Summary of Expert Review Comments and Responses:
Draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016*

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U.S. Environmental Protection Agency
Office of Atmospheric Programs
Washington, D.C.

Responses to Comments Received during the Expert Review Period on the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016*

Preface

EPA thanks all commenters for their interest and feedback on the annual Inventory of U.S. Greenhouse Gas Emissions and Sinks. In an effort to continue to improve the estimates in the annual Inventory of U.S. Greenhouse Gas Emissions and Sinks, EPA distributed draft chapters of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016* for a preliminary Expert Review of estimates and methodological updates prior to release for Public Review. The Expert Review ranged from 15 to 30 days by sector, and included charge questions to focus review on methodological refinements and other areas identified by EPA as needing a more in-depth review by experts. The goal of the expert review is to provide an objective review of the Inventory in order to ensure that the final Inventory estimates and document reflect sound technical information and analysis.

EPA received 61 unique comments as part of the expert review process. The verbatim text of each comment extracted from the original comment letters is included in this document, arranged by sectoral chapters. No comments were received on the Draft Agriculture Chapter. EPA's responses to comments are provided immediately following each comment excerpt. The list of reviewers, dates of review and all charge questions distributed to reviewers are included in the Annex to this document.

Chapter 3. Energy

3.1 CH_4 and N_2O from Mobile Combustion - Methodological Updates in Response to Changes to FHWA's Gasoline Consumption Estimation Models

Comment: Decision to Update Data is Clear
Generally, the proposal to update the historical (1990-2015) motor gasoline time series data by incorporating estimates of historic lawn and garden and recreational vehicle fuel use from the EPA's NONROAD model is relatively clear and transparent. Given that the last "major" update of the NONROAD model occurred in 2008, it is likely that the version that was embedded into MOVES for the release of MOVES2014a is very outdated. Therefore, EPA should devote an effort to ensuring that: (a) its estimates using the NONROAD version of the model that is embedded in MOVES are based on updated estimates of equipment populations, activity, fuel efficiency and emission factors, and (b) the latter are consistent with the data, methodology and assumptions used by FHWA for its estimates of non-highway gasoline usage.

Response: **Although the NONROAD model was incorporated into the MOVES platform in 2014, much of NONROAD's underlying equipment population and activity data are 15-20 years old. EPA is currently developing updated non-road population and activity databases (as well as emission rates), which will be available in future versions of MOVES.**

3.1 CH_4 and N_2O from Mobile Combustion - Updated Methodology for Estimating CH_4 and N_2O Emissions from Alternative Fuel Vehicles

Comment: Reporting Use of RNG in On-Road Vehicles
Based on our review by expert colleagues at Natural Gas Vehicles for America ("NGVAmerica"), which includes many AGA member companies, AGA requests that EPA ensure that the Inventory accounts for the use of Renewable Natural Gas ("RNG") in on-road natural gas vehicles. It is not clear to us whether this has been done, and if so, where this data will be reflected in the Inventory. As the recent September 2017 EPA-AGA Renewable Natural Gas Workshop[1] illustrated, there is increasing interest in using purified biogas from landfills, waste water treatment plants and anaerobic digesters as a source of renewable vehicle fuel. RNG used in natural gas vehicles now accounts for roughly 20 percent of the fuel consumed in on-road NGVs, and the percentage is increasing every year. It is important for the Inventory to report the growing use of RNG in on-road vehicles and the related reduction in GHG emissions from vehicles.

[1] See EPA Methane Challenge outreach and events web page at http://www.ttemidev.com/rng/workshop/

Response:
EPA will continue to research options for breaking out vehicles fueled with renewable natural gas.

Comment: Updated Data Available for GREET
This document proposed to rely on GREET 2016 for generating updated CH_4 and N_2O emission factor estimates for alternative fuel vehicles. Argonne National Laboratory recently released GREET 2017 which is an updated version of GREET 2016. EPA should rely on the most current version of GREET available.

Response: **Efforts to develop updated CH_4 and N_2O emission factors for AFVs precede the October 9, 2017 release of GREET 2017. EPA does, however, continue to endeavor to utilize the most up-to-date data sources and calculation methodologies to produce this Inventory.**

Comment: Numbering of Tables Inconsistent
The numbering of the tables in the text of the subsection labeled "CH_4 and N_2O Emissions by Vehicle and Fuel Type" is not consistent with the table numbers shown in the titles of the tables displayed.

Response: **EPA thanks commenter for feedback. Additional text has been added to the "CH_4 and N_2O Emissions by Vehicle and Fuel Type" portion of the memo to more clearly indicate that the "current" emission factors given in Table 6 are those which are described on Page 4 of the memo. Additionally, the captions for Tables 7 and 8 have been modified to reflect that these tables display "updated" emission factors, per the text description on Page 5.**

Comment: Additional Text Needed for Clarity
In general, this document would benefit by additional text which more clearly explains the data and assumptions which underlie each of the steps used to estimate CH_4 and N_2O emissions from alternative fuel vehicles.

Response: **EPA thanks commenter for feedback and will consider this for the current and future reports.**

Comment: Question about Reviewing EIA and GREET Estimates
Pg. 1, 2nd para: EPA states the following - "For VMT, energy use from EIA is divided by fuel economy estimates from GREET to determine miles driven by fuel and vehicle class. Emission factors are determined directly from GREET."

In performing the above calculation of VMT, EPA is implicitly assuming that EIA energy use values and GREET fuel economy estimates are derived from identical populations of alternative vehicles disaggregated by fuel and vehicle class. Has EPA checked the data and methodologies that underlie the EIA and GREET estimates to verify that this assumption is correct? It may be appropriate to run some sensitivity cases to determine the impact of this assumption on the final results.

Response: **EPA thanks commenter for the suggestion to conduct additional analyses to determine the extent to which energy use data from EIA and fuel economy values from GREET rely on similar populations of AFVs. Such an analysis was not within the scope of this update.**

Comment: Suggestion to Include Referenced Regression
Pg. 1, 2nd para, last sentence: It would be helpful to include a copy of the referenced regression analysis and related regression equation statistics (e.g., R2 values) in an Appendix to this document.

Response: **Regressions were performed, but details were not kept. The best fit was used in all cases.**

Comment: Question about Data Comparison of Biodiesel Consumption
Did EPA compare the results of its regression analysis-based estimate of biodiesel consumption in 2000 with actual data?

Response: **This comparison was not performed and was not within the scope of this update. EPA will investigate data sources appropriate for conducting such a comparison, for possible inclusion in future reports.**

Comment: Data Requested for EVs and PHEVs
Pg. 2, 1st para: EPA states the following assumption - "Fuel use per vehicle for EVs and PHEVs were assumed the same as those for the public fleet vehicles surveyed and provided by EIA. This may overestimate electricity usage as it is likely that fleet vehicles accumulate more annual mileage than personal vehicles."

EPA should provide a range of values of the likely overestimate, especially for long range vehicles such as Tesla S.

Response: **While a comparison of accumulated mileage of fleet vs. personal EV and PHEV vehicles would likely complement this memo, such an analysis is not within the scope of this work.**

Comment: Further Elaboration on Table 2 Suggested
Pg. 2, Table 2: Table 2 is presented with virtually no explanation as to how the data which it contains are being used in the analysis. How do EDTA data on annual sales of light-duty EV and PHEVs relate to the EIA data tables on vehicle "counts?" It seems that sales data are being used interchangeably with vehicle stock (i.e., vehicles in operation) data? Is this correct? If yes, then some additional explanatory text should be incorporated into this document, for it is currently very vague and unclear with respect to methodology.

Response: **Cumulative PHEV and EV sales data are used to define vehicle counts. From 2011 onward, EPA assumes no vehicle scrappage. EIA data is used only to determine fuel/electricity use per vehicle (it assumed that vehicle counts from EIA undercount EVs and PHEVs because only fleet vehicles are included). EPA recognizes that future Inventories will need to account for vehicle scrappage.**

Comment: Question about Years in Table 1
Pg. 5, Table 1: What calendar year is being represented by the values shown in this table? i.e., what does "current" mean in the context of calendar year representation? Such information would be useful in the context of understanding the differences between the table on p. 5 and the tables shown on subsequent pages.

Response: Clarification on Timing Language
"Current" in the context of Table 6 refers to emission factors that have been used to develop past Inventories, through the 1990-2015 Inventory report. Should EPA adopt the emission factor updates described in the memo, the "current" emission factors in Table 6 would then be characterized as "previous."

3.1 CH_4 and N_2O from Mobile Combustion - Updated Non-Highway CH_4 and N_2O Emission Factors

Comment: Proposal Written Clearly
Generally, the proposal to update the non-highway CH_4 and N_2O emission factors is written clearly, comprehensively and transparently.

Response: **EPA appreciates the feedback.**

Comment: Question about Non-Highway Emission Factors

What, if any, effort has EPA made to validate that the "new" non-highway CH_4 and N_2O emission factors for each of the non-road equipment types mentioned in this update are indeed representative of actual, real world operation? It would be useful to reference any such studies, research, etc., that support the "new" estimates of emission factors that are shown in this paper.

Response: **Due to a scarcity of in-use data of CH_4 and N_2O emissions from non-highway sources, EPA has not attempted to validate the updated CH_4 and N_2O emission factors described in the memo. Should in-use data become available in the future, EPA may attempt to validate the emission rates described in this memo.**

Comment: Suggestion to Add a Footnote to Tables
Given the significant changes in CH_4 and N_2O emissions that are shown for some categories in Tables 6,7,13 and 22 that are attributed to the change from "current" to "new" emission factors, it would be useful to include a footnote to each of these tables that emphasizes the fact (if true) that no other changes (i.e., to population and/or activity) were made that impact the comparisons.

Response: **EPA agrees that the memo would benefit from table footnotes affirming that results shown in the tables reflect only changes to emission factors and not from any changes to vehicle population and activity inputs.**

3.1 CH_4 and N_2O from Mobile Combustion - Updated On-Highway CH_4 and N_2O Emission Factors

Comment: Proposal Written Clearly
Generally, the proposal to update the on-highway CH_4 and N_2O emission factors is written clearly and transparently. The methodology, data and assumptions used in the update are presented in an organized, concise manner and they are well-documented by statistical analyses included in the appendices.

