

**March 2022**

**INVENTORY OF U.S.  
GREENHOUSE GAS EMISSIONS  
AND SINKS BY STATE: Peer  
Review**

**Final Report**

Prepared for

U.S. Environmental Protection Agency, Climate Change Division  
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## 1. Introduction

The U.S. Environmental Protection Agency (EPA), Climate Change Division (CCD), contracted with RTI International to conduct an independent external letter peer review of the report *DRAFT Methodology Report: Inventory of U.S. Greenhouse Gas Emissions and Sinks by State (EPA 430-D-21-00)*, developed by the EPA.

RTI was tasked with managing an independent external peer review process to evaluate the *DRAFT Methodology Report: Inventory of U.S. Greenhouse Gas Emissions and Sinks by State (EPA 430-D-21-001)* (hereafter *State Methods* document). The EPA's goal for this peer review was to ensure the use of the highest quality science in its methodology assessments. By so doing, the EPA seeks to assure its stakeholders that the methods used in disaggregating the Inventory are technically sound, credible, properly documented, and clearly presented. The EPA peer review process is intended to identify any technical problems or unresolved issues in a preliminary (or draft) work product through the use of independent experts. This information is then used to revise the draft product to the extent possible so that the final work product reflects sound scientific and technical information and analyses.

The peer reviewer selection process for the *State Methods* document involved selecting 17 expert peer reviewers who were available to participate in the peer review, including preparing individual written peer review comments during a specific time frame. In recruiting these expert peer reviewers, RTI evaluated the qualifications of peer reviewer candidates, conducted a thorough conflict of interest (COI) screening process, and independently selected the peer reviewers. RTI then provided management and oversight of the independent external peer review process. RTI produced this report that documents the peer review process and summarizes the peer reviewer comments on the Charge Questions.

The sections below provide background on the *State Methods*, describe RTI's process for identifying and selecting expert peer reviewers for this peer review, provide the EPA's scope for the peer review of the *State Methods* document, discuss the peer review teleconference and issues encountered affecting the independence of this peer review, discuss the addition of an alternate peer reviewer, and outline the organization of this report.

### 1.1 Background on the *State Methods* Document

The EPA seeks to provide a state-level disaggregation of anthropogenic greenhouse gas (GHG) emissions and sinks. This report is a complementary publication to the EPA's *National Inventory of U.S. Greenhouse Gas Emissions and Sinks* (national *Inventory* hereafter). The estimates described in this report are consistent with international standards, including Intergovernmental Panel on Climate Change (IPCC) and United Nations Framework Convention on Climate Change (UNFCCC) and represent time series data from 1990 to 2019. Consistent with the national *Inventory*, this report is by sectors (energy; industrial processes and product use [IPPU]; agriculture; land use, land-use change and forestry [LULUCF]; and waste) and covers all seven GHGs (carbon dioxide [CO<sub>2</sub>], methane [CH<sub>4</sub>], nitrous oxide [N<sub>2</sub>O], hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], sulfur hexafluoride [SF<sub>6</sub>], and nitrogen trifluoride [NF<sub>3</sub>]).

Emissions estimates were compiled to avoid double counting or gaps in coverage and to ensure that state totals summed to the national *Inventory* and are consistent with the national *Inventory*'s regional disaggregation and reflect the latest methodological improvements in the national *Inventory*.

The new *State Methods* document describes the methodological approaches used to disaggregate and compile national estimates into a new, complementary state-level dataset that covers all categories included in the national *Inventory*.

The objective of this external letter peer review is to ensure that the methods used in disaggregating the national *Inventory* described in the methodology and data found in the EPA's September 2021 *State Methods* document are technically defensible, competently performed, properly documented, and consistent with established quality criteria and to assure the EPA that this study incorporates the highest quality science.

## 1.2 Identification and Selection of Expert Peer Reviewers

The peer reviewer selection process involved selecting between 12 and 24 subject matter experts (SMEs) who were available to participate in the peer review, including preparing individual written comments, during a specific time frame. The reviewers span multiple areas of expertise. In recruiting the peer reviewers, RTI evaluated the qualifications of peer reviewer candidates, conducted a thorough COI screening process, and independently selected the peer reviewers. These activities are discussed in more detail below.

### 1.2.1 Identification of SMEs

RTI participated in a kickoff call with EPA CCD in July 2021 to discuss the qualities for potential SMEs. RTI had the goal of finding and selecting independent peer reviewers across all five chapters and 11 sub-sources. For each category, RTI was tasked with finding at least one reviewer who had the background relevant expertise for the following areas:

- 1) Available state-level datasets related to their respective sub-sources and/or sectors
- 2) Methodology of time-series estimates of GHG emissions from selected sub-sources.

The potential SMEs were identified through EPA recommendation, internal expert recommendation, literature and internet searches of scientific journals, professional societies, universities, scientific meetings, nonprofit organizations.

RTI reached out to 70 people, of whom 20 people were interested in participating, provided their CV/resume, and were also available during the anticipated peer review time frame. Of these, 17 were selected as some categories had more available reviewers than the maximum number of desired reviewers for that sector. RTI contacted the remaining 17 interested individuals to request a signed COI form. Completed COI forms were received from each of the remaining 17 interested individuals.

The names and affiliations of the 17 candidate peer reviewers, as well as a brief summary of their qualifications, are provided in Table 1.1. Peer reviewer CVs can be found in Appendix A – Peer Reviewer CVs.

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**Table 1.1. Experience/Expertise Matrix for Peer Reviewer Candidates**

Name	Affiliation	Academic Degrees	Chapter
<b>Ms. Alissa Benchimol</b>	<ul style="list-style-type: none"> <li>• Greenhouse Gas Management Institute</li> </ul>	<ul style="list-style-type: none"> <li>• M.S. in Sustainability, Saint Louis University</li> <li>• B.A. in Business Administration, Lindenwood University</li> </ul>	Industrial Processes and Product Use
<b>Mr. E. Lee Bray</b>	<ul style="list-style-type: none"> <li>• U.S. Geological Survey – National Minerals Information Center</li> </ul>	<ul style="list-style-type: none"> <li>• M.B.A., University of Illinois at Chicago</li> <li>• M.S. in Geology, Brigham Young University</li> <li>• B.S. in Geology, Brigham Young University</li> </ul>	Industrial Processes and Product Use
<b>Mr. Phillip Cunningham</b>	<ul style="list-style-type: none"> <li>• Ruby Canyon Environmental</li> </ul>	<ul style="list-style-type: none"> <li>• B.S. in Environmental Science and Technology, Colorado Mesa University</li> </ul>	Waste
<b>Mr. Jonathan De’Ath</b>	<ul style="list-style-type: none"> <li>• National Lime Association</li> </ul>	<ul style="list-style-type: none"> <li>• B.S. in Chemistry with Chemical Technology, Brighton University</li> </ul>	Industrial Processes and Product Use
<b>Dr. Olia Glade</b>	<ul style="list-style-type: none"> <li>• Greenhouse Gas Management Institute</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Chemistry and Crystallography, Moscow State University</li> <li>• B.Sc. Hons Chemistry, Moscow State University</li> </ul>	Industrial Processes and Product Use
<b>Dr. Kevin Gurney</b>	<ul style="list-style-type: none"> <li>• Northern Arizona University; School of Informatics, Computing and Cyber Systems</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Ecology, Colorado State University</li> <li>• M.P.P., University of California at Berkeley</li> <li>• S.M., Massachusetts Institute of Technology</li> <li>• B.A. in Environmental Physics, University of California at Berkeley</li> </ul>	Energy
<b>Dr. Hoyoung Kwon</b>	<ul style="list-style-type: none"> <li>• Systems Assessment Center, Energy Systems Division, Argonne National Laboratory</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Natural Resources and Environmental Sciences, University of Illinois, Urbana-Champaign</li> <li>• Master’s in Environmental Management, Duke University</li> <li>• B.S. in Agricultural Biology, Korea University</li> </ul>	Agriculture

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Name	Affiliation	Academic Degrees	Chapter
<b>Dr. April Leythem</b>	<ul style="list-style-type: none"> <li>• USDA-ARS</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Soil Science, North Carolina State University</li> <li>• M.A. in Natural Resources, North Carolina State University</li> <li>• B.A. in Economics, Brandeis University</li> </ul>	Agriculture and Land Use, Land-Use Change, and Forestry
<b>Dr. Gregg Marland</b>	<ul style="list-style-type: none"> <li>• Appalachian State University, Department of Geological and Environmental Sciences and Research Institute for Environment</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Geology, University of Minnesota</li> <li>• Master’s in Geology, Washington University</li> <li>• B.S. General Science, Virginia Polytechnic Institute</li> </ul>	Energy
<b>Dr. Jerry Marks</b>	<ul style="list-style-type: none"> <li>• J Mark &amp; Associates LLC</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Analytical Chemistry, University of Missouri-Columbia</li> </ul>	Industrial Processes and Product Use
<b>Ms. Emily McGlynn</b>	<ul style="list-style-type: none"> <li>• Ph.D. candidate at University of California, Davis</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. candidate in Agricultural and Resource Economics, University of California, Davis</li> <li>• B.A. in Biology, Bryn Mawr College</li> <li>• B.A. in Economics, Bryn Mawr College</li> </ul>	Agriculture and Land Use, Land-Use Change, and Forestry
<b>Mr. Raymond Pilcher</b>	<ul style="list-style-type: none"> <li>• Raven Ridge Resources, Incorporated</li> </ul>	<ul style="list-style-type: none"> <li>• B.S. in Geology, University of Texas at Austin</li> </ul>	Energy

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Name	Affiliation	Academic Degrees	Chapter
<b>Dr. Pallav Purohit</b>	<ul style="list-style-type: none"> <li>• Pollution Management Research Group, Energy, Climate, and Environment Program, International Institute for Applied Systems Analysis (IIASA)</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Energy Policy and Planning, Indian Institute of Technology (IIT)</li> <li>• M.S. in Physics – Nuclear Engineering and Particle Physics, H.N.B. Garhwal University</li> <li>• B.S. in Physics, H.N.B. Garhwal University</li> <li>• B.S. in Chemistry, H.N.B. Garhwal University</li> <li>• B.S. in Mathematics, H.N.B. Garhwal University</li> </ul>	Industrial Processes and Product Use
<b>Mr. Jeffery Rutherford</b>	<ul style="list-style-type: none"> <li>• Ph.D. candidate, Stanford University</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. candidate in Energy Resource Engineering, Stanford University</li> <li>• M.S. in Oceanography and Coastal Science, Louisiana State University</li> <li>• B.S. in Mechanical Engineering, University of Alberta</li> </ul>	Energy
<b>Dr. Rhonda Sherman</b>	<ul style="list-style-type: none"> <li>• North Carolina State University, Horticultural Science Department</li> </ul>	<ul style="list-style-type: none"> <li>• M.A. in Environmental and Resource Analysis: Solid Waste Management, Western Michigan University</li> <li>• B.S. in Environmental Studies, Western Michigan University</li> <li>• B.S. in Urban/Regional Planning, Western Michigan University</li> </ul>	Waste
<b>Dr. Bryan Staley</b>	<ul style="list-style-type: none"> <li>• Environmental Research &amp; Education Foundation</li> </ul>	<ul style="list-style-type: none"> <li>• Ph.D. in Civil Engineering, North Carolina State University</li> <li>• M.S. in Biosystems Engineering, University of Tennessee</li> <li>• B.S. in Biological and Agricultural Engineering, North Carolina State University</li> </ul>	Waste

**Table 1.1. Experience/Expertise Matrix for Peer Reviewer Candidates**

Name	Affiliation	Academic Degrees	Chapter
<b>Mr. Michael E. Van Brunt</b>	<ul style="list-style-type: none"><li>• Covanta</li></ul>	<ul style="list-style-type: none"><li>• Master of Engineering in Biological and Environmental Engineering, Cornell University</li><li>• B.S. in Agricultural and Biological Engineering, Cornell University</li></ul>	Energy

### 1.2.2 COI Screening Process

RTI conducted COI screening for the selected candidate peer reviewers who best met the required fields of expertise (see Table 1.1) to ensure that the SMEs had no COI or appearance of the lack of impartiality. The COI screening was conducted in accordance with the EPA's *Peer Review Handbook* and involved each SME completing a COI questionnaire (COI form) to determine if they were involved with any other work or organizations that might create an actual, potential, or perceived COI for this peer review. Section 7 provides the COI form for this peer review. Completed COI forms were received from each of the 17 candidate peer reviewers.

RTI evaluated each peer reviewer candidate's credentials to select seventeen SMEs who, collectively, cover the areas of expertise needed for this peer review, have no actual or potential COI or appearance of the lack of impartiality, and were available to complete the peer review within the desired time frame, including preparing individual written comments.

RTI completed the Peer Review Charge Document, which included the Charge Questions (see Section 2) that were developed by the EPA. Reviewers were issued a Peer Review Charge Document on September 17, 2021.

### 1.3 Scope of Peer Review

The EPA approved the scope of this peer review as defined by RTI for the *State Methods* document to focus the peer review process effectively on the Charge Questions (see Section 2). The peer reviewers were directed to keep their written peer review comments within the EPA scope, as defined below:

**The scope of this letter peer review is technical in nature, reviewing the methods, data quality, data sources, underlying assumptions, and the overall strengths and limitations of the study. The EPA is especially interested in comments that focus on the validity or scientific merit of the methodology and that identify any significant weaknesses in the scientific information from the methodology.**

- **Peer reviewers should focus on providing comments on the technical nature of the report, and its consistency with the state of current science as you understand it. The peer reviewers should evaluate the analysis used to develop the proposed methods and the suitability of those methods to estimate time series emissions of their respective category.**
- **Peer reviewers should also focus on the clarity and completeness of the presentation in the draft report. Because the review is technical in nature, the peer reviewers should not focus on editorial style.**

### 1.4 Charge Questions

The objective of this external letter peer review was to obtain written peer review comments from individual experts to conduct an independent external peer review and evaluate the *State Methods* document to 1) ensure the work is scientifically sound and enhance its credibility and 2) for the EPA to improve the clarity of presentation of the results. RTI charged each peer reviewer with evaluating the *State Methods* document and responding to the Charge Questions presented in Appendix B –

Charge Questions. Each chapter has a handful of general, cross-cutting questions, followed by more specific questions for categories.

### 1.5 Organization of Report

This peer review report comprises four sections:

- **Section 1** describes the process for this independent external letter peer review.
- **Section 2** includes the summary of the peer reviewers' comments.
- **Section 3** consists of each individual peer reviewer's comments.
- **Section 4** provides the COI form for this peer review.

## 2. Summary of Peer Reviewers' Comments

This section provides a summary of the peer reviewers' comments, concerns, and suggestions regarding the Charge Questions (see Appendix B – Charge Questions), based on the individual peer reviewer's final written peer review comments (see Section 4).

### 1.1 Energy

#### 1. What are your overall impressions of the clarity of this section?

Regarding Combustion emissions, there are mixed opinions on the overall clarity. One reviewer finds the chapter to be confusing and unclear and another commented that it was clear. The reviewer who finds it confusing specified how and why non-energy uses (NEU) emissions are included are unclear. He suggests the inclusion of equations or diagrams to better illustrate adjustments made. Additionally, this reviewer found some commentary to be too vague, specifically regarding line 63, "there could be a difference in heating values used," as something that should be readily available.

***EPA Response: The EPA made changes to the report to improve the clarity including moving the NEU discussion to its own section, providing figures and tables documenting how adjustments were made to the data and clarifying language describing state level disaggregation compared to the national Inventory approach. Regarding the specific comment on line 63, the EPA also updated the language regarding differences in heating values to confirm that is what was causing differences.***

Regarding the section on Fugitive emissions, reviewers generally find it clear and well written with few comments. One reviewer notes the chapter was well written and the description of trends, sources, and data salient and easy to understand. Another reviewer suggests that a deeper explanation of key sources such as SEDS and documentation of spreadsheet appendices would help with the clarity of this chapter.

***EPA Response: The EPA provided more discussion of the EIA State Energy Data System (SEDS) in the report and also clarified and updated the appendices to provide more detail.***

#### 2. What recommendations do you have to add to or improve the overall transparency, completeness, consistency and accuracy of this chapter?

On the transparency and clarity of figures, one reviewer suggests flow diagrams or decision diagrams with explicit breakdowns of each step to clarify calculations and to identify data used for each step. Additionally, he suggests that Figures 2-5 and 2-6 might convey significance better with percent difference rather than absolute difference. Another reviewer suggests disaggregating nuclear and renewable energy sources in Figures 3-4 and 3-5, to better capture the sensibilities of the subject. He also suggests adjusting stack plots for improved legibility. Another suggestion to improve transparency is to add a comparison of data sources between sources so that users can better understand differences in the data given that there are a variety of data sources in the energy sector.

***EPA Response: The EPA provided flow diagrams in the report to outline how adjustments were made to energy data at the national level. A table was also added describing the different sources used for the national- vs. state-level FFC estimates. Percentage change and absolute changes***

*were added to figures and text to highlight the significance of differences where appropriate. Other suggestions were more appropriate for the national Inventory report. Those will be considered as part of ongoing improvements to that report and reflected in the state-level work as needed.*

More generally, another reviewer identifies tension between using international accounting methods in accordance with IPCC and GHG emission reduction policy making at the state and national level. One example provided is the global warming potential (GWP) of methane in the 4<sup>th</sup> assessment report's GWP value of 25 which doesn't reflect near-term wins in reducing growth in radiative forcing. Another example he provides is the accounting for municipal solid waste (MSW) in the Energy sector when it is more appropriately considered waste, which leads to underreporting of waste sector GHG emissions.

*EPA Response: The state-level estimates have been organized in accordance with international reporting guidelines to ensure consistency with the national Inventory and facilitate comparability across states, they but do not preclude alternative examinations or accounting approaches, GWPs, etc.*

*The EPA is using 100-year GWPs consistent with international reporting (e.g., methane GWP is 25 from the IPCC Fourth Assessment Report). The EPA notes that these comments relate to policy and accounting decisions and are not technical comments directly related to the charge questions.*

Two reviewers noted the importance of consistency with the national *Inventory*, and thus the importance of making the datasets and methodologies used explicit. For example, one reviewer believes that there should be consistency with the national *Inventory* and state level data should always be used to apportion the national *Inventory*. Another reiterates his point that a deeper explanation of SEDS data is important given the significance of the data in the calculations. In addition, he suggests some commentary on the fraction of industrial CO<sub>2</sub> emissions adjusted for IPPU as these can be gleaned from the Excel appendices but are not stated upfront in the main methodology document.

*EPA Response: The EPA has provided more discussion of the EIA State Energy Data System (SEDS) in the report and also clarified and updated the appendices to provide more detail. More detail was also added on the fraction of industrial CO<sub>2</sub> emissions adjusted for IPPU.*

**3. Data availability. Please address the following questions for each inventory source:**

- a. **For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b. **For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

For the Combustion sectors, one reviewer believes that the primary data source should be data reported to the EPA under the Mandatory GHG reporting program. Although these data are incomplete, they would provide a robust dataset. He suggests that a “state-level increment” adjustment could be used to reconcile bottom-up vs. top-down approaches. Finally, he notes that

NEI, CAMD, and eGRID data are available at the state level. Another reviewer emphasizes consistency with the national *Inventory*.

***EPA Response: The EPA considered the other sources and does use GHGRP data in the context of the IPPU adjustments to energy used for FFC. Other data are incomplete but would make useful comparisons to the data currently used, and the EPA will consider a more detailed QA/QC effort in future state-level reports.***

For Fugitive emissions from natural gas systems, one reviewer suggests including aerial methane fugitive emission measurements to counteract the known underestimation from GHGRP.<sup>1</sup> To get a more representative estimate of gas processing capacity by state, he recommends using the Oil and Gas Journal Worldwide Gas Processing Survey or EIA data on gas processing capacity to supplement processing segment emissions.<sup>2</sup> Finally, he recommends considering using counts of transmission stations rather than pipeline mileage to apportion transmission segment emissions. For more on this, see comments in 3.1.2.<sup>3,4</sup> The other reviewer of Fugitive emissions is unaware of additional data that could be incorporated.

***EPA Response: Regarding aerial data, the EPA is considering how it can use observational data, consistent with IPCC 2019 guidance,<sup>5</sup> to assess and improve its national Inventory estimates for oil and gas sources. Any updates applied to the national Inventory will also be reflected in the state-level GHG inventory.***

***As commenters suggested, for future iterations of the state GHGI, we are considering alternate state-level activity data for allocating state emissions such as processing plant information for the natural gas processing segment, and station data rather than pipelines for the natural gas transmission segment.***

- 4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better**

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<sup>1</sup> Rutherford, J.S., Sherwin, E.D., Ravikumar, A.P., Heath, G.A., Englander, J., Cooley, D., Lyon, D., Omara, M., Langfitt, Q. and Brandt, A.R., 2021. Closing the methane gap in US oil and natural gas production emissions inventories. *Nature Communications*, 12(1), pp.1-12.

<sup>2</sup> Oil & Gas Journal, 2015. Worldwide Gas Processing Survey. Available online: <https://www.ogj.com/ogj-survey-downloads/worldwide-gas-processing/document/17299826/worldwide-gas-processing-survey>

<sup>3</sup> U.S. Energy Information Administration, 2019. *757 Processing Capacity*, electronic dataset, Natural Gas Annual Respondent Query System. Available online:

<https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2014&year2=2014&company=Name>

<sup>4</sup> Department of Homeland Security, 2020. *Natural Gas Compressor Stations*, electronic dataset, Homeland Infrastructure Foundation-Level Data (HIFLD). Available online: <https://hifld-geoplatform.opendata.arcgis.com/datasets/natural-gas-compressor-stations/explore?location=35.816723%2C-96.043032%2C5.00>

<sup>5</sup> [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1\\_Volume1/19R\\_V1\\_Ch06\\_QA\\_QC.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1_Volume1/19R_V1_Ch06_QA_QC.pdf)

**prioritize our backcasting and methodological efforts across the time series. The EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Regarding which timeframe is most appropriate, one reviewer believes coverage from 1990 to present is appropriate, while two others find data from 2010 to be the most relevant. The reviewer who believes 1990 is the most appropriate start year justifies that this allows for coverage of what are hopefully peak emissions and tracking their change over time and space. For the reviewers who suggest 2010 as an appropriate start year, they argue these data are most interesting and useful, and it is most relevant given data availability has improved. There's also a growing awareness of GHG emissions by state governments, and the energy profile has changed rapidly. One reviewer still acknowledges that more historical data can be useful to researchers.

***EPA Response: The EPA has included qualitative information on uncertainty in the report. The EPA recognizes the interest in uncertainty estimates and will continue to assess uncertainty associated with the state level estimates and will revisit and incorporate more detailed qualitative information in future reports as it becomes available.***

To address uncertainty in available data, one reviewer suggests comparing GHG emissions for NEI, GHGRP, and eGRID data for the electricity sector and comparing the fuel-consumption based approach and the VMT approach. To better address uncertainty in results, another reviewer recommends including 95% confidence intervals for sector and sub-sector totals (e.g., in production segment in petroleum and natural gas systems).

***EPA Response: The EPA has included qualitative information on uncertainty in the report. The EPA will continue to assess uncertainty associated with the state level estimates and will incorporate more detailed qualitative information in future reports as it becomes available. The EPA will consider comparisons with other data sources as part of the QA/QC procedures and uncertainty assessment.***

**5. Key Categories. The EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. The EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

One reviewer finds the oil and gas sector to be reliable and verifiable, but the coal mining sector could benefit from refining uncertainties related to surface mining and closed and abandoned mines; emissions factors need additional effort to verify that they are capturing the range of possible outcomes. Another speculates some sectors might be subject to state-level trend divergence, e.g., households. While not listing a specific sector which might need refining, a third reviewer reiterates the importance of prioritizing uncertainty and relative emissions magnitude of sources, as described above. A fourth reviewer reiterates the existence of the gap in reporting of fugitive methane emissions from petroleum and natural gas systems and his suggestion of closing the gap in emissions by incorporating aerial methane measurements.

***EPA Response: Regarding aerial data, the EPA is considering how it can use observational data, consistent with IPCC 2019 guidance,<sup>6</sup> to assess and improve its national Inventory estimates for oil and gas sources. Any updates applied to the national Inventory would also be reflected in the state-level GHG inventory.***

***Regarding the uncertainty of coal mining emission estimates and improving assessment of uncertainty, the EPA will consider it in the context of potential improvements to the national Inventory.***

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventorvexplorer/>)?**
  - i. Related to the level of category/gas aggregation or disaggregation?**
  - ii. Are there specific categories where further data disaggregation could be helpful?**
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

All reviewers find the Data Explorer generally intuitive and useful.

***EPA Response: The EPA plans to present the state-level data through the Data Explorer.***

Three reviewers note ways in which finer disaggregation of emissions can be useful for transparency and broader applicability. One notes the definitions and boundaries are clear and the calculations consistent, though he notes that the treatment of District of Columbia and territories should be sharply defined. Two reviewers noted that the viewer was coarser resolution than the *National Inventory*. One reviewer notes the inability to view only methane emissions from the coal mining sector. He also suggests that an option to view a map with the emissions by state and mine would be useful for government or private sector and this would improve transparency. Another reviewer notes this same issue for the petroleum and natural gas systems.

***EPA Response: The EPA provided data as part of the peer review process at the level of disaggregation that was available. With final release of the data, other disaggregation and ways to look at the data will be available in Data Explorer to the extent the state-level data are available.***

A third reviewer thinks it would be helpful to include data reported by vehicle type for the transportation, namely between heavy-duty and light-duty vehicles. Additionally, he suggests including a version containing the full dataset that is amenable to analysis in database software or through pivot tables with additional columns of metadata, e.g., Sector, Table, Description, Fuel Subcategory to facilitate use and analysis across states, sectors, and fuels.

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<sup>6</sup> [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1\\_Volume1/19R\\_V1\\_Ch06\\_QA\\_QC.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1_Volume1/19R_V1_Ch06_QA_QC.pdf)

***EPA Response: Data on state-level fuel use by vehicle type were not available, and more detail was added to the report on differences in national- and state-level transportation sector data used. There are data available in the appendices, and emissions data will be available as part of the Data Explorer for download.***

Multiple reviewer thinks data presented in .xlsx form would be the most useful, and some say .xlsx, xls, and .csv format would be useful.

***EPA Response: The data will be available to download in .csv format from the GHG Inventory Data Explorer, and users can convert the data to other formats as needed.***

### *1.1.1 Combustion*

#### 1.1.1.1 Fossil Fuel Combustion

- 1. Some fuels have differences in consumption data between the aggregated state-level totals and national totals. The current approach is to use data from the national *Inventory* in those cases. Are there other approaches that could be taken? Do you know of cases where others have dealt with the differences in the totals, and if so how?**

One reviewer agrees with the approach to use the national *Inventory*. The reviewer reiterates that since this state-level methodology is meant to complement the national *Inventory*, it is important to have state-level data being an exact apportionment of the national *Inventory* such that the sum of the states always equals the national *Inventory* totals. The reviewer suggests that for transparency, any adjustments made to the individual states' emissions should be clearly reported. Another reviewer emphasizes comparing and providing context and explanations for marginal differences between state and national estimates rather than harmonizing state and national estimates.

***EPA Response: One of the key aspects of the state-level analysis is that estimates are compiled to avoid double counting or gaps in emissions coverage between states. This ensures that state totals, when summed, will equal totals in the national Inventory. This is important for those looking for consistent, comparable, and complete state data for analyses and other purposes where double counting or omissions would be problematic. Therefore, the state-level estimates are an exact apportionment of the national Inventory totals. More information was provided in the report on why there were some minor differences in the data between state-level and national totals.***

- 2. Consistent with the IPCC Guidelines, we have adjusted fuel consumption totals in the energy sector to account for consumption in the IPPU sector. In some cases, this step could lead to a negative emission total for a state if the subtracted amount (as determined from the assumed distribution) was greater than consumption data from the State Energy Data System (SEDS). This outcome was corrected to zero if that was the case, but are there other approaches for correcting for that difference?**

One reviewer believes that calculations should be made on a more individual basis and suggests possible reallocation of assumed distribution to or from states. This can help avoid potential misallocation from such a scenario since fuel consumption is much greater in the Energy sector than

the IPPU sector. Another reviewer finds the methodology appropriate but notes trouble with clarity in spreadsheet documentation. Specifically, the units are not provided in “Appendix A Energy Sector Combustion Estimates,” and the methodology for correction values are not clear. A third reviewer notes that negative values are the result of multiple data sources from different scales, i.e., state and national levels. He suggests making explicit the different vintages of each dataset and explain some of the uncertainty.

***EPA Response: The EPA has provided more clarity in the report on how allocations were made and where further adjustments were needed. The EPA has also provided units in the Appendix A. The EPA has also provided some further detail on the different datasets used in the state-level and national Inventories.***

- 3. Consistent with the national *Inventory*, the default approach taken here was to allocate transportation sector CO<sub>2</sub> emissions based on FHWA fuel use/sales by state. For some states, this may not be accurate because fuel sold in a state may be combusted in other states. Another option is to use vehicle miles traveled (VMT) data by state but that approach does not factor in vehicle fuel economy. Are there other alternative or complementary approaches to allocate transportation fuel across states, including VMT data and other sources (e.g., NEI – based on county-level fleet and activity data to generate a bottom-up inventory) that EPA should consider? If so, what data sources exist to help with that alternative approach? Would it be helpful to present transportation sector emissions using multiple approaches in future inventories?**

One reviewer believes it would be useful to present multiple approaches, with the NEI / MOVES approach used as the primary model approach. A second reviewer votes with IPCC to count as point of final sale rather than point of final usage because this is the level for tax collection and potential controls, and how electricity is counted. This reviewer also notes a lack of clarity between international bunkers and interstate bunkers, but a distinction is important because they are accounted for differently.

***EPA Response: Regarding IPCC accounting of vehicle emissions at point of fuel sales, the EPA continues to use that as the primary approach for allocating vehicle emissions to states. Although the EPA is not adopting the NEI/MOVES approach as the primary method for this annual effort, the EPA will continue comparisons with the NEI and other approaches of allocating vehicle emissions. Interstate bunkers or fuel used for domestic flights are treated the same as on road vehicle emissions and allocated to the point of jet fuel sales. Discussion on treatment of international bunkers is provided in the report.***

Another reviewer notes that apportionment error is likely to be larger for long-haul diesel-based trucking. These data come from EIA SEDS, based on FHWA reports, and the state-level diesel sales are point of fuel, not point of purchase, which minimizes this error.<sup>7</sup>

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<sup>7</sup> Office of Highway Policy Information, n.d. Chapter 2: Reports Identifying Motor-Fuel Use and Taxation. Available at: <https://www.fhwa.dot.gov/policyinformation/hss/guide/ch2.cfm>.

*EPA Response: The EPA further researched the FHWA data and confirmed it is based on point of sale as opposed to point of use. However, basing transport emissions on point of sale is consistent with IPCC inventory guidance. IPCC 2006 guidelines Vol 2 Chapter 3 indicates at a country level: Where cross-border transfers take place in vehicle tanks, emissions from road vehicles should be attributed to the country where the fuel is loaded into the vehicle. On a state-level basis, this would attribute vehicle emissions to the state where fuel is purchased.*

**4. Mobile source non-CO<sub>2</sub> emissions are allocated across states based on vehicle-miles-traveled data while mobile source CO<sub>2</sub> emissions were allocated based on fuel sales, as mentioned above. Is there an issue with using two different methodologies for mobile source CO<sub>2</sub> vs. non-CO<sub>2</sub> state splits?**

One reviewer recommends that the state inventory adopt the NEI approach of using the EPA's MOVES model. Transportation fuel sales could be included as supplemental data with the caveat that there would be mismatch due to temporal and state-line issues. Another reviewer notes that SEDS data are consistent with FHWA reports that fuel sales are the most accurate method for apportioning fuel use, and subsequently emissions, by state.<sup>8</sup> This reviewer suggests an explanation for the VMT approach over the fuel sales approach for non-CO<sub>2</sub> emissions because one would assume that apportioning non-CO<sub>2</sub> emissions should be proportional to CO<sub>2</sub> emissions on a kg gas per kg fuel basis.

Although it might be problematic, one reviewer thinks that this is probably the best method and cautions that it should be clear that this is what is being done.

*EPA Response: Regarding the MOVES model, the EPA was not in a position to use it as an additional tool for this initial effort. The NEI/MOVES approach uses as inputs county-level activity data specific to the year of interest, not the model's off-the-shelf default activity inputs. Additionally, the model cannot easily be run at the state level (it requires computationally intensive county-level runs summed to the state level). The national and state-level inventories use different methodologies for calculating CO<sub>2</sub> and non-CO<sub>2</sub> emissions for vehicles. CO<sub>2</sub> emissions are derived from fuel consumption data, while non-CO<sub>2</sub> emissions account for fleet information (i.e., age distribution/vehicle technology break-out, VMT) in the calculation of non-CO<sub>2</sub> emissions. More detail on this is provided in the report, and further clarity can be provided in future releases as needed.*

**5. Several fuels have variable C factors over time including coal, natural gas, gasoline, and diesel fuel. Those fuels might also have variable C factors across areas/states. Are data available to build out state-specific C factors for the fuels with variable C contents? If so, could it be done in a way that the state-level total emissions still matched up to the national total emissions for those fuels?**

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<sup>8</sup> Erickson, R., n.d. Attribution paper. Available at:  
<https://www.fhwa.dot.gov/policyinformation/motorfuel/ftap/appxa.cfm>.

Reviewers are unaware of additional supplemental data sources on C factors. However, while one reviewer is not familiar with any state-specific carbon content values, he notes that a state average of reported carbon content by fuel can be extracted from GHGRP data and applied as a surrogate value for all fuels consumed in the state. He is unaware of additional state-level geothermal data. Another reviewer finds this current approach appropriate, because although there are differences in fuel composition in upstream NG and petroleum fuels, the difference is minimal when combusted.

Another reviewer argues that for solid and gaseous fuels, there is a strong correlation between heat content and C content that can be used uniformly across states. This however does not apply to liquid fuels.

*EPA Response: The EPA continues to use national average C factors to develop the state-level inventory values but will continue to investigate the possibility of using state-specific C factors in future reports, specifically for liquid transportation fuels. The EPA will consider the possibility of applying state-specific factors as part of potential future improvements.*

**6. Geothermal emissions could be allocated by the type of geothermal production per state (because different types have different emissions factors) if that data are available. Is there more information on state-level geothermal emission factors and production?**

No reviewers are familiar with up-to-date geothermal datasets. One reviewer is curious about the emissions factor used for calculating geothermal emissions.

*EPA Response: More information on geothermal emission factors is available in the national Inventory report in annex 2, Table A-32 of the current report.*

1.1.1.2 NEU

**1. For petrochemical feedstocks, non-energy use (NEU) of natural gas is allocated across states based on petrochemicals emissions data per state from the IPPU adjustments, while other fuels are allocated based on the underlying SEDS data. Allocating across states based on the underlying SEDS data ensures there are no states where NEU use is larger than original SEDS data and there are no zeros associated with subtracting NEU (it is not an issue for natural gas because use is so high overall compared with NEU use). Could different approaches be used or can the petrochemical data be used without resulting in negative use?**

One alternative approach to the current method of allocating across states based on SEDS data is using value-add data from the US economic census, according to one reviewer. One drawback to this is that data are not available annually, but it does provide a total value add by industry which may be slightly more directly correlated to production than emissions. Another reviewer noted the benefit of including an explanation for missing state-level natural gas consumption for petrochemicals (from SEDS) as this is necessary for calculating petrochemical emissions.

*EPA Response: The EPA will look into the economic census data as part of future reports, including as a data source for other disaggregation approaches such as IPPU sources. The EPA provided more information on the data sources used and the step of adjusting energy values to account for NEU of fuels.*

#### 1.1.1.3 Incineration of Waste

- 1. Waste incineration emissions are calculated based on the combustion of fossil components of both municipal solid waste (MSW) and tires. However, emissions are disaggregated to states based only on MSW tonnage. Are there approaches or data available to disaggregate emissions based on waste category (e.g., MSW combustion vs. tire combustion)?**

All reviewers find this an acceptable approach. One reviewer emphasizes, regarding more recent years, that waste combustion emissions data should be based directly on GHGRP GHG emissions data. Using that approach captures 99.5% of the sectors emissions and the remaining 0.5% are estimated based on assumed fossil carbon content in MSW and estimated MSW (Appendix C – Supplemental WTE GHG Data v3). MSW throughput is estimated from either EIA reports or on design data from Energy Recovery Council (ERC). Allocation in this way accounts for differences in biogenic/fossil ratios that can occur between facilities.

*EPA Response: Regarding sources for waste incineration, for the current state-level report, the EPA has maintained the current approach but is planning updates to the national Inventory approach for waste incineration, including the use of GHGRP data as part of the 1990–2020 report. These updates at the national level, when finalized, will be implemented in the next annual GHG Inventory by U.S. State report (i.e., likely for the 1990–2020 state-level estimates).*

#### 1.1.1.4 International Bunker Fuels

- 1. The approach used to allocate jet fuel bunker fuels by state is currently based on the total amount of jet fuel used by state which could potentially lead to an over- or under-estimation for some states of bunker fuel emissions. Are there other more accurate approaches to allocate jet fuel bunker data across states as opposed to the percentage of jet fuel total use? For example, using Federal Aviation Administration flight level data on departures and destinations or assuming based on states with international airports and flights?**

No reviewer believes that a better method exists; they both acknowledge the difficulty in allocating aviation based emissions. One reviewer believes that the current methodology for international bunker fuels in the state-level methodology is the best approach, because attempts to allocate flight level data cannot take into account differences in fuel use by destination. Another reviewer notes that the allocation of emissions in aviation is difficult and currently there is no widely accepted approach, which is why the UNFCCC presents nine options.<sup>9</sup> A third reviewer assumes that U.S. reports of international bunker fuels for jet fuel loading on internationally bound flights collected at airports, though he is unaware of data at the sub-national level.

*EPA Response: The EPA will continue to investigate approaches and data for allocating international bunker fuel data at the state level including, for example, flight-level data.*

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<sup>9</sup> SBSTA, 1996. National Communication of the Subsidiary Body for Scientific and Technological Advice, FCCC/SBSTA/1996/9/Add.1, 24th October 1996. Available online: <https://unfccc.int/cop3/resource/docs/1996/sbsta/09a01.htm>

#### 1.1.1.5 Wood Biomass and Biofuels Consumption

### **1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One suggestion to ensure high-quality state-level estimates consistent with the national *Inventory* is to look at EIA capacity or production data by state, according to one reviewer. Another reviewer suggests including more specific explanations for emissions factors as they are applied in the national *Inventory*. Another reviewer thinks U.S. Forest Service might have some data on state-specific wood fuels.

***EPA Response: The EPA will look into U.S. Forest Service data as a possible source for allocating woody biomass combustion emissions to different states.***

#### 1.1.2 *Fugitive*

##### 1.1.2.1 Coal Mining

### **1. Do you have any comments specific to the methodology and emission estimates for active coal mines and abandoned coal mines?**

One reviewer suggests a clearer explanation of mine-level data from GHGRP and how it is disaggregated by state as many coal mines span multiple states. This suggestion is complemented by another reviewer who reiterates his comments in the Charge Questions section on lack of discussion of relevant specific detail of individual mines. This is discussed more in the national *Inventory* than in the state methods. Additionally, the second reviewer also suggests revisiting work done in mid-1990s on basins as there are differences and evaluating this information at a state level might be more useful than apportioning emissions to states within a basin. The second reviewer also notes that there is not a singular Western basin but several basins in the Western U.S. and suggests changing the name and adding an explanation for why emissions are lumped.

