Summary of Public Review Comments and Responses:

Draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017*

April 2019

U.S. Environmental Protection Agency

Office of Atmospheric Programs

Washington, D.C.

Responses to Comments Received during the Public Review Period on the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017*

Preface

EPA thanks all commenters for their interest and feedback on the annual *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. Per Federal Register Notice 2019-01545 published on February 12, 2019, EPA announced document availability and request for comments on the draft "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017" report. The EPA requested recommendations for improving the overall quality of the inventory report finalized April 11, 2019 and submitted to the United Nations Framework Convention on Climate Change (UNFCCC), as well as subsequent inventory reports.

During the 30-day public comment period which ended March 14, 2019, EPA received 13 sets of comments, including 33 unique comments in response to the notice. This document provides EPA's responses to technical comments on methods and data used in developing the annual greenhouse gas inventory. The verbatim text of each comment extracted from the original comment letters is included in this document, arranged by commenter. Full comments can be found in the public docket here: https://www.regulations.gov/docket?D=EPA-HQ-OAR-2018-0853. Note, at time of publication of this document some comments sent to EPA via email were still pending posting to Docket but should be available shortly. Where available, Docket ID numbers are noted under commenter's name for ease of reference. EPA's responses to comments are provided immediately following each comment excerpt.

Commenter: GPA Midstream Association

Matt Hite

Docket ID Number: EPA-HQ-OAR-2018-0853-0007

Comment 1: GPA Midstream urges EPA to reconsider the methodology EPA uses to calculate Greenhouse Gas Emissions (GHGs) for the midstream Gathering and Boosting (G&B) segment of the natural gas production and distribution sector. As is stated in Chapter 3 of the Inventory, EPA does not use data from the Greenhouse Gas Reporting Program (GHGRP) to calculate the emissions for this segment. Instead, EPA uses emissions factors from the 1996 EPA/GRI report and Zimmerle et al. (2015) study. GPA Midstream has significant concerns about the use of both data sources for emissions factors associated with the G&B segment, but we will address our comments to the limitations of the 1996 EPA/GRI data.

As EPA has recently acknowledged, the 1996 EPA/GRI report is now over two decades old and was focused on the equipment and facilities used to produce natural gas. In the recent Proposed Rule, Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Reconsideration 83 Fed. Reg. 52056 (October 15, 2018) – Docket ID No. EPA-HQ-OAR-2017-0483 (NPSP OOOOa), EPA acknowledged in the Background Technical Support Document that the 1996 EPA/GRI report "does not have specific information on major production and processing equipment counts for the gathering and boosting segment." TSD § 2.3.4 at 15-16. In short, the data from the 23-year old GRI study is not only outdated, but not from the G&B industry segment, and therefore the data should not under any circumstances be used to evaluate emissions from the G&B industry.

During a comment period for NSPS OOOOa, GPA Midstream highlighted EPA's clear error in relying on the 1996 EPA/GRI study to estimate emissions from the model midstream G&B plant. In order to counter the outdated, inapposite data from the EPA/GRI 1996 report, GPA Midstream gathered an inventory from member companies of equipment found at current-era G&B facilities. [1] This new data was, in part, gathered from the publicly available data found in the GHGRP, 40 CFR Part 98 Subpart W (Subpart W) for the G&B segment. However, because Subpart W (at 40 CFR Part 98.236(a)(9)) directs operators to report equipment types (separators, meters/piping, gathering compressors, in-line heaters and dehydrators) across a basin, GPA Midstream could not gather a per-site count directly from the reported data.[2] Accordingly, GPA Midstream solicited member companies to submit facility-level data. Table 1 below compares EPA's model plant (based on the 1996 data from non-G&B facilities) with GPA Midstream's updated model plant (based on current G&B facility data). EPA asserts that each facility has 11 separators, seven meters/piping, five gathering compressors, seven in-line heaters and five dehydrators. GPA Midstream's actual data demonstrates that EPA's numbers are not representative of current G&B facilities.

Table 1- Updated Gathering and Boosting Model Plant

[1] GPA Midstream's comments and the supporting data are available on the NSPS OOOOa docket and are incorporated here by reference. https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0483-1261

[2] GPA Midstream has long advocated for Subpart W reporting for the GHG Reporting Rule to be on a per-facility basis. Had the regulation required equipment to be reported at an individual facility level and not a basin level, the data would have been even more precise in informing this rulemaking.

Equipment	Model Plant (GRI)	GPA Model Plant
Separators	11	5
Meter/Piping	7	6
Gathering Compressors	5	3
In-Line Heaters	7	1
Dehydrators	5	1

GPA Midstream compiled its model plant from eight companies and includes 1,821 G&B sites. Due to the basin-wide reporting required by Subpart W, the data may overstate the actual number of meters at a typical G&B facility. Specifically, basin level reporting in Subpart W requires companies to report equipment outside of a traditional G&B facility boundary, such as meters located at production well sites where producers deliver gas to midstream operators. Hence, the rolled-up basin data in Subpart W for G&B facilities included meters located at production well pads. Depending on the size of the basin and the way in which companies document their inventory, GPA Midstream could not readily identify and separate out certain reported meters that are not within the G&B facility but are included in the basin data set. When this was the case, to be conservative in its approach, GPA Midstream used EPA's assumption of 7 meters/site. However, GPA Midstream believes this to be a conservatively high number.

If EPA continues to use a similar flawed methodology to count equipment when EPA prepares the Inventory as EPA used in its NSPS OOOOa support documents, the resulting emissions estimates will be biased high – potentially more than double what they should be, since there is a direct correlation between the size of a G&B facility (measured by the scope of equipment) and the total emissions per site of methane, VOCs, and Hazardous Air Pollutants (HAPs). Accordingly, to more accurately estimate midstream emissions, we urge EPA to utilize GPA Midstream's model plant equipment numbers which can be entered directly back into the calculation analysis and scaled up. At a minimum, EPA should utilize the data gathered from the reporting EPA has required industry to provide under Subpart W to inform the Inventory. If the data gathered in Subpart W is not useful, EPA should revise the reporting rule.

Conclusion

In short, GPA Midstream asks EPA to revise the methodology EPA uses to calculate GHGs for the midstream G&B segment of the natural gas production and distribution sector to reflect the current, more reliable data GPA Midstream has collected from the G&B segment and EPA's subpart W database. GPA Midstream stands ready to answer any questions the Agency may have and looks forward to working with EPA to ensure the GHG data in the Inventory is a reliable estimate of GHG emissions from midstream sector.

Response: The GHGI does not rely on data from GRI/EPA 1996 or Zimmerle et al. 2015 to estimate methane from the gathering and boosting segment. The GHGI emissions estimates are instead developed using the following data sources:

- ***Marchese et al. 2015 and an estimate of station counts (not an estimate of component counts as implied by the comment) for gathering and boosting stations, including episodic events***
- ***GHGRP data for gathering pipeline leaks and blowdowns***

For gathering and boosting stations, EPA proposed to update estimates to use the reported GHGRP data in this year's GHGI, but stakeholder feedback received throughout the development of this year's

GHGI supported delaying such an update until review of upcoming study data and additional years of GHGRP data.

For gathering pipeline leaks and blowdowns, this source was previously estimated using GRI/EPA 1996 data, but has been updated in this year's GHGI to use annual GHGRP data.

Commenter: American Gas Association

Pamela Lacey

EPA Docket ID Number: EPA-HQ-OAR-2018-0853-0008

Comment 2: **Update to Emission Factor for Estimating Emissions from Transmission Pipeline Blowdowns**

In a November 27, 2018 letter to EPA, AGA commented on updates[3] EPA was considering for estimating transmission pipeline blowdowns in the 2019 EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks (GHGI). At that time, EPA was considering updating the emission factor for transmission pipeline blowdowns based on data submitted for the 2016 reporting year under Subpart W of the GHG Reporting Program (GHGRP). In the AGA letter and a subsequent phone call, AGA identified issues with the EPA proposed emission factor for pipeline blowdowns because it included flawed data reported for 2016 by one company. The initial 2016 data from that company included an error, which was subsequently corrected by the reporting company. Thus, the current Subpart W dataset available to EPA corrects the erroneous data. AGA's letter also noted that 2017 reporting year data were also available and should be considered when developing a new emission factor. Ultimately, AGA recommended waiting an additional year to update the pipeline blowdown emission factor, because the emission factor using 2017 blowdown data was lower than the emission factor using 2016 data. A third year of data could potentially provide insight into whether one year was more representative than the other. For example, 2016 data may be atypical due to program maturity associated with the first year of reporting and/or a higher occurrence of blowdowns from construction / commissioning in 2016 that may not be representative of typical conditions.

In addition, it should be noted that companies are making concerted efforts to reduce blowdowns and blowdown emissions. This may lead to a downward trend over time.

In a February 12, 2019 Federal Register notice (84 Fed. Reg. 3444), EPA requested comment on the 2019 draft GHGI report, which updates the emission factor for transmission pipeline blowdowns using the average from corrected 2016 data and 2017 data. The notice also requests feedback on whether year-specific emission factors should be applied for 2016 and 2017, and whether the current emission factors should be applied for earlier years of the time series.

AGA appreciates EPA understanding the issue associated with the flawed 2016 data and revising the emission factor that was initially proposed. While AGA recommended waiting an additional year to integrate Subpart W data, we understand EPA's desire to proceed with the updated emission factor and applaud efforts to utilize Subpart W results to improve emission estimates for natural gas operations.