Response: **EPA appreciates the feedback.**

Comment: Possible Typo or Transcription Error
Pgs. 2-3, Tables 2 and 3: the ~+7-fold increase in HDGV CH_4 emissions due to the use of "new" versus "current" emission factors that is shown in Table 3 is extremely surprising (and very suspect) given the general reduction in methane emission factors (on the order of 0-76%) for this vehicle category that is shown in Table 2. Is this a typo or transcription error? Are there other factors that accompanied the use of updated emission factors (e.g., changes in activity, vehicle population, etc.) that have not been explained?

Response: **Thank you for identifying a critical typo in Table 3. The "current" CH_4 emissions for HDGVs should be 1,551 metric tons, not 23,383 metric tons. The results presented in Table 3 reflect changes to emission factors only (i.e., vehicle population and activity inputs are held constant).**

Chapter 4. Industrial Processes and Product Use (IPPU)

4.17 Iron and Steel Production and Metallurgical Coke Production

Comment: Subchapter is Disjointed and Terms Need Defining

I find this subchapter to be somewhat disjointed. In its opening remarks, it would be best to explain that "pig iron" is the common, but unfortunate term used for what would be better described as "crude iron". Pig iron is really that (small fraction currently; a large fraction 50-100 years ago) subset of crude iron production that is actually poured into small molds to form "pigs". The current interchangeable use of "pig iron" for "crude iron" can lead to problems with the foreign literature/statistics. For example, some years ago, the USGS data on Turkish crude iron output was erroneously revised downwards from, if memory serves, c. 5 Mt/yr. to something like 250,000 MT/year, because the then country specialist (the late Phillip Mobbs) had found a Turkish Govt. reported data series for pig iron. What he had found was a longstanding series for "pik demir" (which is the iron cast into pigs), whereas what he should have (continued to have) used was the reported series for "ham demir" (crude iron). When the error was pointed out to Mr. Mobbs, he revised the data back to the larger number series.

Most of the CO_2 released in iron & steel production is from the production of crude iron; although the chapter does mention this here and there, the main impression is that the focus is on crude steel production.

In blast furnaces, the CO_2 largely comes from the use of coke and the carbonate flux (really, it's a slagging agent, although "flux" will suffice). The use of flux seems not to be dealt with except indirectly. Mention is made of a deduction (from Other Carbonate Uses) to avoid double-counting of the flux used in steel production, but in reality, you should say "...in crude iron production". It is the blast furnace that uses limestone and/or dolomite. Steel furnaces use LIME as a flux, and this use should not release any additional CO_2 (the manufacture of lime, of course, is dealt with in a separate chapter); most U.S. integrated plants, and all independent EAF plants, buy their lime from the lime industry.

In making crude iron in a blast furnace, you will consume c. 0.2 - 0.5 t of carbonate slagging agent (limestone and/or dolomite) per ton of crude iron produced, which would thus yield approx. 0.1-0.2 t of CO_2 per ton of iron; the net calculation (all sources) would be debited for carbon (c. 4%) remaining in the crude iron. Then the subsequent steel furnace will burn off most of this carbon in the crude iron feed; an EAF may burn some C-electrode to add carbon to the melt if it overburned the melt's carbon by mistake.

If you are going to mention the number (11) of iron and steel (integrated) complexes, it would be of interest to note that there were 21 active blast furnaces (only) in 2015 at these plants--a sad decline...

Section 24 (Iron and Steel Production) is introduced by talking about the minor stuff (sinter, DRI, pellets) rather than the major outputs of crude iron and crude steel.

In the first para of section 4-25; add "carbonate fluxes or slagging materials" to the list of inputs to the blast furnace.

In the 2nd para (line 12), fluxes appears as an input for steel production; again, for steel production, the flux is lime, not carbonate, and will not yield CO_2 in the steel furnace. The confusion is continued in lines 15-17 where carbonates are linked to steel manufacture instead of to crude iron production.

Table 4-29 would be more useful if you split the inputs in terms of those for crude iron production (blast furnace) from those for crude steel production (steel furnace).

Table 4-31 needs a data series for flux (slagging agent) consumption for the blast furnaces. It is unclear if any of this (carbonate) flux was put in the EAF and BOF sections; if so, it should be removed. The EAF and BOF flux of interest is lime. However, be aware that some data for "fluxes" for BFs includes silica sand (which is a flux, but yields no CO_2).

Response: **EPA has updated background descriptions to improve the explanation of current production processes and to clarify the use of the terms "pig iron" and "crude iron" in the upfront section of the source category text. This update is to reflect the iron and steel emissive processes, the status of the industry, and changes over the time series. For the current inventory (i.e., 1990 through 2016), EPA has not implemented updates to Table 4-31 to include slagging agent consumption for blast furnaces. EPA will need to assess available data and review appropriate emission factors per the 2006 IPCC Guidelines before including in future reports.**

Chapter 6. Land Use, Land Use Change and Forestry (LULUCF)

Comment: Chapter is Clear

We find the chapter to be clear, transparent, concise, understandable, and thoroughly documented. The basic methodology and data sources are sound and have remained mostly unchanged. EPA is using appropriate data for components of this chapter, and the forest inventory data which forms the basis for all forest carbon stock estimates is undergoing steady improvement with thorough scientific review.

Response: **EPA appreciates the commenter's feedback on clarity and transparency of Chapter 6 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.**

6.1 Representation of the US Land Base

Comment: Question about Availability of Citations

I hope the citations that are described as "in prep" are available to reviewers within the coming year? Especially on page A-207, Theoretical age class transition matrix, Wear and Coulston in prep.

Response: **Most of the references listed as in prep on page A-207 are published, the figure will be updated with the correct citations in the final Inventory published in April 2018.**

Comment: Question about FIA Data Table

I can appreciate the approach to not greatly update the inventories every year, and instead go to biennial reporting. It is a great deal of work to update the inventories.

My main comment is about Table 6-3. If FIA data are not used for forests in Alaska, (top part of table), it is hard to believe it is used in the croplands, grasslands, other lands, settlements, and wetlands for Alaska (bottom part of table, two dots in the FIA column). And how does this table relate to the presentation of the USGS numbers for Alaska? (See table 6-10).

Response: **The table (listed as 6-3 in Expert Review version) will be updated to indicate that FIA was used to determine land area for portions of Alaska. The chapter text already indicates this is the case. This table is not used directly in presentation of the USGS numbers for Alaska as shown in the Forest Land Remaining Forest Land section, but the outputs from the Land Representation analysis for Alaska is overlaid on the USGS spatially explicit estimates for Alaska to approximate the area of managed land and thus the "anthropogenic" emissions.**

Comment: Recommendation of a New Source

For US territories, a new publication has just been released based to a large degree on FIA data that states deforestation is not much of an issue in the islands. Would be worth a look, and perhaps citing. However, it doesn't include the most recent surveys from some of the islands. See Assessing Forest Sustainability in the Tropical Islands of the United States at the link below.

https://www.fs.fed.us/research/sustain/sustainability-reports.php#tabs-2

Response: **EPA will review the publication and when resources allow for inclusion of US Territories, EPA will utilize this to assist in developing estimates of GHG emissions/removals from these territories.**

6.2 Forest Land Remaining Forest Land

Comment: Parenthesis Needed
Typo: 6-31, line 1 – parenthesis missing after A-99

Response: **EPA has included the noted missing parenthesis.**

Comment: Change from 2015 Inventory Supported
We support the decision to move to a biennial compilation schedule, using land area data from the prior inventory (2015) for this report. This is a reasonable compromise to obtain accurate estimates while focusing efforts on other improvements, given the large area of the US land base and the relatively slow rates of change. This is well documented in the methodology sections.

Response: **EPA appreciates the commenter's feedback on the recent implementation of the biennial compilation process with the goal of directing resources to planned improvements for this source and enhancing the overall clarity and transparency of the methodology for Forest land Remaining Forest Land estimates in Chapter 6 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.**

Comment: Recent Improvements on Methodology are Successful
Recent improvements to the report methodology have made for a more comprehensive inventory, reflecting more land areas, all carbon pools, and providing better resolution on land area changes. Especially notable is the beginning of collection of inventory data for interior Alaska. When complete, this will add important information to the inventory.

Response: **EPA appreciates the commenter's feedback supporting the recent improvements to estimates for Forest land Remaining Forest Land in Chapter 6 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.**

Comment: Planned Improvements Supported
The planned improvements for Forest Land remaining Forest Land are well considered. We support the use of remotely sensed data for improving spatial and temporal scale of change data, following scientific review of methods. We also strongly support the dissemination of open source code for transparency in computations. More consistency in soil depth used for soil carbon reporting for land use changes is a worthwhile planned improvement.

Response: **EPA appreciates the commenter's feedback supporting planned improvements to estimates for Forest land Remaining Forest Land in Chapter 6 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks.**

6.8 Wetlands Remaining Wetlands

Comment: Changes Needed to Synthesize Wetland Fluxes

It is clear that work remains to improve the inventory information on wetland changes. Identification of types of transition of lands into and from coastal wetland categories would be informative. In addition, some summarization of fluxes for the overall wetlands category would be beneficial; it is difficult to determine from the present format the total flux from wetlands remaining wetlands and lands converted to wetland as no summary table is presented. Fluxes for peatlands, vegetated wetlands, and un-vegetated wetlands and transitions among them are presented separately, making it difficult to synthesize information on overall wetland fluxes.

Response: **EPA appreciates the commenter's feedback on [additional] planned improvements to consider for Wetlands Remaining Wetlands in Chapter 6 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks. Improvements to the Wetlands section to better represent land use and transitions in the Wetlands category are planned for a future inventory, primarily by integrating the Coastal Change Analysis Program (CCAP) data into the land representation analysis. EPA will also evaluate how to improve the presentation of the Wetlands Section to provide a better summary of the fluxes from this chapter.**

6.10 Settlements Remaining Settlements

Comment: Clarity in Estimates are Underway

As noted in the report, improvements in distinguishing urban forest estimates from the rest of the forest inventory are underway, and will provide clarity in estimates pertaining to settlements remaining settlements as well as relevant transitions to and from the settlement category.

Response: **EPA appreciates the commenter's feedback supporting planned improvements for estimating Settlements Remaining Settlements in Chapter 6 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.**

6.10 Settlements Remaining Settlements – Changes in Yard Trimmings and Food Scrap Carbon Stocks in Landfills

Comment: Description of Food Waste

Overall - I think that the methodology is clear and transparent and applaud EPA for the document's preparation.