***EPA Response: For emissions from underground coal mines, emissions estimates are based on facility-level reporting by coal mines to the GHGRP and the Mine Safety and Health Administration (MSHA). As discussed in the State Methods document, emission estimates are aggregated to the state level based on mine location and reported facility-level emissions.***

***Although coal basins span across state boundaries, the EPA is not aware of underground coal mines that span state boundaries. The master list of underground coal mines used for the national Inventory includes the Mine Safety and Health Administration (MSHA) identifier and location by county and state. For surface mines, emissions estimates are based on coal production by state, as reported in the Energy Information Administration (EIA) annual coal report.***

***The comment regarding basin-level emissions factors appears to refer to the IPCC Tier 2 method that the EPA uses to estimate methane emissions from surface mining activities in the national Inventory. The comment suggests that there may be data available to update the basin-level emissions factors for surface mining used in the national Inventory that break out basin-level emissions by state. The EPA is not aware of any recent studies that have data on basin-level***

*surface mining estimates of methane content of coal or methane emissions. However, if such studies and/or datasets can be identified, the EPA will consider them for potential improvements to the emissions estimates in the national Inventory.*

*The EPA agrees with the comment that there is not a singular Western coal basin but several basins in the Western U.S. and the suggestion that the name referenced in the national Inventory should be changed to “Western Basins.” The EPA also agrees that an explanation should be added for why methane emissions from these basins are lumped together as a single region. The EPA plans to implement these suggested revisions in the 1990–2020 national Inventory.*

Regarding consistency and accuracy of the chapter, one reviewer questions some assumptions made on the emissions factors of methane from surface mines of only considering gas content at the coal seams and not also gas which can migrate from lower levels. The reviewer also challenges the assumptions related to the overall uncertainty of emissions estimates stemming from the uncertainty of underground emissions estimates and suggests that there is greater uncertainty in surface mining. The reviewer continues that abandoned mine methodology is old and data from mines that have produced gas from non-flooding abandoned mines may be underestimated.

*EPA Response: The EPA notes that the comments are focused on the methods used for the national Inventory. The EPA will consider these comments, including data availability, as it assesses potential improvements to the national Inventory.*

**2. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned coal mines, including state-level datasets addressing recovery of methane from abandoned mines?**

Reviewers are unaware of countrywide state-level data. One reviewer does note that there are some state-level datasets for individual states, e.g., Colorado and Kentucky.

*EPA Response: The EPA thanks the reviewers for their feedback.*

**1.1.2.2 Abandoned Underground Coal Mines**

**1. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned coal mines, including state-level datasets addressing recovery of methane from abandoned mines?**

No reviewers are aware of country wide state-level datasets that would improve the methodology for Abandoned Mine emissions. One reviewer notes that states have generally not been actively investigating or reporting emissions data, and these data are related to location and have to be acquired at the state or county level.

*EPA Response: The EPA thanks the reviewers for their feedback.*

### 1.1.2.3 Petroleum Systems and Natural Gas Systems

**1. Are there relevant dataset(s) that could be used to replace or supplement the data currently used to allocate petroleum and natural gas system emissions to the state level? Particularly, state or detailed location information on gathering and boosting stations, processing plants, and transmission and storage stations?**

Regarding data to supplement or replace current data, one reviewer mentions work by EDF, NASA JPL and others to quantify methane emissions from gas and oil fields, natural gas distribution systems, natural gas transmission stations, management infrastructure including landfills, wastewater treatment plants, compost facilities, and anaerobic digestors.<sup>10</sup> Satellite data may also be useful in apportioning fugitive methane emissions.<sup>11</sup> In response to Charge Question 4 on sources for which state-level regulatory or voluntary programs result in large differences in emission rates between states, the age of the distribution systems is likely one of the largest factors. Discourse on this in peer reviewed literature has looked at fugitive emissions in different cities.

Regarding the production segment, another reviewer reiterates the importance of incorporating aerial methane fugitive emissions. This reviewer suggests other bottom-up approaches to close the gap in underestimation in petroleum and NG systems such as unintentional storage tank emissions or unlit flares. The same reviewer suggests for the gathering and processing segment suggests using the Oil and Gas Journal Worldwide Gas Processing Survey data which are currently used for activity data to be apportioning emissions by state over the current approach of using a fraction of onshore natural gas production. One drawback to this dataset is it is not available open-source unlike the EIA dataset of natural gas processing capacity. Regarding the transmission segment, this same reviewer suggests focusing on the transmission segment of compressor stations as they make up a larger contribution of total emissions than pipeline mileage.<sup>12,13,14</sup> Data for this can be found on the Department of Homeland Security website.<sup>15</sup>

***EPA Response: Through its annual stakeholder process on oil and gas GHG data, the EPA considers new studies that could be used to improve the national Inventory. In recent years, the EPA has incorporated several new studies, including several organized by EDF. The EPA will***

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<sup>10</sup> See: <https://methane.jpl.nasa.gov/>

<sup>11</sup> See article by Climate & Clean Air Coalition here: <https://www.ccacoalition.org/en/news/satellite-data-reveals-extreme-methane-emissions-us-permian-oil-gas-operations>

<sup>12</sup> Rutherford, J.S., Sherwin, E.D., Ravikumar, A.P., Heath, G.A., Englander, J., Cooley, D., Lyon, D., Omara, M., Langfitt, Q. and Brandt, A.R., 2021. Closing the methane gap in US oil and natural gas production emissions inventories. *Nature communications*, 12(1), pp.1-12.

<sup>13</sup> Zimmerle, D.J., Williams, L.L., Vaughn, T.L., Quinn, C., Subramanian, R., Duggan, G.P., Willson, B., Opsomer, J.D., Marchese, A.J., Martinez, D.M. and Robinson, A.L., 2015. Methane emissions from the natural gas transmission and storage system in the United States. *Environmental science & technology*, 49(15), pp.9374-9383.

<sup>14</sup> U.S. Energy Information Administration, 2019. *757 Processing Capacity*, electronic dataset, Natural Gas Annual Respondent Query System. Available online:

<https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2014&year2=2014&company=Name>

<sup>15</sup> Department of Homeland Security, 2020. *Natural Gas Compressor Stations*, electronic dataset, Homeland Infrastructure Foundation-Level Data (HIFLD). Available online: <https://hifld-geoplatform.opendata.arcgis.com/datasets/natural-gas-compressor-stations/explore?location=35.816723%2C-96.043032%2C5.00>

*continue to assess new data through its stakeholder process and updates made to the national Inventory estimates would also appear in the GHG Inventory by U.S. State.*

*Regarding satellite and aerial data, the EPA is considering how it can use observational data, consistent with IPCC 2019 guidance,<sup>16</sup> to assess and improve its national Inventory estimates. Any updates applied to the national Inventory would also be reflected in the GHG Inventory by U.S. State.*

*As commenters suggested, for future annual publications of the state-level GHG data, we are considering alternate state-level activity data for allocating state emissions such as processing plant information for the natural gas processing segment and station data rather than pipelines for the natural gas transmission segment.*

**2. Are there additional Greenhouse Gas Reporting Program (GHGRP) data that could be used to allocate natural gas and petroleum emissions to each state?**

One reviewer suggests using GHGRP activity data on equipment activity counts over well counts to apportion emissions because intensity in well counts can vary widely across states.

*EPA Response: The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State.*

**3. Are there particular sources for which state-level regulatory or voluntary programs result in large differences in emission rates between states? Are state-specific datasets available for those sources?**

One reviewer notes the variance in state level legislation regarding data on the fraction of tanks with emission controls across states. Some states (e.g., Colorado, California) require all storage tanks to have a flare or vapor recovery unit while other policies do not exist in other states (e.g., Texas, North Dakota). A second reviewer echoes this statement and remarks that this is a topic of interest in Colorado, where he lives, at the state, county, and municipal level.

*EPA Response: The EPA will assess an update using additional GHGRP data which would take into account variations in tank activity and emissions data between states for future annual publications of the GHG Inventory by U.S. State.*

**4. Are there particular sources for which state-level regulatory or voluntary programs result in large differences in emission rates between states? Are state-specific datasets available for those sources?**

Reviewers are unaware of data sources related to regulatory or voluntary programs.

*EPA Response: The EPA thanks reviewers for their feedback.*

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<sup>16</sup> [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1\\_Volume1/19R\\_V1\\_Ch06\\_QA\\_QC.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1_Volume1/19R_V1_Ch06_QA_QC.pdf)

#### 1.1.2.4 Abandoned Oil and Gas Wells

### **1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

One reviewer notes a lack of specificity of data used by the EPA in the state level calculations, making it difficult to determine which sets have been used already. This reviewer also suggests other data such as the Texas Railroad Commission (<https://gis.rrc.texas.gov/GISViewer/>) have been included in Enverus. Another reviewer reiterates using satellite data to supplement data in this section.

***EPA Response: Datasets used to develop abandoned well estimates in the national Inventory are documented in the national Inventory and in a 2018 memo, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016: Abandoned Oil and Gas Wells.<sup>17</sup>***

***Regarding satellite data, the EPA is considering how it can use observational data, consistent with IPCC 2019 guidance,<sup>18</sup> to assess and improve its national Inventory estimates. Any updates applied to the national Inventory would also be reflected in the GHG Inventory by U.S. State.***

## 1.2 Industrial Processes and Product Use (IPPU)

### **1. What are your overall impressions of the clarity and transparency of this section?**

Regarding the overall clarity, there is some disagreement as three reviewers find the chapter to be clear and comprehensive overall and two reviewers find it unclear and confusingly worded. The two who find it unclear note no specificity for which approach is taken in section 1.2 of the three methods approaches for each individual category. There is also some confusion on the geographic scope as which U.S. territories are considered is not made explicit nor how this compared with the national *Inventory*. Two reviewers recommend including explicit calculations and explanation for which methodology is used, as several sectors include only a reference to the national *Inventory*. The reviewers found that the introduction notes that some states use their own methodologies without providing information on which states or methodologies are used in the subsequent relevant sectors. They note that three approaches are outlined, but not always specified. One of these reviewers cites nitric acid production as an example, which includes just a GHGRP reference, and a sophisticated T2/T3 hybrid approach is used, but the 2006 IPCC Guidelines do not have a description of such a hybrid approach. The reviewer also notes that there are different approaches used for different states for some sectors, such as adipic acid production and titanium production. To remedy this, this reviewer suggests adding a table in the relevant section for which methods were used by which state.

One reviewer notes that the *State Methods* document says some states may have adopted different accounting decisions from those adopted by the IPCC and UNFCCC and may even use different categorization. The reviewer notes that lines 46-49 of the Introduction suggest Scope 1, Scope 3, or a consumption-based approach may be used by states for emissions allocation and is contrasted with

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<sup>17</sup> [https://www.epa.gov/sites/default/files/2018-04/documents/ghgemissions\\_abandoned\\_wells.pdf](https://www.epa.gov/sites/default/files/2018-04/documents/ghgemissions_abandoned_wells.pdf)

<sup>18</sup> [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1\\_Volume1/19R\\_V1\\_Ch06\\_QA\\_QC.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1_Volume1/19R_V1_Ch06_QA_QC.pdf)

“our approach.” This reviewer suggests a more detailed explanation on how specifically the activity data and corresponding emissions have been allocated for each state and whether the allocation has been the same across different sectors and categories.

Reviewers suggest including some description of the market size and trend within states for non-reporting facilities for certain categories under Product Use. One of these reviewers also suggests including activity data references, emissions factors used and developed, and technologies to improve transparency for Product Use sectors. According to one of these reviewers, breaking down the metals section further by state to include specific practices and technologies that are present in facilities at the state level, where known, would be useful. For example, including background on casting practices that release HFCs and CO<sub>2</sub> for magnesium production and processing. One reviewer suggests another way to improve clarity is to specify geographic boundaries and whether they are the same across chapters and sectors. Another suggests including a list of states that are active emitters for sectors for which there is no active production in every state.

***EPA Response: The EPA clarified in the State Methods document which disaggregation approach (Approach 1, 2, or Hybrid) was used for each IPPU category. The EPA has also included a summary table at the front of the industrial processes and product use chapter outlining which approaches were used. The EPA also clarified in the report which states, DC, or territories saw emissions from each IPPU category. As stated in the report, emissions estimates were compiled to avoid double counting or gaps in coverage and to ensure that state totals summed to the national Inventory and are consistent with the national Inventory’s regional disaggregation and reflect the latest methodological improvements in the national Inventory. The EPA will also consider adding information on unique state circumstances for industries where relevant to estimating state-level emissions.***

For transparency, one reviewer also recommends relating the categories not only to the national *Inventory* but also to CRF tables. In the Electronics Industry category, the reviewer notes that the category background refers to both the national *Inventory* and the CRF source category codes, but this is not done consistently throughout the document. Furthermore, the reviewer notes that for some categories such as iron and steel production emissions can be reported in multiple chapters. In the case of iron and steel, CO<sub>2</sub> emissions related to chemical processing and the reduction of iron from ore are reported in IPPU, and CO<sub>2</sub> emissions related to energy use are reported in Energy. The reviewer notes that it is not clear if the Energy and IPPU chapters use the same approach to allocate emissions by state. If not, there runs a risk of under- or overestimating emissions for some or all states from iron and steel. It is also not clear if the by-product fuels are used within the same facility where they are produced or are transferred to other facilities where they are used for energy purposes. To remedy this, the reviewer first suggests investigating if by-product fuels are used within the same facilities where they are produced and to adjust the emissions allocation according to the 2006 IPCC Guidelines. The accuracy of emissions from states that produce and use by-product fuels might be affected if by-product fuels are transferred across state lines. Second, the reviewer recommends ensuring that the same method of disaggregation by state is applied to Energy and IPPU for iron and steel and including relevant explanations as needed.

***EPA Response: The EPA does use the same method to allocate I&S energy use in IPPU and Energy. The IPPU state allocations are used in the energy sector to reduce the energy used in I&S***

*by state. The energy chapter of the State Methods document has more information on the approach used.*

*For the co-products (BFG and COG), the EPA accounted for all of those emissions in the I&S sector even if they are shipped offsite. However, recent trends are that all are being used onsite. There is some further discussion in the uncertainty section for I&S on the implications of this assumption.*

Regarding transparency, one reviewer notes that which proxy data for disaggregating clinker production is unclear. Overall, the chapter does not justify the choice of proxy data chosen, so it is unclear why some measures are chosen over other proxy data sources. For example, lime production is disaggregated at the state level by the number of facilities whereas data for soda ash are disaggregated based on population without a clear explanation. The reviewer also notes that data on industry GDP by state do not seem to be considered for disaggregation, despite their availability.<sup>19</sup>  
<sup>20</sup> The reviewer also notes that data sources referenced for cement production are unclear and incomplete. This section supplements national *Inventory* methods and data with USGS and GHGRP data, but the corresponding references are missing.

One more suggestion for increasing transparency is to provide a comparative analysis of emissions or activity data by state. Finally, the reviewer notes that the *State Methods* document does not work as a stand-alone entity because much of its methods are dependent on what is used in the national Inventory. Because several sectors use different methodologies, this can make it difficult for the reader trying to understand various methods of disaggregation, and the reviewer suggests specifying which methods were used in greater detail. In sectors where there are discrepancies between the disaggregated total and the national *Inventory* values, the reviewer suggests including the percentage difference.

***EPA Response: As included in the State Methods document and consistent with the 2006 IPCC Guidelines, the method used for 1990–2009 relied on USGS clinker production data. The USGS reports clinker production for a few individual states and combines production for other states in groups of two to four to protect company proprietary data. To estimate clinker production for individual states, production for grouped states was evenly divided among the states in the group.***

***The method used for 2010–2019 was based on state-level emissions data from GHGRP to distribute clinker production by state. Facilities that use the Continuous Emissions Monitoring System (CEMS) to measure emissions reported combined combustion and process emissions, while facilities that do not use CEMS reported their process and combustion emissions separately. Using the data from facilities that do not use CEMS, average annual process emissions factors were estimated and applied to the CEMS emissions data to estimate process-only emissions by state. Those process emissions by state were converted into a percentage of national process emissions and applied to national clinker production data to estimate state-level clinker production.***

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<sup>19</sup> Statista. (2021). “Gross Domestic Product (GDP) of the United States in 2020, by state,” Available at: <https://www.statista.com/statistics/248023/us-gross-domestic-product-gdp-by-state/>

<sup>20</sup> FRED (2021). “Gross Domestic Product by State,” Available at: <https://fred.stlouisfed.org/release?rid=140>

***On the suggestion to provide comparative analysis of emissions, the EPA will further consider reviewers' feedback to include synthesis information in the report. The report is intended to document the disaggregation methods applied to ensure consistency with the national Inventory. The EPA will consider supplemental publications including synthesis of data with future annual publications of the GHG Inventory by U.S. State.***

***Should the sum of state totals differ from national totals due to disaggregation approaches, the EPA will document this across sectors and categories.***

Another reviewer thinks that the assumptions and data sources are clear. Regarding uncertainty, this same reviewer recommends prioritizing ODS for uncertainty analysis. The reviewer suggests including data samples from states, assumptions for data disaggregation in the methods section and comparing results with those of the national *Inventory*. The reviewer also suggests complete information on categories, gases, assumptions for the entire time series for available applications. For completeness, the reviewer suggests including activities within a state, total emissions by gas, methods, assumptions, and proxy data with justification for how they are used to estimate emissions, and activity data on recover, reuse, and recycling by state. This can address some of the unclear state or national boundaries regarding activities.

***EPA Response: The EPA plans to consider improvements generally to uncertainty analysis for key categories, including for ODS substitutes.***

***The State Methods document includes enhanced descriptions and data appendices to provide more detail on surrogate data used to reflect activity with a state. The EPA also provided data tables with emissions and sinks for each state by gas, IPCC category, and economic sector to reviewers.***

Another reviewer suggests adding text to discuss and explain CO<sub>2</sub> emissions contributions from calcined waste generation in the Lime production sector. The reviewer acknowledges that a lot of data regarding lime production and capacity is considered proprietary by lime producers in the U.S. and thus in the absence of such state level data, accurate state level emissions cannot be reliably calculated. The reviewer references the results from 1990 to 2009 and notes inaccuracies that are both too high and too low for certain states.

***EPA Response: The EPA clarified in the State Methods document that emissions are also generated from the production of calcined waste, primarily lime kiln dust. The EPA notes the reviewer's acknowledgment that reviewer's feedback that state-level production data are confidential and not readily available. The EPA plans to review and assess the potential for refining methods for allocating emissions from 1990–2009.***

## **2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?**

One reviewer suggests including gas emissions totals breakdowns by category and state. The reviewer also suggests including a percentage breakdown of results by disaggregation method. For example, in the electric industry, there is no information on how disaggregation accounts for emissions from non-reporting facilities for each specific gas. This can vary significantly, and the disaggregation for each gas may not be linear. At the national level this is a transparency issue, but at the state level it could be more a question of accuracy if allocation is based on inappropriate proxy

values that do not match scale and production patterns. This same reviewer suggests profiles on output capacity by state for some categories and notes that missing proxy data for several years could result in under- or overestimating emissions at the state level. For example, no information is provided on disaggregated state-level or plant-specific data on reducing agents and other carbon containing process materials for zinc production.

This same reviewer notes that it is unclear where production occurs in the methods section for Metals and Product Use sectors. While the sum of emissions is consistent with the national *Inventory*, it is unclear what this means in terms of comparability, accuracy, or error range. Allocating equally across facilities leads to over- and underestimated emissions across states if individual capacities differ.

This reviewer also recommends including descriptions of historical change in the methods which could result in changes in emission totals by state. Analysis of historical trends in GHG emissions could reveal unexplained inter-annual variations that could have been attributed to calculation errors. A second reviewer expresses similar views, providing the cement production sector as an example.

This reviewer also notes that the *State Methods* document does not include information on which applications are reported, which are not occurring, which are not estimated, etc. e.g., in electrical transmission and distribution, there is no indication if there was an effort to identify any industrial, military, or small-utility application sources as these could potentially contribute to this category. This same section also does not provide a disaggregation method on the disposal of electrical equipment and recycling or destruction of SF<sub>6</sub>, if existent. To that end, the reviewer suggests including specific percent disaggregation of reporting and non-reporting facilities by category as well as for total emissions.

***EPA Response: Emissions data will be available by category, gas, state, and other filters on the EPA website. The EPA describes in each category if estimates are likely not inclusive of all facilities and will continue to assess the availability of other data to improve the completeness of estimates.***

***The EPA clarified in the report which states, DC, or territories saw emissions from each IPPU category.***

***The EPA added a qualitative explanation of uncertainty to each category to describe the impacts of assumptions and use of surrogate data on emissions.***

***The EPA includes a description of historical industry trends in the national Inventory report and will consider including similar information in future publications of the GHG Inventory by U.S. State.***

***The EPA plans to include notations like NE (Not Estimated) and NO (Not Occurring) in the next GHG Inventory by U.S. State.***

***Information on the estimated percent of national emissions reported by facilities is available in the national Inventory report for electrical transmission and distribution. The EPA did not quantify the percentage of emissions covered by reporting facilities by state but will review the feasibility of adding more information related to this metric in future publications of the GHG Inventory by U.S. State. The EPA does not quantify national- or state-level totals for disposal of electrical equipment and recycling or destruction of SF<sub>6</sub>. Emissions from electrical transmission and distribution are not estimated by application. All applications are required to report to the***

***GHGRP if they meet the threshold requirements for the program and are included in the EPA’s estimate of national emissions.***

Regarding the accuracy, one reviewer notes that in section 2.1.2.2, line 136, there is an erroneous reference to section 3.1.4 instead of 2.1.4. In keeping consistent with the 2006 IPCC Guidelines use of SI units, the reviewer also suggests using abbreviation Mt rather than MMt for mega tonnes. Another reviewer suggests including a table of GWP values for each GHG to convert to CO<sub>2e</sub>.

Another reviewer suggests disaggregating lime production from limestone and dolomite due to the different emission factor for them based on different chemical compositions for the feedstock. This could lead to under- or overestimation of CO<sub>2</sub> emissions from the category depending on the share of dolomite in use. This reviewer also notes using number of facilities as proxy data in IPPU sectors can be problematic because it overlooks variation in production capacities. The reviewer suggests using a state-level capacity average to ameliorate this. Using industry GDP per state rather than population is another suggested alternative. One sector where this could be beneficial is in Urea consumption for non-agricultural purposes, because state allocation by population without reason might be erroneous.

Finally, the reviewer echoes views mentioned above regarding nitric acid production methodology description. The reviewer notes it is not clear which facilities or states have applied abatement technologies, but this can affect the accuracy of the estimates. If abatement technologies are not applied, the reviewer suggests that a relevant assumption should be made and the calculation should be adjusted to avoid overestimating N<sub>2</sub>O emissions.

***EPA Response: Unit abbreviations and GWP values used in the State Methods document are consistent with the national Inventory.***

***Regarding the comment to disaggregate lime production by limestone and dolomite, the EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State, dependent on data availability.***

***Regarding the comment on using a state-level capacity average in place of the number of facilities as proxy for IPPU categories, the number of facilities was used as a proxy for production due to a lack of data on facility capacity or production by state.***

***Regarding the comment on using industry GDP per state instead of population, the EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State.***

***Regarding the comment on nitric acid methodology, abatement technology is taken into account through the disaggregation of national estimates. The application of abatement technologies has less uncertainty for 2010–2019, when GHGRP emissions data from individual facilities—including facilities operating abatement equipment—were used to disaggregate national emissions by state. For earlier years, the EPA will assess options to improve estimate accuracy in applying available information about abatement equipment to the nitric acid facility production capacity data for that time period.***

One reviewer focused on Lime production notes there are erroneous assumptions regarding the CaO and MgO content for both high-calcium and dolomite lime of 95% when NLA data suggest it is

closer to 96%, affecting the emissions factor for hi-cal lime and dolomitic lime. The reviewer also questions the assumption that facilities all have the same amount of input and output, noting that there is wide variation in lime manufacturing plants, ranging from a few thousand tons per year to millions per year. The reviewer notes, as stated above, that production and capacity data are considered confidential and thus not released. Additionally, the reviewer notes that state level aggregation or disaggregation must meet EPA's CBI criteria. Finally, lime plants can be idle up to a year or more and then reopen and this should be taken into account when calculating state-level emissions to improve accuracy.

***EPA Response: Because of the lack of available data on production by state of high-calcium and/or dolomitic lime and on facility capacity, the 1990–2009 methodology currently uses the number of facilities as a proxy in order to estimate emissions. The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State, dependent on data availability.***

Another reviewer suggests including policies and measures to reduce IPPU sector emissions. Some policies he mentions are: California Air Resources Board (CARB) has introduced new rules to reduce HFC emissions to 40% below 2013 levels by 2030, the California Cooling Act created an incentive program to facilitate early adoption of HFC alternatives, the U.S. Climate Alliance (USCA) has committed to reducing short-lived climate pollutants,<sup>21</sup> eight USCA states have passed legislation or committed to issue new regulations to curb specific HFC uses, and several states have finalized bans on HFCs.<sup>22</sup>

***EPA Response: The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State.***

This same reviewer includes policies and measures for alternative of high-GWP refrigerants. For example, on page 4-131, the reviewer suggests including low-GWP options for stationary air conditioning and transport refrigeration sector in the U.S. The reviewer wonders if R-744, pentane, or cyclo-pentane are being considered as a low-GWP options in aerosols and foams. Finally, the reviewer argues that some sectors are missing, namely PFCs and SF<sub>6</sub> emissions from military electronics, though notes country reporting of such information might be missing for confidential reasons.

***EPA Response: The EPA has added in the Refrigeration/Air Conditioning paragraph two low-GWP options—HFC-32 and R-454B—that manufacturers have announced for their equipment in the near future. While cyclopentane is extensively used in foams and is currently integrated into our model, the EPA is unaware of its use in aerosols. The EPA will continue to investigate it, as well as carbon dioxide and pentane, and include if we find evidence of market use.***

***Regarding PFC and SF<sub>6</sub> emissions from military electronics, the EPA is reviewing available information to include estimates of these emissions in future national Inventories and then, in turn, for consistency, also include them in the state-level estimates for consistency. See Annex 5 of***

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<sup>21</sup> [www.usclimatealliance.org/about-initiatives](http://www.usclimatealliance.org/about-initiatives)

<sup>22</sup> <https://www.hfcbans.com/bans-by-region.html>

*the national Inventory for more information on emissions and sinks that are currently not estimated.*

3. **Data availability.** Please address the following questions for each inventory source:
- For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?
  - For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?

One reviewer notes discrepancies in Aluminum production emissions in data compared with USGS reports for some states. Another reviewer notes that there are no reported emissions for Missouri, but Noranda operated a smelter there for the last several years. A third reviewer suggests industry GDP by state for disaggregating soda ash rather than disaggregating by population.<sup>23 24 25</sup> Other reviewers are unaware of supplemental data.

*EPA Response: The EPA corrected the address for several previously identified facilities, which resolved the discrepancies noted by the reviewer with respect to the states with emissions from aluminum production. The EPA also updated timeseries information for individual facilities based on the information in the USGS Minerals Yearbooks, as suggested by the reviewer.*

*Regarding the comment on using industry GDP by state to disaggregate emissions from soda ash consumption, the EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State.*

4. **Uncertainty.** Currently uncertainty ranges are not included for the state-level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data cover 1990–2019 consistent with the 2021 national *Inventory*, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the national *Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. The EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).

Two reviewers suggest prioritizing the base year (1990) and every five years, in accordance with IPCC guidelines. Additionally, the last and the penultimate inventory years ought to be included for better comparison. One of these reviewers also recommends adding an explanation for when different data sources might be used at different times. Another reviewer notes that some states do not have aluminum production emissions despite having reported Aluminum production. Another

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<sup>23</sup> <https://www.statista.com/statistics/248023/us-gross-domestic-product-gdp-by-state/>,

<sup>24</sup> <https://fred.stlouisfed.org/release?rid=140>

<sup>25</sup> <https://apps.bea.gov/itable/index.cfm>

reviewer notes that since PFC became a major focus in the early 90s, and the International Aluminium Institute (ISI). Data reported beginning 1995 has less uncertainty compared to 1990.

***EPA Response: The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State. The EPA corrected the address for several previously identified aluminum production facilities, which resolved the discrepancies noted by the reviewer with respect to the states with emissions from aluminum production. The EPA also updated timeseries information for individual facilities based on the information in the USGS Minerals Yearbooks, as suggested by the reviewer. Regarding the comment about adding an explanation for when different data sources are used, the EPA aims to use the best available data to estimate emissions, which is the reason data sources may differ for portions of the time series. Verified data from GHGRP only became available starting in 2010 for many IPPU categories.***

Another reviewer references the IPCC Guidelines templates for uncertainty inclusions and required values.<sup>26</sup> The reviewer notes the two basic methods for uncertainty calculations: propagation of error and Monte-Carlo. For IPPU, many countries use the propagation method for uncertainty related to emissions factors and activity data. For uncertainties in level estimates, uncertainty in activity data and emission factors for each category. For uncertainties in trends, the reviewer refers to page 3.29 in Chapter 3 of the IPCC Guidelines for details. Another reviewer suggests including a complementary top-down approach using atmospheric measurements and models to reduce uncertainty in non-CO<sub>2</sub> GHGs.

***EPA Response: The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State. The final report includes qualitative characterizations of the data in relation to the national Inventory. Regarding top-down approaches using atmospheric measurements and models to reduce uncertainty, the EPA is considering how it can use observational data, consistent with IPCC 2019 guidance,<sup>27</sup> to assess and improve its national Inventory estimates. Any updates applied to the national Inventory would also be reflected in the GHG Inventory by U.S. State.***

The reviewer focused on Lime production thinks a detailed analysis of recession years 2007 through recovery in 2011 may be of interest, as lime manufacture mirrors the economy.

***EPA Response: The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State, based on available data.***

- 5. Key Categories. The EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. The EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

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<sup>26</sup> [https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1\\_Volume1/V1\\_3\\_Ch3\\_Uncertainties.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_3_Ch3_Uncertainties.pdf)

<sup>27</sup> [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1\\_Volume1/19R\\_V1\\_Ch06\\_QA\\_QC.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/1_Volume1/19R_V1_Ch06_QA_QC.pdf)

One reviewer recommends prioritization process follow the national *Inventory* KCA process. Of the sectors in Metals and Product Use, one reviewer recommends prioritizing ODS and Iron and Steel first. A third reviewer seconds the notion that ODS should be refined, suggesting residential air-conditioning, commercial air-conditioning, mobile air-conditioning, commercial refrigeration, domestic refrigerators and freezers, industrial refrigeration, transport refrigeration, and heat pumps sub-sources.

Another reviewer suggests prioritizing key categories according to level or trend analysis. The reviewer references Ch. 4 of the 2006 IPCC Guidelines to identify these categories.<sup>28</sup> States with greater relative production of chemical sectors could be key sectors even if not at the national level or in other states. The reviewer suggests considering the dynamics of each industry and their growth rate over recent years. Other qualitative trends could be considered, e.g., Urea Consumption for Non-Agricultural Purposes category which has steadily increasing emissions in the national *Inventory*.

***EPA Response: Consistent with the national Inventory, in future annual publications of the GHG Inventory by U.S. State, the EPA plans to provide state-level analysis of key categories in accordance with Volume 1, Chapter 4 of the 2006 IPCC guidelines. This analysis will provide information on significant emissions and sinks source categories in the latest year of the GHG Inventory by U.S. State and also categories influencing trends. The EPA notes, that in the latest draft national Inventory (published for public comment on February 15, 2022), the EPA has subdivided the estimated emissions from “Refrigeration/Air Conditioning” into seven sub-sources.***

## **6. Data Presentation and Usability.**

**a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventorystexplorer/>)?**

- i. Related to the level of category/gas aggregation or disaggregation?**
- ii. Are there specific categories where further data disaggregation could be helpful?**
- iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**

**b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

Three reviewers suggest disaggregating sectors by individual GHG, or sector specific detail, e.g., applicable and sub-application level emissions for relevant sectors. Two reviewers also suggest adding “state” identifiers to compare emissions portfolio of states. Furthermore, the reviewer suggests disaggregated results by sector, category, and gas, presenting in mass of gas (ideally Gg or Mt) and by CO<sub>2</sub>e. Including abatement figures can be useful for Nitric Acid production to demonstrate N<sub>2</sub>O emissions reduction. One of these reviewers also suggests state-specific data tables of the methodological approach, the percent contribution to the total national emissions by state and

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<sup>28</sup> [https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1\\_Volume1/V1\\_4\\_Ch4\\_MethodChoice.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_4_Ch4_MethodChoice.pdf)

industry, and graphics and tables comparing state contributions to national totals for the most recent 2 years. Another reviewer suggests disaggregating ODS emissions into the sectors defined in the previous question.

One reviewer focused on Lime production cautions that releasing disaggregated data that may be considered CBI by the lime industry. The reviewer includes a reminder of the conditions for data release (see Appendix D – NLA supplemental charge question response document 10-21\_DeAth.docx).

Reviewers recommend data be available in .xlsx and .csv formats. One also suggests additional images or graphs be available as .png or .jpeg or available in a summary report PDF.

***EPA Response: The EPA appreciates the specific suggestions on additional datasets, data disaggregation, and data formats to enhance usability of the state-level emission data. The EPA will consider these suggestions with future publications of the state data. The EPA has published the data in the GHG Data Explorer, and it can be downloaded in .xlsx and .csv formats. The GHG Data Explorer also allows users to export charts and graphs in .png and jpeg formats. The EPA also will aim to provide estimates weighted with 100-year GWPs agreed upon for international reporting (e.g., 100-year GWPs from the IPCC Fourth Assessment Report [AR4]).***

***On the cautions conveyed by the reviewer related to Lime Production data, the EPA agrees with the reviewer that data use and publication of estimated state GHG emissions from Lime Production should safeguard from revealing confidential business information (CBI). The treatment of CBI in the GHG Inventory by U.S. State is based on the EPA’s internal guidelines, as well as regulations<sup>29</sup> applicable to the data used. The EPA has specific procedures in place to safeguard CBI during the inventory compilation process. When information derived from CBI data is used for development of inventory calculations, the EPA’s procedures ensure that these confidential data are sufficiently aggregated to protect confidentiality while still providing useful information for analysis.***

### *1.2.1 Minerals*

#### 2.2.1.1.Cement Production

- 1. Are you aware of data on state-level clinker production for the full 1990-2019 time series? If not, is there any surrogate data that could be used (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

One reviewer is unaware of any supplemental data not referenced in the national *Inventory*, but suggests FRED data to use industry GDP by state for proxy data for state disaggregation over population.<sup>30,31</sup>

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<sup>29</sup> 40 CFR part 2, Subpart B titled “Confidentiality of Business Information” which is the regulation establishing rules governing handling of data entitled to confidentiality treatment. See “<https://www.ecfr.gov/current/title-40/chapter-I/subchapter-A/part-2/subpart-B>.”

<sup>30</sup> <https://fred.stlouisfed.org/release?rid=140&t=industry&ob=pv&od=desc>

<sup>31</sup> <https://www.statista.com/statistics/248023/us-gross-domestic-product-gdp-by-state/>

Beyond that, the reviewer notes that in Cement production, combustion and process emissions are to be reported separately and not double-counted. Negative emissions could indicate emissions associated with combustion and process might not be separated fully.

***EPA Response: The EPA will assess the reviewer’s information about FRED data and using industry GDP by state as a proxy, in lieu of population as a potential update for future annual publications of the GHG Inventory by U.S. State.***

***Regarding the comment on cement production, only process emissions are reported in IPPU. For emissions data from facilities using CEMS to report to GHGRP, an adjustment was calculated to differentiate between combustion and process emissions. There were no negative emissions for any state or year.***

#### 1.2.1.2 Lime Production

- 1. Are you aware of state-level data on lime production (activity data) by type (e.g., high-calcium quicklime; dolomitic quicklime, high-calcium, hydrated; dolomitic, hydrated; dead-burned dolomite; CO<sub>2</sub> captured for use in onsite processes) for some or all of the 1990–2019 time series? If not, is there any surrogate data (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of any supplemental data not referenced in the national *Inventory*. One reviewer does however suggest that industrial outputs could be used as a proxy for this category. A second reviewer reiterates that plant-level lime production and capacity data are typically considered Confidential Business Information and are not released.

***EPA Response: The EPA agrees with the reviewer that data use and publication of estimated state GHG emission should ensure that confidential business information (CBI) is not released.***

- 2. Based on analysis of Greenhouse Gas Reporting Program data, it appears that most facilities that manufacture beet sugar and lime, as well as a few lime manufacturing facilities capture CO<sub>2</sub> for use in onsite processes. Are you aware of any information why lime producing facilities capture CO<sub>2</sub> for use in onsite processes, any trends in this practice during the 1990–2019 time series (e.g., have facilities increased or decreased adoption of this practice during the time series), or whether the amount of CO<sub>2</sub> captured is proportional to the amount of lime produced or some other metric? Are you aware of any data on the amount of CO<sub>2</sub> captured onsite per facility or state for 1990–2009?**

Reviewers are unaware of any other data sources beyond those referenced in the national *Inventory*. One reviewer notes that a small number of lime plants used to capture CO<sub>2</sub> for precipitated calcium carbonate (PCC) which is used to manufacture paper. Now only one company makes PCC as others have switched to alternatives which do not require CO<sub>2</sub> for production.

***EPA Response: The EPA thanks the reviewers for their feedback and information on changes in the PCC production process.***

- 3. For some states and years (Colorado for 2010–2015, Idaho for 2011 and 2019, and Nebraska for 2010–2014), calculations using GHGRP data on emissions and CO<sub>2</sub> captured for onsite processes yielded small but erroneous negative emissions. The EPA zeroed emissions for those states and years and plans to adjust calculations so that state emissions totals match national emissions. Do you have any general feedback on this approach?**

One reviewer emphasizes that any methodology accounting for CO<sub>2</sub> capture should consider both combustion and process related capture. Thus, negative emissions could potentially be the result of double counting combustion and process-related CO<sub>2</sub> capture. Zeroing emissions could lead to underestimating emissions from the process and thus she recommends investigating negative emissions for overestimation related to CO<sub>2</sub> capture.

Another reviewer notes that there are no commercial lime manufacturing plants in Idaho or Nebraska. He notes that other facilities in question are more likely sugar manufacturers and beyond the scope of knowledge of NLA.

***EPA Response: The EPA thanks the reviewers for their insight on the uses of captured CO<sub>2</sub>. Consistent with 2006 IPCC Guidelines, the CO<sub>2</sub> captured for onsite use as reported under IPPU is from process emissions only. The EPA will investigate the net negative process emissions.***

#### 1.2.1.3 Glass Production

- 1. Are you aware of state-level data on glass production or the amount of carbonate (i.e., limestone, dolomite, soda ash) consumed for glass production by state (activity data) for some or all of the 1990–2019 time series? If not, can you share any state-level surrogate data (e.g., more complete data on glass facilities by state, amount of glass products by type [i.e., containers, flat (window) glass, fiber glass, and specialty glass]) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

One reviewer is unaware of any supplemental data not referenced in the national *Inventory*. The reviewer does however suggest that industry GDP by state could be used to apportion share as a proxy for glass.

***EPA Response: The EPA will assess industry GDP by state as a potential update for future annual publications of the GHG Inventory by U.S. State.***

#### 1.2.1.4 Other Process Uses of Carbonates

- 1. Are you aware of state-level data on the consumption of limestone and dolomite for the iron and steel sector for the 1990–2019 time series? If not, can you share any state-level surrogate data for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends from carbonate consumption by the iron and steel sector?**

One reviewer is unaware of any supplemental data not referenced in the national *Inventory*. The reviewer does however suggest possibly using historical figures of relevant metal production as a proxy, but cautions that a correlation analysis and sensitivity analysis are recommended before.