In response to EPA's request for feedback and because there are differences in 2016 and 2017 data, AGA recommends using event-specific emissions for 2016 and 2017, and applying the historical/previous

[3] "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017: Other Updates Under Consideration," U.S. EPA (November 2018).

emission factor for the earlier years in the time series. The resulting time series would show a one year increase in emissions in 2016 and similar emissions for other years. Alternatively, EPA could refrain from updating the emission factor in the 2019 inventory report, gather an additional year of Subpart W data, and update the transmission pipeline blowdown emission factor and emission estimates in the 2020 annual inventory report. The third year of Subpart W data (for 2018) could add insight regarding year-to-year variability and whether any data appears to be anomalous.

AGA remains concerned that the first reporting year (2016) may be lower quality data or an atypical year (e.g., more construction projects than representative of an average year), and requests that EPA continue to conduct an annual review of the pipeline blowdown emission factor that integrates additional Subpart W data for the most recent reporting year. For example, EPA should add the 2018 reporting year data when considering the appropriate transmission pipeline blowdown emission factor for the 2020 GHGI. The dataset that includes three years of Subpart W data should be carefully reviewed to consider not only average emissions from the cumulative dataset, but also year to year emissions and emissions and counts by event type for each year. The objective should be developing an emission factor that reflects representative or typical conditions for transmission pipeline operations. AGA offers its assistance in reviewing the data to help develop a high-quality emission factor.

Response: We agree with the comment and have updated the final GHGI to use year-specific GHGRP data for 2016 and 2017 emissions and GRI/EPA 1996 data for 1990-2015 emissions. We plan to review 2018 (and future years) GHGRP data to update the time series, assessing year-specific factors or other options such as average factors.

Commenter: American Petroleum Institute

Karin Ritter

Comment 3: The comments below consist of brief observations and recommendations on several segments of the draft Petroleum and Natural Gas Systems sections of the 2019 GHGI.

The letter also includes an attachment with preliminary comments on potential future revisions to the methodology of estimating emissions from offshore platforms.

1. Gathering & Boosting (G&B) stations emissions

In its October 2018 memo, EPA presented three scenarios for using GHGRP data to estimate G&B station emissions. EPA ultimately decided not to update its estimation methodology for G&B stations due to stakeholder feedback that supported maintaining the current GHGI methodology until new data becomes available.

EPA is seeking feedback on potentially applying a GHGRP-based methodology to estimate CO_2 emissions from G&B stations for inclusion in the final 2019 Inventory, while maintaining the current Inventory approach for CH_4.

<u>API Comments:</u>

In its August 22, 2018 comment letter to EPA API supported EPA's proposed basin level scaling approach for G&B stations emissions. At the same time API recognized the lack of national data for the G&B segment, which would require further research and analysis prior to adopting an amended methodology.

Furthermore, API's December 10, 2018 letter to EPA conveyed its general support for using GHGRP data that is based on actual equipment counts, measurements, or engineering principles. As was pointed out in that letter, calendar year 2017 is only the second reporting year for G&B sources, and emissions estimates for some of these sources is lacking since they are based on generic emission factors.

API continues to request that EPA wait to have an additional year of GHGRP reported data, and new information that may be forthcoming from on-going studies, prior to amending its emission estimation methodology. Such an approach would ensure consistency for G&B stations emissions estimation methodology for both CO_2 and CH_4. Therefore, API is urging EPA to refrain from using a basin scaling based approach for estimating CO_2 emissions while relying on nationwide total dry gas delivery to market for CH_4, emission estimation.

Response: We agree with the comment and plan to review relevant upcoming study data and additional years of GHGRP data and will consider an update for this estimate for future GHGIs.

Comment 4: **2. HF Oil well completions and workovers -** *EPA revised the HF oil well workovers methodology to use the same general approach as for HF oil well completions. EPA states that stakeholder feedback supported an approach of using GHGRP data to update activity and emissions factors on an annual basis from 2016 forward.*

API Comments:

API acknowledges EPA's revised methodology which follows API's request (August 2018 memo) for establishing separate emission factors for oil well completions and oil well workovers. This is now enabling consistent reporting of emissions from these respective activities in the Exploration and Production segments of the inventory.

Response: Noted.

Comment 5: **3. Refinery emissions -** *EPA indicates that there are minimal changes in recalculated CH_4 and CO_2 emissions for 1990 to 2015 for this segment, with some changes for 2016 recalculations, in accordance with GHGRP submission revisions.*

EPA additionally states that one stakeholder noted a recent study that measured three refineries and found higher average emission than those presented in the Inventory. That stakeholder suggested that EPA evaluate the study and any additional information available on this source.

API Comments:

As initially recommended and supported by API, emissions from the petroleum refining sector are based on year-specific emissions data, which is obtained directly from EPA's GHGRP for all the years since the initiation of reporting in 2010. EPA's GHGRP estimation methodology is very detailed and it is based on site specific information and measurement data. Consequently, the GHGRP approach results in very robust estimates of GHG emissions from U.S. refineries.

Although API recognizes the need to review and evaluate new relevant data, API cautions against jumping to unwarranted conclusions based on measurements from a single study that presents measurements obtained during flyover transects of three refineries only. It is imperative to recognize that aircraft-based mass balance measurement techniques are difficult to conduct as they are highly dependent on weather conditions and may be impacted by adjacent sources. Moreover, the results obtained are based on sampling during short-term time flight windows that are not representative of yearly average emissions from refining operations at the facility.

Response: We agree with the comment and have not updated the methodology or data source for refineries in the GHGI. We will continue to review new relevant studies as they become available.

Comment 6: **4. Off-shore platforms**

Among its planned improvements EPA noted that it is considering updates to the offshore platform emissions calculation methodology, per the discussed in the April 2018 memo titled, "Additional Revisions Considered for 2018 and Future GHGIs". EPA states that the current emission factors were based on data from the 2011 Bureau of Ocean Energy Management's (BOEM) dataset, while the 2014 BOEM data are already available. Also, being considered is a different source for platform counts.

API Comments:

API supports utilizing the 2014 BOEM data to update the emission estimation methodology for offshore platforms in order to ensure the utilization of the most current representation of activities and emissions. As the methodology is being updated it ought to be noted that GHG emissions from deep-water GoM facilities have better emissions controls than most international oil and gas production operations. Since GHG emissions are a global concern it is advisable that the U.S. national inventory should strive to highlight the difference between emissions from GoM production as compared to oil and gas production in other offshore areas.

In the attachment to this letter API provides an initial set of specific comments regarding potential improvements to the offshore platforms' methodology in response to EPA's preliminary methodology improvements presented in its April 2018 memo.

API plans to continue to compile and analyze greenhouse gas (GHG) emissions data for petroleum and natural gas systems and is committed to working with EPA in the future on utilizing data provided through EPA's mandatory GHG reporting program (GHGRP) and other relevant information sources.

API welcomes EPA's willingness to work with industry to improve the data used for the national inventory. API encourages EPA to continue these collaborative discussions and is available to work with EPA to make best use of the information available under the GHGRP, or other appropriate sources of information/data, to improve the national emission inventory.

Response: We plan to consider updates to this source for the 2020 GHGI to allow the GHGI to reflect the best country-specific information available.

Comment 7: API is providing below some initial specific comments on the approach presented by EPA on revising the estimates of GHG emissions from Offshore Platforms.[4]

p. 19, Table 18 - EPA should reconsider the practice of categorizing emissions by the water depth of the facility. EPA's approach gives the erroneous impression that shelf production is environmentally preferable (from an air emissions standpoint). That is clearly not the case. Fewer, more dispersed deep-water facilities with fewer wells produce much more oil and gas. The 59 deep-water surface structures

[4] U.S. EPA, "Additional Revisions Considered for 2018 and Future GHGIs", April 2018 Memo.

(about 3% of the GoM total) produce approximately 90% of the oil and 60% of the natural gas. Emissions per barrel of oil equivalent (BOE) are thus much lower for deep-water facilities.

Response: We plan to consider updates to this source for the 2020 GHGI and will consider different categorizations of platforms/complexes.

Comment 8: p. 19 excerpt: *As seen in Table 17, when gas platforms are defined as those producing more than 100 thousand cubic feet of gas per barrel of hydrocarbon liquid (mcf/bbl), there are no deep-water gas platforms in the GOADS database, resulting in no EF for this platform group. EPA assigned the deep-water oil platform EF to deep-water gas platforms as a surrogate.*

This may be a moot point given the absence of deep-water platforms and the likelihood that deep-water production will continue to be predominantly oil. However, dry gas platforms tend to be less complex with fewer wells and less processing equipment. Assigning the oil platform EF to such gas platforms would significantly overstate emissions.

Response: We plan to consider updates to this source for the 2020 GHGI and will consider different options for emission factors for deep-water gas production, if relevant.

Comment 9: p. 20 excerpt: *The activity data for the calculation of these emissions from 1990 through 2008 was provided by U.S. Mineral and Mining Service (MMS)*

API assumes that EPA intended to note that MMS was the Minerals Management Service.

Response: We agree with the comment and will correct the name of the MMS in future memos.

Comment 10: p. 21, Table 19: While the discussion is about flaring and venting, this table only includes the flaring numbers. An important development over the past 10 years is the reduction in gas being vented. Even though oil-well gas production (for which there is a greater incentive to flare) now (since 2016) exceeds gas-well gas production, the volume of gas flared or vented has declined (see chart below). While total gas production has also declined, total flaring/venting volumes have remained relatively stable at around 1% of total gas production.

Response: We plan to consider updates to this source for the 2020 GHGI and will consider different options for reflecting trends in venting and flaring.

