national-level *GHGIA*. Quality control procedures were implemented to review changes to the time series and confirm that waste source estimates sum to national estimates. Issues identified during these checks were addressed, and errors were corrected (e.g., computational formula errors, transcription errors, etc.).

Future areas of improvement

Areas for improving state-level estimates are the same as those presented in Section 7.1 of the previous national-level *GHGIA* (Desai et al., 2026), including improvement of geographic completeness. In addition to these improvements, some state-level planned improvements for waste sources include:

- Reviewing 2024 Greenhouse Gas Reporting Program data published via FOIA (EPA, 2025b)
- Identifying state-level sources for the type of wastewater treatment systems in use for municipal, domestic, or industrial wastewater (by industrial sector).
- Conducting a review of state-level BOD or total nitrogen data from municipal wastewater treatment and significant industrial wastewater sources.
- Identifying waste characterization data to improve waste source emission estimates where data are currently lacking (e.g., Alaska, U.S. Territories).

References

The references listed below only include new references used for compiling and updating the current *GHGIA by State*. Full citations for all references relevant to compiling national-level Waste estimates are found at the end of Chapter 7 (Waste) of the national-level *GHGIA* (Desai et al., 2026) and its Annexes 5.18 and 5.19. The national-level *GHGIA* is available online at <https://ghgi.cgs.umd.edu/>.

General Waste

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). *Greenhouse gas inventory and analysis for the united states: 1990-2024*. Center for Global Sustainability, University of Maryland, College Park. <https://doi.org/10.13016/g1xw-qftw>

U.S. Environmental Protection Agency. (2025a). *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]

U.S. Environmental Protection Agency. (2024a). *Methodology report for inventory of U.S. greenhouse gas emissions and sinks by state: 1990–2022* (EPA-430-R-24-006). <https://www.epa.gov/ghgemissions/methodology-report-inventory-us-greenhouse-gas-emissions-and-sinks-state-1990-2022>

Landfills

U.S. Environmental Protection Agency. (2025b). *2024 Greenhouse gas reporting program data: EF_Views_20251027*. [Unpublished annual data released via Freedom of Information Act Request]

U.S. Environmental Protection Agency. (2024b). *Envirofacts data. Subpart HH: municipal solid waste landfills*. <https://enviro.epa.gov/envirofacts/ghg/search>

Wastewater Treatment and Discharge

Alcohol and Tobacco Tax and Trade Bureau. (2026a). *2024 quarterly beer state statistics*. <https://www.ttb.gov/statistics/2024-quarterly-beer-state-statistical-releases>

Alcohol and Tobacco Tax and Trade Bureau. (2026b). *Revised 2022 quarterly beer state statistics*. <https://www.ttb.gov/statistics/2022-quarterly-beer-state-statistical-releases>

U.S. Census Bureau. (2024). *Annual Estimates of Resident Population Change for the United States, States, District of Columbia, and Puerto Rico and State Rankings: April 1, 2020 to July 1, 2024*. <https://www.census.gov/data/tables/time-series/demo/popest/2020s-national-total.html>

U.S. Census Bureau. (2025). *International Data Base (IDB): Population in U.S. Territories 1990-2024*. Retrieved March 4, 2026, from <https://www.census.gov/data-tools/demo/idb>

U.S. Energy Information Administration. (2026a). *Number and capacity of petroleum refineries*. U.S. Department of Energy. <https://www.eia.gov/state/seds/seds-data-complete.php>

U.S. Energy Information Administration. (2026b). *Refinery and blender net production*. U.S. Department of Energy. https://www.eia.gov/dnav/pet/pet_pnp_refp_a_ep00_ypr_mbbl_a.htm

U.S. Energy Information Administration (EIA) (2026c). *State energy data system (SEDS): 1960–2024 (Complete)*. June, 2026. U.S. Department of Energy. <https://www.eia.gov/state/seds/seds-data-complete.php?sid=US>

U.S. Environmental Protection Agency. (2026). *Water pollution search*. <https://echo.epa.gov/trends/loading-tool/water-pollution-search>



7

Annex



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Annex 1. Access Official State GHG Data

Many states and territories are compiling and publishing state-level GHG inventories on a regular basis. The *GHGIA by State* is intended to supplement and complement official state data. See Chapter 1. Introduction to learn more about potential reasons CGS's estimates may differ from official state estimates.