Page 103: In describing the amounts of yard trimmings and food waste that are generated, I always use the word "estimated" as opposed to writing the text as if these quantities are definite. This is especially important in the case of food waste. The EPA considered food waste from sources that are defined as MSW only and does not include food waste that is generated at commercial food processing facilities (e.g., a factory that cans tomatoes or oranges). As such, the estimate of food waste to landfills is likely low.

Response: **EPA agrees that clarification is helpful and has edited the text to reflect that the values are estimated and not definite. Yard trimming and food scrap generation data are obtained from EPA's Advancing Sustainable Materials Management: Facts and Figures report, "Table 1. Generation, Recycling, Composting, Combustion with Energy Recovery and Landfilling of Materials in MSW". These MSW values include waste from residential, commercial, and institutional sources.**

Comment: Improvement for Methodology Needed

Page 104 – Methodology

This methodology captures food and yard waste present in MSW only. There are other sources. As noted above, in the case of food waste, there is commercial generation. In the case of yard trimmings, some debris from road construction is also disposed in dedicated landfills (I do not have detailed information but am told, for example, that the state Departments of Transportation operate "stump dumps" that received large trees.

Response: **EPA agrees, but has not identified data sources to quantify the food scraps from commercial sources or relevant debris from road construction for inclusion in estimating emissions/removals from landfilled, yard trimmings and food scraps, and have therefore not included these in the current estimates. EPA will continue to search for these data and add this to our list of planned improvements, noting that the commenter did not include any specific data sources to include these sources in the current Inventory report.**

Comment: Clarification of Decay Rates
Page 104 – Methodology

To clarify one item on the decay rates. The individual waste component decay rates that are given in de la Cruz and Barlaz (2010) for a bulk MSW decay rate of 0.04 can be readily adjusted to waste component decay rates for any other desired bulk MSW decay rate as follows:

Individual component decay rate at bulk decay rate of 0.03 = Individual component decay rate at bulk decay rate of 0.04 * 0.03/0.04

I think that EPA is aware of this but wanted to be sure.

Response: **EPA appreciates this feedback and will add this review to the planned future improvements the clarification on the decay rates and update the factors as appropriate following our review in future reports.**

Comment: Recommendation for Planned Improvements
Page 109 – Planned Improvements

It might be possible to consult with agronomists and get estimates of the mass of grass that grows per acre on residential lawns as a function of climate. This would provide a bottom up estimate of total grass generation that could be compared with the EPA methodology.

Response: **EPA will add commenter's suggestion to the list of planned improvements to determine a total residential lawn grass generation for sake of comparison to our methodology as category-specific QC step per IPCC good practice to implement for future reports.**

Comment: Inconsistent Decay Rates
Table 6-76: The Decay Rates here do not match the values in de la Cruz and Barlaz. I think this is because the decay rates in Table 6-76 are weighted average rates across the US based on different regions with different bulk MSW decay rates. If I am correct, I suggest an explanatory note in Table 6-76.

Response: **EPA has included a note in Table 6-81, Section 6.10 of the Public Review version of the report stating that "the decay rates are presented as weighted averages based on annual precipitation categories and population residing in each precipitation category".**

Comment: Attached Recommended Sources
Over the past several years, my group has published a number of papers on the biodegradability of wood. I am attaching those papers for your convenience. I do not think that they are necessarily of immediate use, but do think they provide some useful background for future work.

Response: **EPA appreciates this information and will review the papers in consideration with other planned improvements to consider how they can improve our methods for future estimates.**

Comment: Consistency Needed for Storage Factors
Finally, I agree with the comment that ultimately, we need to make the methane yields and C storage factors internally consistent. We have done this and adjusted methane yields accordingly in the following manuscript (Table S5).

Response: **EPA will review the paper (Hodge, K. L., Levis, J. W., DeCarolis, J. F. and M. A. Barlaz, 2016, "Systematic Evaluation of Industrial, Commercial, and Institutional Food Waste Management Strategies in the U.S," Env. Sci. and Technol., 50, 16, p. 8444 - 52) provided and will evaluate the potential to make adjustments to the inventory methodology for future inventory reports.**

Chapter 7. Waste

7.1 Landfills

Comment: Approval of Updated Approach for MSW Landfills
We have been very pleased with the cooperative effort among EPA and stakeholders to review and update the approach used to estimate greenhouse gas (GHG) emissions at MSW landfills and we look forward to continuing to work with you towards further improvements. The landfill sector strongly supports the Agency's efforts thus far to update the inventory, and particularly your decision to use Greenhouse Gas Reporting Program (GHGRP) data in the most recent inventory. We strongly support continued use of this data.

These data are more reliable and accurate for estimating nationwide emissions from MSW landfills. In previous comments on this issue, we explained why using GHGRP data is the preferred approach.

- The MSW landfill sector (Subpart HH) emissions data are significantly more detailed and up-to-date than the estimation approach used in previous GHG Inventories;

- Every MSW landfill reporting to Subpart HH is subject to annual validation via EPA review of submitted data – a level of scrutiny that does not occur in the GHG Inventory;

Each MSW landfill that reports under Subpart HH has a "designated representative," who must certify – under penalty of law – that the data submitted by the site are accurate and developed in accordance with regulatory requirements. These data are developed using consistent, EPA-approved methods, and are certified by reporters and independently quality-assured by EPA, which ensures transparent and reliable data for use in emissions estimates.

Response: **EPA appreciates the commenter's feedback supporting improvements applied for estimating emissions from Landfills in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.**

Comment: The Scale-Up Factor for MSW Landfills

We thus recommend that EPA recalculate the scale-up factor using Option (a) and an adjusted WIP amount that is at least 60 percent lower than the amount assumed in the Agency's previous calculation. EPA's assessment of non-reporting MSW landfills shows that the GHGRP captures the vast majority of emissions from the MSW landfills and a scale-up factor of no greater than 5 percent would be far more appropriate for use in the Inventory.

Full Context: Recognizing that the 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 supported EPA's decision to use a scale-up factor to estimate emissions from non-reporting landfills in the 2017 Inventory. EPA calculated a scale-up factor of 12.5%, based on the percent difference between the 1990-2014 Inventory emissions and the GHG emissions as reported for 2010-2015 and back-casted emissions for 2005 to 2009. We were, however, concerned that the scale-up factor of 12.5% would be overly conservative, and recommended that a factor of 10% would be sufficient to avoid underestimating emissions. We also encouraged EPA to reassess an appropriate scale-up factor to more accurately account for non-GHGRP reporting landfills.

EPA has endeavored to do so by developing a draft list of MSW landfill facilities that do not report to the GHGRP by comparing the Agency's GHGRP database with the LMOP 2017 database and the Waste Business Journal (WBJ) 2016 database. This exercise has been fraught with difficulty due to the variety of facility names that may be associated with an individual landfill, the incorrect latitude and longitude values assigned to many landfills and the possible inclusion of non-MSW landfill sites in both the LMOP and WBJ datasets. EPA asked the landfill sector for assistance in reviewing the draft list.

Because the analysis of almost 1,800 landfill sites would be very time-consuming, the landfill sector focused its review on those landfills on the list with the greatest amount of waste-in-place. Waste-in-place is the primary variable for calculating potential emissions from a landfill. The landfill sector reviewed approximately a quarter of the sites on the draft list and found significant errors. Many of the sites were identified as reporting into the GHGRP, so their emissions were already captured. Other sites were misidentified as MSW landfills, and still other listed sites were duplicates and therefore accounted for multiple times.

The landfill sector[1] reviewed a total of 450 sites on the EPA's list of non-reporting MSW landfills. The below table summarizes the results of our review.

Summary of Review

450	**Total Sites Checked**
2	Duplicates
14	EXEMPT - NOT MSW landfills
287	Non-Reporting MSW landfills
147	Reporting-MSW landfills in GHGRP
3,057,855,595	EPA Total Forced WIP in tons for non-reporting sites
1,137,266,189	Industry Adjusted Forced WIP in tons for non-reporting sites
37.91%	% of Total

In adjusting the total forced WIP for remaining MSW landfills, the landfill sector removed only the WIP associated with non-MSW landfills (and those sites that are already reporting WIP and emissions through the GHGRP. Adjusting the WIP for this subset of landfills in the spreadsheet reduces the total WIP by more than 60 percent.

Developing an accurate list of non-reporting MSW landfills and the associated WIP is essential to both options the Agency has considered for calculating a scale-up factor.

a) The percentage difference in total waste-in-place between the non-reporting facilities and the GHGRP MSW landfill facilities; or
b) The percentage difference in net methane emissions between the non-reporting facilities and the GHGRP MSW landfills.

Using its draft list on non-reporting landfills, EPA determined that Option (a) yields a scale-up factor of approximately 11%, as shown in Table 1 of the October 16, 2017 EPA Expert Review memo. This value was determined from the estimated total waste-in-place for non-reporting facilities compared to facilities reporting to the GHGRP. To calculate GHG emissions for non-reporting facilities, 11% of the total GHGRP emissions for each year of the time series would be applied.

Option (b) yielded a scale-up factor of approximately 26%, as shown in Table 2. This value was determined from estimated methane emissions for the non-reporting landfills. EPA used the Inventory Waste Model (first order decay methodology) and estimated annual waste disposal data that excludes an average amount of C&D and inert waste, and the same default factors as applied in previous inventories for DOC, MCF, etc., and a 10 percent oxidation factor.

Leaving aside the fundamental flaws with the EPA list of non-reporting landfills, the landfill sector recommends that Option (a) is the more appropriate approach because waste-in-place data are readily available and are more reliable than modeled net emissions. Specifically, Option (a) relies on available waste acceptance data to determine waste-in-place for the non-reporting facilities and waste-in-place data reported under the GHGRP for MSW landfills reporting under Subpart HH. Option (b), in contrast, relies on the first order decay methodology, as well as many default factors that may not be appropriate across the country.

We thus recommend that EPA recalculate the scale-up factor using Option (a) and an adjusted WIP amount that is at least 60 percent lower than the amount assumed in the Agency's previous calculation. EPA's assessment of non-reporting MSW landfills shows that the GHGRP captures the vast majority of emissions from the MSW landfills and a scale-up factor of no greater than 5 percent would be far more appropriate for use in the Inventory.

[1] - SWANA members in state chapters across the country; major, private landfill owner/operators who are members of NWRA; SCS Engineers and Weaver Consulting, which conduct GHG Reporting for many public and private sites, and WM and Republic Services.