Comment 11: Platform emissions are a function of complexity, power requirements, processing equipment, maintenance, reliability, and control systems. Although deep-water platforms tend to be more complex, that is not always the case and emissions are not a direct function of water depth. A different classification scheme that considers complexity and processing capacity should be considered. One option would be to establish emission factors by facility category (e.g. FPSOs, TLPs, production semis, major fixed platforms, minor satellite platforms, guyed towers, and spars).

Response: We plan to consider updates to this source for the 2020 GHGI and will consider different categorizations of platforms/complexes.

Comment 12: The data source for vented and flared volumes is EIA's compilations of natural gas gross gas withdrawal for the time series 1997-2017.[5]

Response: The data source used in the memo table was BOEM's Oil and Gas Operations Reports (OGOR). OGOR-B provides lease disposition data, including codes for flared gas (Disp codes 21 and 22) and vented gas (Disp codes 61 and 62).[6] We plan to consider updates to this source for the 2020 GHGI and will consider different data sources for flaring emissions, such as EIA's compilation.

Comment 13: While EIA data (the only flaring data available online) do not distinguish between flaring and venting volumes, the trend favors flaring (vs. venting) because most gas is now produced at modern deep-water facilities. A 2017 BSEE report (Argonne National Laboratory, 2017, Tables 1 and 2)[7] confirms that oil-well gas is primarily flared (in those instances when not captured and exported to market) and that nearly all the gas released from floating deep- water structures is flared. Given the much higher GHG effect of methane (vs. CO_2), this is a very important distinction and highly favorable trend.

Response: We plan to consider updates to this source for the 2020 GHGI and will consider different data sources for flaring emissions, such as OGOR-B and EIA's compilation, and different methods for estimating the split between venting and flaring emissions.

Commenter: Private Citizen (Chadwick)

Bridget Chadwick

Comment 14: **Re: Table A-44 Electric Power Generation by Fuel Type [Percent]**

The total amount of electricity generated for the "electric power sector" provided in the bottom row of Table A-44 is less than what the Energy Information Administration's (EIA) reports in their October 2018 Monthly Energy Review (MER) Table 7.1 Electricity Overview, column #1 for the "electric power sector" (which is defined elsewhere in the MER as power plants "within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public").

From my calculations, it seems that the EPA's total does not include the electricity generated from "other gases" (defined as "blast furnace gas, and other manufactured and waste gases derived from fossil fuels" in footnote d of Table 7.2b Electricity Net Generation: Electric Power Sector); hydroelectric pumped storage; biomass wood; biomass waste; and the electricity generated from "batteries, chemicals, hydrogen…non-renewable waste (municipal solid waste from non-biogenic sources and tire-derived fuels)" (footnote i of Table 7.2b). The amount of electricity generated from these sources are provided in columns #4, 6, 8, 9 and 13 of Table 7.2b. (The amount of electricity generated from batteries, chemicals etc. is the "Total" electricity generated provided in column #13 minus the total of electricity generated by all other sources in columns #1-12).

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[5] Natural Gas Gross Withdrawals and Production, Federal offshore GoM, vented and flared; https://www.eia.gov/dnav/ng/NG_PROD_SUM_DC_R3FM_MMCF_A.htm

[6] https://www.data.boem.gov/Main/OGOR-B.aspx

[7] BSEE, Venting and Flaring Research Study Report, January 2017; https://www.bsee.gov/sites/bsee.gov/files/5007aa.pdf

The electricity generated from biomass wood and waste, as well as hydro-electric pumped storage should be included in the "renewables" energy source category. Electricity generated from fossil fuel waste, "other gases" and "batteries…municipal solid waste" should be aggregated either with the petroleum category or provided in a separate row. In 2017 then, the breakdown of the electric power sector would be as follows: coal 31.1%; natural gas 30.5%; fossil fuel waste 0.3%; petroleum 0.5%; nuclear 20.9% and renewables 16.8%.

Response: Table A-44 is based on EIA's MER, Table 7.2b Electricity Net Generation: Electric Power Sector. As noted in the comment above, in the Public Review report this table excludes electricity generation from "Other Gases," "Hydro-electric Pumped Storage," "Biomass (Wood and Waste)," and "Batteries…non-renewable waste".

We agree that electricity from "Biomass (Wood and Waste)" should be included under the Renewables category and that change was made in the Final Report. We also agree that electricity from "Other Gases," should be included and that change was made in the Final Report as a new "Other" category in the table with a footnote to clarify what this is referring to.

"Hydro-electric Pumped Storage" is not considered a "fuel" and therefore was not including because the table is specifically referring to fuels used to generate electricity.

Other sources of electricity (i.e., batteries, chemicals, hydrogen, pitch, sulfur, miscellaneous technologies, purchased steam, and non-renewable waste [municipal solid waste from non-biogenic sources, and tire-derived fuels]) are also excluded from the table for the following reasons:

- ***Several of these items (i.e., batteries, chemicals, hydrogen, pitch, sulfur, and miscellaneous technologies) are not considered "fuels" and are therefore not included.***
- ***For purchased steam, there is not any straightforward way of determining whether the fuel that generated the steam was coal, oil, gas, etc. The actual "fuel" that was used to generate the steam cannot be determined.***
- ***Non-renewable wastes (e.g., non-biogenic MSW, tire-derived fuels) could be included, but currently there is not sufficient data to separate this from the other elements described above.***

Further research will be conducted to potentially include other categories in the table in future Inventory reports, to the extent that data are available. A note was added in the Final Report version of the text after the table further explaining how the table was developed and what was included.

Comment 15: **Re: Table A-43 Electricity Consumption by End-Use Sector [billion kilowatt-hours] and Table 2-5 CO_2 Emissions from Fossil Fuel Combustion by End-Use Sector [MMT CO_2 Eq.]**

The EPA's method of allocating emissions from the electric power sector to each end-use sector "according to its share of aggregate electricity use" is in agreement with the EIA's method where emissions are allocated "in proportion to each sector's share of total electricity retail sales".

However, the EPA's electricity consumption for the industrial sector in Table A-43 should not include the "direct use" of electricity (non retail) by the industrial sector MER's Table 7.6 Electricity End Use, column #6 with the retail electricity sold to the industrial sector, Table 7.6 column #3.

Total CO_2 emissions from electricity consumption by all the end-use sectors provided in EPA's Table 2-5 agrees with what the EIA reports in MER Table 12.6 Carbon Dioxide Emissions from Energy Consumption: Electric Power Sector (minus the CO_2 emissions that the EIA reports for non-biomass waste). If the "direct use" of electricity by the industrial sector is handled separately, see below, then the emissions from retail electricity consumption by each end-use sector, presented in the 2nd to last column of MER Tables 12.2, 12.3, 12.4 and 12.5 for the residential, commercial, industrial and transportation sectors, respectively, should correspond with the electricity emissions in EPA's Table 2-5.

The CO_2 emissions from "direct use" of electricity by the industrial and commercial sectors should be inventoried separately from electric power sector emissions. The EIA provides total CO_2 from the electric power sector and "direct use" in their US Electricity Profile spreadsheet, sheet #7 Emissions. With data provided in the MER Table 12.6, the CO_2 emissions from "direct use" can be calculated.

Response: "Direct Use" of electricity in EIA's MER Table 7.6 refers to electricity generated by industrial and commercial sector plants (both combined heat and power and non-combined heat and power) that is consumed onsite for processes such as manufacturing, district heating/cooling, and uses other than power plant station use. Electric power sector emissions do not include "direct use" (they are included in the industrial and commercial sector emissions). Therefore, "Direct Use" should not necessarily be used to distribute electric power emissions. In addition, emissions from "station use" should be not necessarily be distributed to end-use sectors because those are exclusively electric power emissions. Further research can be conducted to obtain further levels of data granularity and potentially separate electric power distributed electricity emissions from electric power "station use" emissions. Some updates and clarifications were made to Table A-43 as part of the Final Report.

Comment 16: **Re: Table 2-13 Transportation-Related Greenhouse Gas Emissions (MMT CO_2 Eq.)**

Using Federal Transit Administration data, the EPA should disaggregate emissions for passenger rail from freight rail. The disaggregation would allow analysis of the passenger transportation sector, separate from freight transportation.

Response: GHG emissions from the rail sector are broken out by freight rail and passenger rail in Annex 3, Section 3.2 (Tables A-123 and A-124).

Commenter: Private Citizen (Laitner)

John A. "Skip" Laitner

Comment 17: First, a positive comment on the current EPA effort. Second, emphasizing the need to provide a stronger forward-looking context in which the final inventory is to be produced. And finally, the need to bring forward and highlight a more proactive emphasis on the role of energy efficiency and resource productivity as key reasons why the growth of emissions over the period 1990 to 2017 – especially the growth of energy-related carbon dioxide emissions – has been somewhat stabilized (even as the robustness of the economy remains reasonably strong).

As to the first item? I want to extend my compliments on the EPA effort. I greatly admire the professional effort, the solid documentation of data and methodologies, and the clarity of the presentation. I congratulate the staff on a first- rate effort.

Response: EPA appreciates the commenter's support for the annual development of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017.

Comment 18: Second, the evidence documents a compelling need for much more than merely a historical context.