Table A1-1 provides links to official greenhouse gas inventories for the states and territories listed below, where available. Where official links are not available, users may find data from state and territorial governments at <https://www.epa.gov/inflation-reduction-act/ghg-inventories-searchable-table>.

Table A1-1: Official U.S. State and Territory Links

State/Territory	Direct State Inventory link
Alabama	
Alaska	https://dec.alaska.gov/air/anpms/projects-reports/greenhouse-gas-inventory
Arizona	
Arkansas	
California	https://ww2.arb.ca.gov/ghg-inventory-data
Colorado	https://cdphe.colorado.gov/apcd/climatechange#inventory
Connecticut	https://portal.ct.gov/deep/climate-change/ct-greenhouse-gas-inventory-reports
Delaware	https://dnrec.delaware.gov/air/greenhouse-gas/
Florida	
Georgia	https://epd.georgia.gov/air-protection-branch/air-branch-programs/planning-and-support-program/greenhouse-gases
Hawaii	https://health.hawaii.gov/cab/hawaii-greenhouse-gas-program/
Idaho	
Illinois	https://epa.illinois.gov/topics/climate/climate-pollution-reduction-grants.html
Indiana	

State/Territory	Direct State Inventory link
Iowa	https://www.iowadnr.gov/environmental-protection/air-quality/greenhouse-gases
Kansas	
Kentucky	
Louisiana	https://www.lsu.edu/ces/research/greenhousegasreport2021.php
Maine	https://www.maine.gov/dep/air/emissions/index.html
Maryland	https://mde.maryland.gov/programs/Air/ClimateChange/Pages/GreenhouseGasInventory.aspx
Massachusetts	https://www.mass.gov/lists/massdep-emissions-inventories#greenhouse-gas-baseline,-inventory-&-projec
Michigan	https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan
Minnesota	https://data.pca.state.mn.us/views/Greenhousegasemissionsdata/TotalGHGemissionsgoals?%3Aembed=y&%3AisGuestRedirectFromVizportal=y&%3Asid=6BAC6F59E3184173B1F4BF5A0A74E32F-1%3A1
Mississippi	
Missouri	
Montana	
Nebraska	
Nevada	https://ndep.nv.gov/air/air-pollutants/greenhouse-gas-emissions
New Hampshire	https://www.des.nh.gov/air/state-implementation-plans/air-emissions-inventory
New Jersey	https://dep.nj.gov/ghg/nj-ghg-inventory/
New Mexico	https://www.env.nm.gov/wp-content/uploads/sites/13/2022/04/Binder6-10.pdf
New York	https://dec.ny.gov/environmental-protection/climate-change/greenhouse-gas-emissions-report
North Carolina	https://www.deq.nc.gov/energy-climate/climate-change/greenhouse-gas-inventory
North Dakota	