***EPA Response: The EPA notes reviewers have no additional feedback.***

**2. Are you aware of state-level data on the consumption of soda ash (not associated with glass manufacturing) for the 1990–2019 time series?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

**3. Are you aware of any state-level data on limestone and dolomite consumption for flux stone, flue gas desulfurization systems, chemical stone, mine dusting or acid water treatment, acid neutralization, and sugar refining activities for the 1990–2019 time series?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

1.2.1.5 CO<sub>2</sub> Consumption

**1. Are you aware of other data on the consumption of CO<sub>2</sub> by state for the 1990–2019 time series?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

1.2.2 Chemicals

1.2.2.1 Ammonia Production

**1. Currently, production capacity is used as a surrogate for state-level ammonia production for 1990–2009. In the absence of ammonia production by state in more recent years, are you aware of other surrogate data (e.g., facility utilization rates by state) that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

1.2.2.2 Urea Consumption for Nonagricultural Purposes

**1. Are you aware of state-level data on urea consumption for nonagricultural purposes (activity data) for some or all of the 1990–2019 time series?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

1.2.2.3 Nitric Acid Production

**3. Are you aware of state-level data on nitric acid production (activity data) for some or all of the 1990–2009 time series? We currently use production capacity as a surrogate for nitric**

**acid production by state for 1990–2009. We know that the production capacity data used for this state inventory calculation are incomplete for 1990–2009. Are you aware of more complete data on facility production capacity by state?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

**4. Are you aware of state-level data other than facility production capacity (e.g., utilization rates by facility or state, information about abatement technology installations and use per facility) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

#### 1.2.2.4 Adipic Acid Production

**1. Are you aware of any other state-level data on adipic acid production (activity or emissions data) for some or all of the 1990–2019 time series?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

#### 1.2.2.5 Caprolactam, Glyoxal, and Glyoxylic Acid Production

**1. Are you aware of state-level data on caprolactam production or emissions for some or all of the 1990–2009 time series? We currently use production capacity as a surrogate for caprolactam production by state. Are you aware of more complete data on facility production capacity or actual production by state? Are you aware of better surrogate data other than facility production capacity (e.g., utilization rates by facility or state, information about abatement technology installations and use per facility) that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

#### 1.2.2.6 Carbide Production and Consumption

**1. Are you aware of state-level data on SiC production (activity data) for the 1990–2019 time series? Are you aware of other data to refine accuracy of the estimation of SiC consumption by state for the 1990–2019 time series?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

*EPA Response: The EPA notes reviewers have no additional feedback.*

**2. Are you aware of information that can help us improve the accuracy of production in the two states where SiC facilities are located?**

One reviewer notes that the available data in those two states are not specified, and further the methodology is not properly specified for production methods of SiC. To improve the accuracy of the T2 method, the amount of carbon contained in the product could be another parameter. Again, The reviewer recommends using industry GDP over population for state disaggregation.

***EPA Response: The EPA thanks reviewers for their feedback. The EPA will assess the availability of new data on SiC production by state.***

1.2.2.7 Titanium Dioxide (TiO<sub>2</sub>) Production

**1. Are you aware of data on TiO<sub>2</sub> production (activity data) by state for the 1990–2009 time series? Please share any other surrogate data than facility production capacity or more data by state (e.g., facility utilization rates by facility or state) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends.**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

1.2.2.8 Petrochemical Production

**1. Are you aware of data on petrochemical production by type by state for the 1990–2019 time series? Is there any other surrogate data by state or facility (e.g., facility production capacity; utilization rates by facility or state; timing of facility expansions, openings, and temporary or permanent closures) for the full 1990–2019 time series that could address data gaps and refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

1.2.2.9 Phosphoric Acid Production

**1. Are you aware of state-level data on phosphoric acid production (activity data) for the 1990–2009 time series? Is there any other surrogate data or information (e.g., timing of facility expansions and temporary or permanent closures, origin of phosphate rock used in facilities) by state or facility for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of other data sources beyond those referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

#### 1.2.2.10 HCFC-22 Production

1. **For the years 1990–2009, there are significant uncertainties in the allocation of national-level U.S. emissions to individual facilities and states, particularly for the five HCFC-22 production facilities that closed before 2003 and for which production capacity data are therefore not available. Are you aware of any more complete sources of production capacity or other relevant historical data?**

While not knowing state-specific data or data on individual facilities, one reviewer references national totals of consumption of controlled substances in ODP CO<sub>2</sub>e tons.<sup>32</sup>

*EPA Response: The EPA already publishes national total HCFC-22 production for 1990–2012 in the national Inventory (see Section 4.14 in the latest draft national Inventory to be finalized in April 2022) available online here: <https://www.epa.gov/ghgemissions/draft-inventory-us-greenhouse-gas-emissions-and-sinks-1990-2020>. To calculate state-level emissions during the years before GHGRP reporting began, the EPA needs to allocate this production to individual HCFC-22 production facilities.*

2. **Do you have recommendations for how to refine the methodology to more accurately estimate emissions from HCFC-22 production over the time series?**

One reviewer suggests working with industry representatives and each facility to obtain data. Another references a study by Stanley et al. (2020) which provides a bottom-up methodology of total HCFC-22 production using UNEP Ozone Secretariat data.<sup>33</sup>

*EPA Response: The EPA appreciates the suggestions for further outreach and recent studies related to HCFC-22 production.*

### 1.2.3 *Metals*

#### 2.2.3.1 Iron and Steel and Metallurgical Coke Production

1. **Are you aware of state-level data on iron and steel production (activity data) by category (i.e., sinter production, iron production, pellet production, steel production, other activities) for some or all of the 1990–2019 time series? In the absence of steel production by state, are you aware of better surrogate data that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**
2. **Are you aware of information to better allocate basic oxygen furnace and electric arc furnace production by state for 1990–2009?**

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<sup>32</sup> <https://ozone.unep.org/countries/data-table>

<sup>33</sup> Stanley, K., M., Say, D., Mühle, J., Harth, C. M., Krummel, P. B., Young, D., O’Doherty, S. J., Salameh, P. K., Simmonds, P.G., Weiss, R. F., Prinn, R. G., Fraser, P. J., & Rigby, M. (2020). “Increase in Global Emissions of HFC-23 Despite Near-Total Expected Reductions,” *Nature Communications* 11, 397. <https://www.nature.com/articles/s41467-019-13899-4#Sec11>

One reviewer is not aware of datasets outside those referenced nor are they aware of relevant datasets for better allocating basic oxygen furnace and electric arc furnace production. The reviewer does recommend reviewing feedstock data for proxy and analysis for production related questions.

***EPA Response: The EPA thanks the reviewer for the feedback.***

#### 2.2.3.2 Ferroalloy Production

- 1. Are you aware of state or facility-level data on ferroalloy production (activity data) for the 1990–2019 time series? Is there any other surrogate data (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

Reviewers are unaware of relevant datasets beyond what have been referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

#### 2.2.3.3 Aluminum Production

- 1. Are you aware of data available to incorporate differences in emissions between smelters based on technology type? Is there any other surrogate data or emission sources that could be used to allocate national total aluminum production emissions across states?**

One reviewer noticed some discrepancies in state level emissions compared to known production reported in the USGS’s Minerals Yearbook chapters on aluminum, which include national level data of smelters. The reviewer refers to emissions in the results spreadsheet “State GHG Emissions and Sinks by Gas Table” and notes that emissions are not reported for Missouri and North Carolina, two states with primary aluminum smelters in 1990. Capacities for Missouri and North Carolina were 204,000 t/yr and 115,000 t/yr, respectively. The smelter in Missouri was producing not only in 1990, but also 2005, 2015, 2016, 2018, 2019. Another discrepancy in the same table is the lack of emissions from primary smelters in Maryland, South Carolina and Ohio, which differs from the 2005 USGS Minerals Yearbook for Aluminum which reported that the primary aluminum smelter in Maryland was producing through the end of December and the capacity was 195,000 t/yr. The Yearbook reported a production capacity for South Carolina of 224,000 t/yr. The smelter in Ohio was shut down in early 2005 so emissions would be small, and the smelter reopened in 2006 only to shut down again permanently in 2013. The final discrepancy noted by this reviewer are the reported emissions for Tennessee from 2015 to 2019. This smelter was closed in 2009, according to the 2009 USGS Minerals Yearbook Aluminum. Other reviewers are unaware of relevant datasets beyond what have been referenced in the U.S. national *Inventory*.

***EPA Response: The EPA corrected the address for several previously identified facilities, which resolved the discrepancies noted by the reviewer with respect to the states with emissions from aluminum production. The EPA also updated timeseries information for individual facilities based on the information in the USGS Minerals Yearbooks, as suggested by the reviewer.***

Two other reviewers suggest data from the International Aluminium Institute, London which has data by individual global facilities. Current or recent data is considered proprietary, but historical data from two decades ago may no longer be. For years after 2010, the EPA GHGRP should be

sufficient for allocating emissions by state, according to one of these reviewers. The other reviewer notes that they have statistics on primary aluminum production and energy intensities. Furthermore, The Anode Effect Survey Reports of IAI provides CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub> intensity per ton of Al processed based on technology type.<sup>34</sup>

***EPA Response: The EPA will review these potential sources of data as part of its planning for future updates. For the years 2010 and later, emissions are already allocated using data from the GHGRP.***

#### 2.2.3.4 Magnesium Production and Processing

1. Are you aware of state or facility-level magnesium production or capacity data (or surrogate data) for the 1990–2019 time series?
2. Are you aware of information on the location (by state) of magnesium production and processing facilities or information on the location (by state) of magnesium production and processing facilities by process type?

Reviewers are unaware of relevant datasets beyond what have been referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

#### 2.2.3.5 Lead Production

1. Are you aware of state or facility-level data on primary or secondary lead production (activity data) for the 1990–2019 time series? Is there any other surrogate data (e.g., primary or secondary production capacity by facility or state) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?

Reviewers are unaware of relevant datasets beyond what have been referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

#### 2.2.3.6 Zinc Production

1. Are you aware of state or facility-level data on zinc production (activity data) by unit type (i.e., electrothermic furnace, Waelz kiln, other furnaces, and flame reactor units) for the 1990–2019 time series? Is there any other surrogate data (e.g., total number of zinc facilities by state, production capacity by unit type and by facility or state) or other data by state (e.g., utilization rates by facility or state) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?

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<sup>34</sup> <https://international-aluminium.org/resource/2019-anode-effect-survey-report/>

Reviewers are unaware of relevant datasets beyond what have been referenced in the national *Inventory*.

***EPA Response: The EPA notes reviewers have no additional feedback.***

#### 2.2.4 Product Use

##### 2.2.4.1 Electronics Industry

- 1. Are you aware of state- or facility-level capacity data or other state-level surrogate data (e.g., sales data) for PV manufacturing for 1990–2006 that could be used to refine the allocations of emissions by state? Is there any surrogate data (e.g., sales data by state) by state for semiconductor or MEMS manufacturing for 1990–2007 that could be used to refine the allocations of emissions by state?**

One reviewer references a list of U.S. solar panel manufacturers/assemblers that produce solar panels for residential, commercial, and utility-scale markets.<sup>35</sup> The reviewer includes an NREL report which provides U.S. PV Manufacturing Capacity.<sup>36</sup> Finally, the reviewer includes EIA's Electric Power Monthly which has aggregate capacities of facilities with less than one megawatt capacity, which are not included in EIA data of electric power sales.<sup>37</sup>

***EPA Response: The EPA notes the recommended references. Fluorinated GHG emissions are only expected from the manufacture of silicon PV solar cells, not the assembly of modules. The EPA is planning to update the PV manufacturing capacity data used in the national Inventory. The U.S. PV manufacturing capacity in the NREL report will be considered when updating the estimated PV silicon cell manufacturing capacity data for 2017. All recommended sources will be reviewed and considered for future annual updates of the GHG Inventory by U.S. State.***

##### 2.2.4.2 Substitution of Ozone-Depleting Substances

- 1. Are you aware of bottom-up modeling data that are available by state? Is there any surrogate data other than population data that could be used to disaggregate the emissions of substitutes for ozone-depleting substances?**

While reviewers are unaware of other bottom-up modeling data by state or other state level data, one reviewer does recommend investigating other national data beyond population, e.g., EIA CBECS reports on energy consumption data, vehicle registration data by state, sales data, chemical sales data, etc.<sup>38</sup> A second reviewer shares similar thoughts, suggesting sector specific drivers for disaggregating emissions, e.g., value added from the service sector to disaggregate HFC emissions from commercial refrigeration or value added to industrial sector to disaggregate HFC emissions for

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<sup>35</sup> <https://www.solarpowerworldonline.com/u-s-solar-panel-manufacturers/>

<sup>36</sup> Smith, B. L., & Margolis, R. (2019). *Expanding the Photovoltaic Supply Chain in the United States: Opportunities and Challenges*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-73363.

<https://www.nrel.gov/docs/fy19osti/73363.pdf>

<sup>37</sup> <https://www.eia.gov/electricity/monthly/>

<sup>38</sup> <https://www.eia.gov/consumption/commercial/>

the industrial sector. This second reviewer also references the California GHGI for potential other data.<sup>39</sup>

***EPA Response: The EPA will investigate these sources to assess what information can be used to further refine our state emissions estimates.***

#### 2.2.4.3 Electrical Transmissions and Distribution

- 1. Are you aware of state-level electrical transmission and distribution equipment data (e.g., nameplate capacity by state) or other data for 1990–2019 (or part of the time series) that could refine this state inventory calculation to reflect state trends in emissions more closely? Is there any other surrogate data (e.g., state population data) to enhance accuracy and consistency of state GHG emissions and trends than the current data being used (transmission mile data by state)?**

Regarding refining the inventory calculation, one reviewer notes that in California, current SF<sub>6</sub> regulations came into effect in 2011, which set annual emission rate limit for SF<sub>6</sub> as a percentage of a gas-insulated equipment (GIE) owner’s cumulative SF<sub>6</sub> nameplate capacity. Allowable emissions started at 10% and decreased by 1% annually until 2020, at which point the allowable emission rate was 1%.<sup>40</sup>

This reviewer references a Discussion Paper titled U.S. Transmission Miles in relation to Electricity Generation, Peak Power, and Number of Customers.<sup>41</sup> The reviewer also cites FERC<sup>42</sup> and Census<sup>43</sup> data on electric transmission and state population totals, respectively.

***EPA Response: The EPA will review these potential sources of data and consider their use for future updates. With respect to California, the state-level inventory currently uses the data reported to the state of California for emissions from electrical transmission and distribution for the years 2011 and later.***

#### 2.2.4.4 N<sub>2</sub>O from Product Use

- 1. Are you aware of state-level data on N<sub>2</sub>O usage for medical and dental anesthesia, food processing propellant and aerosols, sodium azide production, or other applications (e.g., fuel oxidant in auto racing, oxidizing agent in blowtorches) for some or all of the 1990–2019 time series? Is there any other surrogate data (e.g., state population data) that could be used to enhance accuracy and consistency of state GHG emissions and trends other than the current data (transmission mile data by state)?**

One reviewer recommends using national or state data on industry size and related metrics of production and resources.

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<sup>39</sup> <https://ww2.arb.ca.gov/ghg-inventory-data>

<sup>40</sup> <https://www.globalelr.com/2019/03/carb-amending-sf6-regulation-strict-requirements-for-california-electrical-equipment/>

<sup>41</sup> [https://energy.utexas.edu/sites/default/files/UTAustin\\_EIoF\\_Transmission\\_2019-02-21.pdf](https://energy.utexas.edu/sites/default/files/UTAustin_EIoF_Transmission_2019-02-21.pdf)

<sup>42</sup> <https://www.ferc.gov/electric-transmission>

<sup>43</sup> <https://www.census.gov/data/tables/time-series/demo/pepest/2010s-state-total.html>

***EPA Response: The EPA will assess this as a potential update for future annual publications of the GHG Inventory by U.S. State.***

## 2.3 Agriculture

### 1. What are your overall impressions of the clarity and transparency of this section?

One reviewer recommends adding the methods to the introduction to prevent the reader from having to look at the national *Inventory* and annex and make the *State Methods* a more standalone document. They also recommend including more state-specific information related to each GHG category in the section. Another reviewer responds that most sections are clear, and methods are transparent; however, they recommend altering GE Table A. 157 to include units for all data and clearly defining equations. This second reviewer also has a clarifying question regarding the equation for enteric methane and the emissions factors used in Tables A-158 and A-159. The annual emission factor for Table A-158 is 95 kg CH<sub>4</sub>/head/year and in Table A-159 it is 100 kg CH<sub>4</sub>/head/year.

***EPA Response: The EPA plans to take these recommendations into account for the next national Inventory covering 1990–2021.***

### 2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?

One reviewer recommends the EPA provide a specific timeline of the plan to provide user data links to check official data of any state government. Another reviewer suggests adding more past years to be more inclusive of the overall trendline overtime. Another reviewer responds to Table A-171 that the manure stored as a solid is too low for some western states and suggests reviewing the data. This is the case for 1990 to 1996 primarily and so affects historical trendlines but not necessarily current estimations.

***EPA Response: The EPA thanks the reviewers for their feedback on time-series data and accuracy. The EPA continues to investigate updated data to better refine these distributions for earlier years of the time series. As noted in the national Inventory, much of the data on waste management systems within the national Inventory are based on USDA reports, EPA data, and other expert judgment; the EPA appreciates any additional feedback reviewers could provide as to state-specific data sources to better reflect Western state manure management systems for cattle.***

### 3. Data availability. Please address the following questions for each inventory source:

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?

To assist with the state-level inventory estimates, one reviewer provides data on rice cultivation that will be conducted this fall by the USDA’s Agricultural Resource Management Survey (ARMS).<sup>44</sup> Other reviewers are unaware of other data.

*EPA Response: The EPA thanks the reviewers for their feedback.*

- 4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the national *Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

One reviewer comments that from the perspective of USDA’s agriculture innovation agenda, 2010 and later would be a good choice since it adopts a base year of either 2017 for an increase in “total factor productivity and real gross output” by 40 percent to 2050 or 2010 for a reduction in “food loss and waste reduction” by 50 percent to 2030. Other reviewers do not have any comments.

*EPA Response: The EPA thanks the reviewers for their feedback.*

- 5. Key Categories. The EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. The EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

One reviewer mentions direct N<sub>2</sub>O emissions estimated using the process-based model and how it can be refined using improvements listed in Section 5.4. The reviewer also mentions a DayCent publication regarding the development of a new model that might be useful in the modeling of state- and national-level GHG inventory.<sup>45</sup>

*EPA Response: The EPA thanks reviewers for their feedback.*

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventorvexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?

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<sup>44</sup> <https://www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices/documentation/>

<sup>45</sup> Zhang, Y., Lavalley, J. M., Robertson, A. D., Even, R., Ogle, S. M., Paustian, K., & Cotrufo, M. F. (2021). “Simulating Measurable Ecosystem Carbon And Nitrogen Dynamics with the Mechanistically Defined MEMS 2.0 Model,” *Biogeosciences*, 18, 3147-3171. <https://bg.copernicus.org/articles/18/3147/2021/bg-18-3147-2021.html>

- ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

One reviewer notes that the GHG Inventory Data Explorer is a good platform to facilitate data use and that the state-level inventory data can be added to the current Data Explorer. The reviewer recommends allowing users to select different geographic levels such as national or state, including the option to select for multiple states. The reviewer also recommends, along with CO<sub>2</sub>e, making users select options for individual GHGs (N<sub>2</sub>O or CH<sub>4</sub>). The reviewer notes the EPA uses AR4 GWP to calculate CO<sub>2</sub>e while a user might want to use AR5 GWP. The reviewer suggests that if this introduces too much complexity, the EPA should clearly indicate that CO<sub>2</sub>e is based on AR4 GWP. Another reviewer is fond of the spreadsheets for states and suggests more disaggregation (in particular for the livestock data).

*EPA Response: The current Data Explorer will allow for users to select national or state levels of disaggregation. The EPA will clarify its use of 100-year GWPs from the IPCC's Fourth Assessment Report (AR4) consistent with UNFCCC reporting guidelines. The EPA will also consider how best to include options to select multiple states, individual GHGs in mass units, and additional disaggregation in the data in future annual publications of the GHG Inventory by U.S. State. Starting in 2024, the EPA will shift to using 100-year GWPs from IPCC's Fifth Assessment Report (AR5) with the national Inventory covering 1990–2022 as required under updated international reporting guidelines under the Paris Agreement. Until 2024, the EPA will continue using 100-year GWPs from AR4 consistent with current reporting guidelines.*

### 2.3.1 Livestock

#### 2.3.1.1 Enteric Fermentation

**1. Are there other/newer data sources or methods, particularly at the state level, that the EPA should be aware of and consider in calculating these emissions? Especially for:**

- Dry matter/gross energy intake;
- Annual data for the digestible energy (DE) values (expressed as the percent of gross energy intake digested by the animal), CH<sub>4</sub> conversion rates (Y<sub>m</sub>) (expressed as the fraction of gross energy converted to CH<sub>4</sub>), and crude protein values of specific diet and feed components for foraging and feedlot animals;
- Monthly beef births and beef cow lactation rates;
- Weights and weight gains for beef and dairy cattle.

Neither reviewer is aware of any state-level data listed above; however, one reviewer expects this type of data would be available from the USDA- Animal and Plant Health Inspection Service (APHIS), which has been a data source for the national *Inventory* for a while.

*EPA Response: The EPA thanks the reviewers for their feedback.*

**2. Are state-specific diet data available to the EPA to enhance characterization of diet differences across livestock types and states?**

No reviewers are aware of any state-level diet data that is publicly available.

*EPA Response: The EPA notes the reviewers have no additional feedback.*

**3. For the enteric fermentation source category and the Cattle Enteric Fermentation Model (CEFM), are the various regional designations of states (as presented in Annex 3.10 of the national *Inventory*) used for characterizing the diets of foraging cattle appropriate? The CEFM is used to estimate cattle CH<sub>4</sub> emissions from enteric fermentation and incorporates information on livestock population, feeding practices, and production characteristics.**

One reviewer recommends following the same regional classification as the APHIS provides and moving Texas to the West region from the Southwest region. Another reviewer comments that a degree the regional designations of the states are appropriate based on Table A-150. However, for the West, doing the designations by state and having state values may not be the best approach. BLM might have an idea of how many cattle are produced on these rangelands and whether they receive supplemental feed. The number of cattle grazing days may not be large enough to warrant separating them out but given the large number of cattle that graze BLM land in Idaho, the reviewer recommends investigating. A third recommends clarifying the units on Table A-157. The reviewer also comments the values are for 2015 but the title says 2017 and suggests clarification.

*EPA Response: The breakdown of regions currently used in the Cattle Enteric Fermentation Model CEFM is based on representative diet data specific to those regions. The EPA is investigating updated diet data, however, and will adjust regions as appropriate based on available data.*

2.3.1.2 Manure Management

**1. Are there other/newer data sources, particularly at the state-level, that the EPA should be aware of and consider in calculating these emissions? Especially for the following:**

- waste management system data, particularly seasonal changes in emissions from different waste management systems;
- maximum methane-producing capacity;
- volatile solids and nitrogen excretion rates; and
- measured emission estimates (by waste management system) to help refine estimates of methane conversion factors.

One reviewer offers to share published data on GHG emissions from dairy lagoons in Idaho and one limited study in California that does include seasonal changes in emissions. The reviewer also refers to the newest N excretion rates that are included in the 2019 IPCC refinement and the newest updates to the USDA GHG Methodology Guidelines, which will hopefully be available next spring/summer are the best equations to use for estimating N excretion. Other reviewers are not aware of the availability of the state-level data above-listed.

***EPA Response: The EPA plans to continue to integrate updates from 2019 IPCC refinements as time and resources allow and will review the USDA report to determine if there are potential improvements to include in the national Inventory.***

### *2.3.2 Agricultural Soil Management*

#### **1. What are your overall impressions of the clarity and transparency of this section?**

One reviewer suggests clarifying whether there is any work required to disaggregate the agricultural soil management fluxes by state, or whether, like other Agriculture/LULUCF inventory categories the national flux is already calculated as the sum of state-level fluxes. Another reviewer comments that the report has useful information but has repetitive contents as the national *Inventory* report has.

***EPA Response: The EPA thanks the reviewers for their feedback. Please see the final report for more information.***

#### **2. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*?**

One reviewer recommends disaggregating by climate zone such as the 2019 refinement to the 2006 IPCC includes indirect N<sub>2</sub>O emissions factors. One reviewer comments that disaggregation might improve the state-level estimates of indirect N<sub>2</sub>O emissions as well as the national level estimates. One reviewer comments that for N<sub>2</sub>O from biosolids/organic N amendment, population does not seem like a good predictor of application rates or emissions for this source. Area of agricultural/cropland, crop production levels, or biosolid/manure production levels seem like they would be better predictors of state-level emissions.

***EPA Response: The EPA appreciates the feedback on the disaggregation of Agricultural Soil Management emissions. EPA plans to consider other predictors to improve the methodology for a future annual publication of the GHG Inventory by U.S. State. The EPA will consider recommendations of disaggregation using climate zones, areas of cropland, crop production level and other production levels as part of future improvements.***

### *2.3.3 Other Charge Questions*

#### *2.3.3.1 Rice Cultivation*

##### **1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One reviewer recommends aggregating the state-level data to the national level and compare it with the current estimate based on a surrogate data method. This comparison would show the advantages/disadvantage of using the surrogate method when data is unavailable. Another reviewer suggests using use of other state-level surrogate data for post-2015, e.g., state-level agricultural commodity production and weather instead of using historical average state proportion of national total to assign carbon stock change, CH<sub>4</sub>, and N<sub>2</sub>O emissions post-2015. The reviewer acknowledges more research is required to consider appropriate surrogate data and would require determining how

best to specify this model to adjust state weights by their surrogate data, using the historical relationship, i.e., testing each method in its ability to predict state-level emissions given national totals using the historical data.

***EPA Response: The EPA notes that the sum of the EPA’s GHG Inventory by U.S. State data is equivalent to national totals for all years.***

***On the suggestion to use other surrogate data, EPA currently uses a surrogate data method to extend the time series of the national Inventory past 2015 (due to NRI data limitations) for national-level Rice Cultivation estimates but will consider how that methodology could be adapted to incorporate the surrogate method at the state-level instead. See Box 5-2 of the national Inventory for more information. As noted by the reviewer, this will take time and resources to research the appropriate method and data needed, but EPA will consider for a future annual publication of the GHG Inventory by U.S. State.***

#### 2.3.3.2 Liming

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One reviewer recommends elaborating on how many and which states have activity data of liming; therefore, the EPA can evaluate if the amount of liming in each state is aligned with the state’s agricultural production. One reviewer recommends providing more details on the development of the 2019 state-level estimates, instead of indicating “are under development and will be shared in coming weeks.”

***EPA Response: Please see the final report for more information. The EPA will consider how best to describe and/or present state-level activity data on liming.***

#### 2.3.3.3 Urea Fertilization

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One reviewer recommends compiling fertilizing sales data for 2016 through 2019 fertilizer years to help improve state-level estimates.

***EPA Response: The EPA thanks the reviewers for their feedback.***

#### 2.3.3.4 Field Burning of Agricultural Residues

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One reviewer recommends checking if any parameters have been changed in the 2019 refinement to the 2006 IPCC.

*EPA Response: The EPA thanks the reviewers for their feedback.*

## 2.4 Land Use, Land-Use Change, and Forestry

### 1. What are your overall impressions of the clarity and transparency of this section?

One reviewer supports the approach of referring to the national *Inventory* where national methods are already based on summing state-level estimates.

*EPA Response: The EPA thanks the reviewers for their feedback.*

### 2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?

No comments.

### 3. Data availability. Please address the following questions for each inventory source:

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?

No comments.

### 4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates.

**Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the national *Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. The EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

One reviewer recommends providing uncertainty estimates which can help prioritize data investments in states where uncertainty is larger. Particularly for states that have GHG emissions reduction targets, an uncertainty range for the central GHG flux estimate is needed to understand whether emissions reductions can be claimed at a given level of statistical significance.

The reviewer also comments that it would be best to clarify which sources of input, parameter, model, or other types of uncertainty are accounted for, how uncertainty is estimated for each of these individual elements, and how uncertainty across elements is combined to find total uncertainty for the central flux estimate. Methods of inference (e.g., design-based vs. model-based) should be clear as well. It is useful to provide uncertainty estimates for both individual inventory categories, to identify opportunities for inventory improvements and data/research needs, and at the sector level (e.g., for net LULUCF fluxes) to support emissions reduction claims.

*EPA Response: At this time, the uncertainty provided reflects that of the national Inventory and includes a qualitative discussion of state-level uncertainties. The EPA continues to assess how best to analyze and present qualitative uncertainty estimates associated with state-level estimates but will do so in the context of prioritizing improvements in other areas.*

**5. Key Categories.** The EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. The EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.

One reviewer comments that the current omission of the harvested wood product (HWP) carbon pool creates bias for states with large wood products industries; therefore, they recommend prioritizing this addition.

*EPA Response: The EPA continues to work with the U.S. Forest Service in disaggregating harvest wood products at the state-level and plans to include in a future annual publications of the GHG Inventory by U.S. State.*

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

One reviewer recommends presenting the data using the spreadsheet format developed for states and also providing the accompanying methodology report. The reviewer notes that states are more able to finely tune policy to influence LULUCF emissions by working with local- and county-level policy makers and existing or new special districts, and providing more spatially explicit data would be useful. The reviewer concludes that because many of the datasets underlying LULUCF flux

calculations are spatial in nature, it would be worthwhile to work toward a completely spatially explicit LULUCF inventory.

***EPA Response: The EPA plans to make the spreadsheet formats developed for states available with publication of the final data.***

#### *2.4.1 Forest Lands and Lands Converted to Forest Land*

##### 2.4.1.1 Forest Land Remaining Forest Land

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

No comments.

##### 2.4.1.2 Land Converted to Forest Land

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

No comments.

#### *2.4.2 Agricultural Lands (Croplands and Grasslands)*

**1. What are your overall impressions of the clarity and transparency of this section?**

One reviewer suggests using use of other state-level surrogate data for post-2015, e.g., state-level agricultural commodity production and weather instead of using historical average state proportion of national total to assign carbon stock change, CH<sub>4</sub>, and N<sub>2</sub>O emissions post-2015. The reviewer acknowledges more research is required to consider appropriate surrogate data and would require determining how best to specify this model to adjust state weights by their surrogate data, using the historical relationship, i.e., testing each method in its ability to predict state-level emissions given national totals using the historical data.

***EPA Response: EPA currently uses a surrogate data method to extend the time series of the national Inventory past 2015 (due to NRI data timing limitations) to estimate soil organic C stock changes for lands includes in the Tier 2 and Tier 3 methods, including Croplands and Grasslands. See Box 6-4 of the national Inventory for more information. The EPA will consider how that methodology could be adapted to incorporate the surrogate method at the state-level instead. As noted by the reviewer, this will take additional time and effort to research the appropriate method and data needed, but EPA will consider for a future annual publication of the GHG Inventory by U.S. State.***

**2. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*?**

No comments.

### 2.4.3 *Wetlands and Lands Converted to Wetlands*

#### 2.4.3.1 Wetlands Remaining Wetlands

2. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)

No comments.

#### 2.4.3.2 Land Converted to Wetlands

1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)

No comments.

#### 2.4.3.3 Peatlands Remaining Peatlands

1. Are there state-level data available on the application (“consumption”) of peat, including the state of use and the horticultural/landscaping use?

While not having knowledge of data on applications of peat, one reviewer suggests a sensitivity analysis to test assumptions about emissions at the state level.

***EPA Response: The EPA will consider performing a sensitivity analysis to inform future disaggregation efforts in the context of a broader suite of potential improvements.***

2. Are there data sources that could support the EPA determining the quantity of peat harvested per hectare and the total area undergoing peat extraction?

No comments.

### 2.4.4 *Settlements and Lands Converted to Settlements*

#### 2.4.4.1 Settlements Remaining Settlements

1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5). ***NB: Emissions estimates not yet available.***

No comments.

#### 2.4.4.2 Changes in Carbon Stocks in Settlements Trees

1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)

No comments.

#### 2.4.4.3 N<sub>2</sub>O Emissions from Settlement Soils

- 1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5). *NB*: Emissions estimates not yet available.**

One reviewer suggests using use of other state-level surrogate data for post-2015, e.g., state-level agricultural commodity production and weather instead of using historical average state proportion of national total to assign carbon stock change, CH<sub>4</sub>, and N<sub>2</sub>O emissions post-2015. The reviewer acknowledges more research is required to consider appropriate surrogate data and would require determining how best to specify this model to adjust state weights by their surrogate data, using the historical relationship, i.e., testing each method in its ability to predict state-level emissions given national totals using the historical data.

*EPA Response: EPA currently uses a surrogate data method to extend the time series of the national Inventory past 2015. See Box 6-4 of the national Inventory for more information. The EPA will consider how that methodology could be adapted to incorporate the surrogate method at the state-level instead. As noted by the reviewer, this will take time and resources to research the appropriate method and data needed, but EPA will consider for a future annual publication of the GHG Inventory by U.S. State.*

#### 2.4.4.4 Changes in Yard Trimmings and Food Scrab Carbon Stocks in Landfills

- 1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One reviewer suggests allocating emissions for yard trimmings and food scraps separately, weighting food scraps fluxes by state population and yard trimmings by land area classified as settlement.

*EPA Response: As noted in the planned improvements, the EPA plans to continue investigating other activity data to account for state-level estimates. The EPA thanks the commenter for their consideration for population density and its potential correlation to yard trimming volume.*

#### 2.4.4.5 Land Converted to Settlements

- 1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5). *NB*: Emissions estimates not yet available.**

No comments.

#### 2.4.5 *Other Lands and Lands Converted to Other Lands*

- 1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

No comments.

## 2.5 Waste

### 1. What are your overall impressions of the clarity and transparency of this section?

Experts reviewing the Waste chapter of the *State Methods* find the chapter well written, clear, and describing the source categories well, though one reviewer cautions that some terminology is incorrect. A second reviewer emphasizes clarity and specificity related to guidance values used in the equations.

Regarding Landfills, another reviewer finds the methodology transparent, well written, and the formulas explained well. On Page 7-4, in reference to text in section 7.1, this reviewer wonders if there is a more specific estimate of the share of environmental monitoring systems to track performance, collect leachate, and collect landfill gas. He also suggests including a graphic to show decreasing methane generation over time for text on Page 7-5. He also asks for a citation for the assertion that methane production “will continue for 10 to 60 years or longer” on Page 7-5.

***EPA Response: The national Inventory chapter in the draft Inventory released February 15, 2022, has been revised for clarity based on these comments. A graphic was added to Annex 3.14 to show methane generation over time, along with citing ATSDR 2001 for the graphic and the methane generation “for 10 to 60 years or longer.” Estimates of the share of landfills that recirculate leachate and have a gas collection system installed are available from the Landfill Methane Outreach Program (epa.gov/lmop).***

Another point of clarification from this reviewer comes from Page 7-5, on which the last paragraph states “...while industrial waste landfills accounted for the remainder (15.1 MMT CO<sub>2</sub> eq).” He suggests adding why industrial landfills emit less methane for transparency purposes as it is his understanding that most industrial landfills dispose of non-organic material. Similarly, text on Page 7-6 states, “Only 169 facilities with industrial waste landfills met the reporting threshold under Subpart TT,” so an explanation of why industrial landfills don’t usually exceed the GHGRP threshold may be helpful. Also on Page 7-6, he suggests adding explanations for why net CH<sub>4</sub> emissions from MSW landfills have decreased since 1990. This reviewer also suggests more explicit explanations why certain wastes are included or not, e.g., why waste from other industrial sections (e.g., construction and demolition) are not included in industrial waste landfills or why only pulp and paper manufacturing and food and beverage manufacturing are listed as sources for industrial landfills.

***EPA Response: The national Inventory chapter has been revised for clarity based on these comments. The discussion of industrial landfills on page 7-6 has been expanded.***

To improve transparency, this reviewer suggests including an explanation for why a 9% scale-up factor is used on Page 7-10. Another suggestion for clarity is to describe the effect of a decreasing number of active MSW landfills with increasing average landfill size.

***EPA Response: The national Inventory chapter has been revised for clarity based on these comments. The intent of the scale-up factor was added to the methodology explanations on page 7-10 and where the scale-up factor is referenced in graphics and tables.***

To address uncertainty, this reviewer suggests explaining the differences between equations for estimating emissions of landfills as their total Subpart HH emissions. He also suggests comparing values of waste-in-place for non-reporting landfills to waste-in-place for reporting landfills to show what fraction of waste is going to non-reporting landfills. Finally, a definition for “off-ramped” higher in the text might be more useful than including the definition in the paragraph for planned improvements.

***EPA Response: Much of this is detailed in the national Inventory methodology Annex 3.14.***

Regarding Wastewater Treatment and Discharge, this same reviewer suggests a diagram of how equations for each source category roll up into the totals reported in Tables 7-7 and 7-8. Overall, this reviewer thought that the section was clear and well written, and the uncertainty and time-series consistency sections were clear and well thought out. There are some points of clarification, the first being the decoupled increase in population of 32% and TOW increase of 23% in Table 7-12 on Page 7-26. Another point of clarification for this reviewer relates to the distinction between POTW and centrally treated wastewater. If they are different, they are used interchangeably, but if not then this reviewer suggests picking one term for consistency.

***EPA Response: As noted in Table 7-11, as well as sourced in Table 7-12 (ERG 2018a), the reason the population and TOW are not linear is due to having two separate values for BOD produced per capita with and without kitchen scraps (2003 and 2014), which better represent changes to the U.S. wastewater stream over the time series.***

***The EPA thanks the reviewer for their perspective on terminology confusion between “POTW” and “centrally treated wastewater.” The EPA notes that the introductory discussion on page 7-21 introduces the idea that treatment at centralized treatment systems (i.e., “centrally treated wastewater”) occurs most commonly at POTWs. From this point, the terms are used interchangeably for the purposes of the report.***

This reviewer suggests adding graphics and visuals which could help with clarity. For example, simple graphics showing the difference between types of wastewater treatment and collection could be beneficial to the reader. Additionally, he suggests visuals with descriptions of treatment, especially for constructed as opposed to un-constructed wetlands, and visuals for explaining how data sources are incorporated into total results.

***EPA Response: The EPA will consider these suggestions for improvements to the future annual publications of the national Inventory.***

This reviewer also suggested clarifying the reason for the industrial wastewater emissions uptick since 2017 (pg 7-22 of national *Inventory*).

***EPA Response: The EPA is not able to update the 1990–2019 national Inventory to discuss the reasons for industrial wastewater emissions trends; however, as implied in the sentence prior to the commenter’s question, industrial production is a main driver for industrial wastewater emissions; thus, an increase in production would explain the uptick since 2017. The EPA will consider if this language is clear in subsequent publications of the national Inventory text.***

This reviewer also wonders about canneries reporting to GHGRP or ECHO for wastewater and how wastewater outflow and BOD have changed in the last 40 years. Finally, in the ‘Recalculations Discussion’ text on Page 7-51, this reviewer suggests a discussion on the largest drivers of increase and/or interaction between effects.

***EPA Response: The EPA appreciates the commenters’ consideration of the age of the vegetables, fruits, and juices processing data provided in Table 7-26. Within the past few inventory cycles, the EPA has incorporated other readily available summarized data (as indicated in Table 7-26, CAST 1995); however, the EPA is aware these data are still older. The EPA has previously evaluated mining ECHO data for more updated outflow and effluent BOD concentration data but notes that ECHO houses information on direct dischargers only and would not capture treatment operations that occur onsite prior to discharge to a POTW. The EPA is still considering methods to update these data; however, given that fruits, vegetables, and juices processing represent about 3.6% of industrial methane estimates, the EPA has prioritized other improvements and activities to date.***

***The EPA is not able to update the 1990–2019 national Inventory to discuss the largest drivers for the increase in domestic wastewater N<sub>2</sub>O emissions estimates as suggested by the commenter. The EPA did not perform an analysis to determine which of the several changes described within the Recalculation Discussion most affected the change in emissions. This breakdown would be challenging due to not only the updates to several values but the overall methodology (as noted within the Recalculations Discussion). However, in future national Inventories, the EPA will, whenever possible, describe the most impactful change.***

This reviewer also wonders if BOD effluent concentration from about half of the POTWs is sufficient to create a reasonable estimate (related to discussion on page 7-52 of national *Inventory*).