On page ES-1, lines 7-13, for example, the report cites Article 2 of the UNFCCC, noting that the ultimate objective of the Convention is to achieve ”stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time- frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”

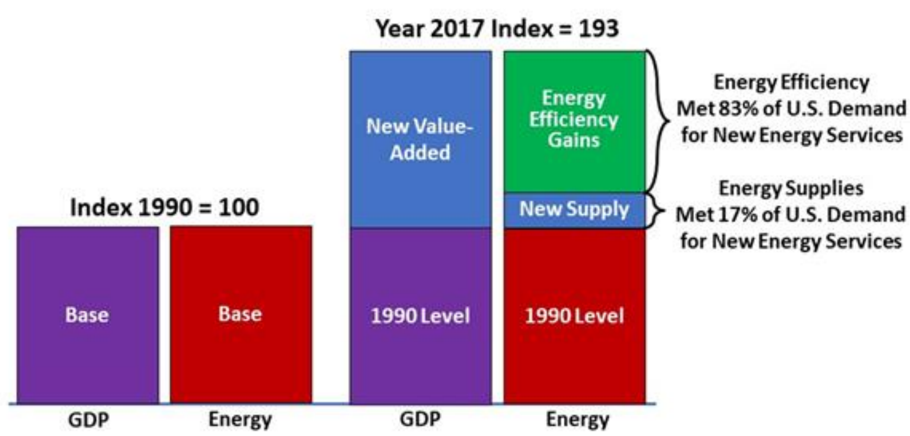
I’ve had the opportunity to talk directly with a number of the authors who participated in the writing of the IPCC Special Report on Global Warming of 1.5 ºC released mid-October last year. Climate scientists have made it very clear that we’ve already dangerously interfered with the natural climate processes, and that by 2030, the world will need to cut annual greenhouse gas emissions by about half. And perhaps 80 percent or more by 2050.

Given that urgency, it seems relatively straight forward for the EPA to acknowledge: (a) current levels of emissions are not at all consistent with Article 2 of the UNFCCC; and (b) that to ensure the prevention of dangerous anthropogenic interference with the climate system, perhaps even the healing of the climate system, the current magnitude of emissions should be cut roughly in half by 2030 through a portfolio of measures including much greater levels of energy efficiency, resource productivity, renewable energy technologies, and a much more productive infrastructure.

Finally, I think it important to inform policy and legislative leaders, businesses, and the average member of the public so that they understand it is the smarter use and the more productive deployment of aggregate resources that can help us reduce emissions by half by 2030. Even a cursory review of data will show that it is not simply a reduction in carbon intensity that has slowed the growth of emissions. Rather, there is a much bigger momentum of energy efficiency that has already driven positive outcomes. I highlight this in the chart I’ve put together below.

As you find it useful, I can more deeply explain the data and the logic that underpins the findings highlighted in the chart. Long-story short? Since 1990, greater energy efficiency has met about 83% of the new demands for energy services to power our economy (which nearly doubled over the 1990-2017 time horizon). New energy supplies, on the other hand, have met only 17% of those new energy service demands.

Since 1990 Energy Efficiency Met 83% of U.S. Demand for New Energy Services While New Energy Supply Only 17%



Source: John Laitner based on U.S. Energy Information Administration Data, March 2019.

With these comments, and for the benefit of building up the public record to highlight much greater opportunities to put energy and resource productivity to greater work, let me provide reference to two major assessments that might inform the EPA about the scale and emerging opportunities that can lower greenhouse gas emissions. The first is a 2018 international exercise while the second is a 2012 assessment done for the U.S. economy. Both examine the opportunities through the year 2050.

Grubler, A., C. Wilson, N. Bento, B. Boza-Kiss, V. Krey, D. McCollum, N. D. Rao, K. Riahi, J. Rogelj, S. D. Stercke, J. Cullen, S. Frank, O. Fricko, F. Guo, P. Havlík, M. Gidden, D. Huppmann, G. Kiesewetter, P. Rafaj, W. Schoepp and H. Valin (2018). "A Low Energy Demand Scenario for Meeting the 1.5oC Target and Sustainable Development Goals without Negative Emission Technologies." Nature Energy [DOI: doi 10.1038/s41560-018-0172-6].

Laitner, JAS, S. Nadel, R. Elliott, H. Sachs, S. Khan (2012). The Long-Term Energy Efficiency Potential: What the Evidence Suggests. Washington, DC: American Council for an Energy-Efficient Economy. https://aceee.org/research-report/e121.

Response: EPA thanks the commenter for the additional information and perspective on the role of energy efficiency improvements in driving historical and possible future reductions of greenhouse gas emissions. The inventory is a policy-neutral, technical report providing information on current GHG emissions and sinks and trends prepared per reporting UNFCCC Annex 1 National GHG Reporting Guidelines (see Box ES-1) and as such, it is not well-suited as a document in which to outline mitigation opportunities and goals. The Inventory does include some discussion of trends and carbon intensity in Box 3-5: Carbon Intensity of U.S. Energy Consumption starting on Page 3-31 including Figure 3-16: U.S. Energy Consumption and Energy-Related CO_2 Emissions Per Capita and Per Dollar GDP on Page 3-33.

Commenter: Environmental Defense Fund and Clean Air Task Force

David Lyon, Ph.D., Lesley Fleischman, David McCabe, Ph.D.

Comment 19: In our comments, we discuss a recently published, peer-reviewed paper that estimates 2015 U.S. Petroleum and Natural Gas Systems emissions and suggest similar approaches that could be used by EPA to more accurately estimate emissions by incorporating facility-level and basin-level data into the GHGI.

Additionally, we support EPA's decision to continue to use empirical, site-level data from Marchese et al (2015) to estimate methane emissions from gathering and boosting stations. Emissions would have been greatly underestimated if EPA changed to the proposed approach based on EPA Greenhouse Gas Reporting Program (GHGRP) emissions data. For future considerations of updates to this source, we suggest that EPA consults our stakeholder feedback on the 2018 GHGI memos, in which we describe an alternative method that uses data from both GHGRP and Marchese et al to most accurately estimate total emissions with a best approximation of source-specific emissions.

1. The current GHGI underestimates Petroleum and Natural Gas Systems methane emissions

A recently published paper in Science, Alvarez et al (2018), synthesized data from several recent studies to estimate 2015 U.S. oil and gas (O&G) supply chain methane (CH_4) emissions of 13±2 teragrams (Tg) CH_4, approximately 60% higher than the estimate for Petroleum and Natural Gas Systems for 2015 in the 2017 EPA GHGI. The O&G production segment is the largest source of this difference (7.6 vs 3.5 Tg) with three other segments also having higher emission estimates than the GHGI: gathering (2.6 vs 2.3 Tg), processing (0.72 vs 0.44 Tg), and transmission and storage (1.8 vs 1.4 Tg).

Alvarez et al (2018) used facility-level measurements as the primary data source for estimating emissions, including data from over 400 well pads in six basins collected with ground-based, mobile approaches such as EPA Other Test Method 33A (OTM 33A). Site-based emission estimates were validated with top-down, basin-level data derived from aerial mass balance estimates in nine basins. The paper also developed an alternative emission inventory using a component-level approach analogous to the GHGI for the production segment with updates to specific source categories. For example, pneumatic controller emissions were estimated with a combination of GHGRP activity data and custom emission factors (EFs) based on Allen et al (2014). The full description of the alternative inventory methods can be found in Alvarez et al supplementary materials section S1.4. The alternative inventory resulted in an emission estimate of 8.8 Tg CH_4 for Petroleum and Natural Gas Systems, substantially lower than the primary estimate based on site- level data and validated with basin-level data.

Both the Alvarez et al alternative inventory and GHGI are thought to underestimate emissions due to limitations of the component-level approach. The positively skewed distribution of O&G component emission rates makes it likely that EFs based on the arithmetic mean of limited measurements will underestimate the mean emission rate of the full population. Additionally, site- level estimates based on the aggregate of component-level measurements tend to be biased low because some emissions sources may be overlooked, misquantified, or unsafe to measure. As described in Alvarez et al (2018),

> *Consequently, the most likely hypothesis for the difference between the EPA GHGI and BU [bottom-up] estimates derived from facility-level measurements is that measurements used to develop GHGI emission factors under-sample abnormal operating conditions encountered during the BU work. Component-based inventory estimates like the GHGI have been shown to underestimate facility-level emissions, probably because of the technical difficulty and safety and liability risks associated with measuring large emissions from, for example, venting tanks such as those observed in aerial surveys.*

For each segment, we discuss specific examples of how the GHGI underestimates emissions.

For the production segment, a previous study based on Barnett Shale data, Zavala-Araiza et al (2017), compared facility-level estimates derived from site-based measurements and aggregate, component-based estimates. Site-based estimates were 50% higher than component-based estimates, with the largest discrepancy found in the highest emitting sources. This gap was attributed primarily to abnormal process conditions that cause high emission rates, such as separator malfunctions that lead to irregular storage tank emissions. This hypothesis is supported by Lyon et al (2016), which used aerial infrared camera surveys of over 8,000 well pads in 7 basins to identify high emitters: tanks accounted for over 90% of these sources, and in several basins, occurred at a greater frequency than expected from normal emissions like tank flashing; in contrast, no large emissions were identified from sources like pneumatic controllers or connector leaks.

Therefore, it is likely that much of the GHGI underestimate is attributable to missing, large sources that are difficult to observe, categorize, and quantify.

For the gathering and boosting (G&B) segment, which the GHGI classifies as a sub-category within the Natural Gas Systems production segment, EPA currently estimates G&B station emissions with facility-level emission factors from Marchese et al (2015). That study estimated 2012 U.S. G&B station emissions were 1,697 (+189/−185) Gg CH_4 based on site-level measurements at 114 stations published in Mitchell et al (2015). The 2018 GHGI estimates 2016 G&B station emissions were 1,968 Gg CH_4 based on the Marchese et al EFs and updated station counts. Alvarez et al estimates 2015 G&B station emissions were 2,100 Gg CH_4 based on a similar approach to the GHGI, but with an updated EF based on a recalculation of Mitchell et al data with a log-normal distribution that accounts for high-emitting facilities above the sampled emission rate.