Response: **EPA appreciates the commenter's feedback supporting planned improvements for estimating emissions from landfill in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA also appreciates the effort undertaken by the landfill industry to review the list of landfills that do not report to the GHGRP and the attempt to remove reporting landfills and duplicates, as well as fill in missing waste-in-place and open/closure year data where available. Based on further review within EPA and industry input, EPA has revised the scale-up factor used in the emissions estimations for 2004-2016 in the time series from 12.5% to 9%. Please**

refer to the Recalculations Discussion in Section 7.1 of the Inventory text as well as the supporting memo "Methodological refinements as applied in the 1990-2016 estimates of U.S. greenhouse gas emissions from MSW landfills to account for emissions from facilities not reporting to the Greenhouse Gas Reporting Program" from Kate Bronstein and Meaghan McGrath of RTI International to Rachel Schmeltz of EPA/CCD, April 4, 2018 for more detail on the steps taken to refine the scale-up factor.

Comment: The Scale-Up Factor for MSW Landfills
1) Additional datasets to generate and/or refine a list of non-reporting landfills.

Both EPA and the landfill sector have spent considerable time attempting to create a useable database of non-reporting landfills based on EPA's LMOP and WBJ databases. There are no other datasets to evaluate. This effort has been difficult and time-consuming for many reasons, including problems in identifying non-reporting landfills, tracking down landfills with addresses but incorrect LAT/LONG coordinates and confirming that GHGRP, C&D, and industrial landfills are not in the non-reporting landfill database. Significant effort was undertaken by the landfill sector to review and revise the list of non-reporting landfills. With additional time, we believe we could further refine the list. However, our review to date of the Agency's database of non-reporting landfills has eliminated over 60 percent of the total waste-in-place used to calculate the Agency's initial scale-up factors of 11% and 26%. We recommend the Agency recalculate the scale-up factor using Option (a) and a reduced WIP amount that is at least 60 percent less than that used in the prior calculation.

Response: **EPA appreciates the commenter's feedback confirming that there are no additional datasets to use in informing the scale-up factor applied to estimating emissions from MSW landfills in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA also appreciates the effort undertaken by the landfill industry to review the list of landfills that do not report to the GHGRP and the attempt to remove reporting landfills and duplicates, as well as fill in missing waste-in-place and open/closure year data where available. Based on further review within EPA and industry input, EPA has revised the scale-up factor used in the emissions estimations for 2004-2016 in the time series from 12.5% to 9%. Please refer to the Recalculations Discussion in Section 7.1 of the Inventory text as well as the supporting memo "Methodological refinements as applied in the 1990-2016 estimates of U.S. greenhouse gas emissions from MSW landfills to account for emissions from facilities not reporting to the Greenhouse Gas Reporting Program" from Kate Bronstein and Meaghan McGrath of RTI International to Rachel Schmeltz of EPA/CCD, April 4, 2018 for more detail on the steps taken to refine the scale-up factor.**

Comment: The Scale-Up Factor for MSW Landfills
2) How to handle landfills that "off-ramp" from the GHGRP.

The first reporting year for Subpart HH (and other subparts) was 2010, and the latest reporting year is 2016. To date, 16 landfills (out of 1137 in 2015) have met the criteria for exiting the GHGRP reporting requirements, representing merely 1.4% of the landfills reporting under Subpart HH. Given the very small number of landfills that have stopped reporting, we find it unnecessary and a very poor use of Agency resources to develop a new approach for accounting for these landfills' emissions. The potential effect of these emissions is tiny, particularly considering the revisions to the dataset of non-reporting sites, and the uncertainties and errors introduced using the first order decay model and non-representative DOC values. Further, EPA has the historical data for the "off-ramp" sites and most if not all the "off-ramp" sites are closed landfills where emissions will continue to decline over time.

Response: **EPA appreciates the commenter's assessment of the utility of developing an approach to account for emissions from landfills that have stopped reporting to the GHGRP because they met**

the "off-ramp" provisions (i.e. reported less than 15,000 metric tons of CO_2 equivalent for 3 consecutive years or less than 25,000 metric tons of CO_2 equivalent for 5 consecutive years). While the data reported by these facilities in previous reporting years is incorporated into the scale-up factor analysis, no separate approach has been developed. EPA will periodically assess the impact these off-ramping facilities may have on emissions estimates to ensure national estimates are as complete as possible.

Comment: The Scale-Up Factor for MSW Landfills
3) What is the best approach for applying a scale-up factor?

EPA is currently applying the same scale-up factor for 2005 to 2016, but is considering whether it would make more sense to apply a scale-up factor to blocks of time (e.g., 5 years), annually, and/or when GHGRP facilities off-ramp.

The landfill sector does not see the value in applying the scale-up factor at such a detailed level, given the significant reduction in the potential impact of non-reporting landfills to nationwide emissions, and the small number of landfills likely to either drop below the threshold for reporting or reach the Subpart HH threshold for reporting. This represents a poor use of the Agency's limited resources.

Response: **EPA appreciates commenter's input on the application of the scale-up factor as applied to estimating emissions from MSW landfills in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016.**

Comment: Degradable Organic Carbon (DOC)
Conclusion: Based on EREF's research, we urge EPA to update the DOC values to reflect significant changes in the amounts and types of organic materials being landfilled over the last several years. The values now in use are inaccurate and should not be used going forward. We request that EPA review and update the DOC values in the next version of the GHG Inventory.

Full Context: In 2016, the Environmental Research and Education Foundation (EREF) undertook a state-based study of DOC values for both MSW Only Landfills and Non-MSW Material going to MSW Landfills. The DOC guideline recommended by EPA for MSW Only Landfills is 0.31 and the recommended guideline for Non-MSW material going to MSW landfills is 0.20. As described below, these guidelines over-estimate the amount of organic waste deposited in landfills, which results in inaccurate estimates of landfill gas generation and methane emissions. We note that neither of the recommended DOC guidelines have been reviewed by EPA in many years, and we support EPA's view that it is time to update the DOC values.

EREF reviewed recent waste composition studies for MSW Only Landfills conducted by 13 states and confirmed that waste composition has and continues to change over time, as fewer organic materials are sent to MSW landfills. In fact, the EREF results show that the percent of the MSW-only stream that is organic waste ranged from 50.1% to 69.4%, with an average of 60.2% (Table 1).[2] EPA data also indicate that the fraction of organics going to landfills generally declined from 1994 to 2009. Quoting EREF:

Subsequent analyses were performed using both state characterization study data and EPA Facts and Figures data to compute DOC values for MSW (DOCMSW). An average DOCMSW of 0.184 was computed from the state study data, with values ranging from 0.142 – 0.209. All characterization studies had DOCMSW values significantly less than the default value of 0.31, which suggests this value is not representative of real-world conditions for MSW (Table 2; Figure 4). Analysis of U.S. EPA data … also results in a significantly lower DOCMSW value compared to the U.S. EPA guideline of 0.31, with

DOCMSW values ranging from 0.218 in 1994 to a minimum of 0.165 in 2011 (Figure 4; Appendix B). Both the state characterization studies and U.S. EPA Facts and Figures data independently suggest that a DOC guideline value of 0.31 for MSW is not representative of the landfilled MSW stream.

The use of a single DOC value as a guideline for all U.S. landfills makes the implicit assumption that waste composition does not change over time or due to location. The results presented here suggest these are not valid assumptions and that, collectively, the use of a static DOC value of 0.31 may lead to inaccurate estimates of landfill gas emissions for landfills that only accept MSW. Because this specific analysis is focused only on MSW materials, one would expect the inclusion of non-MSW materials going to a landfill to impact DOC estimates even more.[3]

With respect to Non-MSW going to MSW Landfills, EREF finds "a common assumption is that all waste materials entering MSW landfills consist only of MSW materials. As noted previously, MSWLFs rarely accept MSW exclusively. Rather, most MSWLFs (landfills in 45 states) are authorized to accept other Subtitle D wastes in addition to MSW."[4] In addition, EREF notes:

Given that a third of incoming waste to MSWLFs consists of non-MSW materials, there is significant potential for non-MSW materials to impact the relative fraction of organics and degradable organic carbon (DOC) of the MSWLF waste stream.[5]

The amount and types of non-MSW Subtitle D organic wastes impact the DOC value for the landfilled waste since it consists of both MSW and non-MSW streams. This combined DOC value (DOCSubD) incorporates degradable organic carbon from all Subtitle D wastes accepted at MSWLFs (both MSW and non-MSW). … State waste characterization studies were used to estimate the relative fraction of each organic constituent for C&D and industrial waste … and DOC for each waste type was calculated using Equation 1b. Based on this analysis the DOCSubD value of landfilled waste is 0.161 (Table 6)."[6]

EREF also highlights that the DOCSubD value is lower than the guideline value of 0.20 for bulk waste. It is also lower than the average DOCMSW value of 0.184 computed in the prior section, indicating the inclusion of non-MSW decreases overall DOC. Using the same approach as for the DOCMSW analysis, state-specific organics content and DOCSubD values for all fourteen states with sufficient data were determined and presented in Table 7, below. The results, all for 2013, highlight differences in DOCSubD based on locale and suggest the use of a static 0.20 guideline for bulk waste may lead to inaccurate estimates of methane generation and emissions, especially in some areas.[7]

Thus, EREF concludes as follows:

The average computed DOC value for MSW using state data was 0.184, or roughly three-fifths of the MSW guideline value. The average computed DOC value for bulk waste using state data was 0.161, or roughly four-fifths of the bulk waste guideline. This analysis suggests that the U.S. EPA's guideline DOC values of 0.31 for MSW-only landfills and 0.20 for facilities accepting non-MSW Subtitle D wastes overestimate DOC at these landfills and may result in inaccurate estimates of landfill gas generation and methane emissions.[8]

Based on this review of the DOC values for MSW landfills, the landfill 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, and second, the increase of Subtitle D non-MSW waste disposed has altered the DOC for all waste deposited in MSW landfills.

Based on EREF's research, we urge EPA to update the DOC values to reflect significant changes in the amounts and types of organic materials being landfilled over the last several years. The values now in use are inaccurate and should not be used going forward. We request that EPA review and update the DOC values in the next version of the GHG Inventory.

