Summary of Public Review Comments and Responses:
Draft *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019*

April 2021
U.S. Environmental Protection Agency
Office of Atmospheric Programs
Washington, D.C.

Responses to Comments Received during the Public Review Period on the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019*

Preface

EPA thanks all commenters for their interest and feedback on the annual *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. Per Federal Register Notice 2021-02910[1] published on February 12, 2021, EPA announced document availability and request for comments on the draft "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019" report. The EPA requested recommendations for improving the overall quality of the inventory report to be finalized in April 2021 and submitted to the United Nations Framework Convention on Climate Change (UNFCCC), as well as subsequent inventory reports.

During the 30-day public comment period which ended March 15, 2021, EPA received 20 sets of comments, including 41 unique comments in response to the notice. This document provides EPA's responses to technical comments on methods and data used in developing the annual greenhouse gas inventory. One comment was submitted after the end of the comment period has also been reflected in this document and the public docket. The verbatim text of each comment extracted from the original comment letters is included in this document, organized by commenter. Full comments can be found in the public docket here: https://www.regulations.gov/document/EPA-HQ-OAR-2021-0008-0001. EPA's responses to comments are provided immediately following each comment excerpt.

[1] https://www.federalregister.gov/documents/2021/02/12/2021-02910/inventory-of-us-greenhouse-gas-emissions-and-sinks-1990-2019

Commenter: Alcoa

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0023

Luis Espinoza-Nava

Comment 1: Re: Low Voltage PFC Emissions

- The low voltage anode effect (LVAE) is not an adequate definition because PFCs can be generated in the absence of an anode effect. Therefore, a better terminology will be to use "low voltage PFC emissions". See "PFC & Anode Products, Myths, Minimization and IPCC Method Updates to Quantify the Environmental Impact", David Wong and Barry Welch, Light Research Metals Centre.
- The Tier 1 specifies that low voltage PFC emissions are approximately 5 % of total emissions in 2019 (page 4-98, line 23), and this is an approximation with high uncertainty. The Tier 1 uncertainties are shown in Table 4.15 of IPCC 2019 refinement. Tier 3 or actual measurements of low voltage PFC emissions should be more accurate.
- There is no certified method to measure LV PFC emissions.
- The International Aluminum Institute (IAI) has published a Good Practice Guidance to measure PFC emissions to update the 2008 USEPA/IAI PFC Measurement Protocol in December 2020. See https://www.world-aluminium.org/media/filer_public/2020/12/23/iai_good_practice_guidance_measuring_perfluorocarbons_2020.pdf

It includes the latest information on the main methods for measuring LV, HV (including cell start-up, CSU) PFC emissions as outlined in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Alcoa was part of the review with inclusion of latest technologies, practices and procedures through research paper published at TMS since 2015.

- *Alcoa, Hydro, Rio Tinto and Alouette will start canister sampling and analytical methodologies to report PFC inventories in April-May 2021 with IAI as sponsor.*
- *EPA should review the methodology of how to distinguish and measure low voltage and high voltage PFC emissions using a combination of gas bags and canisters sampling with FTIR and GC-MS analytical techniques. In addition, if there is no need to distinguish low voltage and high voltage PFC emissions, using integrating canisters sampling with GC-MS analyses is the most sensitive technique and should be recommended as an EPA TO-XX certified method to measure total PFC emissions. Similar EPA methods exist for VOC, like TO-15. However, time PFC measurement frequency should be evaluated. Alcoa experience recommends measurement time being between 6-14 days, or even do measurements multiple times within a year to average total PFC emissions to calculate the average per plant. Low voltage PFC emissions are highly variable on process stability based on pot room cycle during anode changes, tapping, pot starts, etc. Therefore, a minimum of 3 pot cycles (48 hours per cycle) is needed to average the low voltage PFC emissions contribution. The aluminum industry will also test a continuous monitor, which might be better used to reduce PFC emissions by optimizing pot control processes.*

Response: EPA appreciates the comment. EPA uses the term "low voltage anode effect (LVAE)," consistent with the terminology used in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. A Tier 1 method was used to estimate the emissions due LVAEs due to

the limitations of the data that is currently available. If facility-specific data is available in the future, higher tier methods may be incorporated. EPA appreciates the additional information on the newly available good practice guidance and will review this for future improvements.

Comment 2: Broken hyperlink on page 4-94

On page 4-94 the reference link [67]"Code of Federal Regulations, Title 40: Protection of Environment, Part 98: Mandatory Greenhouse Gas Reporting, Subpart F- Aluminum Production. See www.epa.gov/ghgreporting/documents/pdf/infosheets/aluminumproduction.pdf" doesn't work. The link should be corrected.

Response: EPA appreciates the comments. The reference link has been corrected on page 4-94 to shown as https://www.ecfr.gov/cgi-bin/text-idx?SID=24a41781dfe4218b339e914de03e8727&mc=true&node=pt40.23.98&rgn=div5#sp40.23.98.f

Commenter: American Gas Association (AGA)

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0017

Pamela Lacey

Comment 3: Use of Emission Factors from Gas Technology Institute for Industrial and Commercial NG meters

The American Gas Association (AGA) appreciates the opportunity to comment on EPA's Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2019) (Draft 2021 Inventory). AGA is pleased to see that the Draft 2021 Inventory shows that methane emissions from natural gas distribution systems across the nation declined by 69 percent from 1990 to 2019, and that methane emissions from the natural gas value chain from production to the burner tip are still estimated to be just one percent of annual production in 2018 and 2019. However, we urge EPA to reconsider the proposed methodology for recalculating emissions from industrial and commercial meters.

AGA, founded in 1918, represents more than 200 local energy companies that deliver clean natural gas throughout the United States. There are more than 75 million residential, commercial, and industrial natural gas customers in the U.S., of which 95 percent — more than 72 million customers — receive their gas from AGA members. Today, natural gas meets more than 30 percent of the United States' energy needs.

AGA is very concerned that EPA's new approach of averaging emissions factors from the Gas Technology Institute's (GTI) 2009 Study[2] and GTI's 2019 Study would likely overestimate emissions and undermine accuracy. AGA urges EPA to work with GTI and our members to develop a more complete and granular data set that will inform a more accurate approach for estimating emissions from industrial and commercial meters. AGA believes a deliberate approach to developing new estimates from these meter sets is the prudent and correct path, and that more data is necessary before changing the methodology for commercial and industrial emission factors and calculations.

[2] Gas Technology Institute and Innovative Environmental Solutions, Field Measurement Program to Improve Uncertainties for Key Greenhouse Gas Emission Factors for Distribution Sources, November 2009. GTI Project Number 20497. OTD Project Number 7.7b (GTI 2009).

In the 2020 Inventory, EPA used the GTI 2009 data and resulting commercial meter emission factor to both commercial and industrial meters, due to the limitations of available industrial meter data. It is understood that industrial and commercial meter sets collectively are likely emitting more methane overall than currently presented in the GHGI. This is due to significant emission rate differences between industrial and commercial meters, across regions, and among meter set types.[3]

However, the solution is not to adopt EPA's proposal to simply average emissions factors (EFs) from GTI 2009 and GTI 2019, applying weighted average population EFs from the two studies across the time series for the methodology implemented in the Inventory. That approach would likely result in significantly overestimating emissions, thereby undermining accuracy. Recalculations based on the proposed methodology would result in a 19.5 percent increase in estimated distribution methane emissions from commercial and industrial meters.

The previous inventory used a lower EF (based on commercial meter measurements only) and applied that EF to both commercial and industrial meter counts. The proposed methodology uses commercial meter data from both the 2009 and 2019 GTI studies to develop an EF that is applied to commercial meter counts, and uses industrial meter data from both the 2009 (leak emissions only) and GTI 2019 studies to develop an EF that is applied to industrial meter counts.

As GTI itself recommended, more data is needed to develop separate emission factors for different categories of industrial/commercial meters, since only 186 industrial meters and 337 commercial meters of approximately 5.7 million meters nationwide were visited in the GTI 2019 study.

AGA recommends EPA should instead use separate emission factors, delineated first by facility type and then by region. In GTI 2019 and in GTI's presentation at the EPA GHGI Webinar in September 2020, GTI indicated the large regional differences could be linked to low sample numbers in some regions leading to overall uncertainty nationwide data. Based on these factors, AGA believes it is necessary to collect more data to be able to use region-specific EFs rather than national EFs and provide the most accurate Inventory estimation.

Response: EPA appreciates the comment. EPA reviewed the information and updated the GHG Inventory estimates for customer meters in natural gas systems. EPA notes responses to stakeholder comments (along with other information on the update) on pages 3-107: "EPA received comments on the September 2020 version of the Customer Meters Memo and through the public review draft of the Inventory. These comments included a recommendation to delay updates until additional data could be collected. The comments also recommended using separate EFs for commercial and industrial meters and region-specific EFs. The largest source of emissions from customer meters in the 2009 study was vented emissions from industrial meters, with an average emission factor per meter of 3,487 kg/year, compared with an average emission factor per industrial meter from leaks of 105 kg/year. Venting emissions were observed and measured at 2 out of the 6 companies participating in the 2009 GTI study. This source of emissions was not studied in the 2019 GTI study. The final methodology for industrial meters uses an EF calculated only from leak emissions, which have less variability, and does not include the more limited and highly variable vented emissions. EPA did not use region-specific EFs due to the limited data available for each region, but did finalize separate EFs

[3] Gas Technology Institute and US Department of Energy, Classification of Methane Emissions from Industrial Meters, Vintage vs Modern Plastic Pipe, and Plastic-lined Steel and Cast-Iron Pipe. June 2019. GTI Project Number 22070. DOE project Number ED-FE0029061. (GTI 2019).

for commercial and industrial meters that rely on the leak emissions from the 2009 and 2019 GTI studies. Using data from both studies to calculate population EFs greatly increases the number of data points that serve as the basis of the EFs, instead of only using the commercial meter EF from the 2009 GTI study. EPA seeks stakeholder feedback on upcoming or ongoing research studies that measure vented emissions from industrial meters."

Commenter: American Petroleum Institute (API)

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0012

Marcus Koblitz

Comment 4: Recalculations for produced water

API has provided comments on EPA's proposed updated methodology to estimate produced water emissions in its letter of October 16, 2020. Key highlights of these comments are reiterated below:

- Produced water is produced along with oil, gas and condensate. Once the stream is brought to the surface it is separated into oil, gas, condensate and water fractions and routed to an applicable tank battery (tank storage facility).
- Current regulations under 40CFR60 subpart OOOOa require that each storage vessel that exceeds an emissions threshold of 6 tons of VOC per year should be controlled to reduce emissions of VOCs by routing the emission vapors to a recovery device, a flare or other control device that are at least 95% efficient, and it is expected that controlling 95% of VOC emissions will have an associated benefit of reducing CH_4 as well. The regulatory requirement specified above should be addressed in the updated methodology in conjunction with the produced water management practices.
- Based on the 2012 Ground Water Protection Council produced water management practices survey – cited by EPA in its technical memorandum - it is likely that about 16% of produced water has the potential of being stored in a tank battery[4] that could potentially flash, and these emissions would be controlled in accordance with recent regulatory requirements, as discussed above.