For the processing segment, the 2018 GHGI uses GHGRP data to estimate 2015 processing plant emissions were 410 Gg CH_4. As discussed in the stakeholder feedback previously submitted by EDF and Colorado State University (CSU) in 2017 to on *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2015: Updates Under Consideration for Natural Gas Systems Processing Segment Emissions*, **we believe this approach underestimates emissions due to methodological issues associated with the GHGRP**. In our feedback, we proposed using an alternative approach that uses facility-level data from Marchese et al and Mitchell et al, which includes site-level measurements from 16 processing plants, to estimate total emissions. GHGRP data could be used to allocate total emissions among sources as a best approximation of source-specific emissions. Alvarez et al estimates 2015 processing plant emissions are 680 Gg CH_4 using an analogous approach with an updated processing plant EF based on a recalculation of Mitchell et al similar to the approach described above for G&B stations.

For the transmission and storage (T&S) segment, the 2018 GHGI estimates 2015 station emissions were 1,100 Gg CH_4 based on partial data from Zimmerle et al (2015), which used component- and site-level measurements from 45 stations measured in Subramanian et al (2015). The 2018 GHGI underestimates T&S emissions by excluding a substantial portion of observed emissions from Zimmerle et al that were classified as super-emitters/uncategorized. This category represents emissions that were quantified by site-level measurements but missing from aggregate component- level measurements due to known issues such as very high emission rate sources that are difficult to quantify at the component level – a phenomenon that was directly observed in these studies. In contrast, Alvarez et al estimates 2015 T&S station emissions were 1,540 Gg CH_4 because it included the 440 Gg from these uncategorized sources.

2. Component-level data such as the GHGRP should not be used to estimate total emissions unless emissions are validated with empirical site- and basin-level data

As discussed in Alvarez et al, emission estimates based on site- and basin-level measurements consistently show that component-based estimates underestimate emissions. While component- based estimates are valuable for understanding the approximate allocation of emissions among sources, they are not suitable for estimating total emissions without the support of other empirical data, because (as discussed above on page 2) component-level studies under-sample abnormal operating conditions which are responsible for a very substantial portion of real emissions.

Therefore, relying on component-level GHGRP data to estimate total emissions likely cause the GHGI to underestimate emissions from Natural Gas and Petroleum Systems.

For future years of the GHGI, EPA should improve the accuracy of their emission estimates by incorporating more empirical data including facility- and basin-level. As discussed in the National Academy of Science's report Improving Characterization of Anthropogenic Methane Emissions in the United States, verifiability is the key to an accurate, high quality inventory. For example, spatially gridding the GHGI can allow a comparison to basin-level estimates, but the utility of gridding the current GHGI is limited by the spatial resolution of certain GHGI / GHGRP data which aggregates emissions from all facilities owned by an operator in an AAPG basin. To make better use of site-level data, EPA should consider updates to the GHGI and GHGRP when the current format does not allow a straightforward estimate of region-specific, facility EFs. In particular, the GHGRP methodology for the G&B segment would benefit from updates that allow basin-level emissions to be disaggregated to the facility-level. By reorganizing the GHGI and underlying data such as the GHGRP to be verifiable at the site- and basin-level, EPA could use existing and future empirical data to test the accuracy of the inventory. When inaccuracies are discovered, EPA could use empirical data to adjust the GHGI emission estimates and/or focus future efforts on improving methodologies for the sources or regions with the largest discrepancies. A more inclusive use of empirical data from multiple spatial scales will allow EPA to more accurately understand Natural Gas and Petroleum Systems methane emissions.

Response: **The natural gas and petroleum emission estimates in the Inventory are continually being reviewed and assessed to determine whether emission factors and activity factors accurately reflect current industry practices. A QA/QC analysis was performed for data gathering and input, documentation, and calculation. QA/QC checks are consistently conducted to minimize human error in the model calculations. EPA performs a thorough review of information associated with new studies, GHGRP data, regulations, public webcasts, and the Natural Gas STAR Program to assess whether the assumptions in the Inventory are consistent with current industry practices. The EPA has a multi-step data verification process for GHGRP data, including automatic checks during data-entry, statistical analyses on completed reports, and staff review of the reported data. Based on the results of the verification process, the EPA follows up with facilities to resolve mistakes that may have occurred.**

As in previous years, EPA conducted early engagement and communication with stakeholders on updates prior to public review. EPA held a stakeholder workshop on greenhouse gas data for oil and gas in October of 2018, and webinars in June of 2018 and February of 2019. EPA released memos detailing updates under consideration and requesting stakeholder feedback. Stakeholder feedback received through these processes is discussed in the Recalculations Discussion and Planned Improvements sections below.

In recent years, several studies have measured emissions at the source level and at the national or regional level and calculated emission estimates that may differ from the Inventory. There are a variety of potential uses of data from new studies, including replacing a previous estimate or factor, verifying or QA of an existing estimate or factor, and identifying areas for updates. In general, there are two major types of studies related to oil and gas greenhouse gas data: studies that focus on measurement or quantification of emissions from specific activities, processes and equipment, and studies that use tools such as inverse modeling to estimate the level of overall emissions needed to account for measured atmospheric concentrations of greenhouse gases at various scales. The first type of study can lead to direct improvements to or verification of Inventory estimates. In the past few years, EPA has reviewed and in many cases, incorporated data from these data sources. The second type of study can provide general indications on potential over- and under-estimates. A key challenge in using these types of studies to assess Inventory results is having a relevant basis for comparison (i.e., the independent study should assess data from the Inventory and not another data set, such as EDGAR.). In an effort to improve the ability to compare the national-level inventory with measurement results that may be at other scales, a team at Harvard University along with EPA and other coauthors developed a gridded inventory of U.S. anthropogenic methane emissions with 0.1° x 0.1° spatial resolution, monthly temporal resolution, and detailed scale-dependent error characterization. The gridded methane inventory is designed to be consistent with the 2016 Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014 estimates for the year 2012, which presents national totals.

Commenter: Interstate Natural Gas Association of America

Sandra Snyder

Docket ID Number: EPA-HQ-OAR-2018-0853-0005

Comment 20: In November 2018, EPA released a document[8] (the "November 2018 memo") describing potential updates to the annual inventory report, including proposed updates to the methane emission factor for transmission pipeline blowdowns based on 2016 data submitted under Subpart W of the GHGRP. EPA amended Subpart W to add reporting of transmission pipeline blowdown emissions by event type, and 2016 was the first reporting year. EPA was made aware of several issues regarding the November 2018 memo: erroneous data reported by one company in 2016 significantly affected the pipeline blowdown emission factor; the company had corrected the error and updated 2016 data were available; and, 2017 GHGRP data were also available for consideration. In the Draft Inventory Report, EPA addressed this problem by developing a transmission pipeline blowdown emission factor that averages the Subpart W data from 2016 and 2017, and applied the emission factor for the entire time series. EPA requested feedback on whether year-specific emission factors should be applied for 2016 and 2017, and whether the current emission factors should be applied for earlier years of the time series.

INGAA welcomes EPA's efforts to utilize data from Subpart W to improve methane emission estimates in the annual inventory report for the natural gas transmission and storage sector.

However, INGAA recommends alternatives for applying the 2016 and 2017 pipeline blowdown data and for subsequent annual inventory reports. INGAA's review of the historical / previous emission factor used for the annual inventory and more current data indicates that an emission factor based on 2016 Subpart W pipeline blowdown data is marginally higher than the previous emission factor, while an emission factor based on 2017 Subpart W pipeline blowdown data is approximately the same as the previous factor. Details are not provided in the Draft Inventory Report, but a summary based on INGAA's review indicates:

- The November 2018 memo presents the previous pipeline blowdown emission factor: 0.6 metric tons (mt) methane per mile of pipe (mt/mi).
- The November 2018 memo proposed increasing the emission factor to 1.2 mt/mi, but this emission factor included the erroneous 2016 data.
- The Draft Inventory Report proposes to average the 2016 corrected data and 2017 data, and INGAA's review indicates that emission factor is 0.72 mt/mi.
- The emission factor based on 2017 data is 0.61 mt/mi.
- The emission factor based on 2016 data is 0.84 mt/mi.
- The event-specific information indicates that 2016 Subpart W data showed higher emissions and events than 2017 data for new construction or modification (including commissioning) and equipment replacement or repair. Higher emissions from those event types may not be typical or representative of other years.

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[8] "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017: Other Updates Under Consideration," U.S. EPA (November 2018).

In response to EPA's request and in light of the differences in 2016 and 2017 data, INGAA recommends using year-specific emissions for 2016 and 2017, and applying the historical/previous emission factor for the earlier years in the time series. The resulting time series would show a one- year increase in emissions in 2016 and similar emissions for other years. Alternatively, EPA could refrain from updating the emission factor in the 2019 inventory report, gather an additional year of Subpart W data, and update the transmission pipeline blowdown emission factor and emission estimates in the 2020 annual inventory report. The third year of Subpart W data (for 2018) could provide insight regarding year-to-year variability and whether any data appears to be anomalous. For example, data quality associated with the first year of reporting (or higher than typical construction and equipment replacement events) could indicate that 2016 is not representative of typical natural gas transmission pipeline operations.

Response: We agree with the comment and have updated the final GHGI to use year-specific GHGRP data for 2016 and 2017 emissions and GRI/EPA 1996 data for 1990-2015 emissions. We plan to review 2018 (and future years) GHGRP data to update the time series, assessing year-specific factors or other options such as average factors.