State/Territory	Direct State Inventory link
Ohio	
Oklahoma	https://oklahoma.gov/deq/divisions/air-quality/emissions-inventory/state-emissions-totals-infographics.html
Oregon	https://www.oregon.gov/deq/ghgp/Pages/GHG-Inventory.aspx
Pennsylvania	https://www.pa.gov/agencies/dep/residents/climate-change/ghg-inventory
Rhode Island	https://dem.ri.gov/environmental-protection-bureau/air-resources/climate-change/rhode-island-greenhouse-gas-inventory
South Carolina	
South Dakota	
Tennessee	
Texas	
Utah	https://deq.utah.gov/daq/statewide-emissions-inventories
Vermont	https://dec.vermont.gov/air-quality/planning/vermonts-greenhouse-gas-emissions
Virginia	https://www.deq.virginia.gov/air-energy/greenhouse-gases
Washington	https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/tracking-greenhouse-gases/ghg-inventories
West Virginia	https://dep.wv.gov/daq/planning/Pages/GreenhouseGas.aspx
Wisconsin	https://dnr.wisconsin.gov/climatechange/science
Wyoming	https://deq.wyoming.gov/aqd/emissions-inventories/
District of Columbia	https://doee.dc.gov/service/greenhouse-gas-inventories
Puerto Rico	https://www.drna.pr.gov/noticias/inventario-gei-2019-2021/
American Samoa	
Guam	

State/Territory	Direct State Inventory link
Northern Mariana Islands	
U.S. Virgin Islands	
Outlying minor islands	

Annex 2. Summary of Geographic Completeness

The geographic coverage or completeness of the *GHGIA by State* is consistent with the national-level *GHGIA*. Completeness is summarized in Table A2-1 below and is available with downloadable data tables on the *GHGIA by State* website.

Table A2-1: Geographic Completeness Summary

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Energy													
Fossil Fuel Combustion	CO ₂												
Transportation	CO ₂	Y	Y	Y	Y	Y*	Y*	Y*	Y*	Y*		Y	Y* = included in U.S. territories estimate under FFC (note: territories data is not broken out by end-use sector)
Electric Power	CO ₂	Y	Y	Y	Y	Y*	Y*	Y*	Y*	Y*		Y	Y* = included in U.S. territories estimate under FFC (note: territories data is not broken out by end-use sector)
Industrial	CO ₂	Y	Y	Y	Y	Y*	Y*	Y*	Y*	Y*		Y	Y* = included in U.S. territories estimate under FFC (note: territories data is not broken out by end-use sector)
Commercial	CO ₂	Y	Y	Y	Y	Y*	Y*	Y*	Y*	Y*		Y	Y* = included in U.S. territories estimate under FFC (note: territories data is not broken out by end-use sector)

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Residential	CO ₂	Y	Y	Y	Y	Y*	Y*	Y*	Y*	Y*	Y*	Y	Y* = included in U.S. territories estimate under FFC (note: territories data is not broken out by end-use sector)
Non-Energy Use of Fossil Fuels	CO ₂	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Stationary Combustion (excluding CO ₂)	CH ₄ , N ₂ O	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Mobile Combustion (excluding CO ₂)	CH ₄ , N ₂ O	Y	Y	Y	Y	IE	IE	IE	IE	IE	IE	Y	Gasoline and diesel fuel use non-CO ₂ emissions in territories based on stationary combustion factors, reported under stationary non-CO ₂
Coal Mining	CH ₄ , CO ₂	Y	NO	NO	Y	NO	NO	NO	NO	NO	NO	Y	
Abandoned Underground Coal Mines	CH ₄	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	Y	
Petroleum Systems	CO ₂ , CH ₄ , N ₂ O	Y	Y	Y	Y	NO	NO	Y	Y	NO	NO	Y	
Natural Gas Systems	CO ₂ , CH ₄ , N ₂ O	Y	Y	Y	Y	NO	NO	Y	Y	NO	NO	Y	
Abandoned Oil and Gas Wells	CO ₂ , CH ₄	Y	NO	NO	Y	NO	NO	NO	NO	NO	NO	Y	

