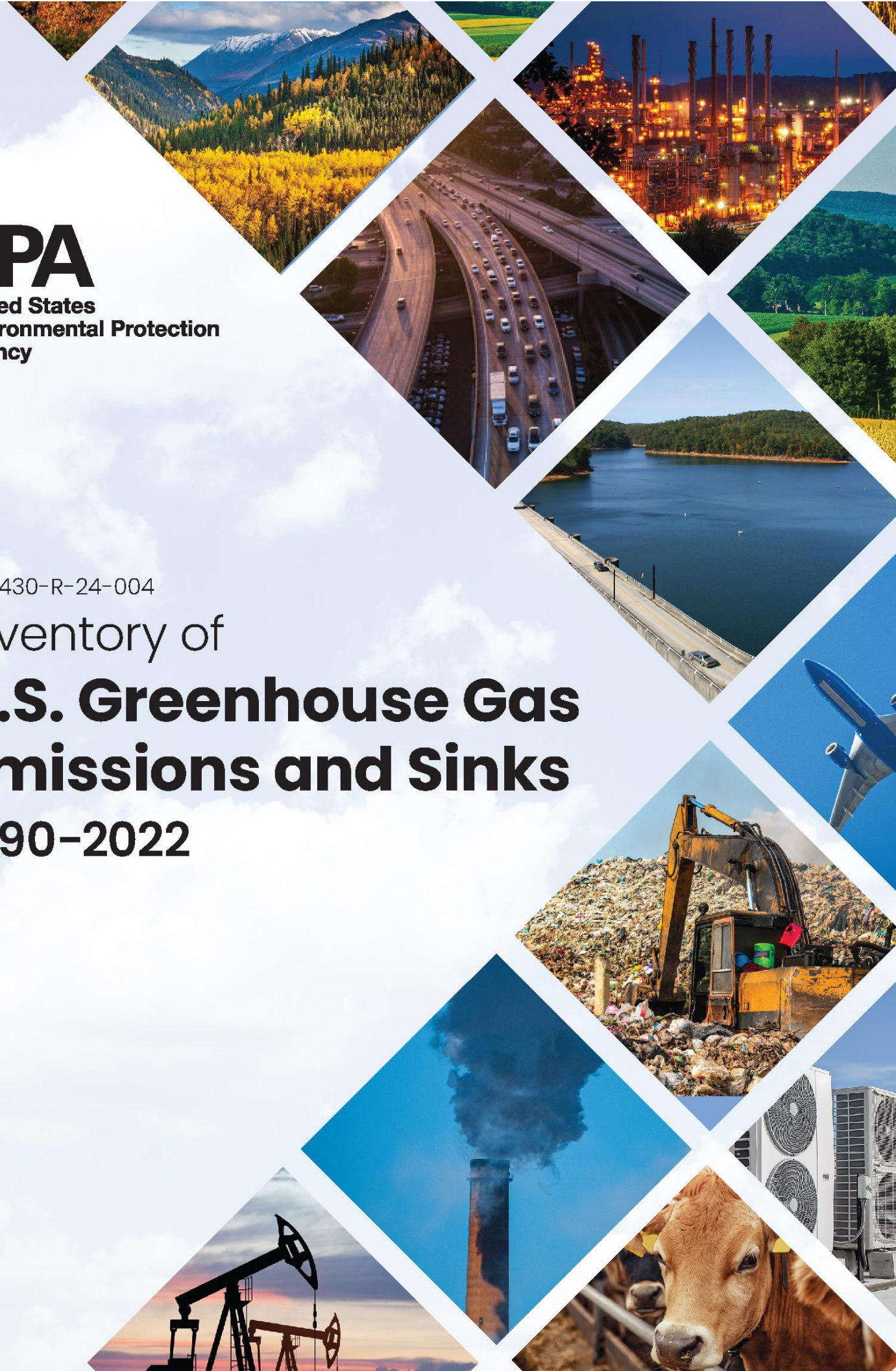

EPA

United States
Environmental Protection
Agency

EPA 430-R-24-004

Inventory of

U.S. Greenhouse Gas Emissions and Sinks

1990–2022

Front cover photo credit for cow and digester: Vanguard Renewables.

HOW TO OBTAIN COPIES

You can electronically download this document on the U.S. EPA's homepage at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

All data tables of this document for the full time series 1990 through 2022, inclusive, will be made available within 4-6 weeks after publication of the final report online at the link mentioned in the citation below.