Commenter: National Association of Clean Water Agencies

Cynthia Finley, Ph.D.

Docket ID Number:

Comment 21: The National Association of Clean Water Agencies (NACWA) has submitted comments on the wastewater treatment section since the 2005 Inventory, and we appreciate the clarifications that EPA has made over the years for the emissions calculations and the factors that are used in the calculations. Several references were updated in the 2017 Inventory to better reflect current characteristics of the sector. However, more work needs to be done on updating data sources. For example, the outdated 2004 Clean Watershed Needs Survey (CWNS) was still used as the basis for the percent of wastewater flow to aerobic and anaerobic systems, the percent of utilities that do and do not employ primary treatment, and the wastewater flow to POTWs that have anaerobic digesters. The forecasts made using the 2004 CWNS and previous editions of the CWNS may not accurately reflect recent trends and practices for wastewater utilities.

NACWA agrees with EPA's planned improvement to investigate updated sources and re-evaluate its methodology as related to wastewater system type and methane emissions.

Response: EPA continues to search for and review updated sources of activity data for wastewater treatment system type to distinguish between aerobic, anaerobic, and aerobic systems with the potential to generate CH4. Due to significant changes in format, CWNS data for 2008 and 2012 require additional evaluation to determine a methodology for incorporation into the Inventory. In addition, other data continue to be evaluated to update future years of the Inventory, including anaerobic digester data available at biogasdata.org. EPA will continue to monitor the status of these data as a potential source of digester, sludge, and biogas data from POTWs.

Comment 22: Another factor that should be updated is the wastewater flow of 100 gal/person/day, which was taken from a 2004 document published by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. Due to droughts and effective water conservation measures, many areas of the US now have wastewater flows significantly less than this value. NACWA recommends that EPA consider updated wastewater flow references that represent other regions of the country.

Response: EPA continues to search for and review updated sources of activity data, including improved data on the amount of biogas generated in anaerobic digesters. EPA will continue to monitor the status of data available from biogasdata.org as a potential source of biogas generated from anaerobic digesters, which would obviate the need to use the estimated wastewater flow of 100 gal/person/day.

Comment 23: NACWA agrees with EPA's planned improvements for the Inventory and encourages development of US-specific methodologies and emission factors when appropriate. As NACWA has explained in comments on the Inventory in previous years, the Association believes that the nitrogen loading rates for $N_2O_{EFFLUENT}$ are sourced incorrectly and that using information from the existing National Pollutant Discharge Elimination System (NPDES) database will yield more accurate and justifiable loading rates. The NPDES permitting program represents long-term, nationwide facility performance that would allow emissions estimate projections over the time series represented in the Inventory. EPA should also investigate additional references for nitrogen loading rates.

Response: EPA has considered NACWA's suggestion to estimate nitrogen effluency loads based on data reported under EPA's National Pollutant Discharge Elimination System (NPDES) Program. Unfortunately, very few POTWs are required to report their effluent nitrogen concentration or load, and those that do are typically required to meet more stringent limits that the average POTW. At this time, EPA is unable to confirm that these data would be representative of the entire industry. In addition, this would represent a departure from the IPCC accepted methodology and would require substantiation that it results in a more robust estimation of these nitrous oxide emissions.

Comment 24: As EPA notes in the Inventory, the refinements to the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* – which are currently undergoing government review – may incorporate newer scientific information. The IPCC's refinement of the emissions factors used in wastewater treatment emissions calculations may resolve some of the issues with the current methodology. Since the refinements will not be available for public review and comment prior to publication, NACWA asks that EPA allow additional time for expert review when the refinements are incorporated into the Inventory for the first time.

Response: EPA agrees that the potential refinements to the 2006 IPCC Guidelines will inform how the methodology may need to be revised. EPA continues to evaluate potential new data sources to update and improve the Inventory data as they become available, including improved activity data on wastewater treatment operations as well as nitrogen loading rates. Addition data sources will continue to be researched with the goal of reducing uncertainty of the estimate of N entering municipal treatment systems, as well as the estimate of N discharged to receiving waters. EPA provides opportunities to review changes to the Inventory during expert review, typically from mid-October to mid-November of each year. And during the 30-day public review period, typically from mid-February to mid-March of each year. EPA then finalizes the Inventory for publication in April. EPA will ensure that NACWA is provided opportunity to comment during both review periods which should allow sufficient time for review of any changes made as a result of the refinements.

Commenter: National Cattlemen's Beef Association

Document ID Number: EPA-HQ-OAR-2018-0853-0006

Comment 25: While enteric fermentation from cattle composes a notable portion of methane emissions (26%), methane emissions are only a fraction (10.2%) of overall greenhouse gas (GHG) emissions that enter our environment. Cattle producers are frequently portrayed as one of our nation's top greenhouse gas emitters, when the Draft Inventory makes clear that beef production falls behind transportation, electricity generation, refrigerants, and myriad other emission sources. The Draft Inventory posits that agricultural emissions contribute 8.4% of all GHG emissions, with agricultural soil management, enteric fermentation, and manure management systems contributing the most to this percentage. NCBA appreciates the Agency's attempt to reach science-based conclusions and notes some areas where the Agency can further bolster its Inventory. Specifically, for these comments, NCBA will focus on EPA's enteric fermentation calculation and analysis.

The Draft Inventory is littered with assumptions left unsubstantiated in the academic record. The Draft Inventory provides, at best, hollow analysis for its conclusion that, although the Agency ties enteric fermentation emissions to U.S. beef cattle population, and the beef cattle population decreased from 1990 to 2017, enteric fermentation emissions did not correlate. To substantiate its claim that EPA enteric fermentation from beef cattle has increased by 6.1 percent in the last 27 years, EPA cites five instances of "personal communication." Though EPA includes a scarce list of citations, the studies referenced show that the primary contributors of enteric fermentation emissions are not grain fed cattle. However, the Agency's rhetoric in preparing the Draft Inventory suggests differently: "Beef cattle emissions generally increased from 2004 to 2007, as beef cattle populations underwent increases and an extensive literature review indicated a trend toward a decrease in feed digestibility for those years." While perhaps unintended, the Agency's focus on feedlot cattle populations leads readers to conclude that grain fed cattle are the primary contributor to enteric fermentation emissions, when EPA's referenced studies conclude otherwise. At minimum, NCBA urges EPA to better contextualize these statements.

The Draft Inventory bases its methane emissions estimates from enteric fermentation on the United Nation's model found in the Intergovernmental Panel on Climate Change's Guidelines for GHG Inventories. However, this model is unusable according to the Agency's own standard. In the Draft Inventory's introduction, the Agency states that it will use emissions calculators from the EPA or other U.S. governmental agencies. The United Nations IPCC model does not meet this criterion. A national source-specific model will likely provide more accurate data than a broad, international model. NCBA suggests that the Agency consider adopting the Integrated Farm System Model, used in a recently published USDA ARS-led beef lifecycle assessment.[9] The published lifecycle assessment considers all inputs, including electricity use and transportation, a notably different approach than the EPA Draft Inventory. However, the Integrated Farm System Model can be tailored to exclude these inputs. Nevertheless, USDA's beef lifecycle assessment is vital to the Inventory and NCBA urges EPA to include it in the final Inventory.

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[9] C.A. Rotz, B.J. Isenberg, K.R. Stackhouse-Lawson, J. Pollak, *A Simulation-Based Approach for Evaluating and Comparing the Environmental Footprints of Beef Production Systems*, J. Anim. Sci., 91 (2013), pp. 5427-5437; C.A. Rotz, S. Asem- Hiablie, S. Place, G. Thomas, *Environmental Footprints of Beef Cattle Production in the United States*, Agricultural Systems, 169, pp. 1-13.

NCBA is pleased with the Agency's effort to recognize existing GHG emission offsets. The Agency has attempted to do this for the first time by calculating benefits gained from carbon sinks. As the Agency noted in its previous GHG inventory, carbon sinks account for a 20% offset of agricultural GHG emissions – significantly reducing the net impact of the industry. NCBA encourages the bolstering of this section generally, so that regulated stakeholders and consumers alike can assess the net impact of GHG emitters. Going forward, NCBA urges EPA to specifically consider the environmental benefit of planned rotational grazing, a conservation practice implemented by ranchers across the country. It is well-known that rotational grazing leads to increased carbon sequestration.[10] Globally, if soil organic carbon in agricultural lands and grasslands increase 10% over the course of the 21st century, carbon dioxide concentrations in the atmosphere could be reduced by 110 ppm.[11]

***Response**: EPA appreciates the commenter's suggestions on the emission calculations and analyses conducted for the Enteric Fermentation source category of the Public Review draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017 (Inventory). The EPA works closely with partners including USDA, other government agencies, academia and consultants to develop the best estimates using the best available data.*

As described in the Chapter 5.1 and Annex 3.10 of the Inventory, the enteric fermentation emissions are estimated using EPA's Cattle Enteric Fermentation Model (CEFM). The CEFM is a national, source-specific model whose calculations are based upon Intergovernmental Panel on Climate Change (IPCC) Tier 2 methodology for cattle, which is a detailed approach that involves national, regional, and state-level data for the U.S. cattle sector.

Beef cattle populations are one of many variables of data used to estimate emissions. Additional variables that influence emissions estimates are feed digestibility and animal weight. As a result, and noted within the trends discussion of Chapter 5.1, population decreases alone do not necessarily result in a decrease in enteric fermentation emissions for that population.