***EPA Response: The EPA noted in the 1990–2020 national Inventory that this planned improvement may be implemented within the next two to three inventory cycles, pending time and resource constraints. The EPA noted that the analysis requires evaluation and resolution of multiple BOD parameters reported before the data would be fit for inclusion.***

## **2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?**

One reviewer wonders about the percentage GHGRP emissions cover for all of the landfill sector and what estimate of percentage of landfills in the US not reported to GHGRP. Similarly, he wonders about the lack of GHGRP references in the wastewater sector.

Another reviewer suggests rewording the third sentence of Chapter 7 Waste which implies that aerobic composting facilities produce more methane than anaerobic composting operations, as it is misleading. She also suggests separating N<sub>2</sub>O emissions from wastewater treatment and composting because emissions from wastewater treatment are significantly higher than composting. This reviewer also notes that the statement “Those emission (sic) are likely insignificant as those Pacific Islands have no permanent population” on page 7-3 is not accurate. Finally, she suggests changing the last sentence of the first paragraph of 7.3 Composting to “If the product is of lesser quality, it can be used as Alternative Daily Cover for landfills,” as making compost and then paying to dispose of it in a landfill doesn’t make economic sense.

***EPA Response: Regarding the percentage of GHGRP reported emissions and the percentage of landfills not reported to GHGRP, the EPA refers the reviewer to information detailed in the national Inventory methodology Annex 3.14.***

***Regarding the introductory text about emissions from composting and anaerobic digestion, these are summary values of the emissions from each source category. The full explanation of what is included for composting and anaerobic digestion is included in each source’s introduction and methodology sections.***

***Regarding the comment about wastewater emissions on Pacific Islands, the national Inventory chapter text will be evaluated and clarified as necessary.***

***Regarding the comment about using compost of lesser quality, the national Inventory chapter text has been revised.***

A third reviewer suggests making explicit that the scale up values are most important in the discussion on backcasting and scale up values related to incompleteness of the GHGRP dataset. He also suggests more transparency regarding the justification of guidance factors and values in equations used to estimate emissions. Namely, he suggests justification and discussion of variability for Lo, DOC and DOCf, CH<sub>4</sub> oxidation, and gas collection efficiency. Updated research and demonstrated values for many of these assumptions would benefit from refining.<sup>46</sup>

***EPA Response: The EPA appreciates the feedback with regard to scale up factor and equation values used to estimate emissions. This suggestion is applicable and relevant to improving/refining methods to estimate MSW landfill methane emissions for the national Inventory and will be considered for planned improvements in compiling those estimates.***

- 3. Data availability. Please address the following questions for each inventory source:**
- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
  - b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

One reviewer suggests sources related to GHG offset projects from Climate Action Reserve, American Carbon Registry, or Verified Carbon Standard websites. Reviewing public documentation

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<sup>46</sup> For more see comments by Dr. Bryan Staley in Section 4.16.

of landfill gas destruction, avoided GHG emissions from composting waste, and methane destruction from wastewater treatment offset projects, the EPA may be able to find more information regarding how emissions are avoided.

***EPA Response: The EPA appreciates the comment and will continue to investigate availability of state-specific data.***

Another reviewer challenges assumptions that all commercial or industrial composting takes place in windrows and that materials are primarily yard trimmings, food waste, and some paper products. She asserts that yard trimmings are by far the primary ingredient in composting facilities and a smaller number of operations handle food waste. Additionally, Aerated-static piles and in-vessel composting are very common because it is more efficient and controls odors better, not just windrows are used.<sup>47</sup> She notes that state compost regulatory offices have records of types and amounts of materials composted and the methodology used.

***EPA Response: The national composting methodology does assume that most composting takes place in windrows with yard trimmings as the main stream composted. BioCycle 2017 presents this information. The EPA did conduct a literature search to identify emissions factors for specific waste streams (e.g., yard trimmings versus food waste) and composting methods to improve the national estimates. The challenge was finding annual estimates of material composted nationally using composting methods other than windrows. Therefore, the EPA makes these general assumptions due to a lack of nationally representative data. State agencies may have this data, but the EPA has found, through initial research efforts, that the data each state collects are not comparable, are slightly different, and are in slightly different formats, which requires a significant data collection and quality review effort that goes beyond the scope of this effort.***

A third reviewer notes that there are waste composition data from characterization studies at the state, county, and city level which could be used to create or validate estimates of Lo and DOC values.

***EPA Response: The EPA appreciates the feedback with regard to waste composition studies at the state, county, and city levels. This suggestion is applicable and relevant to improving/refining methods to estimate MSW landfill methane emissions for the national Inventory and will be considered for planned improvements in compiling those estimates.***

- 4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better**

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<sup>47</sup> She recommends work by Dr. James Levis and Dr. Morton Barlaz at NC State University on emissions from landfills, AD, and composting facilities.

**prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

One reviewer suggests including uncertainty ranges at the state level but does not have an answer for which years would be most representative. Another reviewer notes that states have had solid waste management rules since the early 1990s. North Carolina has requirements for reporting materials going to landfills, recycling, incineration, and composting, and other states likely have similar requirements. Another reviewer emphasizes prioritizing data related to baseline values to minimize uncertainty.

***EPA Response: The EPA appreciates the comment and will continue to investigate availability of state-specific data and how it could reduce the uncertainty of these state estimates.***

**5. Key Categories. The EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. The EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

One reviewer suggests looking at oxidation rates for methane in more detail to understand whether more refined oxidation rates could be developed based on site specific parameters. This reviewer also suggests looking at N<sub>2</sub>O emissions from treating wastewater as the emissions are quite high and there is a lot of uncertainty regarding these emissions (Table 7-7). As stated above, another reviewer suggests refining GHG emissions from windrows, aerated-static piles, and in-vessel composting systems. She cautions that these are methods of aerobic composting, so methane emission assumptions might be too high.

***EPA Response: These suggestions are applicable and relevant to improving/refining methods to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions for the national Inventory and will be considered for planned improvements in compiling those estimates.***

Another reviewer reiterates that the Lo value is a function of waste composition, which shifts over time and this the value may differ from a decade ago. DOC values have been directly computed from how much non-MSW is going to MSW landfills. The actual values tend to be lower than the guidance value and updating this value would reduce uncertainty. Finally, he suggests comparing computed vs. measured values of direct emissions.

***EPA Response: With regard to Lo and DOC values, this suggestion is applicable and relevant to improving/refining methods to estimate MSW landfill methane emissions for the national Inventory and will be considered for planned improvements in compiling those estimates.***

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

One reviewer notes a landfill-only option was missing. Another suggests including an explanation of why methane emissions are higher for aerated composting than for AD and related assumptions. Reviewers suggest more disaggregation in the presentation of emissions results.

*EPA Response: The EPA will review the clarifying information presented in the Data Explorer tool. CH<sub>4</sub> and N<sub>2</sub>O emissions for composting are covered in national Inventory Section 7.3 and the national Inventory assumes all are commercial scale, windrow (aerated) method composting operations. The emissions are calculated using an IPCC emission factor. CH<sub>4</sub> emissions from anaerobic digesters are covered in national Inventory Section 7.4, and anaerobic digesters are managing significantly less waste than is composted, and any emissions are from system leakages or unexpected events.*

### 2.5.1 Solid Waste

#### 2.5.1.1 MSW Landfills

##### 1. Data Questions

- Are there datasets for individual states' landfill gas (LFG) recovery activity?
- Are there data available for open dumpsites in the U.S. territories?

One reviewer acknowledges offset project databases which could be used but assumes the data in LMOP already include this. Another reviewer refers to unpublished EREF data that summarizes beneficial landfill gas use for Subtitle D landfills. Reviewers are unaware of data available for open dumpsites.

*EPA Response: It is correct that the Inventory already makes use of data from the LMOP Database of landfill gas energy projects. The EPA will review the EREF data for improvements and updates to the non-reporter database when published.*

2. The current method makes some simplifying assumptions and includes uncertainties in the allocation of national-level U.S. emissions to states (e.g., recovery rates are the same for all states and match the national recovery rate). Are there alternative assumptions or different datasets that would improve the accuracy of MSW landfill estimates? Do you have recommendations to refine the methodology to estimate emissions over the time series more accurately?

One reviewer notes that states have different land to people ratios and states with more limited land are more likely to recycle, so a blanket assumption for all states is not reliable. More heavily populated states or areas will have higher collection rates. Tipping rates and recovery rates are likely to not be uniform and to incentivize people to recycle more to avoid fees. This reviewer suggests looking at tipping fees for each state to inform assumptions on diversion and recycling. Another reviewer suggests shifting to models that integrate more site-specific data that will reduce uncertainty.

***EPA Response: Related to the variety of recycling rates, this is not the recovery meant in this context. Recovery for this question was specific to landfill gas recovery, not recovery of recyclable goods from the waste stream. Related to the suggestion to integrate more site-specific data, the EPA will consider a technique that could allow for bottom-up estimation of landfill gas recovery within each state, instead of national disaggregation via a proxy.***

#### 2.5.1.2 Industrial Landfills

##### **1. Do you have recommendations to refine the methodology to estimate emissions over the time series more accurately?**

One reviewer uses @risk to model uncertainty at his place of work and assumes that some statistical software could be used for trending purposes. Another reviewer mentions an EREF funded study by Yale University looking at industrial waste generation which could be useful.

***EPA Response: The EPA will review the findings of the 2020 Yale study for potential improvements to the estimates of industrial waste generation used in the national Inventory.***

#### 2.5.1.3 Composting

##### **1. Data Questions**

- **Is the assumption that Alaska has no commercial composting operations correct?**
- **Are there any data about composting in U.S. territories?**
- **Are there any state-level data sources that describe composting activity over time?**

One reviewer notes that Alaska and U.S. Territories do have aerobic composting facilities. There are composting facilities in Anchorage, Fairbanks, Juneau, Haines, Gustavus, Kodiak, Skagway, and Homer, to name a few. These facilities compost biosolids, food waste, animal waste, and municipal waste and some have been operating since 1996.<sup>48</sup> She also lists aerobic composting operations on Puerto Rico, Guam, and St. John. The facilities included is a non-exhaustive list, but she also notes that states have composting regulations and lists of permitted facilities and types of quantities of materials composted.

***EPA Response: At this time, the national Inventory only includes commercial-scale composting operations and assumes it is all windrow composting. The state of Alaska provided comments and review and confirmed they have no commercial-sized composting operations.***

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<sup>48</sup> For more details on facilities operating in Alaska, see comments by Rhonda Sherman in Section 4.15.

Another reviewer is unsure of the assumption on Alaska’s lack of commercial composting but suggests water availability is probably more relevant to composting. Regarding data on composting in U.S. Territories, this reviewer again refers to offset project registries. With respect to state-level data sources that describe composting over time, he suspects CA and MA might have information on how composting operations have fared in their respective states over time.

***EPA Response: The EPA appreciates the comment and will continue to investigate availability of state-specific data on composting operations.***

A third reviewer remarks that the necessary data are currently being collected as part of a joint effort by EREF and the U.S. Composting Council.

***EPA Response: The EPA appreciates the suggestion and will watch for publication of these data.***

#### 2.5.1.4 Stand-Alone Anaerobic Digestion

**1. Do you have or know of any state-level data for counts of operational anaerobic digesters (processing food waste) by year?**

One reviewer wonders if there are required permits for digesters which can be accessed and reviewed by NAICS code. Another reviewer notes that every state’s Division of Waste Management should have that information and BioCycle may have compiled it. A third reviewer notes that EREF has updated a national dataset of AD facilities and is expected to publish in 2022.

***EPA Response: The EPA appreciates the comments and will review the new dataset when published.***

**2. Are there any facility-specific data sources we could use to fill data gaps on the quantity of waste processed by stand-alone digesters for any and all years of the 1990–2019 time series?**

One reviewer reiterates her suggestion of checking state solid waste offices for this information. She also cautions against wording in the first sentence of Section 7.3 Stand-Alone Anaerobic Digestion on Page 7-57. She notes that AD produces biogas and digestate, which are not compost. Reviewers had no new suggestions for this question. AD data are summarized in an EREF report, points out another reviewer.

***EPA Response: The EPA appreciates the comment about terminology and has edited the national Inventory chapter text for the next annual publication.***

#### 2.5.2 *Wastewater*

**1. The following national average parameters were used to estimate emissions by state, with state populations used to proxy the distribution of domestic emissions and state-level**

production data (if available) used to proxy the distribution of industrial emissions. Please comment if you believe states would differ significantly from the national averages for the following parameters and, if so, whether there are state-specific data sources for the EPA to consider:

- wastewater outflow
- biological oxygen demand (BOD), total N, and chemical oxygen demand (COD) concentration in untreated wastewater
- BOD:COD ratios for industrial wastewater
- wastewater treatment unit operations in use at centralized domestic treatment plants or at industrial plants

Regarding wastewater outflow, one reviewer doesn't believe that a specific industry would differ significantly between states, except possibly for western states where water is scarce. Wastewater treatment unit operations can vary by state based on regulation, noting some states may have stricter regulations on water quality. The same reviewer noted that California will likely have better treatment than a state with a low population like the Midwest. No reviewers commented on BOD, total N, or COD concentration in untreated wastewater or BOD:COD ratios for industrial wastewater.

*EPA Response: The EPA will consider this when investigating improvements to individual industries (as noted in the Planned Improvements).*

*On variability of wastewater treatment unit operations in use, the EPA agrees there is likely variation and includes searching for state-level sources for type of wastewater treatment in the Planned Improvements.*

**2. Are there domestic or industrial wastewater treatment operations present on other Pacific islands for industrial sectors included in the national Inventory?**

Reviewers are unaware if there are operations or not.

*EPA Response: The EPA takes note that reviewers are unaware of wastewater treatment operations on other Pacific islands.*

**3. For each of the wastewater treatment and discharge subcategories listed for this category, is there any information that was not considered on available state-level data sources with regional or other disaggregated information on emissions?**

Beyond sources already used in the state level methodology (ECHO), one reviewer suggests state specific databases, e.g., PARIS for Washington state. The reviewer further notes, the only other data source that might be helpful is NPDES permitting, but acknowledges that relevant outflow data would ultimately still be reported to ECHO.

*EPA Response: The EPA agrees that ECHO is a source of state-level data and used ECHO for pulp, paper, and paperboard state-level emissions.*

#### 2.5.2.1 Domestic

**1. The following national average parameters were used to estimate domestic wastewater treatment emissions by state. Please comment on whether you think that states would differ significantly from the national averages for the following parameters and, if so, are there state-specific data sources for the EPA to consider:**

- **discharge of publicly owned treatment works (POTWs) to impaired waterbodies and nonimpaired waterbodies**
- **discharge of POTWs to reservoirs, lakes, and estuaries**
- **consumed protein**
- **percentage of the population on septic (versus centralized treatment)**

Regarding discharge of POTWs to impaired and nonimpaired waterbodies, one reviewer believes that states on the coast or with larger bodies of water have opportunity to discharge there as opposed to Midwest states which might discharge into aquifers, which might affect emissions. Discharge of POTWs to reservoirs, lakes, and estuaries of states also might vary by availability. One reviewer does not see any reason why consumed protein might affect national average parameters, but he does think that midwestern and rural states would likely have a higher percentage of population on septic.

*EPA Response: The EPA agrees discharge location and water body conditions would affect emissions and also agrees discharge location affects the ability to discharge to certain water body types. On the comment responding to percentage of population on septic, the EPA agrees there could be differences in centralized versus onsite treatment in the states and notes that the EPA is continuing to determine state-level sources for type of wastewater treatment (in the Planned Improvements section) that may inform this point.*

#### 2.5.2.2 Industrial – Pulp and Paper

**1. Pulp and paper wastewater flows were estimated using the EPA’s Enforcement and Compliance History Online (ECHO) datasets. Do you have any reason to believe that states’ pulp and paper wastewater information is underrepresented in ECHO? If so, do you have an alternative, publicly available pulp and paper wastewater dataset by state?**

Reviewers have no reason to believe that ECHO is not a reliable source for pulp and paper wastewater. One reviewer notes that there are state level databases, though is unsure if these numbers would differ from those reported in ECHO.

*EPA Response: The EPA appreciates the commenter’s opinion concerning the use of ECHO data.*

**2. Currently, a single year, 2019, is used to estimate the distribution of national estimates to each state and territory for every year of the time series. Is there reason to believe states’ pulp and paper manufacturing operations have changed significantly since 1990? If so, are there data sources to quantify those changes?**

One reviewer believes that state pulp and paper manufacturing operations have changed as lumber operations have increased in the East. This reviewer suggests looking at lumber products from state

to state as a proxy for pulp/paper manufacturing operations and where emissions are shifting, as different species of trees produce different percentages of pulp/non-lumber product. This reviewer suggests if one can assess the main lumber production by state, it may be possible to indicate which states have greater pulp/paper manufacturing operations and where activity may be shifting.

*EPA Response: The EPA appreciates the commenter's thoughts on how to determine where emissions may be happening. It is unclear if this method would quantify emissions, but the EPA does plan to continue to evaluate state-level sources for production (in the Planned Improvements section).*

**3. Data for pulp and paper manufacturing for U.S. territories are limited in the ECHO dataset. Are there resources to help estimate a time series of production data for pulp and paper wastewater flows? Or are there territory-level data on the number of pulp and paper plants in each U.S. territories?**

One reviewer suggests a US Forest Service publication for US timber production, trade, consumption, and price statistics for years 1965 to 2017. This reviewer suggests this data could be correlated to pulp and paper wastewater flows given that mills are generally near timber production.

*EPA Response: The EPA thanks the commenter for their additional data source; determining state-level sources of production is included in the Planned Improvements.*

#### 2.5.2.3 Industrial – Meat and Poultry

**1. Currently, a single year, 2019, is used to estimate the distribution of national estimates to each state and territory for every year of the time series. Is there reason to believe states' meat and poultry processing operations have changed significantly since 1990? If so, are there data sources to quantify those changes?**

While processing operations have not changed, they may have shifted. The reviewer noted that they believe that production of meat and poultry has probably shifted, noting operations from North Carolina have generally moved out west to rural communities to avoid nuisance complaints. Reviewers are unaware of any processing operations changing by state.

*EPA Response: The EPA appreciates the commenter's comments on potential changes to the state distribution of meat and poultry processing operations over the time series. The EPA included investigating additional years of USDA in the Planned Improvements section to better inform the time series and could potentially speak to this comment.*

**2. Data for meat and poultry processing for U.S. territories are not captured in the USDA dataset. Are there resources to help estimate a time series of production data for poultry (broilers, turkeys, chicken), beef and calves, hogs, and sheep (lamb and mutton), for example, live weight killed, number of head slaughtered?**

Reviewers are unaware of the answer to this question.

*EPA Response: The EPA notes reviewers have no feedback.*

2.5.2.4 Industrial – Fruits and Vegetables

1. **Currently, a single year, 2017, is used to estimate the distribution of national estimates to each state and territory for every year of the time series. Is there reason to believe states' fruit and vegetable processing operations have changed significantly since 1990? If so, are there data sources to quantify those changes?**

Reviewers are unaware of any reason to believe states' fruit and vegetable processing operations have changed significantly since 1990.

*EPA Response: The EPA notes reviewers have no additional feedback.*

2. **Data for fruit and vegetable processing for U.S. territories are not captured in the USDA dataset. Are there resources to help estimate a time series of territory-level production data for fruits and vegetables, for example, canned and frozen processed vegetables, potato production, noncitrus fruits, and citrus production?**

Reviewers are unaware of the answer to this question.

*EPA Response: The EPA notes reviewers have no feedback.*

2.5.2.5 Industrial – Ethanol

1. **Ethanol production for each state was estimated using the Energy Information Administration (EIA) SEDS dataset. Do you have any reason to believe that states' information is underrepresented in the SEDS dataset? If so, do you have an alternative, publicly available ethanol production dataset by state?**

Reviewers have no reason to believe that there is a better source than EIA.

*EPA Response: The EPA appreciates reviewers' feedback on the EIA data.*

2. **Data for ethanol production for U.S. territories are limited in the SEDS dataset. Are there resources to help estimate a time series of production data for ethanol production?**

Reviewers are unable to answer this question.

*EPA Response: The EPA notes reviewers have no feedback.*

3. **What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

One reviewer suggests using California's LCFS program database, which covers the whole country, which could potentially be used gain insight into which states that are participating in LCFS which have ethanol production.

*EPA Response: The EPA thanks the commenter for information on an additional data source.*

#### 3.5.2.6 Industrial – Petroleum

- 3. Petroleum production for each state was estimated using EIA’s Petroleum Administration for Defense Districts production and state-level operating capacity datasets. Do you have any reason to believe that states’ information is underrepresented in the EIA datasets? If so, do you know of an alternative, publicly available petroleum refining production dataset by state?**

Reviewers have no reason to believe that there is a better source than EIA.

*EPA Response: The EPA appreciates reviewers’ feedback on the EIA data.*

- 4. Do you have any concerns about using operating capacity to estimate petroleum production by state is not a good method? If so, would you suggest an alternative method?**

One reviewer notes that production is largely drive by price, so operating capacity might not be the best indicator for when oil prices are low and producers are cutting back.

*EPA Response: The EPA appreciates the commenter’s perspective but has no alternative indicator at this time.*

- 5. Data for petroleum refining for U.S. territories are limited in the EIA dataset. Are there resources to help estimate a time series of territory-level production data for petroleum production?**

Reviewers are unable to answer this question.

*EPA Response: The EPA notes reviewers have no feedback.*

#### 5.5.1.7 Industrial – Breweries

- 1. Brewery production, and by extension brewery production emissions, for each state was estimated using the Alcohol and Tobacco Tax and Trade Bureau (TTB) taxable production dataset.**

- **The TTB dataset is based on taxable production/volume. Is there any reason why taxable production from breweries may be underrepresented by state and therefore potentially underrepresent total emissions? If so, do you know of an alternative dataset or assumption?**
- **The TTB dataset provides production data from 2008 to the present. The 2008 values were used as a proxy for 1990–2007 values. Is there reason to believe states’ brewery production has significantly changed over that time period? If so, do you have an alternative, publicly available state-level brewery production dataset (i.e., barrels produced), or suggestions for alternative data to use as a proxy?**

Reviewers are unable to answer this question.

*EPA Response: The EPA notes reviewers have no feedback.*

**2. Data for brewery production for U.S. territories are limited in the TTB dataset. Are there resources to help estimate a time series of territory-level production data for brewery production (i.e., barrels produced)?**

Reviewers are unable to answer this question.

*EPA Response: The EPA notes reviewers have no feedback.*

### 3 Individual Peer Reviewers' Comments

This section provides the individual peer reviewers' comments, with the peer reviewers presented in alphabetical order.

#### 3.1 Ms. Alissa Benchimol (IPPU)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Alissa Benchimol
<b>AFFILIATION:</b> Greenhouse Gas Management Institute
<b>DATE:</b> 15 October 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
1. What are your overall impressions of the clarity and transparency of this section?
<p><b>Overarching comments for 2.3 Metals and 2.4 Product Use</b></p> <ul style="list-style-type: none"> <li>• Under section 1.2, the document, introduces the methods approaches (Approach 1, 2, and 3) used to compile the state-level estimates. However, the report does not clearly reference which of the three approaches was used to estimate emissions from each individual category.</li> <li>• The IPPU chapter does not clearly explain which U.S. territories are taken into consideration into the full inventory and how this matches with the <i>National Inventory</i>. Additionally, for transparency, for the categories with reported emissions that occur only in some states, we recommend including the list of these states within the overview of the category.</li> <li>• Most sections do not include calculations methodologies used to estimate emissions. Some of those provide just a general reference to the <i>National Inventory</i>. However, the introduction sections of the chapter state that some states are using their own methodologies without specifying either states or methodologies. For transparency of the IPPU chapter, I recommend including methodological information on estimating emissions in each section. For instance, main activity data references, emission factors used and developed (indicate default, country-specific, facility-specific, etc.), technologies, product specifications, tier (1,2,3) applied in each of the categories, etc.</li> <li>• For transparency in the document, I recommend including all emissions estimates by category and by state to provide a clear picture of their emission profile, and enable comparisons between states. Additionally, in the sections where it is mentioned there are discrepancies in totals due to inconsistency in proxies being used, I recommend including the difference (percentage) from the <i>National Inventory</i> totals – by state. Further, I recommend specific indication of methods for each gas and provide totals per gas by state within method section.</li> <li>• The metals section can be further broken down by state to include specific practices and technologies that are present in each facility at the state level, where known. For instance, under Magnesium Production and Processing, I recommend including background on casting practices that release HFCs and CO<sub>2</sub>, as well as indicate emissions by gas at the state level.</li> </ul>

## PEER REVIEW COMMENT TEMPLATE

### *Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

- For transparency, I recommend relating each category to not only the *National Inventory* code system but also to CRF tables. For instance, in the section for the Electronics Industry category, the category background refers to the *National Inventory* (4.23 in this case), as well as the CRF source category codes such as 2E4 and 2E3, but this is not consistently used throughout the whole document.
- In some categories (e.g., Iron and steel production), CO<sub>2</sub> emissions can be associated with both the chemical process of processing and reduction of iron from ore, and auto-produced energy or by-product fuels (like furnace gas) that is used to support the industrial process or transferred to another facility, where they are used for the energy purposes. The report states that CO<sub>2</sub> associated with the energy use is reported in the energy sector, and CO<sub>2</sub> from the chemical process is reported in the IPPU sector. The report also states that by-product fuels are produced in the iron and steel industry. However, it is not clear if:
  - the Energy and IPPU sectors use the same approach to allocation emissions by state. If they do not, there is a risk of under- or overestimating (due to double-counting) CO<sub>2</sub> emissions for some (or all) states from iron and steel production.
  - the by-product fuels are used within the same facility where they are produced (in this case, the relevant emissions should be reported under the IPPU sector), or they are transferred to some other facilities where they are used for the energy purposes (in this case they should be reported under the energy sector).

Therefore, I recommend to:

(1) investigate if by-product fuels are used within the same facilities they are produced at and adjust the emission allocations according the 2006 IPCC Guidelines (Box 1-1, Ch.1, ch.V.2). If by-product fuels are transferred across the state line, then the issue of incorrect allocation can result in the accuracy issue for emissions from states producing and using the by-product fuels

(2) ensure that the same disaggregation by state approach is applied to the energy and IPPU sectors for iron and steel production, (3) include relevant explanations in the states' inventory.

- Under Product Use, ODS category, a description of the Vintaging model and its assumptions are not provided. For instance, there's no indication on whether chemical blends are being accounted for as well as individual substances. The section does not include the names of the 78 end-use activities (and it does not name their sub-categories and applications), and what the breakdown by state is. Additionally, the section includes United States territories (e.g., Guam) not previously mentioned, and it's unclear if all inventory data is disaggregated to these territories as well.
  - Although the section includes description of time series development and outlines the approach used to disaggregate data and challenges/limitations, it is not broken down by application and differences in state emission profile.
- Under Product Use, ODS category, it is not clear if the Vintaging model considers bank development and interaction with cross-state emissions profile and how that's being taken into account in disaggregation for contained applications (non-emissive). This category also doesn't include any missing activities, categories, or gases not being currently estimated.

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### 2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?

#### Overarching comments for 2.3 Metals and 2.4 Product Use

- These chapters could include any gas emission totals breakdown (with accompanied CO<sub>2</sub>e total) by category and by state. Additionally, a percentage breakdown that result from different methods of disaggregation could be added along with totals. For instance, in the electronics industry, there's no information on how disaggregation takes into consideration emissions from non-reporting facilities for each specific gas – as it could vary significantly and not be linear disaggregation for each gas. At the national level, this would have been a transparency issue, but for the state level, the amount of emissions by state could be an accuracy issue (if an allocation is based on inappropriate proxy values that do not match the state industry scale and production patterns).
- Under the Metals section, a couple of categories could have a profile by state on output capacity. This could be resulting in under/overestimating emissions at the state-level if production output is missing for proxy (e.g., 1990-2009). For instance, under Zinc Production, no information is provided on disaggregated state-level data (and/or plant-specific, when available) on reducing agents and other carbon containing process materials.
- It is not clear where production happens in what states/territories in the methods section. It is mentioned the sum of emissions is “consistent” with the *National Inventory*, but it is unclear what this means in terms of comparability, total accuracy, or error range. Allocating emissions “equally” across facilities leads to over/underestimating emissions across states if their individual capacity varies significantly. There's no information on total number of producing facilities in the document neither. In the data reported, it is more transparent/accurate to include “NO” (not occurring) for the years where facilities weren't opened yet instead of zero. Increase transparency and completeness on including total number of facilities and emissions differences through time series with different method types applied. Discrepancies mentioned in this section should be given specifics as this will be critical for uncertainty analysis and QA/QC.
- I recommend including, under the methodology sections, descriptions on how time series change in methods result in changes in emission totals by states (in significant variance). Analysis of historical trends in GHG emissions could reveal the unexplained inter-annual variations that could have been attributed to calculation errors.
- The report does not provide the information on which applications (or sub-applications) are reported, which are not occurring, not estimated, etc. For instance, under Electrical Transmission and Distribution, there is no indication if there was an effort to identify any industrial, military, and small-utility application sources as these could potentially contribute to this source for the country. Additionally, same section does not provide a disaggregation method on disposal of electrical equipment and recycling/destruction of SF<sub>6</sub>, if existent.
- I recommend including specifics on percentage disaggregation of reporting and non-reporting facilities per each category as well as in relation to total emissions. Additionally, there's no indication of the general market size and trend within states for non-reporting facilities for certain categories under Product Use.

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### *Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

- I recommend prioritizing the ODS category for uncertainty analysis, and consider including in the method section data samples from states, as well as all assumptions for data disaggregation and check if the results match with those in the *National Inventory* (or are comparable). I also recommend adding complete information on categories, gases included, and assumptions for the entire time series and, when applicable, by application.
- For the ODS category, sales data by state (top-down) approach could be used for proxy analysis. It's unclear what the state/national boundary is for these activities and this could be improved. state profiles should include activities within the state, total emissions by gas and as CO<sub>2</sub>e, methods, assumptions, and proxy data with justification that are used to estimate emissions from each category. Additionally, indicate the activity data profile by state on recovery, reuse, and recycling activities as they may vary significantly by state/application.

### **3. Data availability. Please address the following questions for each inventory source:**

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?

I am not aware of any additional available data sets apart from those referred to in the US National GHG Inventory (1990-2019).

### **4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

As commented above, consistency in methods and time series can be better addressed and, therefore, reflecting in better uncertainty analysis. As per 2006 IPCC guidelines and good practices, consider prioritizing base year (1990) and every 5 years. Further, the latest inventory year should also be included and for better comparison, the year immediately before the last inventory year should be included as well. Additionally, it is advised to provide better references and detailed explanation of uncertainty analysis – and consider including comparison of disaggregated data developed by this methodology to state-level inventories, when available.

### **5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

I recommend for EPA’s key categories prioritization process to follow the *National Inventory KCA* process. Additionally, due to this aiming at disaggregating data at the state level, a KCA could be conducted for each state based on these first findings attempt. During this review for Metals and Product Use, I recommend prioritizing ODS and Iron and Steel, at minimum and to start with.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?**
- c. Related to the level of category/gas aggregation or disaggregation?**
- d. Are there specific categories where further data disaggregation could be helpful?**
- e. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

It would be good to adapt the tool for its state-level version disaggregation. This could allow for the tool to create state profiles on what sectors and categories are the biggest sources of GHGs. Prioritize disaggregation for categories present at all states. For instance, given ODS category is present in all states and territories, breaking it down to the applicable and sub-application level would be highly encouraged. Additionally, and generally, providing the breakdown by each individual GHG, and total CO<sub>2</sub> equivalent should also be prioritized in this type of tool enhancement.

For data format, both .xlsx download and .csv would be good exports options. Additionally, for any graphs auto-generated by the tool, these could also be downloaded as images (.png, .jpeg) or as a summary report on PDF format.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Alissa Benchimol

**AFFILIATION:** Greenhouse Gas Management Institute

**DATE:** 15 October 2021

**RESPONSE TO METALS CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Iron and Steel and Metallurgical Coke Production**

**1. Are you aware of state-level data on iron and steel production (activity data) by category (i.e., sinter production, iron production, pellet production, steel production, other activities) for some or all of the 1990–2019 time series? In the absence of steel production by state, are you aware of better surrogate data that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

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I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources. For all production-related charge questions, recommend reviewing feedstock data for proxy and analysis, as found in USGS and other national/international statistics datasets, if dataset is available.

**2. Are you aware of information to better allocate basic oxygen furnace and electric arc furnace production by state for 1990–2009?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**Ferroalloy Production**

**1. Are you aware of state or facility-level data on ferroalloy production (activity data) for the 1990–2019 time series? Is there any other surrogate data (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**Aluminum Production**

**1. Are you aware of data available to incorporate differences in emissions between smelters based on technology type? Is there any other surrogate data or emission sources that could be used to allocate national total aluminum production emissions across states?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**Magnesium Production and Processing**

**1. Are you aware of state or facility-level magnesium production or capacity data (or surrogate data) for the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**2. Are you aware of information on the location (by state) of magnesium production and processing facilities or information on the location (by state) of magnesium production and processing facilities by process type?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**Lead Production**

**1. Are you aware of state or facility-level data on primary or secondary lead production (activity data) for the 1990–2019 time series? Is there any other surrogate data (e.g., primary or secondary production capacity by facility or state) for 1990–2009 that could refine this state**

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**inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**Zinc Production**

**1. Are you aware of state or facility-level data on zinc production (activity data) by unit type (i.e., electrothermic furnace, Waelz kiln, other furnaces, and flame reactor units) for the 1990–2019 time series? Is there any other surrogate data (e.g., total number of zinc facilities by state, production capacity by unit type and by facility or state) or other data by state (e.g., utilization rates by facility or state) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

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*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Alissa Benchimol

**AFFILIATION:** Greenhouse Gas Management Institute

**DATE:** 15 October 2021

**RESPONSE TO PRODUCT USE CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Electronics Industry**

**1. Are you aware of state- or facility-level capacity data or other state-level surrogate data (e.g., sales data) for PV manufacturing for 1990–2006 that could be used to refine the allocations of emissions by state? Is there any surrogate data (e.g., sales data by state) by state for semiconductor or MEMS manufacturing for 1990–2007 that could be used to refine the allocations of emissions by state?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**Substitution of Ozone-Depleting Substances**

**1. Are you aware of bottom-up modeling data that are available by state? Is there any surrogate data other than population data that could be used to disaggregate the emissions of substitutes for ozone-depleting substances?**

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I am not aware of any other bottom-up modeling data by state. It's recommended to prioritize this category and look into other data sources for each of the sub-applications.

Though I am not aware of specific state-level data sets, I recommend investigating other national data beyond population. For example, [EIA CBECS](#) reports on energy consumption data; vehicle registration data by state, sales data (e.g., MDI manufacturers), chemical sales data to product producers (import/export statistics), etc.

**Electrical Transmissions and Distribution**

**1. Are you aware of state-level electrical transmission and distribution equipment data (e.g., nameplate capacity by state) or other data for 1990–2019 (or part of the time series) that could refine this state inventory calculation to reflect state trends in emissions more closely? Is there any other surrogate data (e.g., state population data) to enhance accuracy and consistency of state GHG emissions and trends than the current data being used (transmission mile data by state)?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources.

**N<sub>2</sub>O from Product Use**

**1. Are you aware of state-level data on N<sub>2</sub>O usage for medical and dental anesthesia, food processing propellant and aerosols, sodium azide production, or other applications (e.g., fuel oxidant in auto racing, oxidizing agent in blowtorches) for some or all of the 1990–2019 time series? Is there any other surrogate data (e.g., state population data) that could be used to enhance accuracy and consistency of state GHG emissions and trends other than the current data (transmission mile data by state)?**

(A note that the current data being used is population data and note transmission line)

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have access to any relevant data sources. Consider using national/state statistics on industry sizer and related metrics of production and resources.

### 3.2 Mr. E. Lee Bray (IPPU)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> E. Lee Bray
<b>AFFILIATION:</b> Assistant Chief of Mineral Commodities National Minerals Information Center US Geological Survey Reston, VA lbray@usgs.gov
<b>DATE:</b> October 7, 2021
<b>RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS</b>
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
This section on primary aluminum smelter emissions is clear and explains relevant processes well.
<b>2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?</b>
I think this section is satisfactory.
<b>3. <u>Data availability.</u> Please address the following questions for each inventory source:</b>
<ul style="list-style-type: none"> <li><b>a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?</b></li> <li><b>b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?</b></li> </ul>
I noted discrepancies between aluminum production emissions in the data provided compared with USGS reports on aluminum production in the years covered for some states. See comments in later section.
<b>4. <u>Uncertainty.</u> Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the <i>National Inventory</i>. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).</b>
My only comment is concerning some states not having emissions included that have reported aluminum production. See comments later. Other methodology appears to be reasonable.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**5. Key Categories.** EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.

I have no suggestions.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

I have no suggestions.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** E. Lee Bray

**AFFILIATION:**

Assistant Chief of Mineral Commodities  
 National Minerals Information Center  
 US Geological Survey  
 Reston, VA 20192  
 lbray@usgs.gov

**DATE:** October 7, 2021

**RESPONSE TO METALS CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Aluminum Production**

**1. Are you aware of data available to incorporate differences in emissions between smelters based on technology type? Is there any other surrogate data or emission sources that could be used to allocate national total aluminum production emissions across states?**

I do not have data on emission rate differences between smelter technology types.

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I did find some discrepancies in state level emissions compared to known production reported in the US Geological Survey's Minerals Yearbook chapters on aluminum. Although the USGS is prohibited from disclosing production at individual smelters, the reports do have total US production and a summary of activities at smelters including shutdowns, restarts, and stated capacity. Below is a summary of the discrepancies that I found on the Sinks by Gas table.

According to the 1990 USGS Mineral Yearbook for Aluminum, all smelters were producing at or near full capacity for the entire year. Total yearend stated capacity was 4,016,000 t/yr and production was 4,048,000 t. (Sometimes production exceeds stated capacity because the stated capacity is based on a multi-year average and the timing of periodic maintenance may result in some years exceeding their stated capacity while other year's production is less than stated capacity.) The states with primary aluminum production in 1990 were IN, KY, MD, MO, MT, NC, NY, OH, OR, SC, TN, TX, WA, and WV. The "Sinks by Gas" table with does not list emissions from primary aluminum smelters in 1990 for MO and NC. Capacity in MO was 204,000 t/yr and in NC capacity was 115,000 t/yr.

In 2005, the "Sinks by Gas" table with does not list emissions from primary aluminum smelters in MD and SC. The 2005 USGS Minerals Yearbook for Aluminum reported that the primary aluminum smelter in MD was producing throughout the year until the end of December when the smelter was shut down. I do not have actual production available, but the capacity was 195,000 t/yr. The smelter never reopened and has been demolished, so no emissions have occurred since 2005. The smelter in SC had capacity of 224,000 t/yr but information on capacity utilization is not available, although it appears to have produced the entire year.

No emissions from primary aluminum smelters are listed in the "Sinks by Gas" table for any of the years for MO, but there is a smelter in the state and it was producing in 1990, 2005, 2015, 2016, 2018, and 2019. The smelter was shut down for part of 2016, all of 2017, and part of 2018. In 1990 the capacity was 204,000 t/yr, in 2005 it was 250,000 t/yr, in 2015 and all years since it has been 263,000 t/yr. (Information from USGS Minerals Yearbook Aluminum 1990, 2005, 2015, 2016, 2017, 2018, 2019.)

The "Sinks by Gas" table does not report any emissions from primary aluminum smelters for OH in 2005. The primary aluminum smelter in OH shut down in January 2005 so it would have had a small amount of emissions. The smelter restarted production in 2006 but was shut down again in 2013 and never produced again. These years are not specified in the review so those emissions are not included in this study. But there are some emissions of PFCs attributed to primary aluminum smelting in OH in 2015 through 2019. Since the smelter was permanently shut down in 2013, there should not be any emissions attributed to aluminum smelting in OH for these years. (Information from USGS Minerals Yearbook Aluminum 2005, 2007, 2013.)