API recommends that EPA update its activity data on produced water management in accordance with the results of the 2017 Ground Water Protection Council survey.[5] API also continues to contend that the data available for updating the emission estimation from produced water is sparse and not based on sufficient information. As this source category has previously not been considered as significant, API believes EPA should defer the inclusion of produced water sources into the 2021 GHGI while EPA collects more representative information.

[4] EPA September 2020 Technical Memorandum provides a reference to: U.S. Produced Water Volumes and Management Practices in 2012. Veil Environmental, LLC for the Ground Water Protection Council. April 2015. The survey results address management practices that could entail storage of PW in storage tanks. These include surface discharge (5.4%), evaporation (3.4%), and offsite commercial disposal (6.7%), or a combined total of 15.5%.

[5] Ground Water Research and Education Foundation, *U.S. Produced Water Volumes and Management Practices in 2017*, by Veil Environmental, LLC, February 2020; https://www.gwpc.org/sites/gwpc/uploads/documents/publications/pw_report_2017___final.pdf

Response: EPA appreciates the comment. EPA reviewed the references noted and updated the GHG Inventory to include estimates for produced water in petroleum systems and natural gas systems. EPA notes responses to stakeholder comments (along with other information on the update) on pages 3-81 to 3-82: " A stakeholder indicated that the typical practice is to route produced water to a tank battery, once it reaches the surface and has been separated from the oil and gas. A stakeholder requested that data from the latest 2017 Ground Water Protection Council produced water management practices survey be used to determine the percent of produced water that is stored in tanks. The stakeholder indicated that approximately 16 percent of produced water has the potential of being stored in a tank battery that could potentially flash (based on the 2012 Ground Water Protection Council produced water management practices survey). After further assessment of the 2012 and 2017 water management practice surveys, EPA has maintained the assumption that all produced water goes through tanks and emissions are flashed, consistent with the approach used for the public review draft of the Inventory. A stakeholder commented that current regulations under 40 CFR 60 subpart OOOOa require that certain storage vessels route emission vapors to a recovery device, flare, or other control device. EPA currently does not have specific data to address the use of controls on produced water tanks but will continue to assess this issue in future inventories should additional data become available."

Comment 5: GHGRP Resubmissions

EPA states that for sources that did not undergo methodological updates, there still may be CH_4 and/or CO_2 emissions changes due primarily to GHGRP data submission revisions. For Petroleum Systems these sources include: hydraulically fractured oil well completions, associated gas flaring, miscellaneous production flaring, production storage tanks, and pneumatic controllers. For Natural Gas Systems these sources include: HF gas well completions, non-HF gas well completions, G&B stations, liquids unloading, HF workovers, reciprocating compressors, and pneumatic controllers.

- API supports EPA updating the emissions estimation in accordance with GHGRP data submissions and revisions.
- API requests that EPA confirm that the most recent GHGRP data (2019 data, as of November 2020) was used for all of these recalculations.

Response: EPA appreciates the comment and confirms that the most recent GHGRP data (reported as of September 26, 2020) were used for the final GHG Inventory.

Comment 6: Planned improvements for mud degassing

The current inventory does not include estimates of greenhouse gas emissions from mud degassing for onshore exploration. The issue of emissions from mud degassing was discussed during the stakeholders' process during the fall of 2020 but EPA did not include updated emission estimates for mud degassing in the Draft GHGI that was issued for review.

EPA continues to seek feedback on alternate assumptions for borehole diameter and porosity, average total drilling days and drilling days in the producing formation, CH_4 content of the gas, and the effect of balanced and over-balanced mud degassing systems. API shared anecdotal information received from member companies on these issues, and is reiterating this information here for EPA's reconsideration.

- As a general practice, ambient combustible gas detectors are typically placed at various locations around the drill site to measure the levels of combustible gas in the atmosphere and serve as safety alarms near the shale shaker and mud pits, among other locations. From API

members' experience it seems that for balanced or slightly overbalanced wells the hydrostatic head of the mud column keeps the gas in the formation rather than in the mud and as a result ambient concentrations rarely reach the safety alarm level.

- The assumptions (offshore based) used in EPA's derivation of the applicable EFs are not representative of current onshore drilling practices in the U.S. The derivation assumes that typical wells have a 12" diameter bore hole and 25% porosity, while API member companies contend that for most current onshore wells, the bore hole size is around 8", which is 44% of the bore cross section assumed in the EPA derivation, and the porosity for most current onshoren wells is generally below 10% (tight sands, shales, and other tight formations), which is 40% of the porosity used for the EF derivation.
- The activity data used for the preliminary national emissions estimate assumes an average of 26 drilling days per well (based on 2014 Marcellus well estimate). However, comments received from API member companies indicate that a current Marcellus well takes about a total of 10 days to drill while only 2-3 of those drilling days are in the hydrocarbon bearing formation. Similarly, an EIA example indicates that in the Fayetteville shale, the field time required for drilling a well dropped from a total of 20 days in the first quarter of 2007 to a total of 11 days by the second quarter of 2009.[6] Only a portion of this time is spent in a hydrocarbon bearing formation where there is a potential for gas in the pore space. API would like to reemphasize that in accordance with EPA's 1977 estimate, when accounting for drilling activity, the derived mud degassing EFs should be applied only to the number of days in the hydrocarbon containing (producing) formations. In the proposed GHGI methodology update, it appears the EPA mistakenly uses the outdated full drilling time for a Marcellus well of 26 days rather than just the amount of time spent drilling in the hydrocarbon bearing formations.
- EPA stated that it will further assess the average drilling duration in an updated Enverus DrillingInfo dataset prior to incorporating the data into the GHGI. API emphasizes that in order to properly estimate emissions from mud degassing it is imperative that any new dataset used by EPA should consist of information on actual drilling days spent in the hydrocarbon bearing formation and not merely the total drilling days, which is typically the data available from state oil and gas regulators.
- For illustration purposes, if we were to adjust EPA's proposed emissions estimate to account for the smaller diameter hole, lower porosity, and using an assumed drilling duration of 6 days in the hydrocarbon bearing formation the calculation would yield a national estimate of about 6,000 metric tons of CH_4 rather than EPA's estimate of around 140,000 tons.

API continues to suggest that EPA survey a representative sample of the major onshore rig companies that could provide information to address these questions. Another source for more information may be the International Association of Drilling Contractors (IADC).

API recommends that EPA delay including mud degassing emissions in the GHGI until more current information becomes available.

Response: EPA appreciates the comment. EPA did not implement the update for mud degassing in the final GHG Inventory. EPA continues to seek feedback on average total drilling days and drilling days in the producing formation, CH_4 content of the gas, and the effect of balanced and over-balanced mud degassing systems. EPA will further assess the average drilling duration using updated Enverus data.

[6] John Cochener, *Quantifying Drilling Efficiency*, U.S. Energy Information Administration, June 28, 2010.

Additionally, EPA is considering developing CO_2 estimates for onshore production mud degassing using the CH_4 estimates and a ratio of CO_2-to-CH_4. For additional information, please see pages 3-86 to 3-87.

Comment 7: CO_2 Transport, Injection, and Geological Storage
EPA continues to seek available data for sources that are part of the process of capture, transport, injection and storage of CO_2. In the current GHGI, CO_2 that is used in non-EOR industrial and commercial applications (e.g., food processing, chemical production) is assumed to be emitted to the atmosphere during its industrial use and is addressed in other parts of the GHGI. API encourages EPA to update the methodology to account for GHG emissions and emission reductions associated with Carbon Capture Utilization and Storage (CCUS). Such an improved approach will allow more visibility of actions and progress to reduce GHG emissions.

Response: Box 3-6: Carbon Dioxide Transport, Injection, and Geological Storage in the Inventory report (pages 3-87 and 3-88) has been updated to reflect the latest GHGRP data on Geologic Sequestration. EPA is considering updates to its approach for this source for future Inventories.

Comment 8: Editorial comment on Tables 3-59 and 3-60
There is an error in Tables 3-59 and 3-60 in the Natural Gas Systems section of the Draft GHGI. The rows for Gathering & Boosting and Offshore Production seem to have been switched. It does not affect the calculation of total production emissions but should be amended for the final GHGI.

Response: EPA appreciates the comments. The rows were corrected in the final GHGI.

Commenter: Ascension 33 Dance Studio et al.

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0010

Shanique Scott

Comment 9: Omission of sugarcane burning from Chapter 5.7

To whom it may concern,

We, the undersigned 83 organizations and businesses, urge the USEPA to rectify the failure to reference and include sugarcane burning in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F; starting on page 456 here).

Sugarcane is even missing from the list of commonly burned crops in the contiguous U.S. This is an egregious omission: Approximately 400,000 acres of sugarcane fields are burned annually in Florida during the harvest season from October to April:
https://ui.adsabs.harvard.edu/abs/2019AGUFMGH14A..07N/abstract

Exclusion of this crop in the final report would result in an intentional underestimation of the amount of greenhouse gas emissions from agricultural burning. We strenuously oppose this exclusion in the draft report for the above and following reasons:

- Crops burned on a much smaller scale with less emissions, like sugar beets, are included while sugarcane is excluded.

- Between the years 2003 and 2007, 34% of all agricultural burning CO_2, CH_4, CO, NO_2, SO_2, $PM_{2.5}$, and PM_{10} emissions within the US were associated with sugarcane burning (here)
    - This same research found Florida to be responsible for 17% of all annual CO2 and CO emissions in the US. attributable to crop burning due largely to the annual sugarcane harvesting season (ibid)
- Further information on the GHG emissions associated with sugarcane growing in Florida is available here
- Omission of GHG emissions from sugarcane field burning could allow the sugar industry to sidestep federal agricultural sector GHG emission reduction regulations.
- It is important to document GHG emissions attributable to sugarcane burning so that this report can create an accurate depiction of GHG emissions attributable to agricultural burning.
- Omitting sugar field burning emissions can be interpreted as preferential treatment to the sugar industry.
- Ignoring the GHG emissions from the annual burning of over 400,000 acres of sugarcane fields in Florida allows the EPA to ignore the environmental racism perpetuated by this toxic practice (see http://stopsugarburning.org/).

Please include the greenhouse gas emissions from pre-harvest sugarcane field burning in the final report. Leaving them out of the report would constitute a dereliction of duty.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0015

Roger Caiazza

Comment 10: Methane Emissions from Oil and Gas Operations

My primary concern with the Greenhouse Gas (GHG) emission inventory is methane from oil and gas operations. I only have one comment. I believe that the methane emission inventory should be consistent with long-term methane monitoring. If the inventory is inconsistent then it is wrong, period, end of story.