[2] - 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.
[3] Ibid. pp. 6 - 7
[4] Ibid. p. 8
[5] Ibid. p. 10
[6] Ibid. p. 11
[7] Ibid. p. 12
[8] Ibid. p. 13

Response: **As stated in the Planned Improvement section of Section 7.1 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, the Inventory 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).**

Comment: The k Factor (Methane Generation Rate Constant)
On page 25 of the U.S. Greenhouse Gas Inventory: Update on Methodology Improvement for MSW Landfills,[9] EPA notes that it is using k-values based on climate. Estimation of the CH_4 generation constant (k) is a function of a variety of factors, including moisture, pH, temperature, and other environmental factors, and landfill operating conditions."[10] For many years, EPA has used three k values, disaggregated by climate: 0.02 [dry climate], 0.038 [moderate climate], and 0.057 [wet climate].

We are 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 Lo. The recommended defaults k and Lo 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.[11]

As noted above, the landfill 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 LandGEM model, it is difficult to take these data seriously. For this reason, we again urge EPA to review and resolve the significant problems in the k value data set.

[9] U.S. EPA, U.S. Greenhouse Gas Inventory: Update on Methodology Improvements for MSW Landfills, August 16, 2017.
[10] U.S. EPA, Draft AP 42.2.4: Municipal Solid Waste Landfills, October 2008, p. 2.4-6.
[11] Ibid.

Response: **As stated in the Planned Improvement section of Section 7.1 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, in a future Inventory cycle, EPA will review 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 to these k values in the Waste Model. A 30 percent uncertainty factor is applied to each k value in the Monte Carlo analysis, which is consistent with that recommended by the IPCC (2006).**

Comment: The 10 Percent Oxidation Factor
For the period 1990 – 2004 in the inventory time series, a national estimate of methane generation and emissions are calculated 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.

We understand that EPA is considering revisions to the value of the oxidation factor and possibly including two oxidation factors: one for waste disposed at facilities with landfill gas collection and control systems (GCCS), and the other for landfills without GCCS. EPA acknowledges that the Agency has not developed a way of assigning a percentage of waste disposed in landfills with gas collection or without for those years.

While assigning different methane oxidation values to landfills with and without gas collection systems may seem to be a valid concept, that one site variable should not be applied to all sites in the inventory universe as THE defining characteristic affecting methane flux and oxidation. Other site-specific landfill attributes are important in assessing methane oxidation potential (e.g., WIP, modeled CH_4 generation, cover area and cover type). Sites with gas collection might have lower methane flux into the cover and thus would be expected to have higher rates of oxidation due to this lower flux. However, applying this one characteristic to all landfills in the Inventory without respect to their other site-specific attributes will not provide a valid, nationwide analysis. Many sites in the Inventory are small or older sites with low gas generation rates and low methane flux. They would still be expected to have oxidation rates that exceed 10% even without gas collection systems. So, the information needed to provide an accurate estimate of methane oxidation goes beyond simply knowing whether the site employs gas collection or not.

Response: **EPA appreciates commenter's input 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: 1990-2016. As stated in the Planned Improvement section of Section 7.1 of the Inventory, EPA is continuing to investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as 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 2016) averages at 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: The 10 Percent Oxidation Factor
1) Available data sources to address trends in installation of landfill gas collection systems.

The landfill sector is not aware of sources that would provide information on the extent of landfill gas collection within the industry or the trends in gas system installation outside of the reporting landfills in the GHGRP. The EPA LMOP dataset only indicates whether a landfill has a gas collection system, but does not note the date of installation or expansion.

Response: **EPA appreciates commenter's input and takes note that the commenter is not aware of any data sources to address trends in installation of landfill gas collection system. As stated in the Planned Improvement section of Section 7.1 of the Inventory, EPA is continuing to investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as 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 2016) averages at 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: The 10 Percent Oxidation Factor
2) Appropriate oxidation factors for landfills with and without landfill gas collection systems.

The landfill sector does not think that it is appropriate to assign oxidation factors to a landfill based solely on whether it operates a GCCS. As explained above, other site-specific landfill attributes, such as WIP, type and extent of cover and modeled methane generation are also important factors in assessing potential methane oxidation. Developing an accurate estimate of methane oxidation is significantly more complicated than relying on whether the landfill has a gas collection system.

Response: **EPA appreciates commenter's input 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: 1990-2016 and that the existence of a GCCS is not the sole factor in estimating the amount of methane oxidation. As stated in the Planned Improvement section of Section 7.1 of the Inventory, EPA is continuing to investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as 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 2016) averages at 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: The 10 Percent Oxidation Factor
3) Appropriate oxidation factor if only one factor is used for all waste disposed between 1990 and 2004.

The existing Subpart HH treatment of methane oxidation requires knowledge of landfill attributes to calculate methane flux and assess the corresponding methane oxidation value based on the bin approach. The bin approach is a conservative estimate based on 800 field estimates of oxidation for a range of methane flux results, as provided in the SWICS addendum and RTI memo. It is our view that EPA should use the flux based oxidation factor, as it could be applied more broadly than the current application in Subpart HH and is the most defensible approach.

Response: **EPA appreciates commenter's input 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: 1990-2016. As stated in the Planned Improvement section of Section 7.1 of the Inventory, EPA is continuing to investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as 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 2016) averages at 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: The 10 Percent Oxidation Factor

4) Methane leakage from cracks and fissures in the cover, and whether to apply a leakage factor for landfills when assigning oxidation rates.

We find it very hard to understand how the Agency could know or even estimate the extent of cracks and fissures at landfills on a site-specific basis or more broadly on a nationwide, inventory basis. Furthermore, there is no proven or accepted method to determine leakage from cracks and fissures. The reason is that the flux through the cover (and the fraction oxidized) is dependent upon the interactions among many factors, including soil and physical properties of cover such as gas porosity; organic content and moisture; microbiological factors such as temperature and substrate availability; and the presence or absence of a gas collection system. In a 2011 paper in Environmental Science & Technology, researchers looked at the surface air methane 13C value at 20 landfills and found that the oxidation percentage was 36%, as compared to an oxidation rate of 37% measured in surface chambers. Based on this result, methane emitted via cracks and fissures did not appear to be a significant factor, and the presence of cracks and fissures did not necessarily result in higher emissions or lower oxidation.

The landfill sector does not support the development of additional leakage factors for landfills because leakage is already reflected in the calculated flux rates. The higher the flux rate the lower the oxidation rate. We think it is neither valid, nor reasonable to develop leakage factors beyond the GHGRP flux rate calculations for determining an appropriate methane oxidation rate, without extensive scientific support.

Response: **EPA appreciates commenter's lack of support for developing an additional leakage factor when assigning oxidation rates as applied to estimating emissions from MSW landfills in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. As stated in the Planned Improvement section of Section 7.1 of the Inventory, EPA is continuing to investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as 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 2016) averages at 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: Data Change for Material Discarded

On page 7-12, Table 7-3 represents Material Discarded. These numbers should add up to 100%. They do for 1990, but not for any of the other years. These amounts are off significantly enough that it is unlikely due to rounding.

- 1990 – adds to 100%
- 2005 – totals 98%
- 2010 – totals 93.8%
- 2011 – totals 112.2%
- 2012 – totals 91.3%
- 2013 – totals 92.7%
- 2014 – totals 93.6%

Also, it seems to me that this table should follow Table 4 of EPA's Advancing Sustainable Materials Management: Facts and Figures 2014 which represents materials landfilled. Rather, it states that it also includes discards that went to WTE facilities. That being said, the 1990 column matches EPA's SMM Table 4.

Response: **EPA appreciates the commenter's detailed review of the tables in the landfills section of Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA has**

reviewed and revised the numbers in and footnotes to the table titled "Materials Discarded in the Municipal Waste Stream by Waste Type from 1990 to 2014" based on these comments.

Comment: Additional Information for Text
Page 3, Line 22: Another factor is the relatively low price being paid for natural gas

Response: **EPA acknowledges that the fluctuation in natural gas pricing may be a factor in the feasibility of LFGTE projects and will investigate this and other potential factors that are impacting the development of new LFGTE projects for inclusion in a future Inventory report, as appropriate.**

Comment: Scale-up Factor Needs Clarification
Page 5, Line 27: With respect to the scale-up factor, this is a challenging issue. See the Appendix of the attached article by Powell et al where they try to address the same issue. They provide an estimate of MSW in landfills not obligated to report.

The method used by EPA is a little hard to follow. One factor that I want to be sure to consider is that the landfills not captured in various databases are likely smaller landfills. As such, scaling should be done on the basis of MSW buried and not on the basis of an estimate of the number of missing landfills. I also think it important to recognize that the estimates are not likely to be within 12.5% anyway so I do not think that too much significance should be placed on the factor actually used. Using 12.5% as opposed to 10 or 12 implies more significance than is appropriate.

Response: **EPA appreciates the commenter's input and the article reference provided (Powell, J., et al., 2015, "Estimates of Solid Waste Disposal Rates and Reduction Targets for Landfill Gas Emissions," Nature Climate Change, 21 September 2015). EPA will review the article and evaluate the potential to make adjustments to the inventory methodology.**

Please refer to the supporting memo "Methodological refinements as applied in the 1990-2016 estimates of U.S. greenhouse gas emissions from MSW landfills to account for emissions from facilities not reporting to the Greenhouse Gas Reporting Program" from Kate Bronstein and Meaghan McGrath of RTI International to Rachel Schmeltz of EPA/CCD, April 4, 2018 for more detail on the steps taken to refine the scale-up factor including use of the Waste Business Journal database as one of the sources for this work. EPA agrees that landfills not captured in the databases are likely small and EPA has pursued the path of basing our scale-up factor on WIP, rather than numbers of landfills not reporting to the GHGRP.

Comment: Discussion with Flare Vendors Suggested
Page 8 – lines 7-18: In evaluating appropriate destruction efficiencies for flares, I encourage EPA to discuss with some flare vendors as they may have unpublished data that is useful. The values in AP-42 are so old that there should be an opportunity for additional data to be considered.

Response: **EPA appreciates commenter's input. EPA acknowledges that the AP-42 document references is old and potentially outdated. EPA will investigate revisions to the destruction efficiencies for flares in a future Inventory report, as appropriate.**

Comment: Methane Oxidation
If using one value for all landfills from 1990-2004, I think 10% is biased low. Some of these landfills had good collection and control, however, I do not have a good basis for suggesting what the oxidation factor should be. One compromise might be to allow 20% for landfills with gas collection.