The Inventory categorizes methane emissions by type of beef cattle in Annex Table A-178, where emissions by feedlot cattle, steer stockers, heifer stockers, and replacements are reported. Furthermore, Annex Table A-175 provides the methane emission factors for cattle by animal type. This table demonstrates the higher emissions associated with a less-digestible diet from stockers when compared to feedlot cattle. The Annex presents additional information utilized in the emissions calculation such as the percent of digestible energy in feed for different beef types and changes in population broken out by type of beef livestock over time, as well as a breakdown of emissions.

EPA consults with experts in the field of beef cattle production to help inform the data variables used in estimating emissions, citing these as "expert judgement" or "personal communications" within the Inventory. This is a common practice for Inventory compilation that is necessary because the data required to estimate emissions are not always available in publications. Within the Inventory, discussion and values for emissions trends over time are based directly on results from the CEFM, which derives its inputs from the data sources cited in the chapter. We welcome additional data to improve future Inventory estimates, and EPA and USDA would like to work with NCBA and other

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[10] Wang, T.; Teague, W.R.; Park, S.C.; Bevers, S. *GHG Mitigation Potential of Different Grazing Strategies in the United States Southern Great Plains*. Sustainability, 7 (2015), pp. 13500-13521.

[11] Lal, R., *Sequestering carbon in soils of agro-ecosystems*. Food Policy. 36 (2011), (Suppl. 1): S33-S39.

stakeholders to learn about any other data available that could contribute to future Inventory estimates.

EPA and USDA are currently reviewing many data sources and improvements that could be used in future Inventory reports. Many of these improvements will require significant effort and may take multiple years to implement in full. As part of the overall improvement process within the Agriculture chapter, EPA and USDA held a data workshop in March 2018 with industry and researchers to assess the availability of activity data that could be used in the Inventory to better inform us of current industry practices. Once incorporated, these updates will improve the Inventory estimates by better reflecting recent trends in farm management. Potential improvement options that EPA is considering are currently listed in the Planned Improvements section of Chapter 5.1.

Commenter: Waste Management, Republic Services, National Waste & Recycling Association, Solid Waste Association of North America, SCS Engineers, Weaver Consulting Group

Amy Van Kolken Banister

Docket ID Number: EPA-HQ-OAR-2018-0853-0004

Comment 26: The waste sector strongly supports the Agency's efforts thus far to update the inventory, and we are pleased that EPA intends to continue its dialogue with stakeholders, academic researchers and landfill experts. We think this is important work and we are particularly pleased that EPA is planning on considering improvements in the Inventory's assumed DOC value, and decay rates used in estimating methane generation at landfills and recognizes the need to update those factors in the Greenhouse Gas (GHG) Reporting Rule.

The Scale-Up Factor for MSW Landfills

Recognizing that the GHG Reporting Program (GHGRP) does not include every MSW landfill in the country – (MSW landfills that ceased taking waste prior to 1980 or have potential emissions less than 25,000 tons CO_2e) – we continue to support EPA's decision to use a scale-up factor to estimate emissions from non-reporting landfills in the draft 1990-2017 Inventory. As part of the expert review of the draft 2018 Inventory, the landfill sector reviewed the largest of the Agency's list of potential landfills not reporting emissions to the GHGRP. We found that the Agency overestimated Waste in Place (WIP) by more than 60 percent and recommended adjusting the scale-up factor to 5 percent from 12.5 percent. We were pleased that EPA adjusted the factor for the 2018 Inventory and employed a lower scale-up factor of 9 percent; however, adjusting the scale-up factor to a lower, more appropriate value could be reflected in the 2019 Inventory as the analysis of non-reporting landfills has been accomplished. **We thus recommend that EPA consider using an even lower factor of five percent before finalizing the 2019 Inventory.**

Further, EPA should evaluate and revise the scale-up factor on a routine basis to account for the additional WIP for sites reporting to GHGRP which is likely to significantly exceed non- reporting facilities that have closed and are no longer receiving waste. The Agency can reasonably anticipate a downward trend in WIP at landfills outside the GHGRP, and the scale-up factor should reflect these changing landfill demographics.

Response: EPA appreciates commenter's support of the scale-up factor approach to account for landfills that do not report to the GHGRP. EPA also appreciates and agrees with the commenter's feedback that the scale-up factor should be evaluated on a routine basis. EPA plans to reexamine the scale-up factor with each inventory cycle to determine if there are additional landfills reporting to the GHGRP such that the WIP assumed for those landfills can be removed from the scale-up factor. At the same time, EPA will also account for those landfills that have stopped reporting to the program because they were able to exercise the off-ramp provisions.

Comment 27: <u>Methane Oxidation Factor</u>

For the period 1990 – 2004 in the inventory time series, EPA calculates a national estimate of methane generation and emissions using a combination of secondary data sources that detail the annual quantity of waste landfilled and the annual quantity of methane recovered from facilities with landfill gas collection and control systems. EPA applies a 10% oxidation factor to all facilities for the years 1990 to 2004. This ten percent default factor contrasts significantly with the average methane oxidation factor of 19.5 percent applied through use of GHGRP data, to the later years of the time series (2005 to 2016). Importantly, the 19.5 percent average oxidation rate incorporated in the GHGRP, subpart HH emissions data is premised on a more detailed and up-to-date estimation approach than is the default value of 10 percent. It is also a conservative average value, as the GHGRP methodology restricted the maximum oxidation rate to 35 percent.

In its work to review and revise the method for calculating methane oxidation under subpart HH of the GHGRP, EPA acknowledged the need to update the default 10 percent oxidation value. The default value was based on only one field study, at a landfill without gas collection and control, and did not reflect the much higher oxidation values found in numerous subsequent, peer-reviewed field studies. **Given the plethora of scientific studies showing methane oxidation to be several times higher than the EPA and Intergovernmental Panel on Climate Change (IPCC) default value, we strongly recommend EPA apply a revised value (perhaps the average oxidation value from the GHGRP) to the earlier years of the time series.**

Response: EPA appreciates commenter's feedback on the oxidation factor as applied to estimating emissions from MSW landfills in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017. As stated in the Planned Improvements section of Section 7.1 of the Inventory, EPA is continuing to review new literature and investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as a the binned approach used in the GHGRP (e.g., 10 percent, 25 percent, or 35 percent based on methane flux). The oxidation factor currently applied in the later portion of the time series (2005 to 2017) averages to 19.5 percent due to the use of the GHGRP data while the earlier portion of the time series applies the default of 10 percent.

Comment 28: <u>Compost Emission Factor</u>

In ideal conditions, the composting process occurs at a moisture content of between 50 and 60%, but the moisture content of feedstocks received at composting sites varies and can range from 20% to 80%. It is common for moisture to be added to dry feedstocks prior to the start of composting to optimize the biological process. In the calculation of emissions from composting in the draft chapter, it appears that all incoming wastes were assumed to have a moisture content of 60%. If 60% is not reflective of the actual weighted average of all feedstocks, this will introduce errors in the inventory calculation that could be significant.

We recommend that the calculations be based on waste subcategories (i.e., leaves, grass and garden debris, food waste) and category-specific moisture contents, or ask that further information to be provided on the rationale for assuming 60% as the average moisture content of all inbound materials.

Response: EPA notes commenter's feedback on the moisture content levels used in the calculation of emissions from composting. The calculations for composting are based on IPCC Tier 1 methodology defaults. Under this methodology, the emission factors for CH_4 and N_2O assume a moisture content of 60% in the wet waste. (IPCC 2006). EPA has added this detail to the Methodology section of Section 7.3 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017 so that the source of the moisture content is more transparent. In addition, EPA has added to the Planned Improvements section of Section 7.3 that EPA is looking into the possibility of incorporating more specific waste subcategories and category-specific moisture contents into the emissions estimates for composting in the United States to improve accuracy. However, to date the EPA has not been able to locate substantial information on the composition of waste at U.S. composting facilities in order to do so. As additional data becomes available on the composition of waste at these facilities, EPA will consider using this information in order to create a more detailed calculation of U.S. composting emissions.

Comment 29: The k Factor (Methane Generation Rate Constant)

The waste sector strongly supports EPA's plans to assess using k values based on climate and recommends that the Agency review the k-values against new data and other landfill gas models, as well as to assess the uncertainty factor applied to these k values in the Waste Model. We have been concerned that these k-values are outdated and rife with uncertainty, as confirmed by the *Draft AP 42.2.4 Municipal Solid Waste Landfills*, which states:

> *There is a significant level of uncertainty in Equation 2 and its recommended default values for k and L_o. The recommended defaults k and L_o for conventional landfills, based upon the best fit to 40 different landfills, yielded predicted CH_4 emissions that ranged from ~30 to 400% of measured values and had a relative standard deviation of 0.73 (Table 2-2). The default values for wet landfills were based on a more limited set of data and are expected to contain even greater uncertainty.*[12]

The waste sector has previously highlighted the significant issues with the k values used in the Draft AP-42 Section 2.4: Municipal Solid Waste Landfills. In fact, EPA has never finalized AP-42 for MSW landfills, despite the k-value issues identified *by EPA* in both AP-42 and the Background Information Document. With uncertainties in CH_4 emissions ranging from -30% to 400% under EPA's assessment of the Landfill Gas Emissions (LandGEM) model, it is difficult to rely on these data. For this reason, we support EPA's plan to review and resolve the significant problems in the k value data set.