The "Sinks by Gas" table lists emissions from primary aluminum smelting in TN for 2015 through 2019. However, the smelter in TN was permanently shut down in 2009 so no emissions should be attributed for any year since 2009. (Information from USGS Minerals Yearbook Aluminum 2009.)

### 3.3 Mr. Phillip Cunningham (Waste)

#### PEER REVIEW COMMENT TEMPLATE

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Phillip Cunningham

**AFFILIATION:**

Ruby Canyon Environmental, Inc.  
743 Horizon Ct. Suite 385  
Grand Junction, CO 81506

**DATE:** 10/7/21

#### RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS

**1. What are your overall impressions of the clarity and transparency of this section?**

Overall, this document is well written and describes these sources categories extremely well. It is very descriptive and accurate as far as my understanding of GHG emissions from these source categories.

I really enjoyed the opening paragraphs; I found them easy to understand.

I'm going to use this box to list my questions because question 1. is for clarity and transparency.

#### 7.1 Landfills (CRF Source Category 5A1)

The methodology section is well written and easy to understand. Outside of the scale up factor (9-11%; see below comment #7) I thought everything in this section was very transparent and the formulas were laid out nicely. I thought the summary of methodologies used for past inventories was clear.

I thought the Uncertainty and time-series consistency section was well thought out and clear.

1. Page 7-4, first paragraph under section 7.1 landfills states (about mid-way through) “many have environmental monitoring systems to track performance, collect leachate, and collect landfill gas”. Is there an estimate % of how many landfills have this (rather than stating ‘many’)?
2. Page 7-5, second paragraph last sentence, “Methane production...will continue for 10 to 60 years or longer...”. Is there a citation for this? Also, it might be helpful to include a graphic showing how methane generation decreases over time. It might be misconstrued that generation is the same amount over 60 years when in actuality, generation tapers off over time.
3. Page 7-5 last paragraph states “...while industrial waste landfills accounted for the remainder (15.1 MMT CO2 eq.)”. It may be more transparent if a note is added about why industrial landfills emit less methane. My understanding is that most industrial landfills dispose of non-organic

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material (although I did not realize industrial landfills included pulp and paper industry and waste from some food/meat processing facilities).

4. Bottom of page 7-5 through the top of page 7-6 states, “While the number of active MSW landfills has decreased significantly...the average landfill size had increased”. It may help readers understanding by describing what effect this has on emissions. Do more large landfills mean more collection and less emissions?
5. Related to #3. above, at the end of the first paragraph on page 7-6 it states, “Only 169 facilities with industrial waste landfills met the reporting threshold under Subpart TT”; it may be helpful to include an explanation as to why industrial landfills don’t usually exceed the GHGRP threshold (my assumption was that not many organics are disposed of at industrial landfills).
6. Page 7-6, second paragraph, last sentence states “Net CH<sub>4</sub> emissions from MSW landfills have decreased since 1990...” but doesn’t give an explanation why. May be helpful to have a note as to why emissions are decreasing.
7. Page 7-6 third paragraph states, “The estimated quantity of waste placed in industrial waste landfills (from the pulp and paper, and food processing sectors)...”. I didn’t find it clear why waste from other industrial sections (like construction and demolition) is not included here. Again, my assumption is that industrial waste besides these two source categories is negligible because of inorganic material.
8. Page 7-10, third bullet in the first sentence was the first time I noticed the 9 percent scale-up factor. I searched for this wording in the document but couldn’t find an explanation as to why 9 percent is used. I don’t have an issue with the number, I just don’t see any citation for its usage.
- 
9. Page 7-11 first paragraph; similar to comment #7 above, I didn’t see a justification for only including the pulp and paper manufacturing and food and beverage manufacturing as the only two sources for industrial landfills.
- 
10. Page 7-16, 1<sup>st</sup> paragraph states, “Reporters can choose which of these two methodologies they believe best represents the emissions at their landfill and are required to submit that value as their total Subpart HH emissions”. It might be beneficial to the reader to briefly discuss the differences between the equations or at least state what fraction of landfills report to each different HH equation (in case the reader wanted to review the differences in equations themselves).

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- 11. Page 7-16, 2<sup>nd</sup> paragraph states, “Overall, the estimated waste-in-place for non-reporting landfills increased by approximately 274 million MT.” It may help to compare this value to WIP for landfills that are reporting (to GHGRP?) to show what fraction of waste is going to non-reporting landfills. I don’t think I saw total WIP for reporting landfills in this section.
- 12. Page 7-17, 2<sup>nd</sup> paragraph from the top states “...because of the inclusion of 194 GHGRP Subpart HH facilities that have off-ramped...”. May be helpful to state the definition here instead of in the 3<sup>rd</sup> paragraph under planned improvements. I was unfamiliar with the term ‘off-ramped’ until I read the definition you provided in the planned improvements section.

### **7.2 Wastewater Treatment and Discharge (CRF Source Category 5D)**

1. Overall, I enjoyed this section and thought it was well written.

I did like the equations in the text with tables describing the parameters. However, it may be helpful to have a diagram of how all of the equations / emissions from each source category roll-up into the totals listed in Table 7-7 and 7-8.

I like the equations with each data table, but it was difficult for me to visualize how emissions are combined into the final values. This doesn’t need to be complicated; it was just hard to read the subcategories.

I thought the Uncertainty and time-series consistency section was well thought out and clear.

1. Page 7-26 Table 7-12; the U.S. population increases 32% from 1990 but TOW only increased 23%. Is there a reason these increases aren’t linear?
  -
2. Please ignore this comment if I’m wrong; I didn’t see a clear distinction between POTW and centrally treated wastewater. Are these two things the same (I assume yes)? If so, they are used interchangeably throughout the document. If they are the same thing, maybe just state one or the other?
  -
3. In general, some visuals could really help improve the clarity of this section.
  - 
  - Some simple graphics showing the different between all the types of wastewater collection and treatment would be helpful. This doesn’t need to be extensive or complicated, just maybe a graphic of all the different types.
  - 
  - I had a hard time reading the sources, equation and tables without a visual representation of the treatment systems. Everything is clear and well written but it might be helpful to

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have some visuals interspersed with descriptions of each treatment. This is probably most important for constructed as opposed to un-constructed wetlands.

- 
- I enjoyed the tables (it makes is very transparent of where the data is coming from) but some visuals could really help the laymen understand how all these different sources are rolled up into the final total emissions for wastewater.
- 
- 4. Regarding Table 7-26; some of this data is from 1974 and 1975. I realize this is probably not a large emission source. I was wondering if any canneries report to GHGRP or ECHO regarding wastewater outflow. Surely wastewater outflow and BOD content have changed in the last 40 years? I would assume that NPDES permitting would require these types of facilities to report information regarding outflow and BOD somewhere.
- 
- 5. Page 7-51, last sentence under third paragraph under ‘Recalculations Discussion’ heading; this paragraph lists several reasons for the increase in emissions. It might be helpful to identify which item had the largest impact on the increase over the time-series. The overall increase seems very large; was this increase based on the combined effects or was there something in particular that had more influence than others?

### **2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?**

2For completeness, I don’t recall seeing an assessment of what percentage the GHGRP emissions cover for the entire landfill sector. Is there an estimate of what percentage of landfills in the U.S. DO NOT report to GHGRP? What is an estimate of overall emissions from these landfills (1%, 5%)?

•  
3So comment as #1. For wastewater. Although I did not see references to the GHGRP for the wastewater sector. Is this because wastewater treatment facilities generally don’t report to GHGRP? It seemed like there was a great deal of discussion in the landfill section regarding GHGRP but not really any discussion in the wastewater section.

### **3. Data availability. Please address the following questions for each inventory source:**

- a. **For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b. **For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

1. The nature of our work limits us in academic knowledge. Generally, the only sources that I believe could possibly be helpful would be GHG offset projects listed on the Climate Action Reserve, American Carbon Registry or Verified Carbon Standard websites. This would strictly be useful for avoided emissions.

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By reviewing public documentation of landfill gas destruction projects, avoided GHG from composting waste and methane destruction from wastewater treatment offset projects, EPA may be able to find information regarding how emissions are avoided at a more granular level.

2. Due to the nature of our work, we do not usually have time or resources to devote to research. I am not aware of datasets other than those referenced in each section.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

1. I'm confused about why uncertainty ranges are not included at the state level. If uncertainty is included at the national level isn't the uncertainty by default extended to the state level?
2. I can't answer the question regarding which year would be most representative.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

1. Regarding landfills, it may be worth studying oxidation rates in more detail. The amount of methane removed from the atmosphere appears to be roughly 10% of generation. It would be interesting to study these rates in more detail in order to understand whether more refined oxidation rates could be developed based on site specific parameters.
2. Table 7-7 lists N<sub>2</sub>O emissions from treatment of wastewater. I was surprised to see that these emissions were higher than methane generation. I know N<sub>2</sub>O from wastewater treatment is highly uncertain so that might be an area worth looking into.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

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1. I really enjoyed this tool and thought it was very helpful and easy to use. My only comment was when I selected the waste sector, under category, there wasn't a landfill only option. All I saw was 'entire sector' and 'wastewater'. Why isn't there just 'landfill', 'composting' etc.?
2. I liked the spreadsheets that were sent to us with dropdown selection by state.

### PEER REVIEW COMMENT TEMPLATE

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

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**DATE:** 10/13/21

### RESPONSE TO SOLID WASTE MANAGEMENT CHARGE QUESTIONS

#### MSW Landfills

#### 1. Data Questions

- Are there datasets for individual states' landfill gas (LFG) recovery activity?
- Are there data available for open dumpsites in the U.S. territories?

First bullet – see comment above; offset project databases could be utilized but I assume the data in LMOP already includes this.

Second bullet – I am unable to answer this question due to my limited knowledge.

**2. The current method makes some simplifying assumptions and includes uncertainties in the allocation of national-level U.S. emissions to states (e.g., recovery rates are the same for all states and match the national recovery rate). Are there alternative assumptions or different datasets that would improve the accuracy of MSW landfill estimates? Do you have recommendations to refine the methodology to estimate emissions over the time series more accurately?**

In general, I would say assuming recovery rates are the same for all states is not a good assumption. To my knowledge, where land is limited (i.e. around heavily populated areas), recycling would be much more common as compared to rural areas where tipping fees are low. I would say more heavily populated areas / states will have higher collection rates.

For example, tipping fees in New York City are likely to be very high and people will take steps to recover / recycle in order to avoid paying higher waste disposal costs. Also, if you assume that recovery rates are higher in higher populated areas, then this is further magnified.

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Could you look at tipping fees for each state and develop a formula that assumes recycling / diversion is more common in areas that have the highest waste disposal costs?

Also, not to be political but liberal populations likely divert more waste from the waste stream. In my experience, liberal populations are more concerned about the environment and are likely more willing to partake in recycling. Not saying conservatives don't recycle. I'm neutral on politics.

### **Industrial Landfills**

**1. Do you have recommendations to refine the methodology to estimate emissions over the time series more accurately?**

RCE has used @risk to model uncertainty. I'm not sure how the emissions are back-casted but I assume you could use some statistical software for trending purposes.

### **Composting**

#### **1. Data Questions**

- **Is the assumption that Alaska has no commercial composting operations correct?**
- **Are there any data about composting in U.S. territories?**
- **Are there any state-level data sources that describe composting activity over time?**

First bullet – I don't know the answer to this. Composting can generate its own heat and isn't necessarily limited to warmer areas. Water availability is probably more relevant to where composting is more common.

Section bullet – Again, the only data set I'm familiar with that would be of value is offset project registries. These sites contain public information regarding offset composting project. Information in these reports may be helpful for understanding how real world composting operations work / how impactful they are at reducing GHG emissions.

Third bullet – the only states I would think of that may have this information is California and Massachusetts. Both have very strict requirements and / or ban organics in landfills. They may have information about how composting operations have fared in their respective states over time.

### **Stand-Alone Anaerobic Digestion**

**1. Do you have or know of any state-level data for counts of operational anaerobic digesters (processing food waste) by year?**

Same comment as above; public offset registries publish documents that describe offset projects in detail. It may be possible to glean some information from these registries. Also, is there a NAICS code for digesting food waste? If so, could you review how many facilities have that code? I assume that if you operate a digester, some state permit would be required. Could you inquire each state and ask how many facilities applied for an applicable air permit?

**2. Are there any facility-specific data sources we could use to fill data gaps on the quantity of waste processed by stand-alone digesters for any and all years of the 1990–2019 time series?**

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Outside of the registries (and that information would be very limited) I don't have knowledge of data sources regarding this question.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

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**DATE:** 10/14/21

**RESPONSE TO WASTEWATER MANAGEMENT CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**1. The following national average parameters were used to estimate emissions by state, with state populations used to proxy the distribution of domestic emissions and state-level production data (if available) used to proxy the distribution of industrial emissions. Please comment if you believe states would differ significantly from the national averages for the following parameters and, if so, whether there are state-specific data sources for EPA to consider:**

- **wastewater outflow**
- **biological oxygen demand (BOD), total N, and chemical oxygen demand (COD) concentration in untreated wastewater**
- **BOD:COD ratios for industrial wastewater**
- **wastewater treatment unit operations in use at centralized domestic treatment plants or at industrial plants**

For wastewater outflow, I don't think outflow within a specific industry would differ significantly between states. The only exception would be western states where there is a scarcity of water. Industry in the west is going to try and save money on water and be more efficient (especially in the future).

Second bullet point – nothing comes to mind that would indicate these parameters vary significantly within industry.

Third bullet point – same comment as #2.

For the fourth bullet point, states with stricter state regulations on water quality like California will likely have better treatment than a state with a low population like the Midwest. I would say this could vary significantly state to state based on regulation.

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**2. Are there domestic or industrial wastewater treatment operations present on other Pacific islands for industrial sectors included in the *National Inventory*?**

I don't know the answer to this question.

**3. For each of the wastewater treatment and discharge subcategories listed for this category, is there any information that was not considered on available state-level data sources with regional or other disaggregated information on emissions?**

The only data sources I'm aware of regarding discharging would be ECHO and possibly some state databases like PARIS for Washington state. The only other source data I could think of that might be helpful is NPDES permitting. However, I assume if you are under NPDES then you will report outflow to ECHO.

**Domestic**

**1. The following national average parameters were used to estimate domestic wastewater treatment emissions by state. Please comment on whether you think that states would differ significantly from the national averages for the following parameters and, if so, are there state-specific data sources for EPA to consider:**

- discharge of publicly owned treatment works (POTWs) to impaired waterbodies and nonimpaired waterbodies
- discharge of POTWs to reservoirs, lakes, and estuaries
- consumed protein
- percentage of the population on septic (versus centralized treatment)

- First bullet point – yes; if you are a state on the coast or a state with large water bodies then you would have the opportunity to discharge to impaired and non-impaired waterbodies. If you are in the Midwest, POTWs can discharge into aquifers, correct? This would impact emissions in some way I assume.
- Second bullet point – yes; again, if you are a state with these water bodies then you would have the opportunity to discharge to them. Western states without shorelines are going to be limited in discharging to large water bodies that are not moving.
- Third bullet point – I don't see a reason with this would be different state to state.
- Fourth bullet point – Midwest and rural states will likely have a higher percentage of population on septic?

**Industrial – Pulp and Paper**

**1. Pulp and paper wastewater flows were estimated using EPA's Enforcement and Compliance History Online (ECHO) datasets. Do you have any reason to believe that states' pulp and paper wastewater information is underrepresented in ECHO? If so, do you have an alternative, publicly available pulp and paper wastewater dataset by state?**

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I think ECHO would be a good source for this. I am familiar with PARIS which is Washington's state database for water quality. I believe there are a number of state databases that deal with water quality but I'm not sure if the reported numbers in ECHO would differ from the state databases. I would assume that ECHO is reliable as pulp and paper would need to report discharge for their NPDES, correct?

**2. Currently, a single year, 2019, is used to estimate the distribution of national estimates to each state and territory for every year of the time series. Is there reason to believe states' pulp and paper manufacturing operations have changed significantly since 1990? If so, are there data sources to quantify those changes?**

I think there have been changes; namely lumber operations in the East have probably increased. Lumber practices outside of Washington, Oregon and California (I would assume) are less strict. You could also look at lumber products from state to state. I believe that different species of trees produce different percentages of pulp / non-lumber product. If you could assess the main types of lumber production by state, you may be able to estimate which states would have greater pulp/paper manufacturing operations and therefore where emissions are shifting to.

**3. Data for pulp and paper manufacturing for U.S. territories are limited in the ECHO dataset. Are there resources to help estimate a time series of production data for pulp and paper wastewater flows? Or are there territory-level data on the number of pulp and paper plants in each U.S. territories?**

I can't answer the question about U.S. territories. The U.S. Forest Service has a publication for U.S. timber production, trade, consumption, and price statistics, 1965-2017 (<https://www.fs.usda.gov/treesearch/pubs/58506>).

I don't know what is in this report but I would assume that timber production by state could be correlated to pulp and paper wastewater flows as mills are generally within a few hundred miles of timber production?

### **Industrial – Meat and Poultry**

**1. Currently, a single year, 2019, is used to estimate the distribution of national estimates to each state and territory for every year of the time series. Is there reason to believe states' meat and poultry processing operations have changed significantly since 1990? If so, are there data sources to quantify those changes?**

I'm not sure about processing operations changing by state. I believe that production of meat and poultry has probably shifted somewhat. Operations from North Carolina have generally moved out west to more rural communities to avoid nuisance complaints. There is nothing I'm aware of that would indicate processing operations have changed.

**2. Data for meat and poultry processing for U.S. territories are not captured in the USDA dataset. Are there resources to help estimate a time series of production data for poultry**

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**(broilers, turkeys, chicken), beef and calves, hogs, and sheep (lamb and mutton), for example, live weight killed, number of head slaughtered?**

Don't know the answer to this.

**Industrial – Fruits and Vegetables**

**1. Currently, a single year, 2017, is used to estimate the distribution of national estimates to each state and territory for every year of the time series. Is there reason to believe states' fruit and vegetable processing operations have changed significantly since 1990? If so, are there data sources to quantify those changes?**

Nothing comes to mind.

**2. Data for fruit and vegetable processing for U.S. territories are not captured in the USDA dataset. Are there resources to help estimate a time series of territory-level production data for fruits and vegetables, for example, canned and frozen processed vegetables, potato production, noncitrus fruits, and citrus production?**

Don't know the answer to this.

**Industrial - Ethanol**

**1. Ethanol production for each state was estimated using the Energy Information Administration (EIA) SEDS dataset. Do you have any reason to believe that states' information is underrepresented in the SEDS dataset? If so, do you have an alternative, publicly available ethanol production dataset by state?**

No reason to believe there is a better data source than EIA.

**2. Data for ethanol production for U.S. territories are limited in the SEDS dataset. Are there resources to help estimate a time series of production data for ethanol production?**

Unable to answer this question.

**3. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

California's LCFS program includes ethanol producers. The LCFS program covers the whole country. It may be worth examining the LCFS database to gain insights into which states have ethanol production that are participating in LCFS.

**Industrial - Petroleum**

**1. Petroleum production for each state was estimated using EIA's Petroleum Administration for Defense Districts production and state-level operating capacity datasets. Do you have any reason to believe that states' information is underrepresented in the EIA datasets? If so, do you know of an alternative, publicly available petroleum refining production dataset by state?**

EIA is the main data source I would reference for this data source.

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**2. Do you have any concerns about using operating capacity to estimate petroleum production by state is not a good method? If so, would you suggest an alternative method?**

My only comment would be that I know production is largely driven by price so operating capacity might not be the best indicator when oil prices are low and producers are cutting back.

**3. Data for petroleum refining for U.S. territories are limited in the EIA dataset. Are there resources to help estimate a time series of territory-level production data for petroleum production?**

I don't have an answer for this question.

**Industrial – Breweries**

**1. Brewery production, and by extension brewery production emissions, for each state was estimated using the Alcohol and Tobacco Tax and Trade Bureau (TTB) taxable production dataset.**

- **The TTB dataset is based on taxable production/volume. Is there any reason why taxable production from breweries may be underrepresented by state and therefore potentially underrepresent total emissions? If so, do you know of an alternative dataset or assumption?**
- **The TTB dataset provides production data from 2008 to the present. The 2008 values were used as a proxy for 1990–2007 values. Is there reason to believe states' brewery production has significantly changed over that time period? If so, do you have an alternative, publicly available state-level brewery production dataset (i.e., barrels produced), or suggestions for alternative data to use as a proxy?**

1. First bullet – I don't have knowledge on this subject.
2. Second bullet – Not to my knowledge; as indicated on page 7-39, most of the growth in craft breweries has been since 2010.

**2. Data for brewery production for U.S. territories are limited in the TTB dataset. Are there resources to help estimate a time series of territory-level production data for brewery production (i.e., barrels produced)?**

I don't have an answer for this question.

### 3.4 Mr. Jonathan De’Ath (IPPU)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Jonathan De’Ath
<b>AFFILIATION:</b> National Lime Association 200 N. Glebe Road, Suite 800 Arlington, VA 22203
<b>DATE:</b> 10/5/21
<b>RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
As written, the text has clarity and transparency. However, additional text should be included that discusses and explains CO <sub>2</sub> emissions contribution from calcined waste generation (LKD in particular) (see separate attachment); also, back calculating accurate state level emissions will always be inherently inaccurate when certain assumptions must be made. However, the required data for accurate state level emission (for example, production and capacity) are considered confidential business information by the lime industry. In the absence of such data, accurate state level emissions cannot be reliably calculated. A review of the accompanying Excel spreadsheets (“State-GHG_Trends_Emissions_&_Sinks_Economic_Sector” for example) for lime at state level for years 1990 to 2009 are inaccurate and include estimates that are both too high and too low for certain states, often several by orders of magnitude.
<b>2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?</b>
Response to this question provided as a separate attachment.
<b>3. <u>Data availability.</u> Please address the following questions for each inventory source:</b>
<b>a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?</b> <b>b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?</b>
No. NLA is not aware of additional relevant data sources. There are no national or state level comparable datasets available.
<b>4. <u>Uncertainty.</u> Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent</b>

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**publications of this data will also strive to maintain this consistency with the national *Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Because lime manufacture mirrors the economy, a more detailed analyses of recession years 2007 through to recovery in 2011 may be of interest.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

As previously mentioned, accurate accounting of CO<sub>2</sub> emissions from LKD production and other calcined waste is important. State level LKD production by type, plus other calcined waste production would improve accuracy, although obtaining such data are problematic.

**6. Data Presentation and Usability.**

**a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at:**

**<https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?**

**i. Related to the level of category/gas aggregation or disaggregation?**

**ii. Are there specific categories where further data disaggregation could be helpful?**

**iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**

**c. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

As a caution, the problem with further data disaggregation for the lime industry at state level is risk of releasing CBI (please see separate attachment).

Non CBI downloadable data is easiest as .xlsx format.

NLA is not aware of any additional datasets which would increase the usability of state-level emissions data.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Jonathan De'Ath

**AFFILIATION:**

National Lime Association  
200 N. Glebe Road, Suite 800  
Arlington, VA 22203

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**DATE: 10/5/21**

**RESPONSE TO MINERALS CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Cement Production**

**1. Are you aware of data on state-level clinker production for the full 1990-2019 time series? If not, is there any surrogate data that could be used (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

N/A

**Lime Production**

**1. Are you aware of state-level data on lime production (activity data) by type (e.g., high-calcium quicklime; dolomitic quicklime, high-calcium, hydrated; dolomitic, hydrated; dead-burned dolomite; CO<sub>2</sub> captured for use in onsite processes) for some or all of the 1990–2019 time series? If not, is there any surrogate data (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

NLA is not aware of any state level production data. Plant-level lime production and capacity are typically considered Confidential Business Information and not released.

**2. Based on analysis of Greenhouse Gas Reporting Program data, it appears that most facilities that manufacture beet sugar and lime, as well as a few lime manufacturing facilities capture CO<sub>2</sub> for use in onsite processes. Are you aware of any information why lime producing facilities capture CO<sub>2</sub> for use in onsite processes, any trends in this practice during the 1990–2019 time series (e.g., have facilities increased or decreased adoption of this practice during the time series), or whether the amount of CO<sub>2</sub> captured is proportional to the amount of lime produced or some other metric? Are you aware of any data on the amount of CO<sub>2</sub> captured onsite per facility or state for 1990–2009?**

A very small number of lime plants used to capture CO<sub>2</sub> for the production of precipitated calcium carbonate (PCC) which is used for the manufacture of paper. It is NLA’s understanding that only one company now makes PCC. Other companies have stopped PCC manufacture because PCC has been substituted with ground calcium carbonate for use in paper manufacture. This does not require CO<sub>2</sub> for production.

**3. For some states and years (Colorado for 2010–2015, Idaho for 2011 and 2019, and Nebraska for 2010–2014), calculations using GHGRP data on emissions and CO<sub>2</sub> captured for onsite processes yielded small but erroneous negative emissions. EPA zeroed emissions for those states and years and plans to adjust calculations so that state emissions totals match national emissions. Do you have any general feedback on this approach?**

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There are no commercial lime manufacturing plants in Idaho or Nebraska. The facilities in question are most likely sugar manufacturers and therefore have no interaction with NLA so we cannot comment on their emissions accounting methodology.

### 3.5 Dr. Olia Glade (IPPU)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Dr Olia Glade
<b>AFFILIATION:</b> GHGMI
<b>DATE:</b> 15 October 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
1. What are your overall impressions of the clarity and transparency of this section?
<ul style="list-style-type: none"> <li>▪ Producing this report is a big step forward in terms of transparency of reporting the emissions at the state level, for which the US EPA can be congratulated. The IPPU chapter provides some additional insights in the GHG accounting by state, but as this is only a first step in this direction, there is space for improving transparency of the report.</li> <li>▪ As the <i>State Methods</i> is largely based on the US national GHG inventory (1990-2019), the recommendations to the <i>National Inventory</i> provided in the Assessment Review Report FCCC/ARR/2020/USA are applicable to the <i>States Methods</i>. The additional transparency issues noted specifically for the states’ inventory could be grouped as follows:                     <ul style="list-style-type: none"> <li>• Use of methodology</li> <li>• The proxy data</li> <li>• Data sources &amp; references</li> <li>• Comparative analysis of emission trends at state level</li> </ul> </li> <li>▪                     <ul style="list-style-type: none"> <li>A. Transparency issues associated with the Use of methodology: it is not always clear how the emissions among states have been allocated and which methodologies were used by which state, for example:                             <ul style="list-style-type: none"> <li>1. The Introduction section (lines 10-15, Introduction) states that the report is consistent with the national GHG inventory and, as such, follows the same methodology. However, later in the same section (lines 39-45, Introduction) it is stated that states may use different methodologies, activity data and emission factors at a different level of granularity (like facility-level in contrast to the USA’s <i>National Inventory</i>). It is also stated that states may have adopted different accounting decisions that differ from those adopted by the IPCC and UNFCCC and even use different categorization.</li> <li>2. Lines 46-49 (Introduction) suggest that Scope 1, Scope 3 (both conceptually belong to the GHG Protocol, not the 2006 IPCC Guidelines or the UNFCCC Reporting Guidelines), or consumption-based approach may be used by some states for emission allocations, which is contrasted with “our approach” (line 47, Introduction). This sounds very unclear and requires a more detailed explanation on how specifically the activity data and corresponding emissions have been allocated for each state and whether the allocation has been the same across different sectors and categories. For example, are the state boundaries defined in the same way for the energy sector and the IPPU sector, for 2.F and 2.A categories?</li> <li>3. Section 1.2 introduces three approaches used by the states inventory: Approach 1—Estimates were built by applying national methods directly to more geographically disaggregated data (at</li> </ul> </li> </ul> </li> </ul>

state or finer level), Approach 2 - estimates were disaggregated from national-level estimates using geographic proxies or other indicators (i.e., population, production capacity, GHGRP, etc.), and Approach 3 – a hybrid approach between approaches 1 and 2. However, the inventory does not always provide a clear indication which of these approaches was used for allocating emissions for each specific category. For instance, lines 23 and 24 (section 2.1.1.1) states that *to allocate process emissions to all applicable U.S. states and territories using activity data broken down at a state level*. However, it does not explicitly describe which particular approach (1, 2 or the hybrid) was used for such allocation. In addition, Table 3-1 in the same section (Summary of Approaches to Disaggregate the *National Inventory* for Cement Production Across Time Series), does not mention approaches 1, 2 or hybrid, but provides yet another way of allocations using either USGS data for one period and GHGRP data for the other period. It is not clear how the disaggregation methods included in Table 3-1 map to the disaggregation approaches described in section 1.2. Similar issues can be found in other sections of the Mineral Industries category, Metal production, Chemicals, and Product Use.

4. The method of emissions estimates is not transparently described. For example, for Nitric acid production, where just a reference to GHGRP is provided, while the method is quite sophisticated – a hybrid T2/3 approach. However, there is not such hybrid method in the 2006 IPCC Guidelines, the methodology description is provided for T2 and T3, but not the hybrid. Therefore, the inventory should include a detailed description of how specifically T2 and T3 methodologies have been combined as well as the reference to the relevant paper, especially in the first inventory release.
5. For some categories (e.g., Adipic Acid production), some states used T2 and some – T3 calculations. It would be good to see which states used which methods. A similar situation occurred for Titanium dioxide production, where some states used chloride process and some (before 2004) – sulfate process, or both. It would be good to see a table in the relevant section which methods were used by which state.
6. In the tables accompanying the inventory for the Chemicals industry (appendix D), 2010-2019 GHGRP CO<sub>2</sub> emissions are presented as CO<sub>2</sub>e, which does not seem relevant or transparent as (a) CO<sub>2</sub> is not emitted from the Nitric Acid production (it should be N<sub>2</sub>O) and the GWP value for CO<sub>2</sub> is 1, so for CO<sub>2</sub> emissions, the values in kt CO<sub>2</sub> and kt CO<sub>2</sub>e are exactly the same.
  - 
  - B. Transparency issues associated with selection and use of Proxy data
    1. The chapter is using different proxy data for disaggregating national emissions by state, but always transparently describes which particular type of proxy data have been used. For example, it is not clear which proxy data were used to disaggregate clinker production.
    2. The IPPU chapter does not justify the choice of the proxy data, so it is not clear, for example, why number of facilities is used to disaggregate the data for lime production at the state level, but the data for soda ash use are disaggregated on a basis of population, and why the industry GDP by state has not even been considered for such disaggregation, although the relevant figures are available from <https://www.statista.com/statistics/248023/us-gross-domestic-product-gdp-by-state/>, or <https://fred.stlouisfed.org/release?rid=140> and
      - <https://apps.bea.gov/itable/index.cfm>. For example, it is doubtful that population trend would provide a good proxy for the enhancement of oil recovery (EOR) by state.
  - C. Data sources, references, and units
    1. Some data sources for the states' IPPU inventory are not clear. For example, section 2.1.1 (Cement production) has only two references – to the 2006 IPCC Guidelines and to the USA's

National GHG Inventory, which is not sufficient for coverage of the data and information presented in the section. The section uses the USGS and GHGRP data, but the corresponding references are missing.

2. Section 2.1.2.2 contains incorrect section reference (line 136) – there is no section 3.1.4 in the chapter, the correct references should be 2.1.4. All tables in the chapter have numbers starting with 3, which is confusing as this does not follow the logic of the section numbering.
3. The document does not work as a stand-alone entity. Practically, for every category it should be read in conjunction with the *National Inventory*. Considering the statements in the introduction that some states may use methodologies that differ from the national methodology, the activity data could have been collected at a different level of aggregation, the approaches to data disaggregation differ for different categories within the same sector, it makes it very difficult for a reader to identify which specific methods were used for each state and each category and how the sectoral total have been calculated. This require detailed explanation, which is not included in the report.
4. The 2006 IPCC Guidelines use SI units (International System of Units). In this system, mega tonnes should be abbreviated as Mt, not MMT.

▪

D. Comparative analysis of emission trends at state level

1. The chapter does not provide comparative analysis of emissions or activity data by state, which would have been an excellent insight for the state inventory and one of its biggest achievements. Apart from increasing the transparency of the inventory, it would increase the usability of the state inventory for setting mitigation targets, monitoring progress in emissions reductions state-wide, and informing policy decisions.

## **2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?**

1. Whenever possible, disaggregate lime production from limestone and dolomite. Because of different chemical composition of the feedstock, the relevant emission factor based on stoichiometry of the calcinating and molar mass of the feedstock, the emission factor for CO<sub>2</sub> resulting from calcinating the two different types of feedstocks are different by approximately 8%. That is why an incorrect assumption regarding the feedstock composition could lead to under- or overestimates of CO<sub>2</sub> emissions from the category depending on the actual proportion of dolomite use.
2. In many categories in the IPPU sector, the state allocation has been made on a basis of number of facilities as a proxy parameter. This could lead to inaccuracy of state emissions estimates because the facilities could have very different production capacities and therefore, produce the amount of emissions that would be significantly different from the amounts currently presented in the IPPU inventory. Taking into account potential confidentiality issues, the capacity by state could be averaged or the overall capacity could be used. Alternatively, the total amount of the product produced by a state could also be used. A similar situation could occur when population is used as a proxy for the state level disaggregation. Perhaps, consider using the GDP per industry per state instead, if possible.
3. It is likely that there is an accuracy issue in the Urea consumption for non-agricultural purposes category as the method of state allocation is population based without appropriate justification. Perhaps, consider the GDP by industry data as a proxy instead as urea consumption may not be

correlated with the population numbers. At a minimum, perform a correlation analysis and factor analysis to identify the sensitivity of urea consumption to population and other potential candidates for proxy parameters.

4. Please include a more detailed description of methodology for emission estimates (e.g., for Nitric acid production). It is not clear from the text of the chapter which facilities (or all in all states?) have applied abatement technologies and therefore, whether destruction factor abatement technology has been used and taken into account when estimating emissions and this, in turn would affect the accuracy of the estimates (it should be in Tier 2). If the abatement technologies are not applied in all facilities, then a relevant assumption should be made and the calculation adjusted accordingly to avoid overestimating N<sub>2</sub>O emissions.

**3. Data availability. Please address the following questions for each inventory source:**

- a. **For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b. **For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

- a) Please refer to the Transparency section, comment B2.
- b) I am not aware of any additional available data sets apart from those referred to in the US National GHG Inventory (1990-2019).

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Uncertainty

Please refer to the templates for uncertainty inclusions and the required values in the 2006 IPCC Guidelines:

[https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1\\_Volume1/V1\\_3\\_Ch3\\_Uncertainties.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_3_Ch3_Uncertainties.pdf)

Chapter 3 of the General volume (v.1) provides the list of the required parameters and the guidance for uncertainty calculations. There are two basic methods for uncertainty calculations – propagation of error and Monte-Carlo method.

Many developed countries are using propagation method for the IPPU sector categories, where uncertainty in emissions can be propagated from uncertainties in activity data and emission factors. So, these two parameters (uncertainty of emission factors and activity data) are the key values required for the uncertainty estimates.

Uncertainties should be estimated in level and in trend.

For level estimates it is sufficient to have uncertainties for activity data and emission factors for each category.

For the uncertainty in trend, some additional parameters are required (please refer to page 3.29 in chapter 3 of the 2006 IPCC Guidelines for further details).

Please note that 2006 IPCC Guidelines provide a table for calculating and presenting uncertainties (table 3.2, p. 3.31) that all inventories should follow. I would recommend using this table for the states' inventory.

Timeseries consistency.

Indeed, there are consistency issues in the inventory that resulted from the lack of data for certain years. Perhaps, consider splicing techniques described in the 2006 IPCC Guidelines to fill the gaps in the time series or where different calculation methods have been applied in different time periods ([https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1\\_Volume1/V1\\_5\\_Ch5\\_Timeseries.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_5_Ch5_Timeseries.pdf), section 5.3).

Regarding the years of the inventory, the years that would be good to reflect include the base year (for the *National Inventory* it's 1990), then every 5 years (1995, 2000, 2005, 2010, 2015), then the last two years of the inventory (e.g., for 1990-2019 inventory the last two years would be 2018 and 2019).

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

According to the 2006 IPCC Guidelines, it is good practice to prioritize the categories that are key categories according to either level or trend analysis. It is also a good practice to identify categories that may be key according to their importance for the country/state even if they are not present the top 95% of the national (or state) totals, which is a qualitative approach.

To identify such category, it's best to follow the method for key category analysis described in Ch. 4 of the 2006 IPCC Guidelines

[https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1\\_Volume1/V1\\_4\\_Ch4\\_MethodChoice.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_4_Ch4_MethodChoice.pdf)

It is possible to start with the key category list at the national level, but this may not be applicable to some states as they do not equally contribute to the national emissions by category. For example, for a state that does have petrochemical production, this category cannot be a key category even if it is at the national level. To the contrary, for some states where chemical industry is very strong, but other industries are less so, some subcategories of the chemical industries category could also be key even if they are not at the national level or in other states.

When performing key category analysis for different states, please use table 4.2 for level assessment and table 4.3 for the trend assessment. If it is not possible to run a proper key category analysis as described in the 2006 IPCC Guidelines, a level of industrial output for each industry for each state for the past 2-3 years and the base year (or close to the base year) would provide a good starting point.

When performing a key category analysis, do take into account the dynamics in each industry, especially to the industries that demonstrate a fast or steady growth over the past 5 – 10 years. These categories could be identified as key on a qualitative basis even if the level of production output from those categories is not very high. For example, Urea Consumption for Non-Agricultural Purposes category, that demonstrates a steady increase in emissions according to the *National Inventory* could be one such candidate.

**6. Data Presentation and Usability.**

- a. **Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?**
  - i. **Related to the level of category/gas aggregation or disaggregation?**
  - ii. **Are there specific categories where further data disaggregation could be helpful?**
  - iii. **What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**
- b. **What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

It would be good to adapt a tool like the inventory data explorer would be an excellent presentation of the state emissions data and their emission portfolios. Perhaps, you could extend the existing tool by adding “state” identifier to enable analysis and comparisons by state.

Disaggregation by sector and category (and industry or application within the category) would be desirable. Emissions from each category/sector should be presented by both mass of gas (ideally, Gg or Mt of gas) AND by gas mass as CO<sub>2</sub> equivalent.

In such categories, where different (conceptually) methods could be applied to emissions estimates due to different industrial processes, it would be good to disaggregate by the process (like for TiO<sub>2</sub> or Soda Ash production, for instance). For Other product Use category (Fluorinated gases), it would be good to disaggregate by application and, if possible, by sub-application for better transparency. For Nitric Acid production, it would be good to show abatement figures as they could demonstrate progress in N<sub>2</sub>O emissions mitigation.

The best data formats to facilitate the use of data by a wider audience would be excel-compatible formats (like csv, xlsx) with enabled file download.

In addition, it would be useful to have a table in the inventory presenting for state-specific data. For example:

- the methodological approach by state by state (T1 – 3)
- % Contribution to the total national emissions by state by industry
- Graphics and tables representing trends by state and comparisons between states in their contributions to the national totals (at least for the base year, 2018 and 2019)

**RESPONSE TO MINERALS CHARGE QUESTIONS**

### Cement Production

**1. Are you aware of data on state-level clinker production for the full 1990-2019 time series? If not, is there any surrogate data that could be used (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019).

Production capacity data or overall cement production figure by state could be used as a proxy for this category. For disaggregation by state, perhaps, industry GDP by state would be a better proxy than population. These data are available from <https://fred.stlouisfed.org/release?rid=140&t=industry&ob=pv&od=desc> (timeseries for each state is presented), or <https://www.statista.com/statistics/248023/us-gross-domestic-product-gdp-by-state/>,

### Lime Production

**1. Are you aware of state-level data on lime production (activity data) by type (e.g., high-calcium quicklime; dolomitic quicklime, high-calcium, hydrated; dolomitic, hydrated; dead-burned dolomite; CO<sub>2</sub> captured for use in onsite processes) for some or all of the 1990–2019 time series? If not, is there any surrogate data (e.g., facility production capacity, utilization rates by facility or state) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019).