I do not suggest the application of a leakage factor to account for cracks and fissures. While mechanistically appropriate, there is so much uncertainty in the leakage factor as well as the methane oxidation rate that adding another factor with a highly uncertain value does not improve estimates of methane oxidation.

Response: **EPA appreciates commenter's lack of support for developing an additional leakage factor for 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: 1990-2016. As stated in the Planned Improvement section of Section 7.1 of the Inventory, EPA is continuing to investigate options to adjust the oxidation factor from the 10 percent currently used for 1990 to 2004 to another value or approach such as the binned approached used in the GHGRP (e.g., 10 percent, 25 percent, 35 percent based on methane flux). The oxidation factor currently applied in the later portion of the time series (2005 to 2016) averages at 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: Use of LMOP database
I think that considerable caution is needed. The LMOP database is self-reported with no quality control. In addition, it is not updated when a gas to energy project changes.

Response: **EPA appreciates commenter's input. Please refer to the supporting memo "Methodological refinements as applied in the 1990-2016 estimates of U.S. greenhouse gas emissions from MSW landfills to account for emissions from facilities not reporting to the Greenhouse Gas Reporting Program" from Kate Bronstein and Meaghan McGrath of RTI International to Rachel Schmeltz of EPA/CCD, April 4, 2018 for more detail on the steps taken to refine the scale-up factor including use of the LMOP database as one of the sources for this work.**

LMOP is a voluntary partnership program designed to help reduce methane emissions from landfills by encouraging the recovery and use of landfill gas (LFG) energy as an energy resource. To support its mission, LMOP collects information from its Partners (using its approved ICR, No. 1849.07; OMB Control Number 2060-0446) on their landfill gas energy project development activities as well as basic physical and operational data about municipal solid waste landfills. LMOP has processes and procedures in place to ensure the data collected is consistent and accurate.

For example, LMOP provides instructions to Partners on how to collect and report data to EPA. Once data is submitted, program staff and federal contractor staff review and discuss. Any data inconsistencies or other issues identified are resolved through follow-up correspondence with the Partner company representative to obtain needed corrections or clarifications. Data that has been reviewed and verified is then entered into the LMOP Landfill and LFG Energy Project Database (LMOP Database). In addition to Partner reported data, LMOP compiles data from additional publicly available sources such as news articles, press releases, reports, presentations, and organization websites; state websites, databases, reports, and permits; and EPA's Greenhouse Gas Reporting Program. For these data sources, LMOP follows the same review processes as outlined above to ensure data is consistent and accurate.

Comment: DOC
Without question, the DOC of waste entering landfills has changed since 1990 and continues to change as more fiber is recycled and the residual MSW is enriched in food waste as well as non-recyclables. I would like to see the DOC vary annually or perhaps in 5 year increments to recognize that the DOC is changing. More broadly, EPA has estimates of the methane yield for individual waste components and estimates of waste composition. I would prefer to use these data to calculate L0 and DOC. The L0 based

on AP-42 results in an empirical value that gives the best curve fit. However, this value, while referred to as the methane production potential, in fact has lots of other factors embedded given the empirical nature of the LandGEM model for which it is used.

Response: **As stated in the Planned Improvement section of Section 7.1 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, the Inventory 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).**

Comment: Annex Table A-2
I have done extensive analysis of decay rates in consideration of landfill gas collection efficiencies. I have attached 2 manuscripts that suggest that higher decay rates and lower values of L_0 may be more appropriate.

Response: **EPA will review the manuscripts provided (Wang, X. et al. 2015 "Characterization of Uncertainty in Estimation of Methane Collection from Select U.S. Landfills," Env. Sci. and Technol., 49, p. 1545-1551 and Wang, X., et al. 2013"Using Observed Data to Improve Estimated Methane Collection from Select U.S. Landfills," Env. Sci. and Technol., 47, p. 3251-3257) and evaluate the potential to make adjustments to the inventory methodology for future inventory reports.**

Comment: MCF and open dumps
I would assume that all open dumps in the U.S. were deep. This is because our populations are so high. I think of shallow open dumps as applicable to rural areas in underdeveloped countries.

Response: **For the Final Inventory report, the EPA will revise the text to revise the word "dump" to match the specific solid waste disposal sites (SWDS) category included in the IPCC 2006 Guidelines and modeled. While there are categories for unmanaged shallow (MCF of 0.4) and deep (MCF of 0.8) SWDS in the waste model, the EPA does not apportion any percentage of waste being disposed in these categories at any point since 1940. From 1940 to 1979, a portion of the waste disposed is assigned to the uncategorized SWDS category (with an MCF of 0.6). The EPA has not found sources documenting the depth of the unmanaged sites across the US, and therefore models waste disposed in the IPCC's uncategorized SWDS category.**

Comment: Additional Source Attached
I have also attached some work we did for EPA in support of the WARM Model.

Response: **EPA will review the work done in support of the WARM model (Levis, J. and Barlaz, M., 2014, "Landfill Gas Monte Carlo Model Documentation") and will evaluate the potential to make adjustments to the inventory methodology section for future inventory reports.**

7.2 Wastewater Treatment

Comment: Suggestion for Methodology of Characterizing Production of Pulp and Paper Sector
NCASI has previously submitted comments on some of the parameters used by the agency (see Supporting Material), and offers the following input.

Production. EPA continues to characterize production of the pulp and paper sector as the sum of woodpulp production plus paper and paperboard production, based on data from the Food and Agriculture Organization of the United Nations (FAO). As NCASI has commented in prior years, summing wood pulp, paper, and paperboard production results in double counting, because the majority of wood pulp production is used to produce paper and paperboard at integrated mills (an integrated mill includes both pulping and papermaking at the same facility, with a single wastewater treatment system). Therefore, production statistics used by EPA to represent the pulp and paper sector are too high, resulting in exaggerated estimates of pulp and paper industrial wastewater methane emissions.

As we have suggested before, a more appropriate method for characterizing total pulp and paper sector production would be to sum paper production, paperboard production, and market pulp production. The American Forest and Paper Association (AF&PA) publishes this information annually in its Statistical Summary reports, which are submitted each year to the US Library of Congress, and which EPA has cited as a source of information used to update industry wastewater generation rates.

Response: **EPA thanks the commenter for their input on the accuracy of estimating emissions from industrial wastewater treatment in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA is in continued discussions with NCASI to evaluate the availability of more accurate data for use in revising the factors used to estimate emissions from wastewater treatment at pulp and paper manufacturing facilities.**

Comment: Average Outflow
EPA characterizes wastewater generation per ton of production based on water discharge statistics from AF&PA Sustainability Reports. These are the most current and relevant data for this characterization, and NCASI submits no comments on this use other than to emphasize that the agency should ensure it is using the most current version of the AF&PA Sustainability Report.

Response: **EPA thanks the commenter for their input on the accuracy of estimating emissions from industrial wastewater treatment in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA is in continued discussions with NCASI to evaluate the availability of more accurate data for use in revising the factors used to estimate emissions from wastewater treatment at pulp and paper manufacturing facilities.**

Comment: Organic Loading in the Outflow
EPA characterizes the organic load in untreated wastewater using a legacy value of 0.4 gram BOD per liter of untreated effluent and a multiplier of 2 to convert from BOD to COD. NCASI has very limited data on untreated effluent organic load. Therefore, until additional data are available, we cannot suggest an alternative value.

Response: **EPA thanks the commenter for their input on the accuracy of estimating emissions from industrial wastewater treatment in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA is in continued discussions with NCASI to evaluate the availability of more accurate data for use in revising the factors used to estimate emissions from wastewater treatment at pulp and paper manufacturing facilities.**

Comment: Production Statistics for Pulp and Paper Sector are Inaccurate
On page A-9, lines 2-5 of Annex 3.14 to the draft inventory, EPA outlines how pulp and paper industry production data used to estimate the sector's industrial landfill methane emissions are derived (by summing wood pulp, paper, and paperboard production data from FAO). As indicated above, this approach results in double counting because the majority of wood pulp production is used to produce paper and paperboard at integrated mills. Therefore, production statistics used by EPA to represent the

pulp and paper sector are too high, resulting in exaggerated estimates of pulp and paper industrial landfill methane emissions.

In summary, the agency's use of FAO statistics overstates the pulp and paper industrial sector's production by double counting pulp used to produce paper and board at integrated mills, which in turn results in estimates of pulp and paper sector industrial wastewater treatment and industrial landfill methane emissions being far too high. The agency should use production data from AF&PA's Statistical Summary reports to avoid this double counting. This will result in more accurate characterization of industrial wastewater treatment and industrial landfill methane emissions from this sector.

Response: **EPA thanks the commenter for their input on the accuracy of estimating emissions from industrial wastewater treatment in Chapter 7 of the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016. EPA is in continued discussions with NCASI to evaluate the availability of more accurate data for use in revising the factors used to estimate emissions from wastewater treatment at pulp and paper manufacturing facilities.**

Annex 3: Methodological Descriptions for Additional Source or Sink Categories

Annex 3.14 Methodology for Estimating CH_4 Emissions from Landfills

Comment: Additional Information Attached

Annex Table A-2: I have done extensive analysis of decay rates in consideration of landfill gas collection efficiencies. I have attached 2 manuscripts that suggest that higher decay rates and lower values of L0 may be more appropriate.

Response: **EPA will review the manuscripts provided (Wang, X. et al. 2015 "Characterization of Uncertainty in Estimation of Methane Collection from Select U.S. Landfills," Env. Sci. and Technol., 49, p. 1545-1551 and Wang, X., et al. 2013 "Using Observed Data to Improve Estimated Methane Collection from Select U.S. Landfills," Env. Sci. and Technol., 47, p. 3251-3257) and evaluate the potential to make adjustments to the inventory methodology for future inventory reports.**

Appendix A: List of Reviewers and Commenters

EPA distributed the expert review chapters of the draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016* to a list of 177 expert reviewers across all sectors of the Inventory. The list below includes names of those expert reviewers who submitted comments as part of the Expert Review Period.