I am a retired utility meteorologist with nearly 45 years air pollution meteorology and emission inventory development and assessment experience. The opinions expressed in these comments do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

I spent a lot of time developing comments on New York's GHG 1990 emission inventory including a document with methane references. The New York inventory is a requirement of the Climate Leadership and Community Protection Act. That process is proving that any law includes specific mandates for

emission inventories will not end well. In particular, the emission inventory is supposed to account for upstream emissions for natural gas operations which makes the New York inventory incompatible with any other inventory. My comment on the EPA inventory is based on that research.

One of the first things I learned when developing emission inventories is that consistency was important in all aspects. However, it is absolutely critical that the inventory emissions should be consistent with ambient monitoring results. If there are inconsistencies the problem is because the inventory is wrong.

There is a relevant methane monitoring network. Lan et al., 2019 evaluated data from the National Oceanic and Atmospheric Administration Global Greenhouse Gas Reference Network and determined trends for 2006–2015. This covers the period when Pennsylvania shale-gas production increased tremendously and according to the emission factors in the New York inventory methane emissions should be very high. According to the plain language summary for the report:

> In the past decade, natural gas production in the United States has increased by ~46%. Methane emissions associated with oil and natural gas productions have raised concerns since methane is a potent greenhouse gas with the second largest influence on global warming. Recent studies show conflicting results regarding whether methane emissions from oil and gas operations have been increased in the United States. Based on long-term and well-calibrated measurements, we find that (i) there is no large increase of total methane emissions in the United States in the past decade; (ii) there is a modest increase in oil and gas methane emissions, but this increase is much lower than some previous studies suggest; and (iii) the assumption of a time-constant relationship between methane and ethane emissions has resulted in major overestimation of an oil and gas emissions trend in some previous studies.

As a result of the fact that the relevant high quality, long-term monitoring network does not show a trend consistent with the New York inventory I believe their numbers are wrong.

Unfortunately, I have not had time to evaluate the EPA inventory relative to the Lan et al. study. My comment is that those monitoring data should be compared to your inventory to confirm consistency. If the values are consistent then your inventory is very likely correct.

Response: EPA appreciates the comment and has noted it in the GHG Inventory, page 3-78: "One comment on the public review draft suggested that the inventory estimates be compared with an observational analysis from a 2019 Lan et al. study. Lan et al. estimated an average increasing trend of U.S. oil and gas methane emissions of 3.4 percent +/-1.4 percent per year between 2006 and 2015, based on three U.S. measurement sites that were "substantially influenced by O&NG activities." This study did not address the magnitude of emissions. Nationally, in the Inventory, methane emissions from oil and gas decreased by an average of 1 percent per year from 2006 to 2015, largely driven by the natural gas distribution and transmission and storage segments."

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0022

Bridget Chadwick

Comment 11: Edit to p. 2-12, Figure 2-6

Add a sentence to introduce Figure 2-6

Aside: I like this new figure with all its detail. And, putting the electric power sector at the bottom makes it easier to see the impact of the power sector emissions trends (its upward trend from 1990-2007 and its downward trend from 2007-19) on the energy chapter's overall emissions trend.

Response: A reference to Figure 2-6 was added as part of the introductory text on pg 2-10.

Comment 12: Edits to p. 2-14

p. 2-14, lines 1-12
I have written in blue and highlighted in gray how my bulleted points might be made:

- Break the first sentence of the paragraph into two; replace "historically" with trend years; and, reference the Figure that shows the trend

From 1990 to 2017, the electric power sector accounted for the largest share of the combustion emissions (see Figure 2-18).

- Emphasize that there are two main drivers of power sector emissions; replace "fuels" with "energy mix" to describe both fossil and non-fossil energy sources

The two main drivers of power sector emissions are: (i) the amount of electricity generated to meet electricity demand; and (ii) the carbon intensity of the electricity generated from an energy mix (fossil fuels and non-fossil energy) (see Table 3-12).

- Add detail about the power sector emissions trend from 1990 to 2005

From 1990 to 2005, power sector CO_2 emissions increased 31.9 percent from 1820.0 to 2400.1 $MMtCO_2$ with a 34.3 percent increase in generation from 2,905 to 3,902 TWh (see Figure 2-9).

- Explain how carbon intensity has driven down power sector CO_2 since 2005

From 2005 to 2019, power sector CO_2 emissions dropped 33.1 percent (see Figure 2-9) with a 34.1 percent decrease in the carbon intensity* of the energy mix (from 615 to 405 gCO_2/kWh). The drop in carbon intensity reflects an energy mix with more renewable energy (115 percent increase) and natural gas (116 percent increase) and less coal (52 percent decrease). Renewable energy is carbon-free and natural gas is less carbon intensive** than coal.

Between 2018 and 2019, emissions from the electric power sector decreased 8.4 percent due to a decrease in electric power generation of 1.4 percent and a decrease in the carbon intensity of the energy mix of 7.1 percent reflecting the continued shift from coal to natural gas and renewable energy.

* carbon intensity of the power sector energy mix, in gCO_2/kWh, should be calculated for each year and provided as the last row of Table 3-12.

Response: The text of this section was modified to reflect comments on the clarity of historic power sector emissions and trends. A detailed discussion and analysis of the carbon intensity of the power sector energy mix was not included in the Inventory report. Note, the inventory is a policy-neutral, technical report providing information on current GHG emissions and sinks and trends prepared per reporting UNFCCC Annex 1 National GHG Reporting Guidelines (see Box ES-1) and as such, it is not well-suited as a document for in-depth analysis of drivers of emission trends. EPA will continue to evaluate this issue as part of ongoing clarification efforts and will add more discussion to future Inventory reports as appropriate.

Comment 13: Edit to p. 3-17, line 15

Add more detail to explain the overall drop in electric power sector emissions of 11.5 percent. Explain that the overall power sector emissions trend can be broken into an upward trend from 1990 to a peak in 2005, and a downward trend from 2005 to 2019.

> From 1990 to 2005, electric power sector emissions *increased* by 32 percent, driven by a significant increase in electricity demand (34 percent). The carbon intensity of electricity generated decreased by only 2 percent. From 2005 to 2019, electric power sector emissions decreased by 33 percent, driven by a significant drop in the carbon intensity of electricity generated (- 28 percent). Electricity demand decreased by only 7 percent. The table below provides a summary of the electric power sector CO_2 emissions trends from 1990 to 2019.

	CO_2 Emissions [$MMtCO_2$]	**Generation** [billion kWh]	**Carbon Intensity** [gCO_2/kWh]
1990	1820.0	2905	627
2005	2400.1	3902	615
2019	1606.0	3962	405
% change: 1990 - 2005	31.9	34.3	-1.8
% change: 2005 - 2019	-33.1	1.5	-34.1

Response: The text of this section (page 3-17) was modified to reflect comments on clarity of historic power sector emissions and trends.

Comment 14: Edit to p. 3-17, lines 15-18

Delete or clarify the statement: "The carbon intensity of the electric power sector…has significantly decreased, by 16 percent". The carbon intensity is the carbon intensity of the *fossil fuel* primary energy mix. Readers should be referred to Box 3-4, Table 3-16: Carbon Intensity from Direct Fossil Fuel Combustion by Sector (MMT CO_2 Eq./QBtu) for the data used in this calculation.

Response: Reference to Box 3-4 was added to the text to clarify the 16% decrease in carbon intensity of the electric power sector.

Comment 15: Edit to p. 3-17, line 24-26
Simplify the comparison of natural gas and coal carbon intensities by comparing the average emission factors of natural gas generation and coal generation (referred to as the "implied emission factors" by the IEA in their *CO_2 Emissions from Fuel Combustion - Highlights* reports).

> Natural gas has a much lower carbon content than coal, and is generated in power plants with lower operating heat rates (Btu/kWh). In 2019, electricity from natural gas was generated with an average carbon intensity of 418 gCO_2/kWh. Electricity from coal was generated with an average carbon intensity of 1015 gCO_2/kWh.

*I used data in the EIA's *Monthly Energy Review* Tables 11.6 and 7.2b to calculate the average carbon intensities, above.

Response: The text in this section was modified to indicate that natural gas power plants are generally more efficient in terms of kWh produced per Btu of fuel combusted than coal power plants based on available analysis and literature. Exact numbers were not included as that required more detailed calculations. EPA will continue to evaluate this issue as part of ongoing clarification efforts and will add more discussion to future Inventory reports as appropriate.

Comment 16: Edits to p. 3-17, Table 3-12

- Add the same note that appears under Table A-31 table in the *Annexes*:

"Does not include electricity generation from purchased steam as the fuel used to generate the steam cannot be determined. Does not include non-renewable waste (i.e., municipal solid waste from non-biogenic sources, and tire-derived fuels)".

- Add a row to the table with the average carbon intensity of total electricity generated for each year [gCO_2/kWh].

- Add a row to the table with the carbon intensity of total fossil fuel electricity generated for each year [gCO_2/kWh] below the last row of the table.

*I used data in the EIA's *Monthly Energy Review* Tables 11.6 and 7.2b to calculate the carbon intensities for 1990, 2005 and 2019 in the table below.

gCO_2/kWh	**1990**	**2005**	**2019**
Carbon intensity of Total Electricity	627	615	405

Carbon Intensity of Fossil Fuel Generation	913	864	654

Response: A note was included under Table 3-12 on pages 3-18 about excluding emissions from purchased steam, however, the table does include electricity from non-renewable waste. Carbon intensity values were not specifically included in the Table as that required more detailed calculations. EPA will continue to evaluate this issue as part of ongoing clarification efforts and will add more discussion to future Inventory reports as appropriate.

Comment 17: Edit to *Inventory Annexes*, p. A-86, Table A-31

Add carbon intensity [gCO_2/kWh] for each year with more detail as is done in Canada's *National Inventory Report (NIR), Part 3, Annex 13* (the top portion of Table A13-1 is copied below).

> In tables A13-1 to A13-14, for Canada, its province and territories, public electricity sector GHG emissions are broken down by fossil fuels and other products and electricity generation is broken down by fossil and non-fossil energy source. The total GHG intensity of electricity generated, the "generation intensity" [gCO_2e per kWh] is calculated from this data. Since the CH_4 and N_2O intensities are small, the total GHG intensity is shown as equal to the CO_2 intensity (gCO_2/kWh).