RECOMMENDED CITATION

EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. U.S. Environmental Protection Agency, EPA 430-R-24-004. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.

FOR FURTHER INFORMATION

Contact Ms. Mausami Desai, Environmental Protection Agency, (202) 304–8932, desai.mausami@epa.gov,

or Mr. Vincent Camobreco, Environmental Protection Agency, (202) 617–6678, camobreco.vincent@epa.gov.

For more information regarding climate change and greenhouse gas emissions, see the EPA web site at https://www.epa.gov/ghgemissions.

Acknowledgments

The Environmental Protection Agency would like to acknowledge the many individual and organizational contributors to this document, without whose efforts this report would not be complete. Although the complete list of researchers, government employees, and consultants who have provided technical and editorial support is too long to list here, EPA would like to thank some key contributors and reviewers whose work has significantly improved this year's report.

Within EPA's Office of Atmospheric Protection (OAP), development and compilation of emissions from fuel combustion was led by Vincent Camobreco. Sarah Roberts (EPA Office of Transportation and Air Quality (OTAQ)) directed the work to compile estimates of emissions from mobile sources. Work on fugitive methane emissions from the Energy sector was directed by Julie Powers, Melissa Weitz and Chris Sherry. Development and compilation of emissions estimates for the Waste sector were led by Lauren Aepli and Mausami Desai. John Steller and Kenna Rewcastle directed work to compile estimates for the Agriculture and the Land Use, Land-Use Change, and Forestry chapters with support from Jake Beaulieu and Alex Hall (EPA Office of Research and Development (ORD) on compiling the inventories for CO_2 and CH_4 associated with flooded lands. Development and compilation of Industrial Processes and Product Use (IPPU) CO_2, CH_4, and N_2O emissions was directed by Amanda Chiu and Vincent Camobreco. Development and compilation of emissions of HFCs, PFCs, SF_6, and NF_3 from the IPPU sector was directed by Deborah Ottinger, Dave Godwin, and Stephanie Bogle. Cross-cutting work was directed by Mausami Desai. We thank Bill Irving for general advice, guidance, and cross-cutting review.

Other EPA offices and programs also contributed data, analysis, and technical review for this report. OAP's Greenhouse Gas Reporting Program staff facilitated aggregation and review of facility-level data for use in the Inventory, in particular aggregation of confidential business information data. The Office of Air Quality Planning and Standards (OAQPS) with contributions from OTAQ provided analysis for precursor estimates and review for several of the source categories (i.e., natural gas and petroleum systems) included in this report. ORD conducted field research and developed estimates associated with flooded lands. The Office of Land and Emergency Management (OLEM) also contributed analysis and research.

The Energy Information Administration (EIA) and the Department of Energy (DOE) contributed invaluable data and analysis on numerous energy-related topics. William Sanchez and Kevin Nakolan at EIA provided annual energy data that are used in fossil fuel combustion estimates. We also thank Chris Tremper, Soudeh Motamedi, and Ashley Ruocco at the Department of Energy for providing data and information on emissions of SF_6 and PFCs from Other Product Use. Other government agencies have contributed data as well, including the U.S. Geological Survey (USGS), the Federal Highway Administration (FHWA), the Department of Transportation (DOT), the Bureau of Transportation Statistics (BTS), the Department of Commerce, the Mine Safety and Health Administration (MSHA), and the National Agricultural Statistics Service (NASS).

We thank the Department of Defense (DOD) (David Asiello, DoD and Matthew Cleaver of Leidos) for compiling the data on military bunker fuel use.

We thank the Federal Aviation Administration (FAA) (Ralph Lovinelli and Jeetendra Upadhyay) for compiling the inventory of emissions from commercial aircraft jet fuel consumption.

We thank the United States Department of Agriculture's Office of the Chief Economist (USDA-OCE) (Meg Xiarchos) and Economic Research Service (USDA-ERS) (Jeffrey Hopkins) for providing data on agricultural energy use.

We thank the U.S. Forest Service (USFS) (Grant Domke, Brian Walters, James Smith, and Courtney Giebink) for compiling the inventories for CO_2, CH_4, and N_2O fluxes associated with forest land.