- Hendrick G. van Oss – U.S. Geological Survey
- Kerry Kelly - Waste Management, Republic Services, National Waste & Recycling Association, Solid Waste Association of North America, SCS Engineers, and Weaver Consulting Group
- Anne Germain - National Waste & Recycling Association
- Morton Barlaz - NC State University - Department of Civil, Construction, and Environmental Engineering
- David H. Lax - American Petroleum Institute
- Pamela Lacey - American Gas Association
- Brad Upton - National Council for Air and Stream Improvement, Inc.
- Linda S. Heath - USDA Forest Service
- Stephen Prisley - National Council for Air and Stream Improvement, Inc.
- Morton Barlaz - NC State University - Department of Civil, Construction, and Environmental Engineering

Note: Names of commenters are listed in no particular order.

Appendix B: Dates of review

- Energy, Industrial Processes and Product Use (IPPU), and Waste: October 16 – November 14, 2017
- Supplemental Energy (Mobile Sources, CH_4, N_2O updates): October 31 – November 14, 2017
- Agriculture: October 19 – November 17, 2017
- Land Use, Land Use Change and Forestry (LULUCF): October 20 – November 17, 2017

Appendix C: EPA Charge Questions to Expert Reviewers

To facilitate expert review and indicate where input would be helpful, the EPA included charge questions for the Expert Review Period of the draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016* report. EPA also noted to expert reviewers that while these charge questions were designed to assist in conducting a more targeted expert review, comments outside of the charge questions were also welcome. Included below is a list of the charge questions by Inventory chapter.

Energy

General Questions

1. Please provide your overall impressions of the clarity and transparency of the Energy chapter.
2. Please provide any recommendations that EPA can consider to improve the completeness and/or accuracy of the Energy chapter.

CO_2 from Fossil Fuel Combustion

1. Please provide your overall impressions of the clarity of the discussion on trends in CO_2 emissions from fossil fuel combustion. Please provide recommendations for any information that could be added to the discussion to provide additional transparency and clarity.
2. Data for energy use in U.S. Territories comes from the International Energy Statistics provided by the Energy Information Administration (EIA). At the time of this 1990-2016 expert review draft Inventory, this source has data only through 2014, the data for years 2015 and 2016 are proxies in the Inventory. Are there other sources of U.S. Territory energy use that could be used?
3. Facility-level combustion emissions data from EPA's Greenhouse Gas Reporting Program (GHGRP) are currently used to help describe the changes in the industrial sector energy use. Are there other ways in which the GHGRP data could be used to help better characterize the industrial sector's energy use? Are there ways the industrial sector's emissions could be better classified by industrial economic activity type?
4. Electricity data is allocated between economic sectors based on electricity sales data provided by the industry through EIA reports. The data for electricity used in transportation only includes electricity used for railroads and railways. As a planned improvement, we will look into the possibility of breaking out electricity used to charge electric vehicles and report that electricity use under the transportation sector. Are data available on electricity used for battery electric and plug-in hybrid electric vehicle charging that could be used for this analysis?
5. Are you aware of any newer/updated carbon content coefficients, emission factors, or research we should be considering?

CH_4 and N_2O from Stationary Combustion

1. The CH_4 and N_2O emission factors for electric power sector are based on a Tier 2 methodology, whereas all other sectors utilize a Tier 1 methodology. The emission factors are primarily taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Are there other more U.S. specific CH_4 and N_2O emission factor data sources that could be utilized?
2. In the 1990-2016 expert review draft Inventory, EPA adjusted the CH_4 and N_2O emission factors for combined cycle natural gas units in the electric power sector to use EPA's Compilation of Air

Pollutant Emission Factors, AP-42, instead of the emission factors presented in the 2006 IPCC Guidelines. Are you aware of CH_4 and N_2O emission factors that have been developed more recently than the AP-42 factors that are as comprehensive (if not more)?

Carbon Emitted from Non-Energy Uses of Fossil Fuels

Please provide your overall impressions of the clarity of the discussion on Carbon Emitted from Non-Energy Uses of Fossil Fuels. Please provide recommendations for any information that could be added to the discussion to provide additional transparency and clarity especially in regards to links with the IPPU chapter.

Mobile Sources

1. Please provide your overall impressions of the clarity and transparency of the proposed mobile source updates.
2. Please provide any recommendations that EPA can consider to improve the completeness and/or accuracy of the proposed mobile source updates.

Methodological Updates in Response to Changes to FHWA's Gasoline Consumption Estimation Models

Underlying data sources

As discussed EPA currently uses EIA data to represent total gasoline use and FHWA data to represent "Transportation" Sector gasoline use. The difference between the two is allocated to the "Commercial" and "Industrial" sectors for the Inventory. Primarily EPA used the FHWA Table MF-21 to determine overall Highway gasoline use but there are other sources available including FHWA Table MF-27 as well as FHWA Table VM-1 (which is used to determine fuel use by vehicle type).

1. Why are there differences in the different sources? Is FHWA Table MF-21 the best source of Highway gasoline use?
2. Why are there historic differences in FWHA Table MF-21 and MF-27 data? For the most recent years the MF-21 and MF-27 data match up, except for 2014, will the MF-21 data for 2014 be updated?
3. Are there other data sources we should be considering?

Proposed update:

The proposed update plans to adjust the gasoline consumption for the lawn & garden and recreational vehicle non-road categories. However, as shown in the tables above there were also changes to the other non-road categories in Table MF-24 in 2015.

1. Should the proposed update include adjustments to other non-road categories in table MF-24 (e.g., industrial and commercial)? If so, how should adjustments be made (e.g., use of EPA's NONROAD model data)?
2. How far back should the backcasting go? Should data back to 1990 be updated or only back to the previous FHWA of-road update?
3. Are there other approaches to backcast changes in gasoline use that EPA should consider (e.g., simple ratios)?

Other changes:

Currently "Transportation" sector gasoline use includes highway and recreational boat categories.

1. Is this an appropriate representation of "Transportation" sector? Should other categories be included here (e.g., recreational vehicles)?

Historically, CH_4 and N_2O emissions from non-road sources have been based on data from EPA's NONROAD model for different categories of non-road sources. These totals did not always match the totals from the FHWA MF-24 categories used in the CO_2 calculations.

2. Should these estimates be made more consistent? If so how? What are the main differences between the FWHA non-road calculations and EPA NONROAD model results?
3. Generally, are there other updates or changes we should consider for allocation of gasoline use to different source categories?

Industrial Processes and Product Use (IPPU)

General

1. Please provide your overall impressions of the transparency of the IPPU chapter.
2. Please provide any recommendations of improvements that EPA can consider to improve the completeness and/or accuracy of the IPPU chapter.
3. For the source categories included in the expert review draft, is the state of the industry current and accurately described? Are there technologies, practices, or trends that EPA should consider?

Source Specific

1. With the inclusion of a new IPPU source category, EPA requests feedback on the overall chapter text, assumptions and information on the state of the industry for the following category:
    a. Caprolactam, Glyoxal and Glyoxylic Acid Production
2. Please provide input on:
    a. Data sources and industry information on production of calcium carbide.
    b. Data on carbonate use in non-metallurgical magnesium production.
    c. Data on carbonate use in the production of ceramics.
    d. Recent/alternative production statistics for various N_2O product use subcategories listed within the Nitrous Oxide from Product Uses source chapter.
3. The EPA seeks comments on assumptions applied to determine the split between primary and secondary zinc production based on U.S. Geological Survey national totals. Are other options/data sources available to distinguish between process production totals?

Agriculture

General

1. Provide your overall impressions of the clarity and transparency of the Agriculture chapter.
2. Provide any recommendations that EPA can consider to improve the completeness and/or accuracy of the Agriculture chapter.
3. Provide feedback on the methodologies and activity data used to estimate emissions for categories within the Agriculture chapter.
4. Some categories in the Agriculture chapter have used surrogate methods to extend the emissions time series that are different from the methods used to estimate emissions during the earlier portion of the time series. These include Enteric Fermentation, Manure Management, Rice Cultivation, Agricultural Soil Management and Field Burning of Agricultural Residues. Please provide your input on the surrogate methods used to extend the time series for these categories.

Source Specific

1. For the Manure Management source category, is the state of the industry current and accurately described? Are there other technologies, practices, trends that we should consider? Especially:
    a. Are the regional waste management system data used in the inventory (from USDA data sources) representative of actual observed waste management systems throughout the country?
    b. Are the trends observed in the inventory waste management system data over time representative of the trends observed in the industry?
2. The Manure Management source category relies on national/regional livestock production and management data for calculating emissions estimates. Are there other data sources that EPA should be aware of and consider in the calculating these emissions? Especially for:
    a. Waste management system data
    b. Maximum methane producing capacity
    c. Volatile solids and nitrogen excretion rates
    d. Measured emission estimates (by waste management system) to help refine estimates of methane conversion factors
3. For the Enteric Fermentation source category, is the state of the industry current and accurately described? Are there other technologies, practices, trends that we should consider?
4. The Enteric Fermentation source category relies on national/regional livestock production, diet and management data for calculating emissions estimates. Are there other data sources or methods that EPA should be aware of and consider in the calculating these emissions? Especially for:
    a. Dry matter/gross energy intake
    b. Annual data for the DE, Y_m, and crude protein values of specific diet and feed components for foraging and feedlot animals
    c. Monthly beef births and beef cow lactation rates
    d. Weights and weight gains for beef and dairy cattle
    e. Given the challenges in characterizing dairy diets, are there better methodologies we could be using to estimate DE for dairy? If so, what would you recommend, and what sources should be used?
5. Are you aware of other datasets or products that could be used to inform the management activities influencing soil N_2O emissions for Cropland or Grassland?
6. Are there management activities that would have a significant impact on soil N_2O emissions and are not currently addressed in the analysis for Cropland and Grassland?

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

General

1. Provide your overall impressions of the clarity and transparency of the LULUCF chapter.
2. Provide any recommendations that EPA can consider to improve the completeness and/or accuracy of the LULUCF chapter.
3. Provide feedback on the methodologies and activity data used to estimate emissions for categories within the LULUCF chapter.
4. As noted in the Introductory section above, some categories in the LULUCF chapter have used surrogate methods to extend the emissions time series and are different from the methods used to estimate emissions during the earlier portion of the time series. Please provide your input on the surrogate methods used to extend the time series for these categories.