Table A13–1 **Electricity Generation and GHG Emission Details for Canada**

	1990	2000	2005	2013	2014	2015	2016	2017	2018[a]
					Greenhouse Gas Emissions[b]				
					kt CO_2 equivalent				
Combustion	**94 500**	**132 000**	**125 000**	**87 400**	**83 800**	**87 000**	**80 500**	**78 400**	**69 800**
Coal	80 500	109 000	98 200	63 800	60 300	62 300	57 100	57 200	44 100
Natural Gas	2 720	13 800	15 400	19 300	18 600	19 300	18 300	16 300	21 000
Other Fuels[c]	11 300	9 380	11 300	4 270	4 910	5 450	5 040	4 820	4 690
Other Emissions[d]	**0**	**27**	**52**	**63**	**73**	**87**	**80**	**80**	**78**
Overall Total[e, f, g]	**94 500**	**132 000**	**125 000**	**87 500**	**83 900**	**87 100**	**80 500**	**78 500**	**69 900**
					Electricity Generation[h, i]				
					GWh				
Combustion[j]	**101 000**	**146 000**	**140 000**	**104 000**	**110 000**	**108 000**	**106 000**	**99 300**	**98 800**
Coal	82 200	106 000	93 900	60 900	61 600	57 800	57 900	55 900	47 000
Natural Gas	4 140	26 600	29 800	35 600	40 000	41 200	39 100	35 100	43 300
Other Fuels	14 800	13 400	16 700	7 900	8 640	8 560	9 120	8 290	8 440
Refined Petroleum Products	14 700	10 600	10 800	2 160	3 170	3 550	3 570	3 100	2 880
Biomass	14	1 830	1 780	2 050	2 030	1 980	2 250	2 170	1 950
Other	91	960	4 100	3 700	3 400	3 000	3 300	3 000	3 600
Nuclear	**68 800**	**68 700**	**86 800**	**97 600**	**101 200**	**96 000**	**95 700**	**95 600**	**95 000**
Hydro	**263 000**	**323 000**	**327 000**	**357 000**	**348 000**	**345 000**	**354 000**	**361 000**	**353 000**
Other Renewables[k]	**26**	**264**	**1 580**	**11 400**	**12 900**	**27 500**	**31 600**	**32 100**	**34 000**
Other Generation[l, m]	**0**	**0**	**32**	**9 550**	**2 240**	**140**	**180**	**200**	**210**
Overall Total[f]	**433 000**	**539 000**	**556 000**	**580 000**	**575 000**	**576 000**	**587 000**	**588 000**	**581 000**
					Greenhouse Gas Intensity[n]				
					Generation Intensity (g GHG / kWh electricity generated)				
CO_2 intensity (g CO_2 / kWh)	220	240	220	150	140	150	140	130	120
CH_4 intensity (g CH_4 / kWh)	0.004	0.009	0.01	0.01	0.01	0.01	0.01	0.01	0.01
N_2O intensity (g N_2O / kWh)	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
Generation Intensity (g CO_2 eq / kWh)[f]	**220**	**250**	**220**	**150**	**150**	**150**	**140**	**130**	**120**

Source: National Inventory Report 1990–2018: Greenhouse Gas Sources and Sinks in Canada (2020), Part 3, Annex 13.

Response: Carbon intensity values were not specifically included in the Table as that required more detailed calculations. EPA will continue to evaluate this issue as part of ongoing clarification efforts and will add more discussion to future Inventory reports as appropriate to the scope of this report.

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0004

Patricia Holt

Comment 18: Include sugarcane burning in Field Burning of Agricultural Residues

I urge the USEPA to rectify the failure to reference and include sugarcane burning in Chapter 5.7 Field Burning of Agricultural Residues. Please include the greenhouse gas emissions from pre-harvest sugarcane field burning in the final report. Leaving them out of the report would constitute a dereliction of duty.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: Interstate Natural Gas Association of America

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0014

Sandra Snyder

Comment 19: Storage wells – Emission factors

INGAA recommends updating the estimate for underground storage well leak emissions by updating the population-based emissions factors from recent GSI tests.

Since the inception of the annual inventory report, EPA has relied on emission factors developed in the 1990s from the EPA/Gas Research Institute (GRI) study[7] ("EPA/GRI Study") of methane emissions from natural gas operations. The November Memo provides updated EFs for storage well leak emissions based on a Department of Energy ("DOE") sponsored study conducted by GSI Environmental ("GSI Study"), and EPA requests feedback on the most appropriate EFs to apply to storage wells.

INGAA supports updating the emissions estimate for storage wells using updated EFs from the GSI study. Well-level EFs can be used, because higher quality storage well-counts are now available, as discussed below.

Response: EPA appreciates the comment and will consider the GSI study or other available data for emission factors for this source for future GHG Inventories as we did not have sufficient time to

[7] EPA-600/R-96-080(a-o). "*Methane Emissions from the Natural Gas Industry*," Volumes 1-15, EPA/GRI. (1996).

complete our assessment of use of GSI study data in combination with different options for activity data prior to finalizing this year's report.

Comment 20: Storage wells – Activity data
Rather than estimating storage well counts, "activity data" for storage wells should be based on data published by PHMSA.

For natural gas operations, EPA frequently bases activity data (e.g., facility or equipment counts or other statistics such as miles of pipe) on data available from the DOE Energy Information Administration ("EIA") or Department of Transportation ("DOT") Pipeline and Hazardous Materials Safety Administration ("PHMSA"). For storage wells emission estimates, EPA has relied on activity data from the EPA/GRI Study that is adjusted from year-to-year. The November Memo requests feedback on updating the methodology for estimating storage well counts, but EPA did not mention a superior information source: PHMSA data. In recent years, PHMSA Form 7100.4 has required reporting of underground storage, including well counts. Data are available for 2017 through 2019.[8]

Activity data based on EIA or PHMSA reports are a better option than using a historical value that is updated annually using a proxy like changes in natural gas usage. Since the PHMSA report is relatively new, EPA may not have considered or been aware of this data source. INGAA recommends relying on this new PHMSA data source for "storage well count" activity data.

EPA should use actual storage well counts available from PHMSA since 2017. For the annual inventory time series, EPA can rely on the original well counts from the EPA/GRI Study, and interpolate linearly from 1990 to 2017. When available, INGAA strongly recommends using reported activity data rather than conducting annual adjustments using a proxy parameter (e.g., EPA has adjusted the historical well count based on annual residential gas use). Therefore, for future estimates, PHMSA reported data should be used to update storage well counts.

Similarly, EPA can scale the storage well EFs by using the historical EF in 1990, applying the new EF for the updated estimate, and scaling linearly for the interim years. Notably, since storage well count data are now available annually through PHMSA, the emission estimate can be conducted using storage well counts (i.e., storage well-level data) and not "rolled up" alternatives being considered by EPA such as a station-level EF with storage station count (and assumptions regarding storage well counts per station) as the activity data.

Response: EPA appreciates the comment and will consider the PHMSA or other data sets and/or methods for activity data for this source for future GHG Inventories as we did not have sufficient time to complete our assessment of use of PHMSA data prior to finalizing this year's report.

Comment 21: Activity data time series estimates (e.g., year-to-year scaling) for compressor stations

[8] *See* "Underground Natural Gas Storage (UNGS) Facility (ZIP)" link at: https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids.

EPA should revise its methodology for annually adjusting compressor station counts based on Subpart W reporting facility counts to avoid erroneously reporting that compressor station emissions have increased.

For natural gas transmission compressor stations, a number of emission estimates are directly or indirectly related to compressor station counts from Subpart W facilities. A "station-based" EF is used for emissions from station leaks and station blowdowns, and the station count also affects pneumatic device activity data (device counts by type). In the past, annual activity data adjustments were often tied to changes in pipeline miles reported to PHMSA. In 2016, EPA introduced a change to station counts based on a ratio of compressor stations that do or do not report under Subpart W of the GHGRP. That one-time review concluded that in 2012, 28.4% of transmission stations reported under the GHGRP. The other 72% of stations had emissions below the reporting threshold. Since then, EPA has used that same factor (i.e., 1/0.284 = 3.52) to estimate annual compressor station counts in the time series. Assuming that the "2012 ratio" remains constant over time is a faulty assumption that should not be carried forward because, as further discussed below, it implies infrastructure and equipment changes that are *not* realistic.

The estimated station count affects the activity data applied to several important emission sources for the transmission segment: station leaks, reciprocating and centrifugal compressor leaks, station blowdowns, and pneumatic device counts. However, assuming that 3.52 factor is constant is inaccurate because year-to-year increases in the number of stations that report under the GHGRP is not due to new equipment, but rather due to facility-specific increases in "utilization" to address pipeline demands (i.e., increased operation of compressor drivers) that increase emissions of CO2 from combustion such that certain facilities' emissions now exceed the GHGRP reporting threshold. The current EPA approach has erroneously resulted in a false increase in compressor station counts (and related activity data for compressors and pneumatic devices) of nearly 40% since 2012. Using a higher compressor station count results in anomalies in activity data, such as annual increases in the estimated count of centrifugal compressors with wet seals, and annual increases in the estimated count of high-bleed pneumatic devices. Wet seal compressors have not been sold in the U.S. for many years, and high-bleed pneumatics have been phased out of the natural gas transmission segment, so these are obvious examples of errors. Similarly, U.S. station counts and reciprocating compressor counts are not increasing at the rate implied.

Since emission factors have remained constant for these years, the result is that transmission segment emissions estimates are *increasing*, and the Draft Inventory Report indicates a 6.3% increase in transmission segment methane emissions from 2018 to 2019, and a 27% increase since 2012. Since GHG emissions continue to be more closely scrutinized by agencies and third parties, this erroneous "paper increase" is very problematic and should be remedied.

Assuming that the 2012 count is established as the baseline, EPA should adopt an alternative approach for estimating station counts (and other related activity data). A more detailed analysis could be conducted by reviewing activities such as FERC actions (i.e., certificates required for adding interstate natural gas transmission infrastructure). At this time, INGAA strongly recommends that the station count activity data since 2012 be revised. New pipeline infrastructure is a better indicator of facility changes than using GHGRP station counts as a proxy for infrastructure changes. Until a better alternative is identified, INGAA recommends that annual pipeline miles (currently included in EPA's dataset based on PHMSA data) be used to adjust compressor station counts since 2012.

Response: EPA appreciates the comment and will consider different proxy data sets and/or methods for activity data for this source for future GHG Inventories.

Comment 22: Rolling average emission factor for pipeline blowdown emissions
For pipeline blowdowns, three years of quality data are now available from GHGRP Subpart W reporting. EPA should use a "rolling average" EF to smooth year-to-year variability and eliminate the EF from the initial reporting year.

Starting with the 2016 reporting year, pipeline blowdown emissions reporting was added to the GHGRP. In 2019, EPA updated the pipeline blowdown emissions EF used for 2016 and 2017 GHG inventories, and the Draft Inventory Report uses the annual EF value from the GHGRP for each year from 2016 through 2019. As an alternative, INGAA recommends using an average EF (e.g., 3- to 5-year rolling average) to minimize year-to-year variability. In addition, as discussed in INGAA's 2019 comments,[9] INGAA recommends deleting the EF from the first GHGRP reporting year because the GHGRP allowed "best available monitoring methods" (BAMM) for the initial reporting year, and the dataset, individual pipeline data, and resulting EF appear anomalous when compared to other data.