Industrial outputs could be used as a proxy for this category.

**2. Based on analysis of Greenhouse Gas Reporting Program data, it appears that most facilities that manufacture beet sugar and lime, as well as a few lime manufacturing facilities capture CO<sub>2</sub> for use in onsite processes. Are you aware of any information why lime producing facilities capture CO<sub>2</sub> for use in onsite processes, any trends in this practice during the 1990–2019 time series (e.g., have facilities increased or decreased adoption of this practice during the time series), or whether the amount of CO<sub>2</sub> captured is proportional to the amount of lime produced or some other metric? Are you aware of any data on the amount of CO<sub>2</sub> captured onsite per facility or state for 1990–2009?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019).

**3. For some states and years (Colorado for 2010–2015, Idaho for 2011 and 2019, and Nebraska for 2010–2014), calculations using GHGRP data on emissions and CO<sub>2</sub> captured for onsite processes yielded small but erroneous negative emissions. EPA zeroed emissions for those states and years and plans to adjust calculations so that state emissions totals match national emissions. Do you have any general feedback on this approach?**

Any methodology taking into account CO<sub>2</sub> capture should consider that CO<sub>2</sub> emissions captured in the process may be both combustion and process-related. In case of Cement production, combustion and process emissions are to be reported separately and not double-counted. If the resulting calculations give negative values for emissions, it might indicate that the emissions associated with combustion and the process are not completely separated and some of the captured emissions are from combustion. That is why the total captured CO<sub>2</sub> (if it's captured CO<sub>2</sub> from the process + CO<sub>2</sub> captured from combustion) might exceed the CO<sub>2</sub> from the process and the total emissions from the category would become negative. If this was the case, I would recommend investigating on a case-by-case basis what the reason for the overestimating the captured CO<sub>2</sub> might be and resolve the underlying issue rather than zeroing emissions. By zeroing emissions, one might be running a risk to underestimate emissions from the actual process.

### Glass Production

**1. Are you aware of state-level data on glass production or the amount of carbonate (i.e., limestone, dolomite, soda ash) consumed for glass production by state (activity data) for some or all of the 1990–2019 time series? If not, can you share any state-level surrogate data (e.g., more complete data on glass facilities by state, amount of glass products by type [i.e., containers, flat (window) glass, fiber glass, and specialty glass]) for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

As a proxy, perhaps, use the total glass production figures at the national level with pro-rata on a basis of the historical data on industry GDP by state available from <https://fred.stlouisfed.org/release?rid=140&t=industry&ob=pv&od=desc>, and extrapolate for the remaining years.

### Other Process Uses of Carbonates

**1. Are you aware of state-level data on the consumption of limestone and dolomite for the iron and steel sector for the 1990–2019 time series? If not, can you share any state-level surrogate data for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends from carbonate consumption by the iron and steel sector?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

It might be possible to use historical figures of the relevant metal production as a proxy. Although, if you are considering this, it's a good idea first to do the correlation analysis and data sensitivity analysis before using it as a proxy.

**2. Are you aware of state-level data on the consumption of soda ash (not associated with glass manufacturing) for the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**3. Are you aware of any state-level data on limestone and dolomite consumption for flux stone, flue gas desulfurization systems, chemical stone, mine dusting or acid water treatment, acid neutralization, and sugar refining activities for the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**CO<sub>2</sub> Consumption**

**1. Are you aware of other data on the consumption of CO<sub>2</sub> by state for the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Dr. Olia Glade

**AFFILIATION:** GHGMI

**DATE:** 15 October 2021

**RESPONSE TO CHEMICAL CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Ammonia Production**

**1. Currently, production capacity is used as a surrogate for state-level ammonia production for 1990–2009. In the absence of ammonia production by state in more recent years, are you aware of other surrogate data (e.g., facility utilization rates by state) that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Urea Consumption for Nonagricultural Purposes**

**1. Are you aware of state-level data on urea consumption for nonagricultural purposes (activity data) for some or all of the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Nitric Acid Production**

**1. Are you aware of state-level data on nitric acid production (activity data) for some or all of the 1990–2009 time series? We currently use production capacity as a surrogate for nitric acid production by state for 1990–2009. We know that the production capacity data used for this state inventory calculation are incomplete for 1990–2009. Are you aware of more complete data on facility production capacity by state?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

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*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**2. Are you aware of state-level data other than facility production capacity (e.g., utilization rates by facility or state, information about abatement technology installations and use per facility) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Adipic Acid Production**

**1. Are you aware of any other state-level data on adipic acid production (activity or emissions data) for some or all of the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Caprolactam, Glyoxal, and Glyoxylic Acid Production**

**1. Are you aware of state-level data on caprolactam production or emissions for some or all of the 1990–2009 time series? We currently use production capacity as a surrogate for caprolactam production by state. Are you aware of more complete data on facility production capacity or actual production by state? Are you aware of better surrogate data other than facility production capacity (e.g., utilization rates by facility or state, information about abatement technology installations and use per facility) that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Carbide Production and Consumption**

**1. Are you aware of state-level data on SiC production (activity data) for the 1990–2019 time series? Are you aware of other data to refine accuracy of the estimation of SiC consumption by state for the 1990–2019 time series?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**2. Are you aware of information that can help us improve the accuracy of production in the two states where SiC facilities are located?**

The inventory does not provide sufficient information to understand what specific data are available (or may be available) at those two facilities. Based on the provided information, it is not possible to assess whether any additional data could be obtained from either of those facilities. There are different production methods of SiC, the inventory does not specify which one is used in those two facilities.

In general, to improve accuracy and apply T2 method, the amount of carbon contained in the product would be another parameter that would help to improve the accuracy.

Population data as a proxy for state disaggregation does not seem to be reasonable for this category. An industry GDP by state might be a more reliable parameter.

**Titanium Dioxide (TiO<sub>2</sub>) Production**

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**1. Are you aware of data on TiO<sub>2</sub> production (activity data) by state for the 1990–2009 time series? Please share any other surrogate data than facility production capacity or more data by state (e.g., facility utilization rates by facility or state) for 1990–2009 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends.**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Petrochemical Production**

**1. Are you aware of data on petrochemical production by type by state for the 1990–2019 time series? Is there any other surrogate data by state or facility (e.g., facility production capacity; utilization rates by facility or state; timing of facility expansions, openings, and temporary or permanent closures) for the full 1990–2019 time series that could address data gaps and refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**Phosphoric Acid Production**

**1. Are you aware of state-level data on phosphoric acid production (activity data) for the 1990–2009 time series? Is there any other surrogate data or information (e.g., timing of facility expansions and temporary or permanent closures, origin of phosphate rock used in facilities) by state or facility for 1990–2019 that could refine this state inventory calculation to enhance accuracy and consistency of state GHG emissions and trends?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**HCFC-22 Production**

**1. For the years 1990–2009, there are significant uncertainties in the allocation of national-level U.S. emissions to individual facilities and states, particularly for the five HCFC-22 production facilities that closed before 2003 and for which production capacity data are therefore not available. Are you aware of any more complete sources of production capacity or other relevant historical data?**

I am not aware of the relevant data sets outside those referred to in the United States *National Inventory* (1990-2019) and do not have an access to any relevant data sources.

**2. Do you have recommendations for how to refine the methodology to more accurately estimate emissions from HCFC-22 production over the time series?**

The suggested action in the planned improvement section is the one I would recommend to follow: working with the industry representatives at each facility and obtaining the actual data from the facilities.

### 3.6 Dr. Kevin Gurney (Energy)

At the time of this publishing, comments are still pending from Dr. Gurney.

### 3.7 Dr. Hoyoung Kwon (Agriculture)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Hoyoung Kwon
<b>AFFILIATION:</b> Principal Environmental Scientist Systems Assessment Center Energy Systems Division Argonne National Laboratory, Lemont IL
<b>DATE:</b> 10/15/2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
1. What are your overall impressions of the clarity and transparency of this section?
<p>This state-level report describes detailed methods and approaches to estimate state-level GHG inventory.</p> <p>The contents of the report might be useful as complementary information to the <i>National Inventory</i>, but some parts of the report do not provide any additional information. For example, the methods/approach of each section mostly includes the sentence “using the same methods used in the <i>National Inventory</i>”. As a result, readers won’t be able to get details unless they look at the main report and annex. Instead of repeating this sentence on each section, it would be better to be added into the introduction.</p> <p>Similarly, the sub-section planned improvements does not have a whole lot of new information either. Thus, I would recommend including more state-specific information related to each GHG category in the section if any.</p>
2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?
<p>The pages 1-1 and -2 explain about different accounting decisions made by the EPA and individual state governments and indicates the EPA plan to provide user data links to check official data of any state government. It would be great if the EPA provides a specific timeline of this plan.</p>
3. <u>Data availability.</u> Please address the following questions for each inventory source:
<ol style="list-style-type: none"> <li>a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?</li> <li>b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?</li> </ol>

## PEER REVIEW COMMENT TEMPLATE

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

Rice cultivation – the phase II & III of the USDA’s the Agricultural Resource Management Survey (ARMS) will be conducted starting this fall (<https://www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices/documentation/>). The data from the surveys might have information useful for the EPA state-level inventory estimates.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

From the perspective of USDA’s agriculture innovation agenda, 2010 and later would be a good choice since it adopts a base year of either 2017 for an increase in “total factor productivity and real gross output” by 40 percent to 2050 or 2010 for a reduction in “food loss and waste reduction” by 50 percent to 2030.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

Direct N<sub>2</sub>O emissions estimated using the process-based model (i.e., DayCent) can be further refined with improvements listed in Section 5.4 of the *National Inventory*:

“Several planned improvements are underway associated with improving the DayCent biogeochemical model. These improvements include a better representation of plant phenology, particularly senescence events following grain filling in crops. In addition, crop parameters associated with temperature and water stress effects on plant production will be further improved in DayCent with additional model calibration.”

Interestingly, the key developers of DayCent have published a new article (<https://bg.copernicus.org/articles/18/3147/2021/bg-18-3147-2021.html>) regarding their development of a new model. Some of the new features in the model can be employed in the modeling of state- or national-level GHG inventory.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

The EPA GHG Inventory Data Explorer is a good platform to facilitate data use. The state-level inventory data can be added to the current Explorer.

First, please make users able to select different geographic levels such as national or state. If the state option is selected, make options for users to select multiple states. This is because users might be interested in making the comparison of GHG inventory among states. The suggested approach is similar to what USDA NASS QuickStats currently adopts (<https://quickstats.nass.usda.gov/>).

Second, along with CO<sub>2</sub>e, make users select options for individual GHG (N<sub>2</sub>O or CH<sub>4</sub>). This is because the EPA uses AR4 GWP to calculate CO<sub>2</sub>e while a user might want to use AR5 GWP. If this introduces too much complexity, please clearly indicate that the EPA's CO<sub>2</sub>e is based on AR4 GWP.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Hoyoung Kwon

**AFFILIATION:**

Principal Environmental Scientist  
Systems Assessment Center  
Energy Systems Division  
Argonne National Laboratory, Lemont IL

**DATE:** 10/15/2021

**RESPONSE TO LIVESTOCK CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**Enteric Fermentation**

**1. Are there other/newer data sources or methods, particularly at the state level, that EPA should be aware of and consider in calculating these emissions? Especially for:**

- **Dry matter/gross energy intake;**
- **Annual data for the digestible energy (DE) values (expressed as the percent of gross energy intake digested by the animal), CH<sub>4</sub> conversion rates (Y<sub>m</sub>) (expressed as the fraction of gross energy converted to CH<sub>4</sub>), and crude protein values of specific diet and feed components for foraging and feedlot animals;**
- **Monthly beef births and beef cow lactation rates;**
- **Weights and weight gains for beef and dairy cattle.**

I expect this type of data would be available from the USDA- Animal and Plant Health Inspection Service (APHIS), which has been a data source for the *National Inventory* for a while. Currently, the Beef 2017 report is the latest report available for public use on the website.

Unfortunately, I am not aware of the availability of the state-level data above-listed. USDA might have some of the data but not make them publicly available. Thus, I would recommend the EPA communicating with the USDA.

**2. Are state-specific diet data available to EPA to enhance characterization of diet differences across livestock types and U.S. states?**

I am not sure if such state-specific diet data is publicly available.

**3. For the enteric fermentation source category and the Cattle Enteric Fermentation Model (CEFM), are the various regional designations of U.S. States (as presented in Annex 3.10 of the GHG *Inventory*) used for characterizing the diets of foraging cattle appropriate? The CEFM is used to estimate cattle CH<sub>4</sub> emissions from enteric fermentation and incorporates information on livestock population, feeding practices, and production characteristics.**

According to Beef Cow-calf Health and Management Practices in the United States (2017), Texas is classified as the West region. In the meantime, the current inventory report classifies it as the Southeast region. Unless there is a strong justification on the EPA’s decision on this, I would recommend following the same regional classification as the APHIS provides.

**Manure Management**

**1. Are there other/newer data sources, particularly at the state-level, that EPA should be aware of and consider in calculating these emissions? Especially for the following:**

- **waste management system data, particularly seasonal changes in emissions from different waste management systems;**
- **maximum methane-producing capacity;**
- **volatile solids and nitrogen excretion rates; and**
- **measured emission estimates (by waste management system) to help refine estimates of methane conversion factors.**

Unfortunately, I am not aware of the availability of the state-level data above-listed.

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Hoyoung Kwon
<b>AFFILIATION:</b> Principal Environmental Scientist Systems Assessment Center Energy Systems Division Argonne National Laboratory, Lemont IL
<b>DATE:</b> 10/15/2021
<b>RESPONSE TO AGRICULTURAL SOIL MANAGEMENT CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
The report has useful information but has the repetitive contents as the <i>National Inventory</i> report has.
<b>2. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the <i>National Inventory</i>?</b>
The 2019 refinement to the 2006 IPCC includes indirect N <sub>2</sub> O emissions factors that are disaggregated by climatic zone. Using such might improve the state-level estimates of indirect N <sub>2</sub> O emissions as well as the national level estimates.

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Hoyoung Kwon
<b>AFFILIATION:</b> Principal Environmental Scientist Systems Assessment Center Energy Systems Division Argonne National Laboratory, Lemont IL
<b>DATE:</b> 10/15/2021
<b>RESPONSE TO OTHER CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>Rice Cultivation</b>
<b>1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the <i>National Inventory</i>? (Cf. General Chapter Charge Questions 1-5)</b>
The 2.2.1.2 indicates that the 2016 through 2019 state-level estimates are under development and will be shared in the coming weeks. If the updated state-level data is available now, please aggregate it to the national level and compare it with the current estimate based on a surrogate data method. This comparison would show the advantages/disadvantage of using the surrogate method when data is unavailable.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**Liming**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the *National Inventory*? (Cf. General Chapter Charge Questions 1-5)**

It would be better to elaborate on how many and which states have activity data of liming. Furthermore, the EPA can evaluate if the amount of liming to each state is aligned with the state's agricultural production. In this way, the EPA can ensure the quality of liming data derived from NRI data.

Also provide more details on the development of the 2019 state-level estimates, instead of indicating "are under development and will be shared in coming weeks".

**Urea Fertilization**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the *National Inventory*? (Cf. General Chapter Charge Questions 1-5)**

Compiling fertilizer sales data for 2016 through 2019 fertilizer years would be critical to improving state-level estimates. It would be good for the EPA to clarify its plan to update such data in the future.

The consideration of Urea Ammonium Nitrate (UAN) in estimating Urea CO2 emissions as suggested in the planned improvement of *National Inventory* would provide a better estimate of urea-associated CO2 emissions.

**Field Burning of Agricultural Residues**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the *National Inventory*? (Cf. General Chapter Charge Questions 1-5)**

The parameters for estimating these emissions rely on the IPCC 2006 estimates. It might be worth checking if they have been updated in the 2019 refinement to the 2006 IPCC.

### 3.8 Dr. April Leytem (Agriculture and LULUCF)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME: April Leytem</b>
<b>AFFILIATION:</b> <b>USDA-ARS</b> <b>Kimberly, ID</b>
<b>DATE:</b> 10/07/2021
<b>RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
<p>I feel that most sections are fairly clear and the methods are transparent. Related to my question below regarding the GE table A. 157, please make sure that the units for all data presented in tables and all equations are clearly defined. Another example for the enteric methane equation that includes GE and Ym, is the Ym divided by 100? I would think so but then my numbers were off even farther.</p> <p>For example, I was trying to calculate the CH<sub>4</sub> for beef cows NOF:</p> $\text{DayEmit} = (\text{GE} \times \text{Ym}) / 55.65$ <p>DayEmit = Emission factor (kg CH<sub>4</sub>/head/day)                      GE = Gross energy intake (MJ/head/day)                      Ym = CH<sub>4</sub> conversion rate, which is the fraction of GE in feed converted to CH<sub>4</sub> (%)                      55.65 = A factor for the energy content of methane (MJ/kg CH<sub>4</sub>)</p> <p>GE = 43,008 MJ (for ID) I am assuming that is for all Beef cows NOF so I divided by 508,000 (Table A-139) and then by 365 to get 0.000231 MJ/head/day.</p> <p>Ym = 6.5%</p> $(0.000231 \text{ MJ/head/day} \times 0.065) / 55.65 = 0.0000002698 \text{ kg CH}_4/\text{head/d}$ <p>If I multiply by 365 days that is 0.0000984 kg/head/year</p> <p>The annual emission factor is 95 kg CH<sub>4</sub>/head/yr in Table A-158 or 100 kg CH<sub>4</sub>/head/year Table A-159.</p> <p>Is the CEFM model publicly available?</p>
<b>2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?</b>

## PEER REVIEW COMMENT TEMPLATE

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

In the manure management section, for waste management system usage data the following statement was made:

“Based on EPA site visits and the expert opinion of state contacts, manure from dairy cows at medium (200 through 700 head) and large (greater than 700 head) operations are managed using either flush systems or scrape/slurry systems.”

This appears to be for the years 1990-1996 so not current calculations but would affect your trendline.

If I understand this correctly dairies with greater than 200 cows were assumed to have flush or scrape/slurry systems, is that correct? This would not necessarily be representative of farms in the Western US (ID, NM, TX, CA). A farm with less than 1,000 cows is small and they typically handle manure as a solid as cows are often housed in dry lots. However, even large dairies, 10,000 cows also house animals in dry lots. In some cases, the manure that is collected on the apron behind the feed lanes is flushed, vacuumed or scraped and may or may not end up in a liquid storage system (anaerobic lagoon system). However, the cows do not spend 100% of their time in that area so a large fraction of manure is handled as a solid even when they flush/vacuum/scrape the alley. When manure is intensively handled it usually goes through a solid separator so only part of the manure solids goes to the liquid storage while the rest is either dried and used for bedding or composted and land applied. My other question/comment is whether or not you are assuming the manure from replacement animals is being handled the same way. In ID there are as many replacement animals as there are lactating animals and the vast majority of that manure is handled as a solid. These assumptions will have large effects on the estimated CH<sub>4</sub> production from manure.

You may not be too worried about the numbers from that far back, but it does affect your overall trendlines from then to now.

For the more current data Table A-171, it still seems like the manure stored as a solid is too low for some western states. I thought when I looked at that dataset that I came up with 70% stored as a solid for ID, which is realistic, but that was assuming any exported manure was a solid.

**3. Data availability. Please address the following questions for each inventory source:**

- c. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- d. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

## PEER REVIEW COMMENT TEMPLATE

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

I am not aware of any.

**4. Uncertainty.** Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. **Timeseries Coverage.** Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the national *Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).

Good questions, not sure I have much of a recommendation here. I think it depends on your overall goal.

**5. Key Categories.** EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.

### **6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

I like the spreadsheets that you made for the states. I think those would be useful. To me the more disaggregation the better so that you can hone in on specific values for different livestock classes and gases. I have had a hard time using some of the explorer tools on-line to find what I want. I hope the entire report with all these tables and the individual state tables will be easily accessible. For me it is much easier to find what I want/need that way.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** April Leytem

**AFFILIATION:**

USDA-ARS, Kimberly, ID

**DATE:** 10/07/2021

**RESPONSE TO LIVESTOCK CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Enteric Fermentation**

**1. Are there other/newer data sources or methods, particularly at the state level, that EPA should be aware of and consider in calculating these emissions? Especially for:**

- **Dry matter/gross energy intake;**
- **Annual data for the digestible energy (DE) values (expressed as the percent of gross energy intake digested by the animal), CH<sub>4</sub> conversion rates (Y<sub>m</sub>) (expressed as the fraction of gross energy converted to CH<sub>4</sub>), and crude protein values of specific diet and feed components for foraging and feedlot animals;**
- **Monthly beef births and beef cow lactation rates;**
- **Weights and weight gains for beef and dairy cattle.**

I do not know of any. I do think that we need better data for rangeland in the Great Basin and surrounding areas where cattle are grazing BLM land. Having seasonal values for CP, and DE would be valuable.

**2. Are state-specific diet data available to EPA to enhance characterization of diet differences across livestock types and U.S. states?**

Not that I am aware of.

**3. For the enteric fermentation source category and the Cattle Enteric Fermentation Model (CEFM), are the various regional designations of U.S. states (as presented in Annex 3.10 of the GHG *Inventory*) used for characterizing the diets of foraging cattle appropriate? The CEFM is used to estimate cattle CH<sub>4</sub> emissions from enteric fermentation and incorporates information on livestock population, feeding practices, and production characteristics.**

Based on Table A-150, I think to a degree the regional designations of the states are appropriate. However, for the west, I think doing the designations by state and having state values may not be the best approach. For example, in the west, the DE was calculated as the seasonal average of grass pasture, meadow, and range diets. However, the quality of rangeland forage is likely less than pasture and meadow and changes over the season (better in spring worse in fall). Is there a way to separate out range forage or have regional values instead of state values? I would think this would be most important for ID, western OR and maybe NV. Also, in these areas there is not necessarily supplementation of the diet with other feed, other than mineral blocks. BLM might have an idea of how many cattle are produced on these rangelands and whether or not they receive supplemental feed. Maybe the number of cattle grazing days is not large enough to warrant separating them out, but given the large number of cattle that graze BLM land in ID I would think it would be worth investigating.

## PEER REVIEW COMMENT TEMPLATE

### *Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

I was also wondering about Table A-157: Calculated Annual GE by Animal Type and State. Is this the total GE intake by all cattle each year by state and class? It is megajoules per year? Might want to clarify this. Also, in the text you say these values are for 2015 but in the table title it says 2017. When I try to use the GE values in that table with the equation  $\text{DayEmit} = (\text{GE} \times \text{Ym})/55.65$  I can't get a number that comes close to what you have in Table A-158. I must have a unit issue somewhere but haven't figured out where yet.

### **Manure Management**

**1. Are there other/newer data sources, particularly at the state-level, that EPA should be aware of and consider in calculating these emissions? Especially for the following:**

- **waste management system data, particularly seasonal changes in emissions from different waste management systems;**
- **maximum methane-producing capacity;**
- **volatile solids and nitrogen excretion rates; and**
- **measured emission estimates (by waste management system) to help refine estimates of methane conversion factors.**

We have published some GHG emissions work from dairy lagoons in ID and one limited study in CA that does include seasonal changes in emissions. I think that I have already provided those publications/data to EPA but if not I am happy to share.

We are starting a new study to evaluate the maximum methane producing capacity of manure from dairy cattle in Idaho/Utah and have some preliminary results. Ultimately, we will analyze ~100 samples from three animal classes (lactating, dry, heifer), at two times of the year (winter, summer) with different base diets (silage, alfalfa, grass [this can only be evaluated during grazing season so not winter]). Winter sampling will be done Dec 21/Jan 22 and summer July 22/Aug22. Data will hopefully be published by the end of 2022. Happy to share results as we get them.

The newest N excretion rates that are included in the 2019 IPCC refinement and the newest updates to the USDA GHG Methodology Guidelines which will hopefully be available next spring/summer are the best equations to use for estimating N excretion. These can be combined with the diet information you have for the different regions.

### 3.9 Dr. Jerry Marks (IPPU)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Jerry Marks
Consultant, 312 NE Brockton Dr Lees Summit, MO 64064
<b>DATE:</b> 10/15/2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
The basis for the data presented here is well documented and provides users with what they would need.
<b>2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?</b>
While the document makes reference to IPCC methods it may still be useful to include a table of GWP values for each greenhouse gas that was used to convert to CO <sub>2</sub> equivalents.
<b>3. <u>Data availability.</u> Please address the following questions for each inventory source:</b>
<b>a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?</b>
<b>b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?</b>
As detailed below the International Aluminium Institute, London, has data that would be very useful in allocating emissions across states. I don't know if the historical data could be made available at the state level.
I also note that the aluminum industry has no emissions reported for Missouri. I am aware that Noranda operated a smelter near New Madrid, MO for many years. It was shut down at some point but then restarted in the last several years. I made PFC measurements there in 2004 and again last year.
<b>4. <u>Uncertainty.</u> Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the <i>National Inventory</i>. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).</b>

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

For the primary Aluminum industry, the PFC issue became a major focus of effort in the early 1990s. The first attempt by the International Aluminium Institute (IAI) to put together a global PFC emissions inventory was done in 1993 for the base year 1990. The anode effect data at that time was incomplete, however production data by facility was available. The next survey was made in 1995, and then updated annually after that. The uncertainty in emissions for the base year 1990 is higher than subsequent years, 1995 and onward. Nevertheless the 1990 IAI facility level inventory data is the most accurate data available. A comparison of the data in that compilation for 1990 – and for future years would give a measure of uncertainty.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

No input here.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventorvexplorer/>)?
  - iv. Related to the level of category/gas aggregation or disaggregation?
  - v. Are there specific categories where further data disaggregation could be helpful?
  - vi. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

The “Data Explorer” web reference is really exquisite. I assume a similar “explorer” could be constructed for the state level data. The data should also be available in excel spreadsheet form for further analysis by users.

I know that the GWP values used to translate emissions into CO2 equivalents are referenced but I think a table of the values used for the numbers in the “trends” spreadsheet would be useful to have in the workbook with the CO2 equivalents data.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Jerry Marks

Consultant,  
 312 NE Brockton Dr  
 Lees Summit, MO 64064

**DATE:** 10/15/2021

**RESPONSE TO METALS CHARGE QUESTIONS**

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Please provide narrative responses to each of the Charge Questions below.

**Aluminum Production**

**1. Are you aware of data available to incorporate differences in emissions between smelters based on technology type? Is there any other surrogate data or emission sources that could be used to allocate national total aluminum production emissions across states?**

There is data available at the International Aluminum Institute, London, that could provide detailed primary aluminum production data, technology types and anode effect performance data for individual global facilities, including operators in the United States. While current or recent data is considered proprietary by operators, historical data from two decades ago may no longer need to be protected for US operators. Release of this data would provide a much better basis for allocating PFC emissions among US states for 1990 and 2005. For years following 2010 the EPA GHGRP reporting system should be adequate for allocating emissions by state.

Also, as noted previously, the trends spreadsheet is missing data for the state of Missouri where Noranda operated a smelter for many years and where Magnitude 7 Metals has now restarted the facility.

### 3.10 Dr. Gregg Marland (Energy)

PEER REVIEW COMMENT TEMPLATE
<i>Inventory of US Emissions and Sinks by State: Methods Support Document</i>
<b>NAME:</b> Gregg Marland
<b>AFFILIATION:</b> Appalachian State University
<b>DATE:</b> 10/14/2021
<b>RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity of this section?</b>
<p>My comments are based on the Energy Chapter, combustion section.</p> <p>I have to say that I found part of this chapter to be very confusing and unclear – notably the step 2 section of 2.1.1.2. In the end it is not clear how and why the energy chapter includes any NEU (non-energy uses). I am not clear what aspects of NEU remain in the energy chapter and the string of “adjustments” seems like something that could be clarified – perhaps with nice, simple equations or flow diagrams.</p> <p>I also found it disconcerting to have sentences such as in line 63 - “there could be a difference in heating values used” Uh, could be? That should be an answerable question – yes or no – even if it took a phone call to EIA. It sounds like we are reading someone’s early methodology notes.</p>
<b>2. What recommendations do you have to add to or improve the overall transparency, completeness, consistency and accuracy of this chapter?</b>
<p>I suggest that in many instances flow diagrams or decision diagrams would clarify the calculation steps. These diagrams might also be able to carry citations to identify sources of data at the separate steps.</p> <p>These diagrams could also help to clarify where one commodity flow was used as proxy for the distribution of another commodity or of sources of non-CO2 gases.</p> <p>I also suggest that Figures like 2-5 and 2-6 might be easier to gather the importance if they showed the % difference rather than the absolute difference.</p>
<b>3. <u>Data availability.</u> Please address the following questions for each inventory source:</b>
<p style="margin-left: 20px;"><b>c. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?</b></p> <p style="margin-left: 20px;"><b>d. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?</b></p>
<p>My feeling about data is that the most important feature is consistency. You want data that are comprehensive but you would also like to have consistency over time and consistency across the country.</p>
<b>4. <u>Uncertainty.</u> Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful.</b>

**PEER REVIEW COMMENT TEMPLATE**

*Inventory of US Emissions and Sinks by State: Methods Support Document*

**Timeseries Coverage.** Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).

I think that 1990-present is a very good time interval to cover. Very importantly we are interested in the changes over time, whether or not emissions are declining over time and where. And starting in about 1990 allows us to cover the important time interval over which emissions peak and, hopefully, continue to decline. Having the full time series will allow analysts to see and interpret trends and changes in trends.

**5. Key Categories.** EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.

Part of the reason for doing state-level data is the belief that there is information and insight at the state level that is not apparent at the national level. With this perspective I agree with the current text, which deals heavily with transportation, but are there sectors where we might expect an important divergence among states in trends? Maybe households?

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

For me the keys are clear definitions, clear boundaries, and the whole is equal to the sum of the parts. Make sure that treatment of the District of Columbia and of territories is sharply defined.

**PEER REVIEW COMMENT TEMPLATE**

*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Gregg Marland

PEER REVIEW COMMENT TEMPLATE
<i>Inventory of US Emissions and Sinks by State: Methods Support Document</i>
<b>AFFILIATION: Appalachian State University</b>
<b>DATE: 10/14/2021</b>
<b>RESPONSE TO COMBUSTION CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>Fossil Fuel Combustion</b>
<b>1. Some fuels have differences in consumption data between the aggregated state-level totals and national totals. The current approach is to use data from the <i>National Inventory</i> in those cases. Are there other approaches that could be taken? Do you know of cases where others have dealt with the differences in the totals, and if so how?</b>
From the text it sounds to me like this is now mostly a consequence of using data of different vintages, i.e., the sources of state-level data are not from the same vintage as the national level data. My feeling is that you use the best data available, make clear that they are not all of the same vintage and that the next year’s revision will bring these together better. Properly explained this uses the best available data that can be documented at each step and gives a good indication of data uncertainty. The existing text could do better to explain this issue – again a simple diagram could be helpful. Uncertainty is important and it is possible to convey some insights on uncertainty even if a systematic analysis is not possible.
<b>2. Consistent with the IPCC Guidelines, we have adjusted fuel consumption totals in the energy sector to account for consumption in the IPPU sector. In some cases, this step could lead to a negative emission total for a state if the subtracted amount (as determined from the assumed distribution) was greater than consumption data from the State Energy Data System (SEDS). This outcome was corrected to zero if that was the case, but are there other approaches for correcting for that difference?</b>
I do not have any problem with negative values appearing. Using transparent data and clear descriptions this again helps to convey the data uncertainty. Is this a vintage issue again or does it persist over time? Make clear what are the data sources and what is implied by a negative value.
<b>3. Consistent with the <i>National Inventory</i>, the default approach taken here was to allocate transportation sector CO<sub>2</sub> emissions based on FHWA fuel use/sales by state. For some states, this may not be accurate because fuel sold in a state may be combusted in other states. Another option is to use vehicle miles traveled (VMT) data by state but that approach does not factor in vehicle fuel economy. Are there other alternative or complementary approaches to allocate transportation fuel across states, including VMT data and other sources (e.g., NEI – based on county-level fleet and activity data to generate a bottom-up inventory) that EPA should consider? If so, what data sources exist to help with that alternative approach? Would it be helpful to present transportation sector emissions using multiple approaches in future inventories?</b>
I vote with the IPCC to count these things at the point of final sale. It is where tax is collected and potential for control exists. It is the way electricity is counted – i.e. at the point of final transaction rather than at the point of final usage. Transparency!

**PEER REVIEW COMMENT TEMPLATE**

*Inventory of US Emissions and Sinks by State: Methods Support Document*

The text is not totally clear, but it appears to me that this is what is being done with interstate aviation as well. The text, incidentally, is not always clear between international bunkers and interstate bunkers. Count it at the final transaction for interstate flights but you still have to sort out international bunkers.

**4. Mobile source non-CO<sub>2</sub> emissions are allocated across states based on vehicle-miles-traveled data while mobile source CO<sub>2</sub> emissions were allocated based on fuel sales, as mentioned above. Is there an issue with using two different methodologies for mobile source CO<sub>2</sub> vs. non-CO<sub>2</sub> state splits?**

I would say “yes”. But you should probably do it anyhow – being very clear that this is what is being done.

**5. Several fuels have variable C factors over time including coal, natural gas, gasoline, and diesel fuel. Those fuels might also have variable C factors across areas/states. Are data available to build out state-specific C factors for the fuels with variable C contents? If so, could it be done in a way that the state-level total emissions still matched up to the national total emissions for those fuels?**

I argue that for solid and gaseous fuels there is a strong correlation between heat content and C content and that this can be used uniformly across states. This is not so simple for liquid fuels. There is some data available and C content sometimes changes with time of year as well. The state data should be better than the national data and if there is any mathematical fix it should probably be done to the *National Inventory* once you get the state data well organized. I think that you folks at EPA know how to do this better than I do.

**6. Geothermal emissions could be allocated by the type of geothermal production per state (because different types have different emissions factors) if that data are available. Is there more information on state-level geothermal emission factors and production?**

This is not my expertise.

**Non-Energy Uses (NEU) of Fossil Fuels**

**1. For petrochemical feedstocks, non-energy use (NEU) of natural gas is allocated across states based on petrochemicals emissions data per state from the IPPU adjustments, while other fuels are allocated based on the underlying SEDS data. Allocating across states based on the underlying SEDS data ensures there are no states where NEU use is larger than original SEDS data and there are no zeros associated with subtracting NEU (it is not an issue for natural gas because use is so high overall compared with NEU use). Could different approaches be used or can the petrochemical data be used without resulting in negative use?**

This is not my area of expertise.

**Incineration of Waste**

**1. Waste incineration emissions are calculated based on the combustion of fossil components of both municipal solid waste (MSW) and tires. However, emissions are disaggregated to Sates based only on MSW tonnage. Are there approaches or data available to disaggregate emissions based on waste category (e.g., MSW combustion vs. tire combustion)?**

**PEER REVIEW COMMENT TEMPLATE**

*Inventory of US Emissions and Sinks by State: Methods Support Document*

Sorry, no useful comments here either.

**International Bunker Fuels**

**1. The approach used to allocate jet fuel bunker fuels by state is currently based on the total amount of jet fuel used by state which could potentially lead to an over- or under-estimation for some states of bunker fuel emissions. Are there other more accurate approaches to allocate jet fuel bunker data across states as opposed to the percentage of jet fuel total use? For example, using Federal Aviation Administration flight level data on departures and destinations or assuming based on states with international airports and flights?**

I assume that this question actually refers to international bunkers.

I have always assumed that the U.S. report of international bunker fuels was based on real numbers (or good estimates) for jet fuel loading on internationally bound flights and that this data was actually collected at airports. But I have never had occasion to seek out such data at the sub-national level.

**Wood Biomass and Biofuels Consumption**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the *National Inventory*? (Cf. General Chapter Charge Questions 1-5)**

My reaction is that the method described for allocating the emissions from liquid biofuels seems quite reasonable. For CO<sub>2</sub> from wood fuels my first thoughts are that this likely varies considerably among states and that we ought to be able to do better. I would expect to find some data at the US Forest Service on wood used as a fuel.

### 3.11 Ms. Emily McGlynn (Agriculture and LULUCF)

#### Agriculture

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Emily McGlynn
<b>AFFILIATION:</b> University of California Davis 1 Shields Avenue Davis, CA 95616
<b>DATE:</b> October 15, 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
See my comments on the LULUCF section
<b>4. <u>Uncertainty.</u> Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the <i>National Inventory</i>. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).</b>
See my comments on the LULUCF section.

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Emily McGlynn
<b>AFFILIATION:</b> University of California Davis 1 Shields Avenue Davis, CA 95616
<b>DATE:</b> October 15, 2021 and March 1, 2022
RESPONSE TO AGRICULTURAL SOIL MANAGEMENT CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**1. What are your overall impressions of the clarity and transparency of this section?**

It would be good to clarify whether there any work is required to disaggregate the agricultural soil management fluxes by state, or whether, like other Agriculture/LULUCF inventory categories the national flux is already calculated as the sum of state-level fluxes.

For N<sub>2</sub>O from biosolids/organic N amendment, population does not seem like a good predictor of application rates or emissions for this source. Area of agricultural/cropland, crop production levels, or biosolid/manure production levels seem like they would be better predictors of state-level emissions.

**RESPONSE TO AGRICULTURAL SOIL MANAGEMENT, RICE CULTIVATION, AND FIELD BURNING OF AGRICULTURAL RESIDUES CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

This may take some time/resources to aggregate the data, but instead of using historical average state proportion of national total to assign carbon stock change, CH<sub>4</sub>, and N<sub>2</sub>O emissions post-2015, you could use state-level surrogate data for post-2015, e.g., state-level agricultural commodity production and weather. I would have to do more research to figure out how best to specify this model to adjust state weights by their surrogate data, using the historical relationship, I would think there are some straightforward methods here.

You could test each method in its ability to predict state-level emissions given national totals using the historical data.

**LULUCF**

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*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Emily McGlynn

**AFFILIATION:**

University of California Davis  
 1 Shields Avenue  
 Davis, CA 95616

**DATE:** October 15, 2021

**RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**1. What are your overall impressions of the clarity and transparency of this section?**

I support the approach of referring to the *National Inventory* where national methods are already based on summing state-level estimates, since repeating method descriptions may create confusion.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National**

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### *Inventory of US Emissions and Sinks by State: Methods Support Document*

**GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Quantitative uncertainty estimates are required for interpreting confidence in inventories. Particularly for states that have GHG emissions reduction targets, an uncertainty range for the central GHG flux estimate is needed to understand whether emissions reductions can be claimed at a given level of statistical significance. LULUCF uncertainty is likely to be heterogeneous across states, given different numbers of FIA/NRI plots and different levels of underlying variability. Providing uncertainty estimates can help prioritize data investments in states where uncertainty is larger.

Best practice when providing an uncertainty estimate is to clarify which sources of input, parameter, model, or other types of uncertainty are accounted for, how uncertainty is estimated for each of these individual elements, and how uncertainty across elements is combined to find total uncertainty for the central flux estimate. Where uncertainty is aggregated across multiple inventory categories, any dependency assumptions should be clarified. Methods of inference (e.g. design-based vs. model-based) should be clear as well. It is useful to provide uncertainty estimates for both individual inventory categories, to identify opportunities for inventory improvements and data/research needs, and at the sector level (e.g. for net LULUCF fluxes) to support emissions reduction claims.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

Of all the current omissions in the state-level LULUCF estimates, the harvested wood product (HWP) carbon pool omission is likely to cause the largest bias, especially for states with large wood products industries. I see this is in the works, so I only suggest this be prioritized to the extent possible.