Source Specific

1. Are you aware of other datasets or products that could be used to inform the Land Representation analysis?
2. Are you aware of other datasets or products that could be used to inform our understanding of the current and past management activities for Cropland, Grassland or Settlements?
3. Are there other management activities that would have a significant impact on carbon stock change estimates for soils and are not currently addressed in the analysis for Cropland, Grassland or Settlements?
4. For the Yard Trimmings and Food Scraps category, is the state of the industry current and accurately described? Are there other technologies, practices, trends that we should consider?
5. For the Yard Trimmings and Food Scraps category, are there other data sources that EPA should be aware of and consider in the calculating these emissions? Especially for:
    a. C storage, decay rates, etc. for yard trimmings and food scraps
    b. Decay rates of food scraps, leaves, grass, and branches
    c. National yard waste compositions
    d. Precipitation range percentages for populations for the decay rate sensitivity analysis
6. For the Peatlands Remaining Peatlands category, is the state of the industry current and accurately described? Are there other technologies, practices, trends that we should consider? Especially:
    a. We estimate a rapid decrease of peat production from 2010-2012, with a flattening out of the decrease after 2012. Is this in line with industry trends?
7. For the Peatlands Remaining Peatlands category, are there other data sources that EPA should be aware of and consider in the calculating these emissions? Especially for:
    a. Peat production (mainly Alaska, which has not had reported peat production since 2012 due to a lack of survey responses from industry)
    b. Data to help us develop U.S.-specific emission factors—we currently use IPCC default emission factors.

Waste

General

1. Please provide your overall impressions of the clarity and transparency of the Waste chapter.
2. Please provide any recommendations that EPA can consider to improve the completeness and/or accuracy of the Waste chapter.

Wastewater

1. The wastewater source category relies on national production data from a variety of sources for calculating emissions estimates. Are there other data sources that EPA should be aware of and consider in the emissions calculations of this source?
2. Please provide input on any additional sources of wastewater outflow or BOD production that we may not consider in our industrial methane emissions calculations. Do our estimates of the percent of wastewater treated anaerobically seem reasonable?
3. For domestic wastewater emissions, please provide input on:
    a. Any additional sources for the N content of sludge, amount of sludge produced, and sludge disposal practices.
    b. The estimates of the percent of BOD removed by aerobic, anaerobic, and other treatment systems for our methane estimates.

c. The protein estimates and overall calculations for nitrous oxide. For example, do you have suggestions for developing a country-specific factor, rather than the IPCC default factor, to estimate the amount of nitrogen from industrial and commercial sources co-treated with domestic wastewater?

4. Are there additional industries that are sources of methane or nitrous oxide emissions that should be included in the wastewater inventory? Are there available sources of national-level data for these industries?
5. Do you have suggestions for improving the discussion of our methodology? Is there any additional information that should be included to provide additional transparency?
6. Is the state of domestic and industrial wastewater treatment current and accurately described?

Landfills

Scale-Up Factor for MSW Landfills

A scale-up factor is applied in the inventory to account for landfills that do not report to the GHGRP Subpart HH (MSW landfills). We calculated a scale-up factor of 12.5% percent for the 1990-2015 Inventory based on the percent difference between the 1990-2014 Inventory emissions and the GHGRP emissions as reported for 2010-2015 and back-casted GHGRP emissions for 2005 to 2009. The GHGRP emissions from 2010-2015 were used to back-cast emissions for 2005 to 2009 using a linear Excel forecasting function. In the 1990-2015 Inventory, we applied the 12.5% scale-up factor to the back-casted emissions for 2005 to 2009, and the directly reported GHGRP emissions for 2010 to 2015. We applied the same 12.5% scale-up factor for the draft 1990-2016 Inventory for 2005 to 2016, and are working to refine the scale-up factor for the final 1990-2016 Inventory.

The steps we have taken to date to calculate a more precise scale-up factor include developing a list of facilities that do not report to the GHGRP by extracting GHGRP MSW landfills from the LMOP 2017 database and the Waste Business Journal (WBJ) 2016 database. This list currently includes more than 1,600 landfills. However, we are not confident that this list does not include C&D landfills or industrial waste landfills due to the lack of details in the LMOP or WBJ databases. Without expert insights, we believe a desk-top search would be required to identify any C&D landfills or industrial waste landfills that should be removed from this list.

Additionally, we are working on several manual QA/QC steps, with help from stakeholders, to confirm that no landfills in the list of non-reporting facilities can be matched to any GHGRP landfills. Matching the GHGRP facilities to those in the WBJ and LMOP databases is challenging due to the variety of names for a given landfill and the differences in GPS coordinates across the databases.

We are currently considering two options for a scale-up factor that are based on either:

a) The percentage difference in total waste-in-place between the non-reporting facilities and the GHGRP MSW landfill facilities, or
b) The percentage difference in net methane emissions between the non-reporting facilities and the GHGRP MSW landfill facilities.

While we have not completed a full QA/QC review of the list of non-reporting landfills, we are presenting two values for options (a) and (b).

a) Option (a) yields a scale-up factor of approximately 11%. See Table 1, orange cell. This value was determined from the estimated total waste-in-place for non-reporting facilities compared

to facilities reporting to the GHGRP. Available waste acceptance data from LMOP and WBJ was used to determine waste-in-place for the non-reporting facilities. To calculate GHG emissions for non-reporting facilities, 11% of the total GHGRP emissions for each year of the time series would be applied. Note that this value is based on a pre-QA/QC review of the non-reporting landfills database. A QA/QC review is currently underway.

Table 1. *Scale-up Factor based on total waste-in-place (WIP) for 2015*

Calcs.2 (non-adjusted)	WIP (MT)	%	Comments
Non-reporting facilities (2015)	1,604,238,495	11	Does not exclude any C&D or inerts to be consistent with GHGRP total WIP.
GHGRP (RY2015)	12,936,398,280	89	Total WIP for reporting landfills (RY2015)
Total	14,540,636,775	100	

b) Option (b) yields a scale-up factor of approximately 26%. See Table 2, orange cell. This value was determined from estimated methane emissions for the non-reporting landfills. We used the Inventory Waste Model (first order decay methodology) and estimated annual waste disposal data that excludes an average amount of C&D and inert waste (23% of C&D and inert waste excluded per facility; same disposal amount included in the model for each year of operation) and the same default factors as applied in previous Inventories for DOC, MCF, etc. and a 10 percent oxidation factor. To calculate GHG emissions for non-reporting facilities, 26% of the total GHGRP emissions for each year of the time series would be applied. Note that this value is based on a pre-QA/QC review of the non-reporting landfills database. A QA/QC review is currently underway.

Table 2. *Scale-up Factor based on Net Emissions, as calculated with adjusted WIP for 2015*

Calcs.3 (adjusted for C&D/inerts)	Net Emissions (MMT)	%	Comments
1990-2015 Inventory	4.63	—	Total as calculated by the Waste Model using the back-casted GHGRP data and 12.5% scale-up factor for 2005-2016. Included for reference.
Non-reporting facilities (2015)	1.27	26	Excludes the GHGRP average of C&D/inert waste of 23% for each non-reporting facility.
GHGRP (RY2015)	3.64	74	Total as reported to the GHGRP in RY2015. Data obtained from FLIGHT in CO_2e.
Total	4.91	100	

Scale-Up Factor Questions:

1) Please comment on additional datasets that we can use to generate and/or refine a list of non-reporting landfills. Datasets with WIP data and start/closure years are needed to develop a scale-up factor for landfills that do not report to the GHGRP.

2) How should we consider landfills that "off-ramp" from the GHGRP going forward with respect to the scale-up factor? For context, only facilities that generate 25,000 MT CO_2e annually are required to report to the GHGRP. A facility can off-ramp (i.e., stop reporting) to the GHGRP if it meets one of the following criteria:
    a. Emissions < 15,000 MT CO_2e for 3 consecutive years
    b. Emissions < 25,000 MT CO_2e for 5 consecutive years
    c. Approximately 16 landfills have off-ramped to date. If we consider these landfills as part of the non-reporting set of landfills, should we adjust the scale-up factor accordingly for the year(s) after facilities stop reporting?
3) Please comment on the best approach for applying a scale-up factor. We are currently applying the same scale-up factor for 2005 to 2016. Does it make more sense to apply a scale-up factor for blocks of time (e.g., 5 years), annually, when GHGRP facilities off-ramp, etc.?

Landfill Methane Oxidation for 1990-2004 in the Inventory Time Series (for MSW Landfills)

For the period of 1990-2004 in the Inventory time series, a national estimate of methane generation and emissions are calculated 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. A 10% oxidation factor is applied to all facilities for the years 1990 to 2004.

We are considering revisions to the value of the oxidation factor and possibly using two oxidation factors, one for waste disposed at facilities with landfill gas collection and control systems, and the other without. We currently do not have a way of assigning a percentage of waste disposed in landfills with gas collection or without for those years. Given that this is a national inventory and we do not have facility-specific data for all landfills in the U.S., we need data sources that discuss trends in the installation of landfill gas collection systems, including when the system became operational and at which facilities. The data available for 1990-2004 is currently national level waste generation; it is not landfill-specific.

Oxidation Questions:

1) Please comment on available data sources to address trends in the installation of landfill gas collection systems.
2) Please comment on appropriate oxidation factors for these two general categories (with and without landfill gas collection systems).
3) Please comment on an appropriate oxidation factor if we were to use one oxidation factor for all waste disposed at landfills between 1990 and 2004.
4) Please comment on methane leakage (e.g., from cracks and fissures in the cover) with respect to oxidation factors. If we apply a higher oxidation factor, say 20%, should we also apply a leakage factor to waste disposed at landfills with gas collection and control, or all landfills in general?

Disposal Factor for Industrial Waste Landfills

Industrial waste is estimated for two sectors, pulp & paper and food & beverage. We apply a default disposal factor to estimated annual production data for both sectors.

For pulp & paper, we assume a disposal factor of 5% of the annual amount of woodpulp and paper and paperboard produced per year. The same 5% disposal factor is applied annually across the time series (1990-2016) for pulp & paper.

For food & beverage, we apply a factor that considers the amount of waste landfilled from an EPA study in 1985 (EPA 1993, as referenced in the Waste chapter) and the annual amount produced in a given year in the time series. The production data is based on the following: red meat carcass weight, poultry carcass weight, vegetables processed (apples, citrus fruit, other non-citrus fruit, and grapes). The disposal factor varies by year because it incorporates the annual production for that year.

Disposal Factor Questions:

1) Please comment on the pulp & paper disposal factor and whether we should use a disposal factor based on the GHGRP Subpart TT data.
2) Please comment on new studies that include data on food processing to landfill disposal ratios or annual quantities landfilled.