For 2017 through 2019 reporting years, the annual pipeline blowdown methane emissions EF has been fairly consistent (613.6 – 659.6 kg/mile) and also agrees well with the historical EF (609.6 kg/mile) from the EPA/GRI study. The initial reporting year (2016) EF was much higher and should be eliminated from the dataset due to data quality concerns. In addition, as datasets grow, EPA often relies on the larger dataset. For example, Subpart W uses a three-year rolling average for reciprocating and centrifugal compressor EFs based on company measurements. Subpart W uses a 5-year average for leak EFs from distribution metering and gathering station surveys. To leverage a larger dataset and smooth year-to-year perturbations, INGAA recommends using a 3-year rolling average of the GHGRP Subpart W pipeline blowdown data as the annual inventory report EF for this source.

Response: EPA appreciates the comment. We considered several approaches for incorporation of transmission pipeline blowdown information from GHGRP into the GHG Inventory (2019 GHG Inventory), including: (1) applying the 1996 GRI/EPA EFs to early years of the time series (1990-1992) and linearly interpolating to the year 2016 subpart W EFs, (2) applying the 2018 GHG Inventory EFs for 1990-2015 and year-specific subpart W EFs for 2016 forward, and (3) applying subpart W-based EFs (average EFs or year-specific EFs) to all years of the time series. The approach that was taken used existing EFs for years 1990 through 2015, and newly calculated year-specific EFs from subpart W data starting in year 2016. This allows the GHG Inventory to reflect annual changes in pipeline blowdown activities. For more information, please see https://www.epa.gov/sites/production/files/2019-04/documents/2019_ghgi_updates_-_other_updates_2019-04-10.pdf.

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0013

Jessica L. McCarty, Ph.D.

[9] Docket ID No. EPA-HQ-OAR-2018-0853, INGAA Comments on EPA Annual Inventory Report for 1990 – 2017 (Mar. 14, 2019).

Comment 23: Exclusion of surgcane burning from Field Burning of Agricultural Residues

Completely absent from Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F; starting on page 456 here) are references to the sugarcane burning. As the author of McCarty et al. (2009), sugarcane is even missing from the list of commonly burned crops in the contiguous U.S.

Almost 400,000 acres of sugarcane are burned annually in Florida during the harvest season from October to April: https://ui.adsabs.harvard.edu/abs/2019AGUFMGH14A..07N/abstract

To exclude this crop is to underestimate the amount of greenhouse gas emissions from agricultural burning.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: National Association of Clean Water Agencies (NACWA)

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0018

Cynthia Finley, Ph.D.

Comment 24: General comments on Wastewater Emissions Estimates

The wastewater section of the *Inventory* is clearly written and demonstrates EPA's understanding of domestic wastewater treatment processes. This section defines the boundaries of the emissions estimates, with the sources and offsets that are included in the estimates. NACWA appreciates that EPA has followed the Association's previous recommendation that the calculation variables and data sources be presented in table form. NACWA also appreciates the clarification that EPA has provided in the public review draft on the use of the terms "biosolids" and "sludge."

EPA asked for comment on the disaggregation of national estimates and the availability of disaggregated data, such as at the state level. This would require emissions calculation methods other than the IPCC methods, since the IPCC methods are based largely on population and on estimates of nitrogen and biological oxygen demand (BOD) loading per capita. Some utility-level and state-level data is available, but there is a need for more data to be collected. Although consideration of data at a more granular level is preferable, it must also be used carefully when drawing conclusions at a broader level.

Response: EPA understands the commenter's concerns with state-level emissions estimates and its uncertainty and welcomes any data available to NACWA to assist with considering these more disaggregated emission estimates that may be included with supplemental annexes to the Inventory.

Comment 25: EPA Incorporation of IPCC Refinements

The calculations from the *IPCC Refinement* are based entirely on influent nitrogen loading and do not account for whether POTWs have nitrification/denitrification (N/DN) processes at the treatment plant. Nitrous oxide cannot form without nitrification and/or denitrification occurring. However, as the

calculations are set up, the emission estimate is the same for a plant with N/DN as for a plant without N/DN.

Previous IPCC guidance used population as the basis for nitrous oxide calculations, as does the current *IPCC Refinement*. However, the previous IPCC guidance used different emissions factors depending on whether plants use N/DN processes, with lower emissions resulting from plants without N/DN. The IPCC calculations for nitrous oxide should account for the presence or absence of N/DN processes at different treatment plants.

Actual nitrous oxide emissions are process-specific, with factors such as consistency of dissolved oxygen levels, system upsets, and supplemental carbon addition sources potentially playing a large role in the quantity of nitrous oxide formed. Further refinements are needed with respect to treatment process type to reflect actual conditions.

Response: See response to Comment 56 in the Summary of Expert Review Comments and Responses found here: https://www.epa.gov/system/files/documents/2021-07/us-ghg-inventory-1990-2019-expert-review-comment-log.pdf.

Further, EPA will continue to evaluate if there are sufficient data to develop US-specific and/or treatment-specific emission factors. Sufficient activity data on the numbers of POTWs or the amount of wastewater flow treated by treatment type would be required to apply such factors.

Comment 26: Input on Data Used in Emissions Estimates

Developing US- and treatment-specific methods for estimating nitrous oxide emissions, rather than using IPCC methods, should be a priority for EPA. It is more accurate to have factors for each type of treatment process applied, such as N/DN, in place of an IPCC default factor for domestic wastewater of 0.005 kg N_2O-N/kg N.

NACWA recommends that additional consideration be given to where wastewater discharges occur in the aquatic environment. The current emissions factors apply to "estuaries," but further details describe "slow moving" aquatic systems. A large portion of wastewater discharges go to aquatic systems that are not "slow moving," since discharge points for POTWs are usually selected to meet water quality objectives and to target dilution and movement of the receiving water – conditions that are not conducive for producing GHG emissions. A better understanding of how emissions depend on the discharge points would produce more accurate emissions estimates.

Response: As noted in response to Comment 57 in the Summary of Expert Review Comments and Responses: Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019 found here: https://www.epa.gov/system/files/documents/2021-07/us-ghg-inventory-1990-2019-expert-review-comment-log.pdf.

Further, EPA does account for the nitrogen removed from different types of treatment (primary, secondary, tertiary) before applying the emission factor associated with the resulting discharge. EPA notes that the potential for emission is not just associated with the point of discharge, but also within-stream effects associated with the presence of nitrogen. Discharge mixing zones, for the purpose of meeting water quality objectives of the receiving water, have less of an impact on the potential for nitrous oxide generation than whether the receiving water is already impacted by nutrients or is

hypoxic. EPA welcomes any data NACWA may have on how emissions may differ based on receiving water conditions in the United States.

Comment 27: Recommended Text Changes

NACWA recommends the following edits to the text of Section 7.2 of the *Inventory*. Although these edits will not affect the emission calculations, they will clarify aspects of the wastewater treatment process.

- Page 7-21, line 31 – Replace the phrase, "or as a later treatment step…" with: "or are more commonly used as a final treatment step…"
- Page 7-22, line 14 – At the end of the paragraph, add: "although most POTW discharge points (outfall locations) are regulated to ensure conditions of the receiving water body and the effluent quality are conducive."
- Page 7-22, line 26 – Replace the sentence beginning with, "The principal factor…" with this sentence: "While research has shown that there are many factors that influence the actual generation of N_2O across wastewater treatment processes, for the purposes of this *Inventory*, the principal factor in determining the N2O generation potential of wastewater is the amount of N in the wastewater."

Response: EPA appreciates the feedback. The text of the chapter has been edited to reflect changes based on the commenter's suggested updates for page 7-21, line 31.

EPA did not make the suggested text changes for page 7-22, line 14. EPA notes that wastewater discharge regulations do not specifically address potential GHG emissions and believes the spirit of this comment, to investigate improvements of the domestic discharge methodology, is covered in the Planned Improvements section of the NIR.

EPA did not make the suggested text change for page 7-22, line 26. While EPA agrees that there are several operational factors to consider, the principal factor is still the amount of N in the wastewater, both of which are stated in the NIR.

Comment 28: Additional recommendations for methane emissions

NACWA agrees that there are needed improvements for the *Inventory* and strongly encourages development of US- and treatment-specific methodologies and emission factors. Specifically, NACWA recommends that EPA consider the following next steps regarding methane emissions:

- Continue collecting and reviewing published research and articles on methane release from treatment processes.
- Consider further the relationship of methane saturation of streamflow (influent to each treatment process) and the potential for methane emissions.
- Determine the feasibility of performing direct methane measurements at POTWs.

Response: EPA thanks the commenter for their suggested next steps and sources and has updated the Planned Improvements under Chapter 7.2 Wastewater Treatment and Discharge to reflect some of the suggestions (see pages 7-52, 7-53). EPA does not plan to take any direct measurements at this time, nor does it plan to equate nitrification / denitrification plant emissions to zero as the 2019 IPCC refinement showed this is not accurate.

The 2019 IPCC Refinement is available online at: https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/5_Volume5/19R_V5_6_Ch06_Wastewater.pdf. Please reference section 6.1.1 (page 6.10) and 6.3.1 (page 6.35) for the discussion on nitrification and denitrification EPA cites here.

Comment 29: Additional recommendations for N_2O emissions
Regarding N_2O emissions, NACWA recommends the following next steps:

- Keep reference to the original IPCC emission factor for non-N/DN plants, since they are not represented in the refinement, or equate their N_2O process emissions to zero.
- For POTWs practicing N/DN processes, and in the absence of site-specific data, consider providing the option to use an equation Kartik Chandran determined (just prior to releasing his work in the 2012 WERF study[10]) as a calculation-based method that accounts for aerobic and anaerobic conditions and diurnal and seasonal variability at the wastewater treatment plant (WWTP).

$$N_2O_{WWTP} = Q_i \times TKN_i \times EF_{N2O} \times (44/28) \times 10^{-6}$$

where: N_2O_{WWTP} = N_2O emissions generated from WWTP process (Mg N_2O/hr)
Q_i = wastewater influent flow rate (m^3/hr)
TKN_i = amount of TKN in the influent (mg/L = g/m^3)
EF_{N2O} = N_2O emission factor (g N emitted as N_2O per g TKN in influent)
= 0.0050 g N emitted as N_2O/g TKN (Chandran, 2010)
44/28 = molecular weight conversion, g N_2O per g N emitted as N_2O
10^{-6} = units conversion factor (Mg/g)

- In addition to the equation above, consider reference factors in published literature (e.g., 2012 WERF study) for treatment processes when the factor aligns well with processes used by a large portion of POTWs.
- Continue collecting and researching articles on the evolving understanding of N_2O emissions by treatment process.
- Further examine the relationship of nutrient load in the influent versus effluent to show (1) potential loss of nitrogen from non-N/DN plants (if any), and (2) if the emission factors for N/DN are over-estimating nitrous oxide emissions.

Response: EPA appreciates and thanks the commenter for providing data sources for their comment and will review these sources as part of planned improvements. The text of this chapter has been edited to reflect the source provided by the commenter on page 7-52.