Response: EPA appreciates commenter's support for planned improvements outlined in the report. As stated in the Planned Improvements section of Section 7.1 of the U.S. Greenhouse Gas Inventory of Emissions and Sinks, EPA began investigating the k values for the three climate types (dry, moderate, and wet) against new data and other landfill gas models, and how they are applied to the percentage of the population assigned to these climate types. EPA will also assess the uncertainty factor applied

[12] U.S. EPA, *Draft AP 42.2.4: Municipal Solid Waste Landfills*, October 2008, p. 2.4-6.

to these k values in the Waste Model. Like the DOC value, the k values applied through the Waste Model are for the years 1990 to 2004; the k values for 2005 to 2017 are directly incorporated into the net methane emissions reported to EPA's GHGRP. EPA will continue investigating the literature for available k value data to understand if the data warrant revisions to the k values used in the Waste Model between 1990 to 2004.

Comment 30: Degradable Organic Carbon (DOC)

Chapter 7 of the draft inventory explains that EPA uses one DOC value of 0.20 to calculate emissions for the years 1990 through 2004, and uses emissions reported through the GHGRP for years 2005 through 2017. The GHGRP allows landfills to use 0.20 for bulk MSW or allows a landfill to further delineate waste streams by accounting for separate shipments of construction and demolition (C&D) waste, which uses a DOC of 0.08, and separate shipments of inert wastes, which may use a DOC of 0.0. If a landfill delineates in this way, it must use a DOC of 0.31 for its MSW waste volumes, which applies an artificially high DOC to MSW, and inappropriately overestimates emissions. The required DOC value of 0.31 fails to account for the significant volumes of C&D and inert wastes that are incorporated in MSW, and which cannot be separated from the MSW or accounted for distinctly, as can discrete shipments of inert wastes from industrial or C&D recycling facilities. Furthermore, neither of the EPA- recommended DOC guidelines have been reviewed in many years. **We therefore support EPA's view that it is time to update the DOC values and believe that the most valuable focus would be to reassess the DOC values incorporated in the GHGRP used for inventory years 2005 forward.**

We are pleased to learn that EPA plans to revisit the DOC value of 0.20, and as we discussed with you, **we strongly recommend focusing first on the later portion of the time series.** We believe that the fundamental shifts in the characterization of waste disposed in landfills has occurred in the later portion of the time series and that the research conducted thus far by state agencies and the Environmental Research and Education Foundation (EREF)[13] are illustrative of those changes. **We also recommend that as EPA revises DOC values used in the second half of the time series the Agency should as a priority, also reevaluate and accordingly revise the DOC values incorporated in subpart HH of the GHGRP, which underpins the data used for those years of the inventory.**

Based on EREF's review of the DOC values for MSW landfills, the waste sector concludes that the long-standing DOC values developed in the past are inaccurate and are likely to over- estimate both landfill gas generation and methane emissions. The data provided by EREF confirms that two trends are driving the changes at MSW Landfills. First, many MSW Landfills are handling less organic matter now, and this trend is anticipated to continue due to state and local organics diversion goals. Second, the increase of Subtitle D non-MSW waste disposed has altered the DOC for all waste deposited in MSW Landfills. EPA validates these trends in the Inventory's Chapter 6 discussion of carbon sequestration of harvested wood products, yard waste and food waste, which shows a significant reduction in sequestered carbon since 1990 due to reduced volumes of organic wastes disposed in landfills.

Further, as EPA clearly recognizes that the composition of the waste at MSW Landfills has changed and continues to change, we suggest the Agency add an additional factor, "(5) the composition of the waste" to the sentence on line 42, page 7-2 of the waste chapter that begins: "Methane generation and emissions from landfills are a function of several factors."

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[13] Staley, B.F. and Kantner, D.L., Estimating Degradable Organic Carbon in MSW Landfills and the Impact of Non-MSW Materials, EREF – Environmental Research and Education Foundation, 2016, Table 1, p.4

Response: EPA appreciates commenter's support for planned improvements outlined in the report. As stated in the Planned Improvements section of Section 7.1 of the U.S. Greenhouse Gas Inventory of Emissions and Sinks, EPA currently uses one value of 0.20 for the DOC for years 1990 to 2004. With respect to improvements to the DOC value, EPA developed a database with MSW characterization data from individual studies across the United States. EPA will review this data against the Inventory time series to assess the validity of the current DOC value and how it is applied in the FOD method. Waste characterization studies vary greatly in terms of the granularity of waste types included and the spatial boundaries of each study (e.g., one landfill, a metro area, statewide). EPA also notes the recommendation from the commenter regarding the DOC values used in the GHGRP, in the context of new information on the composition of waste disposed in MSW landfills; these newer values could then be reflected in the 2005 and later years of the Inventory. EPA is continuing to investigate publicly available waste characterization studies and calculated DOC values resulting from the study data.

Commenter: Private Citizen (Isaiah)

Isaiah

Docket ID Number: EPA-HQ-OAR-2018-0853-0003

Comment 31: I feel as if we are overlooking a major problem that is occurring to our environment and not enough regulations are being made to fix this. Greenhouse gases and the change in climate is destroying our environment little by little and by the time these problems start affecting us it will be too late. Ocean acidification and the icebergs melting cannot be solved through money or passing a law. We have to change the whole mindset of our country and instead of focusing on wars in Iran or how Korea will bomb us we should be focusing on the war against pollution and how our ocean will harm us. Instead of being worried about being reelected focus on the impact you will leave for the future generation.

Response: EPA appreciates the commenter's interest in the annual development of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017. These comments are noted but are out of scope of this review.

Commenter: Private Citizen (Matthews)

Mark Matthews

Comment 32: I am concerned that the estimates of the release of methane gas from the processing of coal are not being fully captured. Section 3.4 seems to be saying that the only methane emissions being counted from the post-mining processing and storage of coal involves the kind of bulk crushing of coal that occurs at a mine site before it is transported (usually by train) to a power plant, and where it sits in waiting to be burned at the power plant. All the off-gassing of methane up to that point is being counted. BUT before the coal is burned it is usually further crushed to a very small size before it is actually fed into the burner. It doesn't appear that the release of methane from this process is being counted. According to Diamond and Schatzel (see below) this kind of processing releases the "residual" methane content of the coal and this "residual" is 40 to 50% of the total methane content of the coal. In other words, the total off-gassing of methane from post-mining processing could be twice as much as has been estimated. It could be even higher since some coals can take "months" to degas from even bulk crushing - so if the coal retains its methane tightly and it is sent to the plant quickly (within days or weeks) and burnt shortly after it arrives (it's my understanding that they don't typically keep huge inventories of coal at the plant, so it may be burnt within days or a week) then the vast majority of its methane content may be released by pulverization at the plant. Is this release being inventoried?

> *From: Measuring the gas content of coal: A review William P. Diamond, Steven J. Schatzel (International Journal of Coal Geology 35(1):311-331, February 1998)*
>
> *"The volume of gas desorbing from a coal sample gradually declines with time. Desorption measurements for the extended desorption techniques are terminated at some point when an arbitrary low desorption rate is reached. This rate may be reached in a matter of days for very Mable samples or can take months for some blocky coals. Generally, when the desorption rate reaches an established termination point, some volume of gas remains in the sample. Traditionally, this residual gas has been thought of as gas that is 'trapped' within the coal structure due to slow diffusion rates. Bertard et al. (1970) and Levine (1992) suggest that the residual gas may not be diffusion dependent, but in part, represents gas remaining in equilibrium under approximately 1 atm of methane pressure in the desorption canister. The residual gas volume can be determined by crushing the sample in an airtight container and measuring the volume of gas released by the same method as that used for the desorbed gas (Diamond et al., 1986). The volume of residual gas measured in the laboratory for samples subjected to elevated temperatures to approximate actual reservoir conditions will probably be less than would have been measured if the sample had equilibrated to ambient laboratory temperature during desorption monitoring.* ***Analysis of the gas content component parts for 1,500 coal samples from 250 coalbeds in the United States (Diamond et al., 1986), shows that residual gas can comprise 40 to 50% of the total gas content,*** *in particular for relatively low-rank (high volatile-A bituminous) blocky coalbeds"*

Response: The article cited by the commenter (Diamond and Schatzel, 1998) estimates that the residual methane content of coal after mining ranges from 10 to 50 percent of the total gas content of the coal. EPA uses an emission factor of 32.5 percent to account for methane desorption during coal transport and storage. This emission factor is based on Creedy (1993), which estimates that on average 40 percent of the in-situ gas content of coal remains after mining. This estimate in Creedy is based on gas emission prediction modeling and measured data. Creedy further assumes that this remaining methane content is emitted while the coal is in transit and during storage prior to combustion. The EPA believes that the mid-range emission factor currently used in the Inventory, based on Creedy, is generally consistent with the range of estimates of coal residual gas content presented in the article cited by the commenter. However, EPA will further review the article referenced by the commenter and consider whether adjustment of the emission factor for post-mining activities is warranted.

Other Comments

EPA received one additional anonymous technical public comment as part of the public review of the draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017*. This comment can be found on the public docket and is copied below.

Anonymous

Docket ID: EPA-HQ-OAR-2018-0853-0002

Comment 33: EPA must ensure that it is properly accounting for carbon dioxide emissions from wet flue gas desulfurization (FGD) systems at coal-fired power plants. Wet FGDs which use calcium carbonate and other agents can have significant CO2 emissions which are in addition to the CO2 emissions from the combustion of the coal.

Response: EPA includes and reports these emissions in Chapter 4 under Section 4.4 Other Process Uses of Carbonates which starts on page 4-20 of the report. The component of process uses of carbonates emissions associated with FGD is also reported as part of Electric Power Industry emissions in Table 2-10: U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (MMT CO_2 Eq. and Percent of Total in 2017) on page 2-14 of the report.