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Incineration of Waste	CO ₂ , CH ₄ , N ₂ O	Y	Y	Y	Y	NE	NE	NE	NE	NE	NE	Y	
CO ₂ Transport, Injection and Storage	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Industrial Processes and Product Use													
Cement Production	CO ₂	Y	NO	Y	Y	NO	NO	Y	NO	NO	NO	I	
Lime Production	CO ₂	Y	NO	NO	NO	NO	NO	Y	NO	NO	NO	I	
Glass Production	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Other Process Uses of Carbonates	CO ₂	Y	Y	Y	Y	Y	Y	Y	Y	Y	NO	Y	
Ammonia Production	CO ₂	Y	NO	NO	Y	NO	NO	NO	NO	NO	NO	I	
Urea Consumption for Non-Agricultural Purposes	CO ₂	Y	Y	Y	Y	Y	Y	Y	Y	Y	NO	Y	
Nitric Acid Production	N ₂ O	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Adipic Acid Production	N ₂ O	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Caprolactam, Glyoxal, and Glyoxylic Production	N ₂ O	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	Caprolactam production is included (Y). Glyoxal and Glyoxylic acid production are not currently estimated (NE) due to a lack of publicly available data.
Carbide Production and Consumption	CO ₂ , CH ₄	Y	NO	Y	Y	NO	NO	Y	NO	NO	NO	Y	
Titanium Dioxide Production	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Soda Ash Production	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Petrochemical Production	CO ₂ , CH ₄	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Fluorochemical Production (including HCFC-22 Production)	HFCs	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Non-EOR Carbon Dioxide Utilization	CO ₂	Y	Y	Y	Y	Y	Y	Y	Y	Y	NO	Y	
Phosphoric Acid Production	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Iron and Steel Production & Metallurgical Coke Production	CO ₂ , CH ₄	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Ferroalloy Production	CO ₂ , CH ₄	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Aluminum Production	CO ₂ , CF ₄ , C ₂ F ₆	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Magnesium Production and Processing	CO ₂ , HFCs, SF ₆	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Lead Production	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Zinc Production	CO ₂	Y	NO	NO	NO	NO	NO	NO	NO	NO	NO	I	
Electronics Industry	N ₂ O, HFCs, PFCs, ^a SF ₆ , NF ₃	Y	NO	Y	NO	NO	NO	NO	NO	NO	NO	I	
Substitution of Ozone Depleting Substances	CO ₂ , HFCs, PFCs ^b	Y	Y	Y	Y	Y	Y	Y	Y	Y	NO	Y	
Electrical Transmission and Distribution	SF ₆	Y	Y	Y	Y	NE	Y	Y	Y	NE	NO	Y	
N ₂ O from Product Uses	N ₂ O	Y	Y	Y	Y	Y	Y	Y	Y	Y	NO	Y	

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
SF ₆ and PFCs from particle accelerators and military applications	SF ₆ , PFCs	Y	Y	Y	Y	NO	NO	NO	NO	NO	NO	NO	
Agriculture													
Enteric Fermentation	CH ₄	Y	NO	Y	Y	NE	NE	NE	NE	NE	NO	Y	
Manure Management	CH ₄ , N ₂ O	Y	NO	Y	Y	NE	NE	NE	NE	NE	NO	Y	
Rice Cultivation	CH ₄	Y	NO	NO	NO	NO	NO	NE	NE	NO	NO	Y	Rice is commercially grown in select U.S. states. See the <i>GHGIA</i> for more details
Liming	CO ₂	Y	NE	NE	NE	NE	NE	NE	NE	NE	NO	Y	
Urea Fertilization	CO ₂	Y	NE	Y	Y	NE	NE	Y	NE	NE	NO	Y	
Field Burning of Agricultural Residues	CH ₄ , N ₂ O	Y	NO	NE	NE	NE	NE	NE	NE	NE	NO	Y	
Agricultural Soil Management	N ₂ O	Y	Y	Y*	Y*	NE	NE	NE	NE	NE	NO	Y	*: Agricultural Soil Mgt. Estimates of N ₂ O emissions from managed croplands and grasslands are not available for Alaska and Hawaii except for managed manure and PRP nitrogen, and biosolid additions for Alaska, and