Comment 30: Include diagrams showing wastewater treatment emissions sources
NACWA also suggests that EPA provide diagrams showing emissions sources and offsets related to each process stage in the domestic wastewater treatment train that is necessary for achieving water quality objectives. This would provide context of the function and objective of POTWs to protect public health and water quality through wastewater treatment.

[10] Chandran, K., 2012, *Nitrogen Emission from Wastewater Treatment Operation, Phase 1: Molecular Level Through Whole Reactor Level Characterization*, Water Environment Research Foundation, 170 pp.

Response: See response to Comment 58 in the Summary of Expert Review Comments and Responses: Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019 found here: https://www.epa.gov/system/files/documents/2021-07/us-ghg-inventory-1990-2019-expert-review-comment-log.pdf.

Commenter: National Cattlemen's Beef Association (NCBA)

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0019

Scott Yager and Mary-Thomas Hart

Comment 31: Global Warming Potential Methodology

The Draft Inventory notes that, in 2019, enteric fermentation emissions from cattle accounted for 1.96% of all United States GHG emissions. To complete this calculation (in addition to other contribution percentage calculations in the Draft Inventory), EPA utilized the globally adopted GWP_{100} methodology. As EPA seeks to improve its inventory, NCBA urges the Agency to forgo the GWP_{100} methodology, considering instead the GWP* methodology – specifically with regard to methane emissions.

The 100-year variant of the Global Warming Potential (GWP100) has been formally adopted in international climate policy (currently as established in the Kyoto Protocol, and in the draft text of the Paris Agreement[11]) and standardized Life Cycle Assessment (LCA)/carbon-footprinting approaches[12]). Subsequently, GWP_{100} has become the de facto standard for expressing emissions in the scientific literature and general media, having essentially become shorthand for the relative climate impacts of a given product or activity. Despite its ubiquity, the relationship between aggregate CO_2 Equivalent (CO_2-e). emissions calculated using GWP_{100} and global warming itself is ambiguous. Fundamentally, many of the shortcomings of the GWP_{100} calculation as a universal climate metric arise because it cannot sufficiently differentiate the contrasting impacts of long- and short-lived climate pollutants (SLCPs). In previous reports, the International Panel on Climate Change (IPCC) has acknowledged the shortcomings of current methods of reporting methane impacts, including GWP_{100}. GWP* was first reported by the Climate Dynamics research team at the University of Oxford in 2018, led by Myles Allen (commonly referred to as "the physicist behind net zero") and has been gaining acceptance in the scientific community as a GWP calculation that more effectively measures the global warming impact of methane.[13]

Under the United Nations Framework Convention on Climate Change (UNFCCC), reporting of GHG emissions has been standardized in terms of CO_2-equivalent (CO2-e) emissions using Global Warming Potentials (GWP) over 100 years, but the conventional GWP_{100} methodology does not adequately capture the different behaviors of long-lived climate pollutants (LLCPs) and SLCPs. The atmospheric lifetime and radiative impacts of different GHGs differ dramatically. Acknowledgement of this reality led to the widescale adoption of the GWP_{100} methodology. GWP_{100} equates emissions using a scaling factor – CO_2-e. GHGs are assigned a GHG equivalency, then that number is used to determine the emissions' potential impact. Following GWP_{100}, a pound of methane equates to 25 pounds of CO_2. Thus, methane is

[11] UNFCCC 2018 Presidency consultations on modalities, procedures and guidelines under the Paris Agreement with a focus on transparency Draft Report Version 1.

[12] *ISO 14044 2006 Environmental Management—Life Cycle Assessment—Requirements and Guidelines.*

[13] Allen, M. et al, A solution to the misrepresentations of CO2-equivalent emissions of short-lived climate pollutants under ambitious mitigation, Climate and Atmospheric Science 1, 16 (2018).

calculated as 25CO_2e. However, this simplified scaling factor fails to recognize the amount of time emissions remain in the atmosphere – an equally important factor in determining potential atmospheric impact. The GWP* methodology seeks to remedy this oversight.[14]

Anthropogenic warming estimations are largely determined by the cumulative total emissions of LLCPs and the emission rates of SLCPs. GWP* equates an increase in the emissions rate of an SLCP with a single "pulse" emission of CO_2, and thus considers not only the initial intensity of GHGs, but also the amount of time that they remain in the atmosphere. This approach is a significant improvement on the conventional GWP_{100} methodology. Further, the GWP* methodology modifies the conventional GWP definition to consider CO_2 warming equivalents (CO_2-we) rather than CO_2-e. Following GWP*, SLCPs can be incorporated directly into carbon budgets consistent with long-term temperature goals, because every unit of CO_2-we emitted generates approximately the same amount of warming, whether it is emitted as a SLCP or a LLCP. This is not the case for conventionally derived CO_2-e measurements.

Response: EPA uses 100-year Global Warming Potentials (GWP) from IPCC's Fourth Assessment Report as required in reporting annual inventories to the UNFCCC. This is required to ensure that national GHG Inventories reported by all nations are comparable. The current Inventory presents estimates on a gas-by-gas basis to allow users to understand relative contribution across all sources of methane, see Table 2-1. The report also includes unweighted estimates in kilotons (see Table 2-2 of the Trends chapter) and stakeholder/researchers can and have used these values to apply other metrics. Note, per adopted reporting guidelines under the new Paris Agreement which take effect with reports submitted in 2024, the U.S. and other countries will shift to the use of 100-year GWPs from IPCC's 5th Assessment report. We continue to track the ongoing work of the IPCC in this area related to the development of the forthcoming Sixth Assessment Report. EPA takes note of the supplemental materials submitted with the comments.

Comment 32: Greater Recognition of Grassland Carbon Sinks

NCBA is pleased with the Agency's effort to recognize existing GHG emission offsets. As the Agency noted in the Draft Inventory, carbon sinks account for a 20% offset of agricultural GHG emissions – significantly reducing the net impact of the industry. NCBA encourages the bolstering of this section generally, so that regulated stakeholders and consumers alike can assess the net impact of GHG emitters. Going forward, NCBA urges EPA to specifically consider the environmental benefit of managed grazing, including rotational grazing systems, conservation practices implemented by ranchers across the country. It is well-known that rotational grazing leads to increased carbon sequestration.[15] NCBA continues work to develop rotational grazing system implementation as a conservation and management tool nationwide. Globally, if soil organic carbon in agricultural lands and grasslands increase 10% over the course of the 21st century, carbon dioxide concentrations in the atmosphere could be reduced by 110 ppm.[16]

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[14] Cain, M., Lynch, J., Allen, M.R. et al., *Improved calculation of warming-equivalent emissions for short-lived climate pollutants*, Climate Atmosphere Science 2, 29 (2019). https://doi.org/10.1038/s41612-019-0086-4.

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

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

Response: As noted in previous public review comments, improved grazing management such as rotational grazing is an activity that EPA would like to capture better within the GHG inventory but has proved to be challenging due to lack of a consistent time-series of national activity data for these alternative grazing management approaches. EPA would appreciate information on activity data sources that NCBA is aware of so these practices can be better reflected in the methods currently used to estimate emissions and removals from livestock management on grasslands.

EPA also notes that the offset percentage or "relative" sink cited by NCBA in their comments is not presented in the report. We were unable to replicate this value based on estimates in the Inventory report.

Commenter: Private Citizens

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0011

Holly Nowell, Christopher Holmes, and Jessica McCarty

Comment 33: Emissions from sugarcane field burning

The U.S. Inventory of Greenhouse Gas Emissions and Sinks: 1990-2019 (hereafter, "US GHG Inventory") should include emissions from sugarcane agricultural fires, but the draft version currently does not. Emissions from many agricultural crop fires are included in Section 5.7 "Field Burning of Agricultural Residues (CRF Source Category 3F)" so the omission of sugarcane is notable. We show here that GHG emissions from sugarcane fires are larger than many other crops that are included in section 5.7.

Sugarcane fields are commonly burned before harvest to reduce the volume and mass of plant material that must be harvested and transported to sugar mills (Baucum and Rice 2009; Gullett et al. 2006; Hiscox et al. 2015; Le Blond et al. 2017; McCarty 2011; McCarty et al. 2009). Permit records from the state of Florida show that 169,000 ± 26,000 ha (417,600 ac) of sugarcane fields burned each year over the years 2004 - 2019 (updated from Nowell et al., 2018; uncertainty is standard deviation of annual totals). We estimate annual total emissions (E) from these fires using

$$E = A\ F\ c\ e_i. \quad (1)$$

Here, A = 169,000 ± 26,000 ha yr^{-1} is the area of sugarcane burned in Florida, F = 10,648 kg ha^{-1} is the dry matter fuel load (McCarty 2011; Pouliot et al. 2017), c = 0.65 is the combustion fraction (McCarty, 2011; Pouliot et al., 2017), and e_i is the emission factor for compound i. For sugarcane fires, e_{CH4} = 1.19 ± 1.31 g kg^{-1}, e_{CO} = 58.5 ± 27.5 g kg^{-1}, e_{NOx} = 3.02 ± 1.65 g kg^{-1} (McCarty, 2011), and e_{N2O} = 0.09 ± 0.04 g kg^{-1} (Andreae, 2019). The fuel load, combustion fraction, and emission factors used here are all specific to sugarcane grown in the southern United States, except for the N_2O emission factor, which is an average value for field burning of agricultural residue. We convert the emissions from equation 1 to CO_2 equivalent using a 100-year GWP of 25 for CH_4 and 298 for N_2O.

In addition to Florida, sugarcane is grown in significant quantity in Louisiana and Texas, where fire is also used before harvest. The USDA National Agricultural Statistics Service (https://www.nass.usda.gov/Quick_Stats/CDQT/chapter/1/table/35/state/US/year/2017, accessed 11 Mar 2021) reports that US sugar production was 30.9 × 10^6 tons in 2017, with 15.8 × 10^6 tons from Florida. The area harvested was 8.44 × 10^5 acres nationally and 3.86 × 10^5 acres in Florida. We estimate a range for national emissions from sugarcane fires assuming that they are proportional to sugar production or area harvested.

Table 1 summarizes emissions from sugarcane field burning in Florida and the United States computed with the method described above. This information should be added to Tables 5-29 and 5-30 in the US GHG Inventory. **Sugarcane field burning emits about 3 kt CH_4 yr^{-1} (0.07 MMT CO_2 eq yr^{-1}) and 0.22 kt N_2O yr^{-1} (0.07 MMT CO_2 eq yr^{-1}). This makes sugarcane one of the top four crops for field burning GHG emissions, with national emissions similar to rice. Adding these sugarcane emissions to GHG emissions from other crops listed in Tables 5-29 would increase total US GHG emissions from agricultural field burning by about 20 % for CH_4 and about 30 % for N_2O.** In addition, sugarcane field burning produces about 140 kt CO yr^{-1} and 7 kt NO_x yr^{-1}, which raises emissions of those gases by 40-50% beyond what is stated in Table 5-30.