### **6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

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Since states are able to use more finely tuned policy to influence LULUCF emissions, including working with local- and county-level policy makers and existing or new special districts, providing more spatially explicit data would likely be useful. Since many of the datasets underlying LULUCF flux calculations are already spatial in nature, it would be worthwhile to work towards a completely spatially explicit LULUCF inventory.

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*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Emily McGlynn

**AFFILIATION:**

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1 Shields Avenue  
Davis, CA 95616

**DATE:** October 15, 2021

**RESPONSE TO WETLANDS AND LANDS CONVERTED TO WETLANDS CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Peatlands Remaining Peatlands**

**1. Are there state-level data available on the application (“consumption”) of peat, including the state of use and the horticultural/landscaping use?**

The state-level peat estimates are currently highly assumption dependent. It might help states to understand how important these assumptions are by providing some sensitivity analysis: would different assumptions here significantly influence state-level emissions, either economy-wide or for the LULUCF sector? Given the small magnitude of peatland emissions I assume the answer is no but perhaps for some states the difference could be meaningful. The sensitivity analysis could test different approaches to allocating peat production “remainders” across states (uniformly, weighted by area of organic soils, weighted by total land area, etc.)

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*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Emily McGlynn

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**DATE:** October 15, 2021

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**RESPONSE TO SETTLEMENTS AND LANDS CONVERTED TO SETTLEMENTS  
CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Changes in Yard Trimmings and Food Scrab Carbon Stocks in Landfills**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the national *Inventory*? (Cf. General Chapter Charge Questions 1-5)**

Allocating state-level CO<sub>2</sub> fluxes from yard trimmings and food scraps by population makes sense for food scraps but not yard trimmings, particularly for states with large, densely populated cities (potential for fewer yard trimmings per capita). It may make sense to weight state-level food scraps fluxes by state population and weight yard trimmings fluxes by land area classified as settlement.

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*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Emily McGlynn

**AFFILIATION:**

University of California Davis  
1 Shields Avenue  
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**DATE:** March 1, 2022

**RESPONSE TO CROPLAND REMAINING CROPLAND, LAND CONVERTED TO CROPLAND, GRASSLAND REMAINING GRASSLAND, LAND CONVERTED TO GRASSLAND), SETTLEMENT ORGANIC SOILS, SETTLEMENT SOIL N<sub>2</sub>O EMISSIONS, LAND CONVERTED TO SETTLEMENTS CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

This may take some time/resources to aggregate the data, but instead of using historical average state proportion of national total to assign carbon stock change, CH<sub>4</sub>, and N<sub>2</sub>O emissions post-2015, you could use state-level surrogate data for post-2015, e.g. state-level agricultural commodity production and weather. I would have to do more research to figure out how best to specify this model to adjust state weights by their surrogate data, using the historical relationship, I would think there are some straightforward methods here.

You could test each method in its ability to predict state-level emissions given national totals using the historical data.

### 3.12 Mr. Raymond C. Pilcher (Energy)

PEER REVIEW COMMENT TEMPLATE
<i>Inventory of US Emissions and Sinks by State: Methods Support Document</i>
<b>NAME:</b> Raymond C. Pilcher
<b>AFFILIATION:</b> President, Raven Ridge Resources, Incorporated
<b>DATE:</b> 17 September 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
1. What are your overall impressions of the clarity of this section?
Well written. The discussion of trends was salient and easy to understand. I appreciate the discussion of sources of the data and how it was used. I find that the discussion relative to emissions and groupings within the industrial sector are enlightening and believe that it will be important to perpetuate this analysis as we see the energy economy transition take place.
2. What recommendations do you have to add to or improve the overall transparency, completeness, consistency and accuracy of this chapter?
Figure 3-5: Annual U.S. Energy Use—need to separate contributions from nuclear and renewables. It is understandable but misses the sensibilities around the subject; moreover, it would be good to have figure 3-5 mirror the categories used in figure 3-4. Figure 3-9 (and other similar graphs with mixes of stacked columns and lines) should show lines in the explanation rather than colored squares for the Net Generation and Sector CO2 Emissions—I recognize that this may be difficult with some software but it will make it easier for the reader.
Methane emissions from surface mines is still an issue for all national inventories and especially for the US where surface mines produce the majority of coal. Work in other countries is showing that surface mining methane emission factors are too low. When large underground mines are poisoned on the updip extension of large hydrocarbon bearing structures, gas migrates upward to the low pressure region formed at the open pit. This implies that merely using the gas content of the coal seams to estimate the emissions could yield an estimate that is lower than actual if gas is migrating from deeper sources. Additionally destressing and dewatering that takes place over large areas as overburden is removed results in opening of fractures and bed separation that allows for greater movement of fluids. Additional research needs to be done to verify that large long-lived mines such as those in the Powder River Basin of Wyoming and Montana are emitting in the range of the emission factors being used.
There is circular reasoning involved in a statement related to methane emissions from coal mining in the section Uncertainty and Time-Series Consistency. This statement occurs in paragraph 4 “ <i>Surface mining and post-mining emissions are associated with considerably more uncertainty than underground mines, because of the difficulty in developing accurate emission factors from field measurements. However, since underground emissions constitute the majority of total coal mining emissions, the uncertainty associated with underground emissions is the primary factor that determines overall uncertainty.</i> ” I cannot agree with the statement that the volume of known uncertainty in underground mines determines primacy due to the size of known emissions much of

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which comes from the GHGRP. There is likely to be much greater uncertainty in surface mining as it is an estimate with no reported emissions. Further QA/QC is reliant on reported measurement from underground mines—none can be done at surface mines.

Abandoned mine methodology is old (and I helped develop it) and data from mines that have produced gas over many years at commercial projects suggest that the methodology may underestimate the amount of gas that is emitted from a non-flooding abandoned mine. It may be time to revisit what is known about abandoned mine emission profiles.

I also found that the information and data associated with the Natural Gas industry and its associated emissions to be more comprehensive than for the coal sector. This is a reflection of the level of cooperation, reporting and ease of verification.

### **3. Data availability. Please address the following questions for each inventory source:**

- a) **For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b) **For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

I am not aware of any additional data sets that could be incorporated in state level inventories.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Because of the rapidly changing energy use profile over the last three decades, the time interval from 2010 forward seems to be the most relevant. This also corresponds with a growing awareness of GHG emissions by state governments. Data availability has vastly improved in the last decade.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

Because of my interest and career related to emissions reductions in the fossil fuels industry, I know more about the uncertainty related to coal mining and the oil and gas sector. It is clear that the information and data from the Oil and Gas sectors are more reliable and can be more easily verified in a number of ways. The coal mining sector needs more attention in that the uncertainties related to surface mining and closed and abandoned mines are greater. Most emissions estimates are dependent

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on emissions factors which need additional effort to verify that they are capturing the range of possible outcomes.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

I really find this to be a great tool for visualization and exploration. However, A. I chose “energy” and then “coal mining” and found that I could not look at data that only included methane. I presume that the majority of the emissions are from methane but additional explanation and data would be useful. Downloads as .xlsx are better than .csv

B. If the data is at the state level, then it would be useful to have map options and the ability to look at the emissions data by state and by mine. The inventory has this data and full transparency is warranted and would be useful. Various uses of the inventory are known, but the ability to disaggregate and compare is valuable whether it is for government or private sector efforts to identify and reduce emissions.

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**NAME:** Raymond C. Pilcher

**AFFILIATION:**

Raven Ridge Resources, Incorporated

**DATE:** 17 September 2021

**RESPONSE TO COMBUSTION CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

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**Fossil Fuel Combustion**

**1. Some fuels have differences in consumption data between the aggregated state-level totals and national totals. The current approach is to use data from the *National Inventory* in those cases. Are there other approaches that could be taken? Do you know of cases where others have dealt with the differences in the totals, and if so how?**

I am not aware of other issues such as those described. I cannot understand why it would be better to choose national level data instead of state level information unless there is a known reason for the discrepancy and it is judged that the state data is erroneous.

**2. Consistent with the IPCC Guidelines, we have adjusted fuel consumption totals in the energy sector to account for consumption in the IPPU sector. In some cases, this step could lead to a negative emission total for a state if the subtracted amount (as determined from the assumed distribution) was greater than consumption data from the State Energy Data System (SEDS). This outcome was corrected to zero if that was the case, but are there other approaches for correcting for that difference?**

I am not aware of alternate approaches.

**3. Consistent with the *National Inventory*, the default approach taken here was to allocate transportation sector CO<sub>2</sub> emissions based on FHWA fuel use/sales by state. For some states, this may not be accurate because fuel sold in a state may be combusted in other states. Another option is to use vehicle miles traveled (VMT) data by state but that approach does not factor in vehicle fuel economy. Are there other alternative or complementary approaches to allocate transportation fuel across states, including VMT data and other sources (e.g., NEI – based on county-level fleet and activity data to generate a bottom-up inventory) that EPA should consider? If so, what data sources exist to help with that alternative approach? Would it be helpful to present transportation sector emissions using multiple approaches in future inventories?**

It would be most useful to use multiple methods for comparison in future inventories.

**4. Mobile source non-CO<sub>2</sub> emissions are allocated across states based on vehicle-miles-traveled data while mobile source CO<sub>2</sub> emissions were allocated based on fuel sales, as mentioned above. Is there an issue with using two different methodologies for mobile source CO<sub>2</sub> vs. non-CO<sub>2</sub> state splits?**

There is no problem with using two methodologies as long as there is adequate description of the process and an explanation of the differences.

**5. Several fuels have variable C factors over time including coal, natural gas, gasoline, and diesel fuel. Those fuels might also have variable C factors across areas/states. Are data available to build out state-specific C factors for the fuels with variable C contents? If so, could it be done in a way that the state-level total emissions still matched up to the national total emissions for those fuels?**

Not my area of expertise

**6. Geothermal emissions could be allocated by the type of geothermal production per state (because different types have different emissions factors) if that data are available. Is there more information on state-level geothermal emission factors and production?**

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Not my area of expertise

**Non-Energy Uses (NEU) of Fossil Fuels**

**1. For petrochemical feedstocks, non-energy use (NEU) of natural gas is allocated across states based on petrochemicals emissions data per state from the IPPU adjustments, while other fuels are allocated based on the underlying SEDS data. Allocating across states based on the underlying SEDS data ensures there are no states where NEU use is larger than original SEDS data and there are no zeros associated with subtracting NEU (it is not an issue for natural gas because use is so high overall compared with NEU use). Could different approaches be used or can the petrochemical data be used without resulting in negative use?**

Not my area of expertise

**Incineration of Waste**

**1. Waste incineration emissions are calculated based on the combustion of fossil components of both municipal solid waste (MSW) and tires. However, emissions are disaggregated to Sates based only on MSW tonnage. Are there approaches or data available to disaggregate emissions based on waste category (e.g., MSW combustion vs. tire combustion)?**

Not my area of expertise

**International Bunker Fuels**

**1. The approach used to allocate jet fuel bunker fuels by state is currently based on the total amount of jet fuel used by state which could potentially lead to an over- or under-estimation for some states of bunker fuel emissions. Are there other more accurate approaches to allocate jet fuel bunker data across states as opposed to the percentage of jet fuel total use? For example, using Federal Aviation Administration flight level data on departures and destinations or assuming based on states with international airports and flights?**

Not my area of expertise

**Wood Biomass and Biofuels Consumption**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the *National Inventory*? (Cf. General Chapter Charge Questions 1-5)**

Not my area of expertise

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*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Raymond C. Pilcher

President Raven Ridge Resources, Incorporated.

**DATE:** 15 October 2021

**RESPONSE TO FUGITIVE CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Coal Mining**

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**1. Do you have any comments specific to the methodology and emission estimates for active coal mines and abandoned coal mines?**

I expressed my opinion on these issues in the section related to the *National Inventory*. They are applicable here as the *National Inventory* discussion is more complete. The state level discussion leaves out details that are relevant specifically around the details related to individual mines. It seems awkward to discuss more detail in the *National Inventory* and refer to it in the state level document. It is also important to recognize that there are differences with a basin and that this may mean that it is time to revisit the work that was done in the mid-1990s and evaluate data and information at the state level, rather than allocating a portion of the emissions to a state that lies within a basin. Also, there is no such thing as the Western Basin, there are many basins in the Western US. Perhaps call it Western Basins and explain why emissions are lumped. There is more data than was available in the mid-1990s relative to coal rank, gas content and adsorption isotherms.

**2. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned coal mines, including state-level datasets addressing recovery of methane from abandoned mines?**

There will be data on the state level for some of the states where there is active interest by the state in accounting for and reducing emissions, e.g., Colorado and Kentucky.

**Abandoned Underground Coal Mines**

**1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

For the most part states have not been active in investigating or reporting data related to emissions. There is data related to location but has to be acquired at the state or even at the county level.

**Petroleum Systems and Natural Gas Systems**

**1. Are there relevant dataset(s) that could be used to replace or supplement the data currently used to allocate petroleum and natural gas system emissions to the state level? Particularly, state or detailed location information on gathering and boosting stations, processing plants, and transmission and storage stations?**

I am unaware of any.

**2. Are there additional Greenhouse Gas Reporting Program (GHGRP) data that could be used to allocate natural gas and petroleum emissions to each state?**

I am unaware of any.

**3. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned wells, including state-level datasets addressing plugging status of abandoned wells?**

This is a problem in the state in which I live, Colorado, and there is growing interest and awareness at the state, county and municipal level. The cost of abandonment for many wells are being socialized and this has caused a more detailed data acquisition effort.

**4. Are there particular sources for which state-level regulatory or voluntary programs result in large differences in emission rates between states? Are state-specific data sets available for those sources?**

I am unaware of these sources of data.

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**Abandoned Oil and Gas Wells**

**1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

See 3 above.

### 3.13 Dr. Pallav Purohit (IPPU)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Pallav Purohit
<b>AFFILIATION:</b> Energy, Climate, and Environment (ECE) Program International Institute for Applied Systems Analysis (IIASA) Schlossplatz 1, A-2361 Laxenburg, Austria.
<b>DATE:</b> October 15, 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
The chapter on Industrial Processes and Product Use (IPPU) of the Greenhouse Gas Inventory report includes greenhouse gas emissions occurring from industrial processes and from the use of greenhouse gases in products. This chapter presents emission estimates calculated in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and its refinements. This chapter provides a detailed explanation of the application of methods used to calculate emissions and removals from industrial processes and from the use of greenhouse gases in products in a clear and transparent manner. This chapter is quite comprehensive and lay out all the assumptions and data sources used for estimating the GHG emission inventory.
<b>2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?</b>
For the overall completeness and of this chapter I would suggest incorporating the existing policies and plans to control IPPU sector emissions and low-GWP alternatives being considered in the US market.
<p><b>1. Policies/Measures to reduce IPPU sector emissions</b></p> <p>While the impact of existing policy measures is mentioned in explaining the trend of emissions in recent years a detailed list of existing policies/measures, regulations, standards and plans to control IPPU sector emissions at the National as well as state level are missing. It is all right if these policies are covered in other chapters of the report. For example,</p> <ul style="list-style-type: none"> <li>• The California Air Resources Board (CARB) has introduced new rules to reduce HFC emissions to 40% below 2013 levels by 2030.</li> <li>• The California Cooling Act also created an incentive program to facilitate early adoption of HFC alternatives.</li> <li>• The U.S. Climate Alliance, composed of 24 states representing 55% of the U.S. population and 60% of U.S. GDP, has committed to reducing short-lived climate pollutants, including HFCs (See: <a href="http://www.usclimatealliance.org/about-initiatives">www.usclimatealliance.org/about-initiatives</a>).</li> <li>• In the past year, eight U.S. Climate Alliance states have passed legislation or committed to issue new regulations to curb specific HFC uses – these states account for over 25% of U.S. HFC emissions and host nearly 30% of HVAC jobs in the nation. (See: <a href="http://www.alliancepolicy.org/campaigns/kigali-resources">www.alliancepolicy.org/campaigns/kigali-resources</a>).</li> </ul>

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- Finalized HFC bans by states (See: <https://www.hfcbans.com/bans-by-region.html>)
- 2. Alternative of high-GWP refrigerants**
- Page 4-131, Refrigeration/Air Conditioning: Please indicate the low-GWP options being considered for stationary air conditioning (residential and commercial) and transport refrigeration sector in the US market?
  - Page 4-131, Aerosols: Is R-744 (CO<sub>2</sub>) being considered as a low-GWP option in technical and consumer aerosols?
  - Page 4-131, Foams: In EU, the vast majority rely on hydrocarbons such as pentane or cyclo-pentane as an alternative for high GWP refrigerants in PU foam sector. Is it being considered as a low-GWP option in US market?
  - Figure A-4: Why there is a sudden jump in emissions from Passenger Cars/Motorcycles in 2007? Also, the emissions from Light-Duty Trucks decreased between 2006 and 2007.
  - Page A-209, Figure 4: Why there is a sudden jump in emissions from Passenger Cars/Motorcycles in 2007? Also, the emissions from Light-Duty Trucks decreased between 2006 and 2007.
- 3. Missing source sectors**
- There is wide range of military applications using PFCs or SF<sub>6</sub>. Military electronics are believed to be an important and growing application of PFC heat transfer fluids, which are valued for their stability and dielectric properties. SF<sub>6</sub> is used in high-performance ground and airborne radar systems in their hollow conductors for transmission of high-frequency energy pulses at high voltages from the klystron. Some countries report these emissions but mostly they are missing due to the confidential reasons.

**3. Data availability. Please address the following questions for each inventory source:**

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

In my understanding the IPPU chapter provides detailed information with the most up-to-date data within the chapter itself and in the supporting documents (methodology, Annex). Further information is available in the response to the charge questions.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA**

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**appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

In order to have a complete and accurate picture of the global level of emissions, the national greenhouse gas emissions inventories need to be robust and complete. Some emission sources, in particular non-CO<sub>2</sub> greenhouse gases (NCGGs) have inherent uncertainties that could be quite large. Complementary to bottom-up emission inventories, greenhouse gas emissions can be estimated using atmospheric measurements and atmospheric models (the "top-down" approach). Atmospheric measurements could reduce the uncertainty in NCGG emissions at national and regional scale with respect to existing emission inventories.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

In my opinion, Refrigeration/Air-conditioning sectors under "Substitution of Ozone Depleting Substances" needs to be refined further in residential air-conditioning, commercial air-conditioning, mobile air-conditioning, commercial refrigeration, domestic refrigerators and freezers, industrial refrigeration, transport refrigeration and heat pumps.

**6. Data Presentation and Usability.**

- a. **Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?**
  - i. **Related to the level of category/gas aggregation or disaggregation?**
  - ii. **Are there specific categories where further data disaggregation could be helpful?**
  - iii. **What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**
- b. **What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

The state-level emissions data are presented nicely with appropriate details to the level of category/gas aggregation or disaggregation. In order to increase the usability of the state-level emissions data it will be useful to provide further details in the "Substitution of Ozone Depleting Substances" at the sub-sectoral level (i.e., residential air-conditioning, commercial air-conditioning, mobile air-conditioning, commercial refrigeration, domestic refrigerators and freezers, industrial refrigeration, transport refrigeration and other industrial sectors (aerosols, foams, solvents, fire protection etc.), if possible. Data in Excel format seems ok that can easily be converted for further use.

## PEER REVIEW COMMENT TEMPLATE

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Pallav Purohit

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<p><b>AFFILIATION:</b>                      Energy, Climate, and Environment (ECE) Program                      International Institute for Applied Systems Analysis (IIASA)                      Schlossplatz 1, A-2361 Laxenburg, Austria.</p>
<p><b>DATE:</b> October 15, 2021</p>
RESPONSE TO CHEMICAL CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
HCFC-22 Production
<p><b>1. For the years 1990–2009, there are significant uncertainties in the allocation of national-level U.S. emissions to individual facilities and states, particularly for the five HCFC-22 production facilities that closed before 2003 and for which production capacity data are therefore not available. Are you aware of any more complete sources of production capacity or other relevant historical data?</b></p>
<ul style="list-style-type: none"> <li>The UNEP Ozone Secretariat provides historical data on consumption of controlled substances in ODP tonnes or in CO<sub>2</sub>-eq tonnes (See: <a href="https://ozone.unep.org/countries/data-table">https://ozone.unep.org/countries/data-table</a> or <a href="https://ozone.unep.org/countries">https://ozone.unep.org/countries</a>)</li> </ul>
<p><b>2. Do you have recommendations for how to refine the methodology to more accurately estimate emissions from HCFC-22 production over the time series?</b></p>
<ul style="list-style-type: none"> <li>Stanley et al. (2020) in their study provided bottom-up total HCFC-22 production (Gg/year) and estimated HFC-23 emissions (Gg/year) for developing and developed countries using UNEP Ozone Secretariat data (See: <a href="https://ozone.unep.org/countries">https://ozone.unep.org/countries</a>). Here is the link of the study: <a href="https://www.nature.com/articles/s41467-019-13899-4#Sec11">https://www.nature.com/articles/s41467-019-13899-4#Sec11</a></li> </ul>

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<p><b>NAME:</b> Pallav Purohit</p>
<p><b>AFFILIATION:</b>                      Energy, Climate, and Environment (ECE) Program                      International Institute for Applied Systems Analysis (IIASA)                      Schlossplatz 1, A-2361 Laxenburg, Austria.</p>
<p><b>DATE:</b> October 15, 2021</p>
RESPONSE TO METALS CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
Aluminum Production

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**1. Are you aware of data available to incorporate differences in emissions between smelters based on technology type? Is there any other surrogate data or emission sources that could be used to allocate national total aluminum production emissions across states?**

- The International Aluminium Institute (IAI) provides comprehensive statistics on primary aluminium production and energy intensities (See: <https://international-aluminium.org/>). The Anode Effect Survey Reports of IAI also provides CF4 and C2F6 intensity per ton of Al processed based on technology type (See: <https://international-aluminium.org/resource/2019-anode-effect-survey-report/>). While they publish data for major world regions it may be possible for them to share the results specific to the United States.
- I do agree with the approach used in this report by allocating national estimate totals using the ratio of each state’s smelter capacity to the U.S. total capacity.

**Magnesium Production and Processing**

**1. Are you aware of state or facility-level magnesium production or capacity data (or surrogate data) for the 1990–2019 time series?**

- To the best of my knowledge and understanding US Magnesium is the only producer of primary magnesium in the United States, operating manufacturing facilities on the Great Salt Lake.

**2. Are you aware of information on the location (by state) of magnesium production and processing facilities or information on the location (by state) of magnesium production and processing facilities by process type?**

- No information

**PEER REVIEW COMMENT TEMPLATE**

*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Pallav Purohit

**AFFILIATION:**

Energy, Climate, and Environment (ECE) Program  
 International Institute for Applied Systems Analysis (IIASA)  
 Schlossplatz 1, A-2361 Laxenburg, Austria.

**DATE:** October 15, 2021

**RESPONSE TO PRODUCT USE CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Electronics Industry**

**1. Are you aware of state- or facility-level capacity data or other state-level surrogate data (e.g., sales data) for PV manufacturing for 1990–2006 that could be used to refine the allocations of emissions by state? Is there any surrogate data (e.g., sales data by state) by state**

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*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**for semiconductor or MEMS manufacturing for 1990–2007 that could be used to refine the allocations of emissions by state?**

- A list of U.S. solar panel manufacturers/assemblers that produce solar panels for the traditional residential, commercial and utility-scale markets is available at: <https://www.solarpowerworldonline.com/u-s-solar-panel-manufacturers/>
- The following NREL report also provides U.S. PV Manufacturing Capacity (see: Table 16 at <https://www.nrel.gov/docs/fy19osti/73363.pdf>)
- Solar PV facilities with less than one megawatt in capacity are not included in EIA’s surveys of electricity generators, but their aggregate capacities are included in the EIA’s survey of electric power sales, revenue, and energy efficiency and are represented in EIA’s *Electric Power Monthly*.

### Substitution of Ozone-Depleting Substances

**1. Are you aware of bottom-up modeling data that are available by state? Is there any surrogate data other than population data that could be used to disaggregate the emissions of substitutes for ozone-depleting substances?**

1. California Greenhouse Gas Emissions for 2000 to 2019: Trends of Emissions and Other Indicators (Available at: <https://ww2.arb.ca.gov/ghg-inventory-data>).
2. To disaggregate the emissions of substitutes for ozone-depleting substances at the state-level seems complex. The draft methodology report already pointed out several approaches. One possibility to disaggregate the emissions of substitutes for ozone-depleting substances is to use sector specific drivers. For e.g., value added from the service sector may be used to disaggregate HFC emissions from the commercial refrigeration sector. Similarly, value added from the industrial sector may be used to disaggregate HFC emissions from the industrial refrigeration sector. To disaggregate HFC emissions from the transportation sector industrial, value added from the transport sector may be used.

### Electrical Transmissions and Distribution

**1. Are you aware of state-level electrical transmission and distribution equipment data (e.g., nameplate capacity by state) or other data for 1990–2019 (or part of the time series) that could refine this state inventory calculation to reflect state trends in emissions more closely? Is there any other surrogate data (e.g., state population data) to enhance accuracy and consistency of state GHG emissions and trends than the current data being used (transmission mile data by state)?**

- The current SF<sub>6</sub> Regulation came into effect in 2011, setting an annual emission rate limit for SF<sub>6</sub> as a percentage of a gas-insulated equipment (GIE) owner’s cumulative SF<sub>6</sub> nameplate capacity. Allowable emission rates under the SF<sub>6</sub> Regulation started at 10% in 2011, decreasing by 1% per year until 2020, after which point the allowable emission rate remains constant at 1% (See: <https://www.globalelr.com/2019/03/carb-amending-sf6-regulation-stricter-requirements-for-california-electrical-equipment/>).
- U.S. Transmission Miles in relation to Electricity Generation, Peak Power, and Number of Customers (Available at: [https://energy.utexas.edu/sites/default/files/UTAustin\\_EIoF\\_Transmission\\_2019-02-21.pdf](https://energy.utexas.edu/sites/default/files/UTAustin_EIoF_Transmission_2019-02-21.pdf))

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- Electric Transmission (Available at: <https://www.ferc.gov/electric-transmission>)
- State Population Totals and Components of Change: 2010-2019 (Available at: <https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html>)

### 3.14 Mr. Jeffery Rutherford (Energy)

PEER REVIEW COMMENT TEMPLATE
<i>Inventory of US Emissions and Sinks by State: Methods Support Document</i>
<b>NAME:</b> Jeff Rutherford
<b>AFFILIATION:</b> PhD Student Stanford University
<b>DATE:</b> October 22, 2021
<b>RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity of this section?</b>
<p>This work provides the first GHG emissions inventory disaggregated by state prepared by the United States Environmental Protection Agency. I was charged with assessing the combustion and fugitive sector categories.</p> <p>Overall, the methodology is sound. As a starting point, the state inventory is built around the <i>National Inventory</i> which has been under development for over 25 years.</p> <p>For combustion emissions, national emissions data is disaggregated into state-level emissions largely based on activity data compiled in the Energy Information Administration’s State Energy Data System (SEDS). As is the case with the <i>National Inventory</i>, a significant portion of this section is devoted to accounting for differences in accounting between the inventory (which itself must be based on reporting requirements of the IPCC guidelines) and EIA activity data (for example, allocating portions of emissions to IPPU).</p> <p>For fugitive emissions, emissions data from the <i>National Inventory</i> are allocated using a variety of activity proxies including fraction of wells, oil and gas production, or other information (such as number of well completions) available in the Greenhouse Gas Reporting Program).</p> <p>I can certainly understand the difficulty in documenting such a detailed analysis with many disparate sources. This draft state inventory is an admirable first effort, however, I think work can be done to improve the clarity. As I describe in the prompts, the methodology could benefit from several improvements:</p> <ul style="list-style-type: none"> <li>• More explanation of key sources such as the SEDS and the National Greenhouse Gas Inventory</li> <li>• Improved documentation of spreadsheet appendices.</li> <li>• Contextualization for emissions data (e.g., how much coal versus gas is allocated to IPPU from combustion sector?).</li> </ul>
<b>2. What recommendations do you have to add to or improve the overall transparency, completeness, consistency and accuracy of this chapter?</b>

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### *Inventory of US Emissions and Sinks by State: Methods Support Document*

I have several recommendations for improving the overall transparency, completeness and consistency:

- The State Energy Data System (SEDS) plays a very important role in the analysis of combustion emissions. This dataset should be introduced in greater detail for the benefit of the reader (all I can find for description is a couple sentences at line 49).
- As expected, the analysis leans heavily on the existing work done in the National Greenhouse Gas Inventory. For example, for many of the emission sources, this report refers to the *National Inventory* for descriptions of the emission factors (see for example below, “Wood biomass and biofuels combustion” prompt (1)). At the least and for the benefit of transparency, the State Inventory should describe the data sources for the emission factor and possible risks to applying at the state-level.
- The spreadsheet appendices currently do not contain a “references” section. These should be added. (See, for example, my comment below at Abandoned Oil and Gas Wells prompt (1)).
- My recommendations for contextualizing the emission data are included in other comments (for example below, “fossil fuel combustion” prompt (2)).

### **3. Data availability. Please address the following questions for each inventory source:**

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

I am not aware of additional relevant datasets the EPA should consider for the combustion section.

For fugitive emissions from coal mining and petroleum and natural gas systems:

- The datasets currently employed by the *National Inventory* for emission factors in the petroleum and natural gas systems production segment (the Greenhouse Gas Reporting Program and EPA/GRI 1996) are known to underestimate total emissions (see for example Rutherford et al 2021). As I’m sure they are doing already, the EPA should be planning to incorporate the growing body of aerial methane fugitive emission measurements. Other, bottom-up based approaches to closing this gap should also be considered (e.g., unintentional storage tank emissions or unlit flares, see Rutherford et al. 2021).
- The State Inventory uses a fraction of natural gas to apportion processing segment emissions. The EPA should consider using a dataset more representative of gas processing capacity by state such as the Oil and Gas Journal Worldwide Gas Processing

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Survey or the EIA dataset of gas processing capacity (see additional discussion of this in my response in the fugitives section).

- The EPA should consider using counts of transmission stations instead of pipeline mileage to apportion transmission segment emissions (see additional discussion of this in my response in the fugitives section).

Rutherford, J.S., Sherwin, E.D., Ravikumar, A.P., Heath, G.A., Englander, J., Cooley, D., Lyon, D., Omara, M., Langfitt, Q. and Brandt, A.R., 2021. Closing the methane gap in US oil and natural gas production emissions inventories. *Nature Communications*, 12(1), pp.1-12.

Oil & Gas Journal, 2015. Worldwide Gas Processing Survey. Available online:

<https://www.ogj.com/ogj-survey-downloads/worldwide-gas-processing/document/17299826/worldwide-gas-processing-survey>

U.S. Energy Information Administration, 2019. *757 Processing Capacity*, electronic dataset, Natural Gas Annual Respondent Query System. Available online:

<https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2014&year2=2014&company=Name>

Department of Homeland Security, 2020. *Natural Gas Compressor Stations*, electronic dataset, Homeland Infrastructure Foundation-Level Data (HIFLD). Available online: <https://hifld-geoplatform.opendata.arcgis.com/datasets/natural-gas-compressor-stations/explore?location=35.816723%2C-96.043032%2C5.00>

**4. Uncertainty.** Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. **Timeseries Coverage.** Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).

95% confidence intervals should be provided on sector and sub-sector totals (for example, the production segment in petroleum and natural gas systems).

For my own purposes, I am most interested in recent years (2010 and later) but I can understand how the full time series might be useful to other researchers.

**5. Key Categories.** EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.

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I am most familiar with fugitive emissions from petroleum and natural gas systems. In this area there is a significant gap between reporting of methane emissions in the EPA *National Inventory* and the growing body of aerial methane emission measurements. Incorporating aerial methane measurements, or other approaches (see above), into both the National and state inventories should help to close this gap.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?**
  - i. Related to the level of category/gas aggregation or disaggregation?**
  - ii. Are there specific categories where further data disaggregation could be helpful?**
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

I think the pivot-table style data reporting in the Appendix spreadsheets are intuitive and useful.

However, I notice that the state-level inventory reporting is much coarser compared to the *National Inventory* reporting (especially for the sectors I am familiar with, such as petroleum and natural gas systems). To the extent possible, and given the bottom-up style of calculation, the state-level inventory should be disaggregated to the level of the *National Inventory*.

I consider XLSX downloads the most useful.

**PEER REVIEW COMMENT TEMPLATE**

*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Jeff Rutherford

**AFFILIATION:**  
 PhD Student  
 Stanford University

**DATE:**

**RESPONSE TO COMBUSTION CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

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*Inventory of US Emissions and Sinks by State: Methods Support Document*

**Fossil Fuel Combustion**

**1. Some fuels have differences in consumption data between the aggregated state-level totals and national totals. The current approach is to use data from the *National Inventory* in those cases. Are there other approaches that could be taken? Do you know of cases where others have dealt with the differences in the totals, and if so how?**

The approach seems appropriate and well explained. The *National Inventory* uses a different data source, the EIA Monthly Energy Review, compared to the state level inventory, which uses the EIA State Energy Data System (SEDS), a more appropriate for the state-level case.

For the purposes of creating a state level inventory it seems like it is appropriate to have some marginal difference in totals compared to the *National Inventory* (especially if different EIA datasets need to be used). This leads to many adjustment steps. Why is it necessary that they precisely match? I recognize that this is already listed as a planned improvement.

**2. Consistent with the IPCC Guidelines, we have adjusted fuel consumption totals in the energy sector to account for consumption in the IPPU sector. In some cases, this step could lead to a negative emission total for a state if the subtracted amount (as determined from the assumed distribution) was greater than consumption data from the State Energy Data System (SEDS). This outcome was corrected to zero if that was the case, but are there other approaches for correcting for that difference?**

The approach of correcting negative emission totals to zero seems appropriate. However, I am unable to comment specifically on the mathematical implementation of this approach due to a lack of clarity in the spreadsheet documentation.

This step of the methodology, documented in “Appendix A Energy Sector Combustion Estimates”, is extremely difficult to follow. Specifically, units are not provided for any of the data and, beyond “IPPU Correction From the Inventory” (for example, for Coking Coal, row 57), it is not clear where these correction values actually come from. Searching the US GHG Inventory and its Annexes for 2021, I was not able to locate the correction values to verify the calculations.

Additionally, some commentary in the main methodology report about the fraction of industrial CO<sub>2</sub> emissions adjusted for based on IPPU would be helpful. For example, it seems that close to 100% of coking coal is adjusted while the fraction of natural gas is smaller. This is not clear unless you dig deep into the Excel appendix.

**3. Consistent with the *National Inventory*, the default approach taken here was to allocate transportation sector CO<sub>2</sub> emissions based on FHWA fuel use/sales by state. For some states, this may not be accurate because fuel sold in a state may be combusted in other states. Another option is to use vehicle miles traveled (VMT) data by state but that approach does not factor in vehicle fuel economy. Are there other alternative or complementary approaches to allocate transportation fuel across states, including VMT data and other sources (e.g., NEI – based on county-level fleet and activity data to generate a bottom-up inventory) that EPA should consider? If so, what data sources exist to help**

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**with that alternative approach? Would it be helpful to present transportation sector emissions using multiple approaches in future inventories?**

This issue of apportionment error is likely to be a larger concern for long-haul trucking based diesel consumption, which will cross state lines more frequently compared to light duty vehicle based gasoline consumption. The EIA SEDS data (the source of activity data for this inventory) for transportation fuel consumption is based on FHWA reports. Fortunately, reporting of state-level diesel sales already reflects point of fuel use rather than point of purchase, according to International Fuel Tax Agreement provisions. I have verified this by reviewing FHWA documentation (cited below).

Thus, given that long-haul tracking diesel fuel use is already reported to reflect point of fuel use rather than point of purchase, error introduced in state-level apportionment should be minimal.

Erickson, R., n.d. Attribution paper. Available at:  
<https://www.fhwa.dot.gov/policyinformation/motorfuel/ftap/appxa.cfm>.

Office of Highway Policy Information, n.d. Chapter 2: Reports Identifying Motor-Fuel Use and Taxation. Available at: <https://www.fhwa.dot.gov/policyinformation/hss/guide/ch2.cfm>.

**4. Mobile source non-CO<sub>2</sub> emissions are allocated across states based on vehicle-miles-traveled data while mobile source CO<sub>2</sub> emissions were allocated based on fuel sales, as mentioned above. Is there an issue with using two different methodologies for mobile source CO<sub>2</sub> vs. non-CO<sub>2</sub> state splits?**

Consistent with the EIA SEDS data, the FHWA reports claim that fuel sales are the most accurate method for apportioning fuel use (and thus, emissions) by state (see Erickson’s (n.d.) report cited above, “the VMT methodology does not provide the accuracy and veracity that the motor fuel methodology does”).

One would also assume that apportioning non-CO<sub>2</sub> emissions should be proportional to CO<sub>2</sub> emissions (on a kg gas per kg fuel basis). It is not clear from the main report why the EPA has chosen to adopt the VMT approach over the fuel sales approach for non-CO<sub>2</sub> emissions.

**5. Several fuels have variable C factors over time including coal, natural gas, gasoline, and diesel fuel. Those fuels might also have variable C factors across areas/states. Are data available to build out state-specific C factors for the fuels with variable C contents? If so, could it be done in a way that the state-level total emissions still matched up to the national total emissions for those fuels?**

In the upstream segment of natural gas and petroleum fuels there will be differences in fuel composition. However, by the time the fuel is ready to be combusted, given national and international regulation of fuels, differences in composition will be trivial. Thus, I would consider the current approach fine.

**6. Geothermal emissions could be allocated by the type of geothermal production per state (because different types have different emissions factors) if that data are available. Is there more information on state-level geothermal emission factors and production?**

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I am not aware of any up-to-date geothermal datasets.  
 It would be interesting to know the emission factor that was used to calculate emissions from the geothermal sector in either the state or *National Inventory*, but this factor is not clearly stated as far as I can tell.

**Non-Energy Uses (NEU) of Fossil Fuels**

**1. For petrochemical feedstocks, non-energy use (NEU) of natural gas is allocated across states based on petrochemicals emissions data per state from the IPPU adjustments, while other fuels are allocated based on the underlying SEDS data. Allocating across states based on the underlying SEDS data ensures there are no states where NEU use is larger than original SEDS data and there are no zeros associated with subtracting NEU (it is not an issue for natural gas because use is so high overall compared with NEU use). Could different approaches be used or can the petrochemical data be used without resulting in negative use?**

In order to adequately understand the procedure used in this section:

- For those that aren't familiar with the EIA SEDS data, why is the appropriate activity data not available for state-level natural gas consumption for petrochemicals? These appear to be a necessary parameter in calculating petrochemical emissions. Please note that I was not able to review the procedure used in calculating petrochemical emissions per state. Apparently, Section 3.2.9 was required which was not included in my package provided. Nevertheless, this procedure should at least be briefly described in this section.
- I would also like to see more discussion in this section of the potential for double counting between petrochemical emissions in NEU and in IPPU.

**Incineration of Waste**

**1. Waste incineration emissions are calculated based on the combustion of fossil components of both municipal solid waste (MSW) and tires. However, emissions are disaggregated to States based only on MSW tonnage. Are there approaches or data available to disaggregate emissions based on waste category (e.g., MSW combustion vs. tire combustion)?**

According to 40 CFR § 98.33, “Insofar as there is separate collection, processing and disposal of industrial source waste streams consisting of ... used tires that do not contain hazardous waste identified or listed under 42 U.S.C. § 6921, such wastes are not municipal solid waste. However, such wastes qualify as municipal solid waste where they are collected with other municipal solid waste or are otherwise combined with other municipal solid waste for processing and/or disposal.”

I have not assessed the datasets myself, but if most tires, in general, were collected with MSW then it would be reasonable to use GHGRP tonnage to disaggregate emissions by state (as it is done for recent years).