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
													managed manure and PRP nitrogen, biosolids additions, and crop residue for Hawaii.
Land Use, Land-Use Change, and Forestry ^a													
Forest Land Remaining Forest Land	CO ₂ , CH ₄ , N ₂ O	Y	NO	Y*	Y	Y**	Y**	Y**	Y**	Y**	NO	Y	*: Estimates of biomass carbon stock changes in Forest Land Remaining Forest Land include Hawaii, in addition to non-CO₂ emissions from Forest Fires. Hawaii has a notation key of "NO" for drained organic soils and a notation key of "NE" for lands converted to forest land. ** : Estimates of all forest carbon ecosystem pools stock changes in Forest Land Remaining Forest Land include U.S. Territories. U.S. Territories are also included in the estimates of non-CO₂ emissions from Forest Fires. No other forest land categories include U.S. Territories. In some cases, this is not occurring (e.g., drained organic soils; lands converted to forest land) and in other cases it is not estimates (e.g., harvested wood products).

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Land Converted to Forest Land	CO ₂	Y	NO	NE	Y	NE	NE	NE	NE	NE	NO	Y	
Cropland Remaining Cropland	CO ₂	Y	NO	Y*	NE	NE	NE	NE	NE	NE	NO	Y	*: Only the soil carbon pool is included for HI. The estimates do not include above/ belowground perennial biomass, dead wood or litter carbon stock changes. This is also true for all the other states that we provide estimates (i.e., not AK).
Land Converted to Cropland	CO ₂	Y	NO	Y*	NE	NE	NE	NE	NE	NE	NO	Y	*: Only the soil carbon pool is included for land use conversions to Cropland in HI. In other states (except AK where we currently don't estimate Land Converted to Cropland) where Forest Land conversion to Cropland occurs we do include above/ belowground perennial biomass, dead wood or litter carbon stock changes.
Grassland Remaining Grassland	CO ₂ , CH ₄ , N ₂ O	Y	NO	Y*	NE	NE	NE	NE	NE	NE	NO	Y	*: Only the soil carbon pool and some emissions from grassland fires are included for HI. The estimates do not include

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
													above/belowground perennial biomass, dead wood or litter carbon stock changes. In other states (except AK where we currently don't estimate Grassland Remaining Grassland) we do include some, but not all, above/ belowground perennial biomass, dead wood or litter carbon stock changes and some of the emissions from grassland fires.
Land Converted to Grassland	CO ₂	Y	NO	Y*	NE	NE	NE	NE	NE	NE	NO	Y	*: Only the soil carbon pool is included for all land use conversion to Grassland in HI. In other states (except AK where we currently don't estimate Land Converted to Grassland) for Forest Land conversion to Grassland we do include some, but not all, above/ belowground perennial biomass, dead wood or litter carbon stock changes. Emissions from fires on land converted to grassland are reported under Grassland Remaining Grassland.

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Wetlands Remaining Wetlands (Peatlands)	CO ₂ , CH ₄ , N ₂ O	Y	Y*	NE	Y	NE	NE	NE	NE	NE	NO	Y	*: for off-site peatland emissions only CGS is currently investigating the appropriate notation key for most U.S. Territories, "NO" or "NE"
Wetlands Remaining Wetlands (Flooded Lands)	CO ₂ , CH ₄ , N ₂ O	Y	Y	Y	Y	NE	NE	Y	NE	NE	NO	Y	CGS is currently investigating the appropriate notation key for most U.S. Territories, "NO" or "NE"
Land Converted to Wetlands (Flooded Lands)	CO ₂ , CH ₄	Y	Y	Y	Y	NE	NE	Y	NE	NE	NO	Y	CGS is currently investigating the appropriate notation key for most U.S. Territories, "NO" or "NE"
Wetlands Remaining Wetlands (Coastal Wetlands)	CO ₂ , CH ₄ , N ₂ O	Y	Y	NE	NE	NE	NE	NE	NE	NE	NO	Y	
Land Converted to Wetlands (Coastal Wetlands)	CO ₂ , CH ₄	Y	Y	NE	NE	NE	NE	NE	NE	NE	NO	Y	
Settlements Remaining Settlements (LFYTFS)	CO ₂ , N ₂ O	Y	Y	Y	Y	NE	NE	NE	NE	NE	NO	Y	