Based on this evidence, sugarcane field burning is a substantial source of CH_4, N_2O, CO, and NO_x that should be included in the US GHG Inventory.

Table 1. CH_4, N_2O, CO, and NO_x emissions from field burning of sugarcane agricultural residues, 2004-2019 average

	Florida[a] (kt yr^{-1})	Florida[a] (MMT CO_2 Eq.)	US (kt yr^{-1})	US (MMT CO_2 Eq.)
CH_4	1.4	0.035	2.7-3.0	0.068-0.076
N_2O	0.11	0.031	0.21-0.23	0.062-0.069
CO	68	-	134-149	
NO_x	3.5	-	6.9-7.1	

[a] Florida emissions are from equation 1 using permitted burned area from state records.
[b] US emissions are scaled up from Florida emissions assuming that emissions are proportional to sugar production (lower value) or acres of sugarcane harvested (upper value).

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Pouliot G, Rao V, McCarty JL, Soja AJ. 2017. Development of the crop residue and rangeland burning in the 2014 National Emissions Inventory using information from multiple sources. J Air Waste Manage Assoc 67:613–622; doi:10.1080/10962247.2016.1268982.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: The Sierra Club

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0008

Comment 34: Omission of sugarcane burning from Chapter 5.7

To whom it may concern,

We, the undersigned 83 organizations and businesses, urge the USEPA to rectify the failure to reference and include sugarcane burning in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F; starting on page 456 here).

Sugarcane is even missing from the list of commonly burned crops in the contiguous U.S. This is an egregious omission: Approximately 400,000 acres of sugarcane fields are burned annually in Florida during the harvest season from October to April:
https://ui.adsabs.harvard.edu/abs/2019AGUFMGH14A..07N/abstract

Exclusion of this crop in the final report would result in an intentional underestimation of the amount of greenhouse gas emissions from agricultural burning. We strenuously oppose this exclusion in the draft report for the above and following reasons:

- Crops burned on a much smaller scale with less emissions, like sugar beets, are included while sugarcane is excluded.
- Between the years 2003 and 2007, 34% of all agricultural burning CO_2, CH_4, CO, NO_2, SO_2, $PM_{2.5}$, and PM_{10} emissions within the US were associated with sugarcane burning (here)
    - This same research found Florida to be responsible for 17% of all annual CO2 and CO emissions in the US. attributable to crop burning due largely to the annual sugarcane harvesting season (ibid)
- Further information on the GHG emissions associated with sugarcane growing in Florida is available here
- Omission of GHG emissions from sugarcane field burning could allow the sugar industry to sidestep federal agricultural sector GHG emission reduction regulations.
- It is important to document GHG emissions attributable to sugarcane burning so that this report can create an accurate depiction of GHG emissions attributable to agricultural burning.
- Omitting sugar field burning emissions can be interpreted as preferential treatment to the sugar industry.
- Ignoring the GHG emissions from the annual burning of over 400,000 acres of sugarcane fields in Florida allows the EPA to ignore the environmental racism perpetuated by this toxic practice (see http://stopsugarburning.org/).

Please include the greenhouse gas emissions from pre-harvest sugarcane field burning in the final report. Leaving them out of the report would constitute a dereliction of duty.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: Solid Waste Working Group et al.

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0016

Anne Germain (National Waste & Recycling Association)

Comment 35: Methodology for Municipal Solid Waste Landfills and Industrial Waste Landfills
The following submission includes only our comments on the changes made to Chapter 7.1 (scale-up factor methodology for municipal solid waste landfills and the methodology applied for industrial waste landfills) since last year's GHG Inventory; however, we maintain the same positions espoused in our March 2020 submission (see Appendix) on the areas that remain unchanged from the previous version of the GHG Inventory.

EPA reassessed the scale-up factor for the current (1990 to 2019) GHG Inventory, which resulted in an increase from 9 percent to 11 percent. The scale-up factor increased to reflect (1) 194 landfills that no longer report to EPA under the agency's Greenhouse Gas Reporting Program, (2) a calculation error identified for some non-reporting landfills when developing the 9 percent scale-up factor in 2016, and (3) changes to the estimated waste-in-place for all non-reporting landfills since 2016. In general, we believe that the waste-in-place number should not increase for the off-ramped landfills because the declining landfill gas is likely due to the facility being closed. In addition, we recommend that EPA discount any waste-in-place that is older than 25 years as its emissions are anticipated to be minimal.

For industrial waste landfills, EPA calculated emissions of 15.1 MMT CO_2e. However, the GHGRP only shows about 8.0 MMT $CO2_e$. Because EPA uses calculated emissions rather than reported emissions with a scale up factor as it does with MSW landfills, the amount of emissions from industrial landfills could be significantly misrepresented. Further, EPA states that the amount of waste disposed at food and beverage facilities are approximately an order of magnitude different than estimated for the entire time series. Perhaps this difference accounts for some of the discrepancy. As EPA notes, most emissions from industrial landfills are from sites that took pulp and paper processing waste or food processing waste. This comports with our experience that industrial landfills largely contain inert materials. For example, most of larger industrial landfills contain materials such as contaminated soils, combustor ash, auto shredder fluff, and concrete and asphalt processing materials. We believe that these inert facilities account for the vast majority of non-reporting industrial landfills and recommend that EPA consider whether the majority of emissions from industrial landfills are accounted for by the pulp and paper processing waste and food processing waste industrial landfills that reported under Subpart TT.

Finally, as stated in prior years' submissions on the GHG Inventory, we encourage EPA to review the DOC and k values for both the 1990 to 2004 Inventory series and for 2005 to the present. We also are pleased

that EPA is investigating k values for different climate types, comparing this information with new data and other landfill gas models, and assessing the uncertainty factor applied to these k values in the Waste Model. We offer our support to EPA in collecting and evaluating this information.

Our previous years' comments on methane oxidation factor used for the 1990 to 2004 Inventory time series remain unchanged and are repeated below. In its work to review and revise the method for calculating methane oxidation under subpart HH of the GHGRP, EPA acknowledged the need to update the default 10 percent oxidation value. The default value was based on only one field study, at a landfill without gas collection and control, and did not reflect the much higher oxidation values found in numerous subsequent, peer-reviewed field studies. Given the plethora of scientific studies showing methane oxidation to be several times higher than the EPA and IPCC default value, we strongly recommend EPA apply a revised value (perhaps the average oxidation value from the GHGRP) to the earlier years of the time series.

Response: EPA thanks the reviewers for their comments relating to the revisions of the scale-up factor for MSW landfills. The scale-up factor was revised after a detailed review of the calculations applied in the Non-Reporting Landfills Database. This review identified some calculations errors where the total number of operational years were not being accounted for a subset of landfills; calculation corrections for these landfills were a key driver in the total increased quantity of waste-in-place. The addition of the 194 GHGRP subpart HH off-ramped landfills was also a driver. EPA included the off-ramped landfills in the scale-up factor for completeness, as the intent of the scale-up factor is to account for all landfills that are not reporting to the GHGRP subpart HH. The use of total waste-in-place as the basis of the scale-up factor was developed based on feedback from external reviewers; however, EPA will review the impacts of a time-based threshold for waste-in-place for landfills included in the scale-up factor calculations future improvements.

EPA appreciates the comments on the industrial waste landfills methodology. The GHGRP subpart TT (industrial waste landfills) does not reflect complete coverage of all industrial waste landfills in the U.S. due to the rule's eligibility thresholds. Therefore, it is expected that the inventory estimates will be larger than the GHGRP estimates. EPA does <u>not</u> use a scale-up factor in the industrial waste landfills methodology. EPA compared the pulp and paper estimates from the inventory to facilities reporting to subpart TT with a related NAICS code and found the emissions to be relatively consistent, indicating that the inventory methodology for the pulp and paper sector is reasonable. The same cannot be said for the industrial food and beverage sector estimates, where the inventory estimates are significantly larger than facilities reporting to subpart TT with a related NAICS code. EPA is aware of recently published data sources on excess food that is landfilled and will continue investigating methodological revisions for future improvements.

EPA thanks the reviewers for their comments on the DOC and k emission factors applied in the inventory methodology. As the commenters note, EPA has evaluated revisions to the DOC and k values. These revisions are identified as a planned improvement to the GHGRP. Until these revisions are promulgated, EPA will retain consistency in the emission factors applied between the inventory and GHGRP.

EPA acknowledges the comments on the use of the 10% oxidation factor for the 1990-2004 portion of the time series and a larger average oxidation factor for the latter half of the time series. Using the 10% oxidation factor is in-line with the IPCC 2006 Guidelines. The oxidation factor revisions implemented under the GHGRP subpart HH were based on peer-reviewed studies largely conducted in

the latter half of the time series. The other oxidation factors (i.e., 0%, 25%, and 35%) are allowable for facilities choosing to calculate their methane flux and many HH facilities continue using the 10% oxidation factor under subpart HH. Because the 10% oxidation factor is the recommended factor by the IPCC, EPA shall continue using this oxidation for the early portion of the time series at this time.

Commenter: Waste Combustion Industry

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0021

Comment 36: Review of proposed updates to waste incineration estimates

The industry representatives expressed concern with the EPA use of the Facts and Figures data to determine overall and fossil carbon content of waste combusted. The industry felt the plastics content in particular as determined by the Facts and Figures data was too high compared to actual quantities and percent of plastics and other fossil components of waste combusted. The industry pointed to measured stack level emissions data as reported under the EPA Greenhouse Gas Reporting Program (GHGRP) that indicated the total amount of CO2 and the fossil / biogenic CO2 mix of the emissions from waste combustion was lower than the EPA proposed values.

Response: Based on review and discussions with industry representatives it was agreed that the proposed approach could lead to an overestimate of fossil carbon content of waste combusted. Therefore, the approach used in the current Inventory report reverted to the existing methodology used in past calculations. Future, proposed improvements to the current CO_2 emissions estimation methodology will build off the work done for the proposed approach and include the calculation of an overall carbon content for MSW incinerated. GHGRP and EIA both provide emissions information for CO_2, which could allow EPA to calculate an overall carbon content of MSW incinerated and apply this to MSW mass flows. Further research is required to compare the carbon contents of MSW incinerated from GHGRP and EIA.

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0005

Edward Tedtmann, MCP

Comment 37: Omission of sugarcane burning

Omitting sugarcane burning can be interpreted as Preferential Treatment to the sugarcane industry. Ignoring the GHG emissions from the annual burning of over 400,000 acres of sugarcane fields in Florida, allows the EPA to ignore the Environmental Racism perpetuated by this toxic practice.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0020

Fred Brockman

Comment 38: Sugar cane burning not included

The following references Jessica McCarty's article in Journal of the Air & Waste Management Association, January 2011, Remote Sensing-Based Estimates of Annual and Seasonal Emissions from Crop Residue Burning in the Contiguous United States.
http://bit.ly/2pqESX4

1. Sugar cane burning in FL is a major contributor to U.S. Greenhouse Gas Emissions and also of Particulate Matter.

2. Yet it is not included in the Inventory of U.S. Greenhouse Gas Emissions and Sinks while smaller similar crops such as sugar beets are.