**International Bunker Fuels**

**1. The approach used to allocate jet fuel bunker fuels by state is currently based on the total amount of jet fuel used by state which could potentially lead to an over- or under-**

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<b>estimation for some states of bunker fuel emissions. Are there other more accurate approaches to allocate jet fuel bunker data across states as opposed to the percentage of jet fuel total use? For example, using Federal Aviation Administration flight level data on departures and destinations or assuming based on states with international airports and flights?</b>
How to allocate aviation emissions is far from obvious based on the global nature of air travel (i.e., international travel is a global service, and inter-state travel is a national service, both of which do not fall within the boundaries of a single state or country). Currently, it seems there is no widely accepted approach, which is why the UNFCCC presents a set of nine options. One of these approaches is allocation based on the state of sales. Thus, other options may be considered, but it is not clear if a better option exists.
SBSTA, 1996. National Communication of the Subsidiary Body for Scientific and Technological Advice, FCCC/SBSTA/1996/9/Add.1, 24th October 1996. Available online: <a href="https://unfccc.int/cop3/resource/docs/1996/sbsta/09a01.htm">https://unfccc.int/cop3/resource/docs/1996/sbsta/09a01.htm</a>
<b>Wood Biomass and Biofuels Consumption</b>
<b>1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the <i>National Inventory</i>? (Cf. General Chapter Charge Questions 1-5)</b>
The State Inventory I believe is consistent with emission factors applied in the <i>National Inventory</i> . Separate emission factors were applied for woody biomass, biomass-derived ethanol, and biodiesel. The details regarding these emission factors are very limited (for example, for woody biomass, a citation to a personal communication with Perry Lindstrom). I would recommend providing a more transparent citation for emission factors for each of these biomass types.
<b>Coal Mining</b>
<b>1. Do you have any comments specific to the methodology and emission estimates for active coal mines and abandoned coal mines?</b>
Many of the coal mines span two or more states. The methodology in the State Inventory should be clearer about how mine-level data from the GHGRP is disaggregated by state.
<b>2. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned coal mines, including state-level datasets addressing recovery of methane from abandoned mines?</b>
I am not aware of any state-level datasets that would improve upon the Abandoned Mine Methane methodology proposed for the state-level inventory.
<b>Abandoned Underground Coal Mines</b>
<b>1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?</b>
This appears to be a duplicate of the question above.

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**Petroleum Systems and Natural Gas Systems**

**1. Are there relevant dataset(s) that could be used to replace or supplement the data currently used to allocate petroleum and natural gas system emissions to the state level? Particularly, state or detailed location information on gathering and boosting stations, processing plants, and transmission and storage stations?**

*Production segment*

The datasets currently employed by the *National Inventory* for emission factors in the petroleum and natural gas systems production segment (the Greenhouse Gas Reporting Program and EPA/GRI 1996) are known to underestimate total emissions (see for example Rutherford et al 2021). As I'm sure they are doing already, the EPA should be planning to incorporate the growing body of aerial methane fugitive emission measurements. Other, bottom-up based approaches to closing this gap should also be considered (e.g., unintentional storage tank emissions or unlit flares, see Rutherford et al. 2021).

See also comment (2) below regarding the GHGRP.

*Gathering and processing segment*

The activity data used by the Greenhouse Gas Inventory in computing emissions for gas processing is from the Oil and Gas Journal Worldwide Gas Processing Survey (citation below). Wouldn't it be more appropriate to use this dataset for apportioning emissions by state, compared to the current approach, which uses fraction of onshore natural gas production?

However, it is also worth noting that the Oil and Gas Journal Worldwide Gas Processing Survey is not available open-source online. The EIA dataset of natural gas processing capacity is available open source and is updated every year (citation below).

*Transmission segment*

The methodology documentation describes how pipeline mileage is used to apportion national emissions to each state. According to Zimmerle et al (2015), the pipelines themselves are only a minor contribution towards total emissions (see Table S15 in supplementary information). The majority of emissions within the transmission segment are from the compressor stations. Thus, while pipeline mileage might provide a rough estimate, a more accurate allocation is possible using counts of transmission compressor stations. You can find a database of transmission compressor stations at the Department of Homeland Security website.

Rutherford, J.S., Sherwin, E.D., Ravikumar, A.P., Heath, G.A., Englander, J., Cooley, D., Lyon, D., Omara, M., Langfitt, Q. and Brandt, A.R., 2021. Closing the methane gap in US oil and natural gas production emissions inventories. *Nature communications*, 12(1), pp.1-12.

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Oil & Gas Journal, 2015. Worldwide Gas Processing Survey. Available online:

<https://www.ogj.com/ogj-survey-downloads/worldwide-gas-processing/document/17299826/worldwide-gas-processing-survey>

U.S. Energy Information Administration, 2019. *757 Processing Capacity*, electronic dataset, Natural Gas Annual Respondent Query System. Available online:

<https://www.eia.gov/naturalgas/ngqs/#?report=RP9&year1=2014&year2=2014&company=Name>

Zimmerle, D.J., Williams, L.L., Vaughn, T.L., Quinn, C., Subramanian, R., Duggan, G.P., Willson, B., Opsomer, J.D., Marchese, A.J., Martinez, D.M. and Robinson, A.L., 2015. Methane emissions from the natural gas transmission and storage system in the United States. *Environmental Science & Technology*, 49(15), pp.9374-9383.

Department of Homeland Security, 2020. *Natural Gas Compressor Stations*, electronic dataset, Homeland Infrastructure Foundation-Level Data (HIFLD). Available online: <https://hifld-geoplatform.opendata.arcgis.com/datasets/natural-gas-compressor-stations/explore?location=35.816723%2C-96.043032%2C5.00>

**2. Are there additional Greenhouse Gas Reporting Program (GHGRP) data that could be used to allocate natural gas and petroleum emissions to each state?**

The intensity of oil and natural gas production operations varies across states. For example, a single wellpad in the Central Valley California might only include a single pumpjack while in the Permian Basin it will include several storage tanks and separation equipment in addition to the well itself. Thus, using well counts to apportion emissions across states misses the tremendous variability in emissions intensities.

The GHGRP contains rich datasets in equipment activity counts, in particular within equipment leaks reporting, storage tanks reporting, and other key emission sources. I would strongly recommend using this activity data for apportioning emissions between states.

**3. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned wells, including state-level datasets addressing plugging status of abandoned wells?**

This appears to be a duplicate of question (1) in the next section.

**4. Are there particular sources for which state-level regulatory or voluntary programs result in large differences in emission rates between states? Are state-specific data sets available for those sources?**

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There will be significant differences in fraction of tanks with emission controls across states based on regulations which have been enacted. For example, Colorado and California have established policies (Regulation No. 7 and Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, respectively) which require all storage tanks to have either a flare or a vapor recovery unit while such policies do not yet exist in Texas or North Dakota.

These differences will be manifested in levels of intentional venting emissions. Intentional venting emissions in the Greenhouse Gas Inventory are computed using the GHGRP. Operator-reported values for intentional venting are calculated using engineering equations for flashing and the reported fraction of tanks with emission controls such as flares or vapor recovery systems.

**Abandoned Oil and Gas Wells**

**1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

Given that Appendix B cites for a raw data source “historical count estimates developed by the EPA” but does not provide any citations to where these calculations can be found, it is not possible to tell which datasets have already been used by the EPA.  
I also assume that most useful state datasets, such as the Texas Railroad Commission have been folded in to Enverus.

### 3.15 Dr. Rhonda Sherman (Waste)

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<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Rhonda Sherman
<b>AFFILIATION:</b> Department of Horticultural Science North Carolina State University Raleigh, NC
<b>DATE:</b> October 15, 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity and transparency of this section?</b>
Overall, I think the clarity and transparency of this section is good, although some terminology is incorrect, and some sentences are too simplistic and give the wrong impressions.
<b>2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?</b>
<p>The third sentence of Chapter 7 Waste implies that aerobic composting facilities produce more methane than anaerobic composting operations. It is jarring to anyone who knows that anaerobic composting produces substantially higher amounts of methane than aerobic composting. I know that this is an introductory paragraph and the report gets into more details later, but this sentence should be modified.</p> <p>In the sixth sentence, I do not think that N<sub>2</sub>O emissions from wastewater treatment and composting should be lumped together because WWT emissions are <u>significantly</u> higher than those from composting.</p> <p>On Page 7-3, the report states “Those emission (sic) are likely insignificant as those Pacific Islands have no permanent population.” That is an inaccurate statement.</p> <p>In the Methodology Report EPA-430-D-21-001: Line 229 on page 2-7 in Section 7 states “No state data exists for 1990-1999.” Are you sure about that?</p> <p>On line 254, the report states that Alaska has no known composting operations. Please see my comments in the Composting section where I identified commercial or municipal composting taking place in eight cities in Alaska. There are likely more, as composting is very common in Alaska. For example, many people with large teams of sled dogs are composting their waste instead of landfilling it.</p> <p>Change the last sentence of the first paragraph of 7.3 Composting to “If the product is of lesser quality, it can be used as Alternative Daily Cover for landfills.” Making compost and then paying to dispose of it in a landfill does not make economic sense.</p>

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### **3. Data availability. Please address the following questions for each inventory source:**

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?

Page 7-55: The methodology assumes that all commercial or industrial composting takes place in windrows and that the materials are primarily yard trimmings, food waste, and some paper products. This is incorrect and skews the data due to the following:

- b) Yard trimmings are by far the primary ingredient in these composting facilities.
- c) A much smaller number of composting operations handle food waste. Using food waste as a feedstock requires more permitting requirements.
- d) Aerated-static piles and in-vessel composting is very common. It costs more than building a windrow, but it is more efficient and controls odors and run-off significantly better.
- e) Aerated-static piles and in-vessel composters release negligible amounts of methane. Windrows would likely release small amounts of methane only during the first three weeks of composting.

State compost regulatory offices have records of the types and amounts of materials being composted and the methodology used (i.e., windrows, ASP, in-vessel).

Dr. James Levis and Dr. Morton Barlaz at NC State University have published many papers about emissions from landfills, AD, and composting facilities.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Each state has had solid waste management rules since the early 1990s. North Carolina requires each County to file an annual report on the amount of material going to landfills, recycling, incineration, and composting. I would imagine that most other states have similar requirements.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

Determine the different amounts of GHG emissions from windrows, aerated-static piles, and in-vessel composting systems. These are methods of aerobic composting, so I am concerned that the methane emission assumptions may be too high. (see my comments in 3.)

**6. Data Presentation and Usability.**

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- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?**
- i. Related to the level of category/gas aggregation or disaggregation?**
  - ii. Are there specific categories where further data disaggregation could be helpful?**
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?**
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?**

You need to explain to the public why GHG emissions are so much higher for aerated composting than for AD. Is it because there are more composting than AD facilities? If so, then state it. Moreover, are you assuming that only small amounts of methane gas from AD facilities escape into the atmosphere? I think it is higher than the report shows.

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*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Rhonda Sherman

**AFFILIATION:**

Department of Horticultural Science  
 North Carolina State University  
 Raleigh, NC

**DATE:** October 15, 2021

**RESPONSE TO SOLID WASTE MANAGEMENT CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Composting**

**1. Data Questions**

- Is the assumption that Alaska has no commercial composting operations correct?**
- Are there any data about composting in U.S. territories?**
- Are there any state-level data sources that describe composting activity over time?**

Alaska and U.S. Territories **do** have aerobic composting facilities. Alaskan cities with composting facilities include Anchorage, Fairbanks, Juneau, Haines, Gustavus, Kodiak, Skagway, and Homer. This is not a complete list, but I want you to see that they do exist.

Alaska Green Waste Solutions in Anchorage has had an XACT Systems rotating drum bioreactor since 2009.

Golden Heart Utilities in Fairbanks compost biosolids.

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Juneau Composts does curbside pickup and composts food scraps in covered bays and windrows.

Haines Sanitation Inc. and Community Waste Solutions does in-vessel municipal waste composting in Haines.

City of Gustavus started food scrap composting in 1996 and installed a Green Mountain Technology aerated static pile composting system in 2006.

City of Kodiak is composting biosolids.

City of Skagway is composting food waste and herbivore animal manure inside a large warehouse.

Ocean Earth Fish Compost company has been composting in Homer since 2004.

Puerto Rico, Guam, and St. John have aerobic composting operations.

Trito Agro-Industrial Services (TAIS, Inc.) in San Juan, PR, collects food scraps from businesses and homes and has been composting since 2006.

Puerto Rico Green Waste Composting Group is in Guaynabo, PR.

Vivo Recycling has been composting in Caguas, PR since 2006.

Caribbean Composting in Arecibo, PR since 1998.

University of Guam does windrow composting of food scraps, manure, and yard waste.

Pacific Topsoils and Compost (Pacific Unlimited) is in Tamuning, Guam.

Zero Waste Guam composts biosolids.

Island Green Living is the largest composting operation in St. John.

This is not a complete list of composting facilities in U.S. Territories. I just wanted to show you that there are several in existence.

Every U.S. state requires annual reporting of municipal waste materials management including, landfilling, composting, and incineration. In addition, I think every state has composting regulations, so they have a list of permitted facilities and the types and quantities of materials composted. The state of North Carolina has had composting regulations since 1991.

### **Stand-Alone Anaerobic Digestion**

**1. Do you have or know of any state-level data for counts of operational anaerobic digesters (processing food waste) by year?**

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Every state’s Division of Waste Management should have that information.

BioCycle may have compiled that information.

**2. Are there any facility-specific data sources we could use to fill data gaps on the quantity of waste processed by stand-alone digesters for any and all years of the 1990–2019 time series?**

State solid waste offices would likely have that information. I want to say that I am uncomfortable with the terminology used in the first sentence of 7.3 Stand-Alone Anaerobic Digestion on page 7-57 Waste. AD produces biogas and digestate, which are indigestible materials and dead microorganisms. Please do not refer to it as compost. I suggest you end the sentence with “producing biogas and soil amendments.” Delete “(e.g., compost).”

### 3.16 Dr. Bryan Staley (Waste)

PEER REVIEW COMMENT TEMPLATE
<i>Methods Support Document: Inventory of U.S. Emissions and Sinks by State</i>
<b>NAME:</b> Bryan Staley, PhD, PE
<b>AFFILIATION:</b> Environmental Research & Education Foundation 3301 Benson Drive, Ste 101 Raleigh, NC 27609
<b>DATE:</b> October 28, 2021
RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS
Please provide narrative responses to each of the Charge Questions below.
1. What are your overall impressions of the clarity and transparency of this section?
Generally, the clarity and transparency is average to above average in my opinion. The biggest area of improvement lies in ensuring clarity related to guidance values used in the equations that estimate emissions. For instance, even if a landfill is reporting emissions directly, if they are measured values (e.g., Gas collected) and are inserted into equations to derive emissions then assumptions are still being made, which induces uncertainty and potential inaccuracies. The chapter and supporting information can be more robust in these areas.
2. What recommendations do you have to add to the overall completeness and accuracy of this chapter?
I have a number of suggestions:
<ul style="list-style-type: none"> <li>• A significant amount of narrative is dedicated to the discussion of backcasting and scale up values related to the incompleteness of the GHGRP data set. This is useful, but the way it is written seems to suggest this is a significant piece to ensure accuracy. Of these, the scale up values are most important and the data/approach used to calculate that should be made explicit. For the backcasting, the most important part is to maximize accuracy for the key year(s) that are being used from a policymaking/benchmarking standpoint.</li> <li>• The justification for use of guidance factors/values in the equations used to estimate emissions can be more transparent. Specifically, the science to support the following values should be considered:                         <ul style="list-style-type: none"> <li>○ Lo: waste composition is changing and Lo is entirely a function of waste composition. Prior research has suggested variability in Lo and that Lo generally has tended to be lower than the guidance value used (100). Justification for the reasonableness and variability of this value would aid the reader to understand how much the variability impacts subsequent computed emissions values.</li> <li>○ DOC and DOCf: The guidance values used have been demonstrated to be higher than actual values, in large part because the fraction of waste going to landfills that is MSW is typically significantly less than 100%. Over 40 states currently allow non-MSW wastes to be placed in MSW landfills, which can significantly lower the actual DOC value. Thus, if the guidance DOC value is used then it will overestimate emissions.</li> </ul> </li> </ul>

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- CH<sub>4</sub> Oxidation: Peer-reviewed research in this area has matured substantially over the past decade. Inclusion of a summary of key research findings from these papers would be useful for the reader to understand variability (particularly due to geography).
- Gas Collection efficiency: The assumption of 75% gas collection efficiency could be better justified in the methods documents that illustrates why this number is deemed reasonable and when it should be used. Emphasis that gas collection efficiency is variable and increases over time and exceeds 90% upon closure would be helpful to expound upon.

### **3. Data availability. Please address the following questions for each inventory source:**

- For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

I am not aware of any discrete datasets below a state level unless it has been part of a niche study/effort. While not directly available, there is a significant amount of waste composition data from characterization studies at the state, county and city level. Such data could be used to create estimates of Lo and DOC values to ascertain if local/geographic waste generation comports with guidance values.

**4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

Generally, what is critical is to minimize uncertainty for years or periods that are being used as a datum/baseline and/or for policy purposes, such as goal setting for emissions reductions to be equal to or less than a specific year. In such cases, it is these year(s) or periods that should be prioritized to minimize uncertainty.

Beyond this, uncertainty should be minimized to the extent possible for the current time period and moving forward that that estimates of the impact of waste-related emissions are as accurate as possible.

**5. Key Categories. EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.**

Refinements could be made in the following areas:

Lo: as waste composition shifts over time, so will the Lo value, which means that today's Lo may be different than the Lo 10 years from now. For example, as the fraction of food waste goes up, Lo will

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potentially go up as well. Like the CH<sub>4</sub> oxidation, where different values can be used depending on site specific conditions, the same approach is needed for Lo.

DOC: Currently about 14 states have conducted detailed estimates of how much non-MSW is going to MSW landfills, which allow for DOC values to be directly computed. In states where non-MSW material can be accepted at MSW landfills, the actual DOC values tend to be lower than the guidance DOC value (in a number of cases significantly). Updating this guidance value to be site-specific (or at least multiple options based on what waste is accepted) would reduce uncertainty.

Direct emissions measurements: As direct emissions technologies continue to become more cost-effective and available, comparisons should be made between estimated/computed emissions values and a frequently measured time series analysis of direct emissions measurements. Such a comparison would allow for a side-by-side comparison of the computed vs measured values and ascertain how accurate the models are as a way to validate them.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventoryexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

The webpage provides a decent overview and is easy to read by a layperson.

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*Methods Support Document: Inventory of U.S. Emissions and Sinks by State*

**NAME:** Bryan Staley

**AFFILIATION:**

Environmental Research & Education Foundation  
 3301 Benson Dr., Suite 101  
 Raleigh, NC 27609

**DATE:** October 28, 2021

**RESPONSE TO SOLID WASTE MANAGEMENT CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**MSW Landfills**

**1. Data Questions**

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- Are there datasets for individual states’ landfill gas (LFG) recovery activity?
- Are there data available for open dumpsites in the U.S. territories?

EREF has some unpublished data that summarizes beneficial landfill gas use for Subtitle D landfills. I am not aware of data available for open dumpsites in US territories

**2. The current method makes some simplifying assumptions and includes uncertainties in the allocation of national-level U.S. emissions to states (e.g., recovery rates are the same for all states and match the national recovery rate). Are there alternative assumptions or different datasets that would improve the accuracy of MSW landfill estimates? Do you have recommendations to refine the methodology to estimate emissions over the time series more accurately?**

Certainly, shifting to models that integrate more site-specific (Tier IV model) data will reduce uncertainty associated with simplifying assumptions.

**Industrial Landfills**

**1. Do you have recommendations to refine the methodology to estimate emissions over the time series more accurately?**

EREF funded a study that was recently completed by Yale University that looked at industrial waste generation. This might be a useful study to refer to as it may help inform efforts around estimating industrial waste emissions.

**Composting**

**1. Data Questions**

- Is the assumption that Alaska has no commercial composting operations correct?
- Are there any data about composting in U.S. territories?
- Are there any state-level data sources that describe composting activity over time?

Data that can answer these questions is currently being collected as part of a joint effort by EREF and the US Composting Council.

**Stand-Alone Anaerobic Digestion**

**1. Do you have or know of any state-level data for counts of operational anaerobic digesters (processing food waste) by year?**

Yes. EREF has recently updated its national dataset of AD facilities and expects to publish this data in the first half of 2022.

**2. Are there any facility-specific data sources we could use to fill data gaps on the quantity of waste processed by stand-alone digesters for any and all years of the 1990–2019 time series?**

EREF has a report that summarizes AD data in the early to mid-2010s.

3.17 Mr. Michael E. Van Brunt (Energy)

PEER REVIEW COMMENT TEMPLATE
<i>Inventory of US Emissions and Sinks by State: Methods Support Document</i>
<b>NAME:</b> Michael Van Brunt
<b>AFFILIATION:</b> Covanta 445 South Street Morristown, NJ 07960
<b>DATE:</b> 10/15/2021
<b>RESPONSE TO GENERAL CHAPTER CHARGE QUESTIONS</b>
Please provide narrative responses to each of the Charge Questions below.
<b>1. What are your overall impressions of the clarity of this section?</b>
Section is written clearly and concisely.
<b>2. What recommendations do you have to add to or improve the overall transparency, completeness, consistency and accuracy of this chapter?</b>
<p>Within the energy sector, one can obtain, or relatively quickly calculate, GHG emissions from a variety of sources at a state level, including Form EIA-923, eGRID, GHGRP Flight, Clean Air Markets Division (CAMD) and the National Emissions Inventory (NEI). At the very least, the EPA should consider providing a comparison of the different data sources so the user can see, and understand, the differences in the data.</p> <p>However, given the importance of the climate change challenge, and the large role played by the energy sector, it would be worth moving toward a unified approach developed through the consolidated application of, what is likely today, disparate resources.</p> <p>Perhaps most importantly, the utility of this reporting, and the National GHG Inventory it will accompany, has been impacted by a strict adherence to the IPCC Guidelines. While it is useful to be able to compare emissions from country to country using a similar frame of reference, the real work of mitigating GHG emissions will be driven by state and national level policy. As such, being bound by an international reporting scheme, particularly where its requirements are beginning to deviate from the latest science, runs the risk of misguiding policy development.</p> <p>An important case in point is the use of outdated Global Warming Potentials (GWPs). The use of the 4<sup>th</sup> assessment report’s 100-year methane GWP value of 25 acts to deprioritize methane mitigation relative to CO2 sources. Our current scientific understanding of methane’s potency and the critical nature of SLCPs in achieving near-term wins in quickly reducing the growth in radiative forcing is not adequately reflected in either this state disaggregation, or the <i>National Inventory</i>.</p> <p>A second case in point is the inclusion of MSW combustion or incineration in the energy sector. While the IPCC Guidelines do include MSW combustion for energy within the energy sector, these facilities are more appropriately considered waste facilities. Not only are these facilities classified as solid waste management under NAICS and SIC codes, the majority of their economic “value-add” is in the waste</p>

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sector. Continuing to include these facilities outside of the waste sector results in a systematic underreporting of total waste sector GHG emissions.

Lastly, it appears that in several cases, there can be discrepancies in the data between the *National Inventory* and the sum of the state data. Given that this report accompanies the *National Inventory*, I think it is appropriate to think of this report, first and foremost, as an allocation of the *National Inventory* to the states. With this as a primary objective, the underlying data collected on a state level should always be used to apportion the *National Inventory*, instead of creating another approach to an inventory. For full transparency, it would make sense to clearly report the magnitude of the “adjustment” from the state-based approach to the apportionment of the *National Inventory*.

### **3. Data availability. Please address the following questions for each inventory source:**

- a. For each of the categories, are there additional relevant data sources that are not currently included, but could be incorporated into this analysis?**
- b. For national level datasets that are currently used, are you aware of other comparable datasets of activity, emission factor, or emissions data that are available at the state, county, or zip-code levels?**

Overall, I think the report should use the data reported to the EPA under the Mandatory GHG reporting program as a primary resource. While the coverage of data is incomplete, as the EPA reporting program only applies to facilities with emissions greater than 25,000 t CO<sub>2</sub>e, it would provide a very robust data set to capture the majority of emissions. A “state-level increment” adjustment, similar to what the EIA uses in basing summarized data off of generator form EIA-860 / EIA-923 reports could be used to reconcile the bottom-up versus top-down approaches. This would allow significant QA/QC of data, as the agency could review change over time at the facility level as well as change in the state-level increment over time.

NEI, CAMD, and eGRID data are also all available for the power sector at a state-level.

### **4. Uncertainty. Currently uncertainty ranges are not included for the state level estimates. Please provide feedback on what qualitative and quantitative information would be useful. Timeseries Coverage. Currently state data covers 1990-2019 consistent with the 2021 National GHG Inventory, and inclusive of most known baseline periods for climate policy. Subsequent publications of this data will also strive to maintain this consistency with the *National Inventory*. As state-specific input datasets are not always available over the entire timeseries, understanding which years may be more important can help us to better prioritize our backcasting and methodological efforts across the time series. EPA appreciates feedback on which, if any years should be prioritized for future state-level estimates (e.g., 2000 and later, 2005 and later, 2010 and later, or the full time series).**

For certain portions of the energy sector, a robust analysis of uncertainty could be centered around a comparison of the different methodologies and datasets already in place. For example, for electric generating units, the report could compare the GHG emissions inventory from the NEI, to the GHGRP, to eGRID, to fuel emission-based calculations using NEI data.

For transportation, the comparison would comprise NEI, the fuel-consumption based approach outlined in this report, and VMT approach.

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**5. Key Categories.** EPA anticipates prioritizing methodological refinements for more significant categories to make efficient use of available resources over time. EPA appreciates feedback on which categories are more relevant for further refining for the sector you are reviewing.

Prioritization should be based on relative emissions magnitude of sources and uncertainty.

**6. Data Presentation and Usability.**

- a. Are there other ways the state-level emissions data could be presented to facilitate their use (e.g., in the EPA GHG Inventory Data Explorer available online at: <https://cfpub.epa.gov/ghgdata/inventorvexplorer/>)?
  - i. Related to the level of category/gas aggregation or disaggregation?
  - ii. Are there specific categories where further data disaggregation could be helpful?
  - iii. What data format would best facilitate the use of the state-level emissions data (e.g., .xlsx download, etc.)?
- b. What additional datasets or information could be provided to help increase the usability of the state-level emissions data?

Within the transportation sector, it would be very helpful to have data reported by vehicle type, particularly between heavy-duty and light-duty vehicles. Being able to download the data in .csv and .xlsx / .xls formats would be very helpful.

When tabulating the data in Excel for download, consider creating a version containing the full dataset that is amendable to analysis in database software or through excel pivot tables. Additional columns would be needed, containing metadata fields: Table # (e.g. Table A-52), Sector (e.g. Electricity), Description (e.g. Unadjusted), Fuel Subcategory (e.g. Supplemental NG). This would greatly facilitate use and analysis across states, sectors, and fuels.

**PEER REVIEW COMMENT TEMPLATE**

*Inventory of US Emissions and Sinks by State: Methods Support Document*

**NAME:** Michael Van Brunt

**AFFILIATION:**

Covanta  
 445 South Street  
 Morristown, NJ 07960

**DATE:** 10/15/2021

**RESPONSE TO COMBUSTION CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

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**Fossil Fuel Combustion**

**1. Some fuels have differences in consumption data between the aggregated state-level totals and national totals. The current approach is to use data from the *National Inventory* in those cases. Are there other approaches that could be taken? Do you know of cases where others have dealt with the differences in the totals, and if so how?**

I agree with the approach to use the *National Inventory*. In fact, given that this will be a companion report to the *National Inventory*, I think we are best served by ensuring that the state-level data is an exact apportionment of the *National Inventory*, such that the sum of the states always equals the *National Inventory*. For transparency, any adjustments made to the individual states' emissions should be clearly reported.

**2. Consistent with the IPCC Guidelines, we have adjusted fuel consumption totals in the energy sector to account for consumption in the IPPU sector. In some cases, this step could lead to a negative emission total for a state if the subtracted amount (as determined from the assumed distribution) was greater than consumption data from the State Energy Data System (SEDS). This outcome was corrected to zero if that was the case, but are there other approaches for correcting for that difference?**

Given that energy use of fossil fuels is usually much greater than that in the IPPU sector, it would seem that such a scenario would indicate a significant misallocation in the assumed distribution. As such, I don't think there is a single rule to be applied here. Instead, it will probably warrant some consideration for each individual case which might result in a reallocation of the assumed distribution to/from one or more states.

**3. Consistent with the *National Inventory*, the default approach taken here was to allocate transportation sector CO<sub>2</sub> emissions based on FHWA fuel use/sales by state. For some states, this may not be accurate because fuel sold in a state may be combusted in other states. Another option is to use vehicle miles traveled (VMT) data by state but that approach does not factor in vehicle fuel economy. Are there other alternative or complementary approaches to allocate transportation fuel across states, including VMT data and other sources (e.g., NEI – based on county-level fleet and activity data to generate a bottom-up inventory) that EPA should consider? If so, what data sources exist to help with that alternative approach? Would it be helpful to present transportation sector emissions using multiple approaches in future inventories?**

It would be very helpful to present the data using multiple approaches. While I currently think that the NEI / MOVES model approach should be primary, it would be very interesting and informative to see how those predictions matched against the VMT approach and the fuel sales approach.

**4. Mobile source non-CO<sub>2</sub> emissions are allocated across states based on vehicle-miles-traveled data while mobile source CO<sub>2</sub> emissions were allocated based on fuel sales, as mentioned above. Is there an issue with using two different methodologies for mobile source CO<sub>2</sub> vs. non-CO<sub>2</sub> state splits?**

Yes. I would recommend that the inventory adopt the NEI approach of using the EPA's MOVES model. As supplemental information, the transportation fuel sales could be used as a check, although there would be some mismatch due to temporal and state-line issues.

**5. Several fuels have variable C factors over time including coal, natural gas, gasoline, and diesel fuel. Those fuels might also have variable C factors across areas/states. Are data available to build out state-specific C factors for the fuels with variable C contents? If so, could it be done in a way that the state-level total emissions still matched up to the national total emissions for those fuels?**

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### *Inventory of US Emissions and Sinks by State: Methods Support Document*

I am not aware of state-specific carbon content values. However, a state average of all of the reported average carbon content data by fuel, for both liquid and solid fossil fuels, could be extracted from the GHGRP program data and applied as a surrogate value for all fuels consumed in the state.

**6. Geothermal emissions could be allocated by the type of geothermal production per state (because different types have different emissions factors) if that data are available. Is there more information on state-level geothermal emission factors and production?**

I am not aware of additional state-level geothermal data.

### **Non-Energy Uses (NEU) of Fossil Fuels**

**1. For petrochemical feedstocks, non-energy use (NEU) of natural gas is allocated across states based on petrochemicals emissions data per state from the IPPU adjustments, while other fuels are allocated based on the underlying SEDS data. Allocating across states based on the underlying SEDS data ensures there are no states where NEU use is larger than original SEDS data and there are no zeros associated with subtracting NEU (it is not an issue for natural gas because use is so high overall compared with NEU use). Could different approaches be used or can the petrochemical data be used without resulting in negative use?**

One other approach that might be worth considering would be to use value-add data from the U.S. economic census (<https://www.census.gov/programs-surveys/economic-census.html>). Unfortunately, the economic census is not available each year, but it does provide a total value add by industry which may be slightly more directly correlated to production than emissions.

### **Incineration of Waste**

**1. Waste incineration emissions are calculated based on the combustion of fossil components of both municipal solid waste (MSW) and tires. However, emissions are disaggregated to States based only on MSW tonnage. Are there approaches or data available to disaggregate emissions based on waste category (e.g., MSW combustion vs. tire combustion)?**

Waste combustion emissions data should be based directly on GHGRP GHG emissions data, when available. Taking a look at 2019 reported data, we estimated that this approach will capture 99.5% of the sector's direct GHG emissions (see attached spreadsheet file titled "WTE GHG Data (2019) v3.xlsx"). We estimated the remaining 0.5% based on an assumed fossil carbon content in MSW and estimated MSW throughput. MSW throughput is either taken from the EIA reports, or is estimated based on the design data from the Energy Recovery Council (ERC). Performing the allocation this way will account for differences in biogenic / fossil ratios that can occur between facilities.

For earlier years, the approach provided is reasonable.

### **International Bunker Fuels**

**1. The approach used to allocate jet fuel bunker fuels by state is currently based on the total amount of jet fuel used by state which could potentially lead to an over- or under-estimation for some states of bunker fuel emissions. Are there other more accurate approaches to allocate jet fuel bunker data across states as opposed to the percentage of jet fuel total use? For example, using Federal Aviation Administration flight level data on departures and destinations or assuming based on states with international airports and flights?**

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This is likely the best approach. An attempt to allocate by flight level data will not be able to take into account differences in fuel use by destination.

**Wood Biomass and Biofuels Consumption**

**1. What recommendations do you have to add to ensure high-quality state-level estimates consistent with the *National Inventory*? (Cf. General Chapter Charge Questions 1-5)**

One option would be to look at EIA capacity or production data by state.

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**DATE:** 10/15/2021

**RESPONSE TO FUGITIVE CHARGE QUESTIONS**

Please provide narrative responses to each of the Charge Questions below.

**Coal Mining**

**1. Do you have any comments specific to the methodology and emission estimates for active coal mines and abandoned coal mines?**

No recommendations – coal mine methane is outside my area of expertise.

**2. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned coal mines, including state-level datasets addressing recovery of methane from abandoned mines?**

I'm not aware of any state datasets – coal mine methane is outside my area of expertise.

**Abandoned Underground Coal Mines**

**1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

I'm not aware of other relevant datasets – coal mine methane is outside my area of expertise.

**Petroleum Systems and Natural Gas Systems**

**1. Are there relevant dataset(s) that could be used to replace or supplement the data currently used to allocate petroleum and natural gas system emissions to the state level? Particularly, state or detailed location information on gathering and boosting stations, processing plants, and transmission and storage stations?**

There is significant work underway by EDF, NASA JPL and others to better quantify emissions of methane from gas and oil fields, natural gas distribution systems, and natural gas transmission stations, as

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well as waste management infrastructure including landfills, wastewater treatment plants, compost facilities, and anaerobic digestors. See: <https://methane.jpl.nasa.gov/>

Also, satellite data may be useful in apportioning fugitive methane emissions. See article by Climate & Clean Air Coalition here: <https://www.ccacoalition.org/en/news/satellite-data-reveals-extreme-methane-emissions-us-permian-oil-gas-operations>

**2. Are there additional Greenhouse Gas Reporting Program (GHGRP) data that could be used to allocate natural gas and petroleum emissions to each state?**

I'm not aware of other datasets that would be more useful than Subpart W in this regard.

**3. Are you aware of any state datasets that may be useful in helping to refine emission estimates for abandoned wells, including state-level datasets addressing plugging status of abandoned wells?**

No

**4. Are there particular sources for which state-level regulatory or voluntary programs result in large differences in emission rates between states? Are state-specific data sets available for those sources?**

Probably one of the latest factors will be age of distribution systems. Significant work is available in the peer reviewed literature that has looked at fugitive emissions in different cities.

### **Abandoned Oil and Gas Wells**

**1. What other relevant data sources could be included? If data are used at the national level, are you aware of other comparable data sources at the state level?**

Satellite data may be useful in apportioning fugitive methane emissions. See article by Climate & Clean Air Coalition here: <https://www.ccacoalition.org/en/news/satellite-data-reveals-extreme-methane-emissions-us-permian-oil-gas-operations>

U.S. Environmental Protection Agency/Climate Change Division (EPA/CCD)  
 Contract Number 68-HER-H-19D-0030  
 PEER REVIEW SUMMARY REPORT –Final

#### 4. Conflict of Interest Form

U.S. Environmental Protection Agency  
 Conflict of Interest Inquiry

You have been requested by EPA to serve as a Peer Reviewer for *Inventory of US Emissions and Sinks by State: Methods Support Document* and your involvement in certain activities could pose a conflict of interest or create the appearance of a loss of impartiality in your review. Although your involvement in these activities is not necessarily grounds for exclusion from the peer review, affiliations or activities that could potentially lead to conflicts of interest are included in the table.

Please complete the table and sign the certification below. If you have any questions, contact the Peer Review Lead, Kirsten Franzen, at [kfranzen@rti.org](mailto:kfranzen@rti.org), at your earliest convenience to discuss any potential conflict of interest issues.

Conflict of Interest Analysis		
	YES	NO
a. To the best of your knowledge and belief, is there any connection between the subject topic and any of your and/or your spouse's compensated or uncompensated employment, including government service, during the past 24 months?		
b. To the best of your knowledge and belief, is there any connection between the subject topic and any of your and/or your spouse's research support and project funding, including from any government source, during the past 24 months?		
c. To the best of your knowledge and belief, is there any connection between the subject topic and any consulting by you and/or your spouse, during the past 24 months?		
d. To the best of your knowledge and belief, is there any connection between the subject topic and any expert witness activity by you and/or your spouse, during the past 24 months?		
e. To the best of your knowledge and belief, have you, your spouse, or dependent child, held in the past 24 months, any financial holdings (excluding well-diversified mutual funds and holdings, with a value less than \$15,000) with any connection to the subject topic?		
f. Have you made any public statements or taken positions on or closely related to the subject topic under review?		
g. Have you had previous involvement with the development of the document (or review materials) you have been asked to review?		
h. To the best of your knowledge and belief, is there any other information that might reasonably raise a question about an actual or potential personal conflict of interest or bias?		
i. To the best of your knowledge and belief, is there any financial benefit that might be gained by you or your spouse as a result of the outcome of this review?		

CERTIFICATION

I hereby certify that I have read the above statements and, to the best of my knowledge and belief, no conflict of interest exists that may diminish my capacity to provide an impartial, technically sound, objective review of the subject matter or otherwise result in a biased opinion.

\_\_\_\_\_  
(Name – please print)

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Date)

### Information Relating to Conflict of Interest (COI)

Peer reviewers are expected to provide an impartial, technically sound, objective, independent, and unbiased technical review of the study entitled:

*Inventory of US Emissions and Sinks by State: Methods Support Document.*

We request the information in this COI Inquiry from interested peer reviewer candidates for the purpose of ruling out COI and other concerns as we work to create an independent and balanced selection of peer reviewers. An interested peer reviewer candidate's involvement in certain activities could pose a COI or create the appearance of a loss of impartiality in the peer review. Although involvement in such activities is not necessarily grounds for exclusion from the peer review, peer reviewer candidates need to disclose affiliations, interests, activities, or relationships that could lead to perceived COIs.

Before you can be selected and agree to serve as a peer reviewer, you will need to disclose any Actual or Potential COI (as explained below) on this form. The financial and professional information obtained from the interested peer reviewer candidate as part of the evaluation to determine the existence of an Actual or Potential COI is considered private and non-disclosable to outside entities except as required by law and/or regulation.

The following definitions provide general descriptions of Actual or Potential COI:

- **Actual COI:** An Actual COI would be any financial interest held by an individual (or certain related persons) that could be affected by their participation in the peer review.
- **Potential COI:** A Potential COI could be any circumstance related to an individual (or certain related persons) that may cause "a reasonable person with knowledge of the relevant facts" to question the individual's impartiality in participating in the peer review (i.e., "an appearance of loss of impartiality").

To preserve the independence and ethics of the peer review process, individuals with Actual or Potential COIs may not be allowed to participate in the peer review. Please consider carefully whether you might have an Actual or Potential COI or if any other interests, activities, or relationships would cause your impartiality as a peer reviewer to be questioned.

If you have any questions, contact the RTI Peer Review Lead, Kirsten Franzen ([kfranzen@rti.org](mailto:kfranzen@rti.org)) at your earliest convenience to discuss any perceived COI issues.

For more information about peer reviews, see the EPA Peer Review Handbook, 4th Edition, October 2015.

**Appendix A – Peer Reviewer CVs**

Please see separate file.

**Appendix B – Charge Questions**

Please see separate file.

**Appendix C – Supplemental WTE GHG Data**

Please see separate file.

**Appendix D – NLA Supplemental Charge Question Response**

Please see separate file.