We thank the Department of Agriculture's Agricultural Research Service (USDA-ARS) (Stephen Del Grosso) and the Natural Resource Ecology Laboratory and Department of Statistics at Colorado State University (CSU) (Stephen Ogle, Bill Parton, Shannon Spencer, Alisa Keyser, Lauren Hoskovec, Ram Gurung, Ryan Scheiderer, Veronica Thompson, Stephen Williams, and Guhan Dheenadayalan Sivakami) for compiling the inventories for CH_4 emissions, N_2O emissions, and CO_2 fluxes associated with soils in croplands, grasslands and settlements.

We thank the National Oceanic and Atmospheric Administration (NOAA) (Nate Herold, Ben DeAngelo and Meredith Muth), Silvestrum Climate Associates (Stephen Crooks, Lisa Schile Beers, Rebeca Brenes), the Smithsonian Environmental Research Center (J. Patrick Megonigal, James Holmquist, Jaxine Wolfe and Meng Lu), and Florida International University (Tiffany Troxler) as well as members of the U.S. Coastal Wetland Carbon Working Group for compiling inventories of land use change, soil carbon stocks and stock change, CH_4 emissions, and N_2O emissions from aquaculture in coastal wetlands. We also thank NOAA's Global Monitoring Lab (Stephen Montzka and Lei Hu) for information on atmospheric measurements and derived emissions of HFCs and SF_6.

We thank Marian Martin Van Pelt, Leslie Chinery, Alexander Lataille, Mollie Carroll, and the full Inventory team at ICF including Diana Pape, Robert Lanza, Mollie Averyt, Larry O'Rourke, Ted Atwood, Skyler Brown, Deborah Harris, Rebecca Ferenchiak, Fiona Wissell, Bikash Acharya, Sophie Johnson, Kyle Herdegen, Hazelle Tomlin, Lou Browning, Johanna Garfinkel, Anna Cliche, Valerie Hammer, Mallory Giesie, David Landolfi, Emily Carr, Georgia Kerkezis, Isabella Scornaienchi, Katie O'Malley, Maris Welch, Emily Adkins, Zeyu Hu, Alex Da Silva, Sneha Balakrishnan, Kenny Yerardi, Leah Hartung, Molly Rickles, Seth Hartley and Ajo Rabemiarisoa for technical support in compiling synthesis information across the report and preparing many of the individual analyses for specific report chapters including fluorinated emissions and fuel combustion.

We thank Eastern Research Group for their analytical support. Deborah Bartram, Kara Edquist and Madison Eaton support the development of emissions estimates for wastewater. Kara Edquist, Cortney Itle, Amber Allen, Spencer Sauter, Sarah Wagner, and Madison Eaton support the development of emission estimates for manure management, enteric fermentation, peatlands (included in wetlands remaining wetlands*)*, and landfilled yard trimmings and food scraps (included in settlements remaining settlements). Brandon Long, Gopi Manne, and Marty Wolf support the development of estimates for natural gas and petroleum systems. Gopi Manne and Tara Stout support the development of emission estimates for coal mine methane.

Finally, we thank the RTI International team: Kate Bronstein, Emily Thompson, Jeff Coburn, and Keith Weitz for their analytical support in development of the estimates of emissions from landfills; Melissa Icenhour, David Randall, Gabrielle Raymond, Karen Schaffner, Riley Vanek, Ricky Strott, Libby Robinson, Matt Hakos, Betty Gatano, Keegan Waggener, and Jeremy Kaelin for their analytical support in development of IPPU CO_2, CH_4, and N_2O emissions; Karen Schaffner and Haley Key for their analytical support in the development of the estimates of emissions from fluorochemical production; and Tiffany Moore and Matt Hakos for their analytical support on disaggregating industrial sector fossil fuel combustion emissions.

Preface

The United States Environmental Protection Agency (EPA) prepares the official U.S. Inventory of Greenhouse Gas Emissions and Sinks to fulfill annual existing commitments under the Paris Agreement and the United Nations Framework Convention on Climate Change (UNFCCC). National greenhouse gas (GHG) inventory reports are to be submitted each year by April 15.

In an effort to engage the public and researchers across the country, the EPA has instituted an annual public review and comment process for this document. The draft document was announced via Federal Register Notice and published for a 30-day comment period on the EPA Greenhouse Gas Emissions and Removals web site from February 14 through March 15, 2024, and comments received during the public review period are posted to the docket EPA-HQ-OAR-2024-0004. Comments received after the closure of the public comment period will be considered for the next edition of this annual report. Responses to comments are typically posted to EPA's website 2-4 weeks following publication of the final report in April 2024.