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<i>Settlements Remaining Settlements (Soil Carbon)</i>	CO ₂	Y	N	Y	N	NE	NE	NE	NE	NE	NO	Y	
<i>Settlements Remaining Settlements (Soil N₂O)</i>	N ₂ O	Y	N	Y	N	NE	NE	NE	NE	NE	NO	Y	
<i>Settlements Remaining Settlements (Settlement Tree Carbon)</i>	CO ₂	Y	Y	Y	Y	NE	NE	NE	NE	NE	NO	Y	
Land Converted to Settlements (Soil Carbon and Biomass Carbon)	CO ₂	Y	NE	Y	Y*	NE	NE	NE	NE	NE	NO	Y	*: Does not include soils
Waste													
Landfills (MSW)	CH ₄	Y	NO	Y	Y	NE	Y (for 2016–2024); NE (for 1990–2015)	Y	NE	NE	NO	Y	MSW landfills in the territories and Puerto Rico are included in the current methodology. American Samoa, Guam, Northern Mariana Islands, and U.S. Virgin Islands have landfills that are not currently included in estimates for portions of the time series or the full time series.

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
Landfills (Industrial)	CH ₄	Y	NO	Y	Y	NO	NO	NO	NO	NO	NO	Y	It is assumed HI and AK have industrial landfills and the national methodology accounts for emissions from all 50 states. It is assumed U.S. territories do not have industrial landfills.
Wastewater Treatment/ Domestic	CH ₄ , N ₂ O	Y	Y	Y	Y	Y	Y	Y	Y	Y	NE	Y	NE is used for outlying minor islands that are uninhabited but where military operations occur and therefore may also have some type of wastewater collection/ discharge. Note, the IPCC does not provide a default methodology to capture emissions from collection systems. However, dissolved methane that forms in the collection systems and is emitted at the treatment plant is included in the estimates presented.
Wastewater Treatment/ Industrial	CH ₄ , N ₂ O	Y	Y	Y	Y	NE	NE	NE	NE	NE	NE	Y	Data sources do not currently address industrial production in territories or outlying minor islands. NE means that any of the industries currently covered

Sector/Source and/or Sink Category	Gas(es)	CONUS (excluding DC)	District of Columbia	Hawaii	Alaska	American Samoa	Guam	Puerto Rico	US Virgin Islands	Commonwealth of Northern Mariana Islands	Outlying Minor Islands (UM)	Tribal lands	Notes
													(meat and poultry, pulp and paper, ethanol, petroleum, breweries, or fruits and Vegetables) may occur based on basic research.
Composting	CH ₄ , N ₂ O	Y	NO	Y	NE	NE	NE	Y	NO	NO	NO	IE	This source category reflects commercial composting operations based on basic research. NO indicates current research indicates no commercially operated composting facilities.
Anaerobic Digesters at Biogas Facilities	CH ₄	Y	NO	NE	NO	NO	NO	NO	NO	NO	NO	NE	

Notes: Y = included in current inventory; NE = occurs, but not estimated in current inventory; NO = not occurring; IE = included elsewhere; I = Investigating occurrence to update in next *GHGIA* by State

^a Carbon sequestration estimates are expressed as net values, reflecting the balance between annual carbon gains and losses within a given pool. When losses exceed gains, the carbon stock declines and the pool functions as a source resulting in net emissions, whereas when gains exceed losses, the carbon stock increases and the pool acts as a sink and results in net removals of CO₂ from the atmosphere.

*/** See source specific notes in column N