3. This preferential treatment of the sugar industry goes beyond generous crop subsidies. They are allowed to inflict pollution on poor local communities while either stopping or harvesting without burning (green harvesting) when the prevailing wind would blow smoke toward wealthy communities such as Wellington. https://en.wikipedia.org/wiki/Wellington,_Florida This is standard practice and codified into Florida Dept of Forestry burning regulations. This is also environmental racism.

4. The sugar industry has consistently denied that there is ever ANY problem with air pollution in the entirety of Palm Beach County. Yet every single resident knows we have what is called black snow. Soot and ash falling from the sky miles downwind from burning sugar cane fields. It covers cars and laundry out on the line. Homes need to be pressure washed annually to clean the debris off. It sifts into cracks and crannies allowing mold and mildew to flourish during the wet summers.

5. This visible ash is accompanied by invisible 10 and 2.5 micron particulate matter which are known carcinogens. Asthma is epidemic in the Glades especially in children. Doctors consistently tell their patients the cure is to move away from the smoke. Yet this is not an option for most residents who are low income and tied to local jobs often within the sugar industry.

6. The COVID-19 pandemic made an initial mark in Europe in the Po Valley of Italy which is noted as having some of the worst air pollution in Europe. Medical research has since revealed that air pollution greatly increases susceptibility to the virus.
Exploring the Link Between Pollution and COVID-19 Mortality
https://www.thecrimson.com/article/2020/11/6/hsph-pollution-covid-19-link/
Yet neither the Florida EPA or Dept of Agriculture & Consumer Affairs [and Forestry] did nothing to protect local Belle Glade, Pahokee, Canal Point and their rural neighbors from smoke during this pandemic.

7. Why? Money from the sugar industry is infused throughout local, regional, state and national political organizations. Republicans may be mainlining but Democrats are not immune. More money spreads through religious and non-profit organizations. It is sweet, easy to get used to and makes people blind to reality of people suffering.

So why should sugar cane field burning be included in the Inventory? To shine a bright light of unbiased scientific investigation on this situation so that propaganda completely devoid of truth can be replaced by repeatable solid facts.

PS: The industry will plead that going to green harvesting will bankrupt them and cause the loss of thousands of jobs. Yet in 2008 US Sugar was negotiating to sell half of their land holdings to the State of Florida for Everglades Restoration. At that time they stated that green harvesting on the remaining fields and recycling the matter that would otherwise burn would result in a net gain of jobs.

Response: ***EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).***

Commenter: Private Citizen

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0006

Ron Saff, M.D.

Comment 39: Omission of sugarcane burning

I urge the USEPA to rectify the failure to reference and include sugarcane burning in Chapter 5.7 Field Burning of Agricultural Residues. Please include the greenhouse gas emissions from pre-harvest sugarcane field burning in the final report. Leaving them out of the report would constitute a dereliction of duty.

A greenhouse gas is a greenhouse gas. It should make no difference if the gas is emitted from burning other agricultural products, a coal plant or sugar cane burning. Greenhouse gas emissions cause myriad health impacts, and as a physician

I am deeply concerned about the multitude of health problems that my patients can experience. Here in Florida, the sugarcane industry has contributed to the campaigns of numerous politicians, and thus have exempted themselves from numerous regulations. This is not fair.

Your job as stated in your mission statement of the EPA is to protect human health and the environment. Please do your job and include sugarcane burning emissions in your final report.

Response: ***EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).***

Other Comments

EPA received 2 additional anonymous technical public comments as part of the public review of the draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019. The comments can be found on the public docket and is copied below.

Commenter: Anonymous

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0007

Comment 40: Emissions from burning of sugarcane

I urge the USEPA to rectify the failure to reference and include sugarcane burning in Chapter 5.7 Field Burning of Agricultural Residues. Please include the greenhouse gas emissions from pre-harvest sugarcane field burning in the final report. This is of utmost concern to those of us residing in communities affected by sugarcane burning, such as western Palm Beach County.

Response: EPA appreciates the comment. As noted in Chapter 5.7 Field Burning of Agricultural Residues (CRF Source Category 3F) and Annex 5, there are areas of sugarcane burning in the U.S. that are not captured in the sample of locations that were used in the remote sensing analysis used to calculate emissions. EPA will review the provided references/data, as well as other available activity data for the U.S., and notes that this is a planned improvement to include emissions from field burning of sugar cane across U.S. states and territories in future inventory reports (see page 5-59).

Commenter: Anonymous

EPA Docket ID No.: EPA-HQ-OAR-2021-0008-0009

Comment 41: Readability of inventory document

The summary that you gave for this particular notice manages to summarize a 700+ page (opened on Preview on a Mac) in one paragraph? This is the reason that people don't trust the government and make accusations that people bury evil in paperwork. Ultimately, I think there is a better way to present this in a way that is easily read by the general population. If you're asking to "improving the overall quality of the inventory" I would suggest making it readable at a 6th grade level, take out any contractions (most research papers don't use them).

Response: EPA appreciates the Anonymous comment and will consider improving the readability of the report chapters with future improvements. Note, EPA does publish a succinct Data Highlights publication with the final report to explain findings found here: https://www.epa.gov/sites/production/files/2021-04/documents/us-ghg-inventory-1990-2019-data-highlights.pdf). The commenter can also use the GHG Inventory Data Explorer to view current emissions and trends found here: https://cfpub.epa.gov/ghgdata/inventoryexplorer. The methodological detail within the sectoral chapters is included to ensure technical experts can understand the methods and data used to compile the estimates and adhere to the UNFCCC reporting guidelines as explained in Box ES-1 of the report. EPA refers the commenter to the Federal Register for further information on notices. The purpose and scope of a Federal Register's Notice is to make the public aware of the availability of the draft report for review and comment.

Appendix

Appendix A. Solid Waste Working Group's Attachment of previously submitted comments

The Solid Waste working group also provided comments that were previously submitted for earlier years of the U.S. GHG inventory. These comments are provided below. Responses to these comments were provided in Summary of Public Review Comments and Responses: Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018 (comment numbers 15, 17, 18, and 20), EPA Docket ID No.: EPA-HQ-OAR-2019-0706-0005 found here: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2018.

Degradable Organic Carbon (DOC)

We are pleased that EPA has evaluated stakeholder input regarding DOC and k values, and is developing an analysis to update default values for both DOC and k in its Greenhouse Gas Reporting Program (GHGRP) that then would be applied to the emissions estimates for MSW landfills in the GHG Inventory data for years 2005 to the present. We previously submitted comments recognizing that the default DOC value used in the GHGRP does not reflect recent trends in the composition of waste disposed in MSW landfills. Notably, in 2019, the Environmental Research and Education Foundation (EREF) published a white paper updating the DOC values for MSW landfills and revised its DOC estimate in 2020 with additional technical data to further substantiate representative DOC values for MSW. We encourage EPA to account for this recent data in its planned improvements to the GHGRP Subpart HH methodology to present more accurate emissions data from MSW landfills in the 2005 and later years of the GHG Inventory. We also offer our expertise in assisting EPA in preparing the anticipated multivariate analysis that attempts to optimize DOC and k values across our sector.

We also are encouraged by EPA's efforts to identify potential improvements to the DOC and k values for MSW landfills in the GHG Inventory for years 1990 to 2004. EREF has assembled a comprehensive list of waste characterization studies, including those evaluated by EPA, for this Inventory time series. EREF used the reliable data from those studies to reevaluate the DOC values for the years 1990 onward and in February 2020 provided EPA with its new findings to supplement EREF's 2016 white paper and its January 2019 updates. The additional data reinforces the need for updating the DOC values and should be used to inform EPA's process for updating the GHGRP as well as the GHG Inventory.

Chapter 7 of the GHG Inventory explains that EPA uses one DOC value of 0.20 to calculate emissions for the years 1990 through 2004. The GHGRP allows landfills to use 0.20 for bulk MSW or allows a landfill to further delineate waste streams by accounting for separate shipments of construction and demolition (C&D) waste, which uses a DOC of 0.08, and separate shipments of inert wastes, which may use a DOC of 0.0. If a landfill delineates in this way, it must use a DOC of 0.31 for its MSW volumes, which applies an artificially high DOC to MSW, and inappropriately overestimates emissions. The required DOC value of 0.31 fails to account for the significant volumes of C&D and inert wastes that are incorporated in MSW, and which cannot be separated from the MSW or accounted for distinctly, as can discrete shipments of inert wastes from industrial or C&D recycling facilities. Please let us know how we can assist the agency in providing additional data on DOC and k values for this Inventory time series.

As stated previously, in 2016, EREF undertook a state-based study of DOC values for both landfills receiving only MSW (MSW Only Landfills) and for Non-MSW Material going to MSW Landfills. EREF updated the 2016 paper in January 2019 and February 2020 with additional information based on new waste characterization information. The DOC guideline recommended by EPA for MSW Only Landfills is 0.31 and the recommended guideline for bulk material (combined MSW, C&D and inert waste streams) going to MSW landfills is 0.20. EREF concluded both of these guidelines over-estimate the amount of organic waste deposited in landfills, which results in inaccurate estimates of landfill gas generation and methane emissions. Furthermore, neither of the EPA-recommended DOC values have been reviewed in many years. It is time EPA update the DOC values for MSW and Bulk waste and we believe that the most valuable focus would be to reassess the DOC values incorporated in the GHGRP used for inventory years 2005 forward.

EREF reviewed 17 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. Since EPA cites the EREF research as a rationale for reassessing DOC values for 1990-2004, the following quotes from EREF clearly suggest that the data strongly suggest reevaluating DOC values used in the GHGRP for years 2005 and later:

> 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 3; 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 0.160 in 2015 (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.[17]

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, MSW Landfills rarely accept MSW exclusively. Rather, most MSW Landfills (landfills in 45 states) are authorized to accept other Subtitle D wastes in addition to MSW,"[18] and often times non-MSW materials comprise a significant percentage of MSW landfills. In addition, EREF notes:

[17] The Environmental Research & Education Foundation (2019). Analysis of Waste Streams Entering MSW Landfills: Estimating DOC Values & the Impact of Non-MSW Materials., pp 8 – 9. Retrieved from www.erefdn.org

[18] Ibid., p. 10.

> Given that a third of incoming waste to MSW Landfills 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 MSW Landfill waste stream.[19]
>
> 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 MSW Landfills (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 DOCSubDvalue of landfilled waste is 0.167 (Table 7).[20]

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 0.191 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 8, 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.[21]

Thus, EREF concludes as follows:

> The average computed DOC value for MSW using state data was 0.191, or roughly three-fifths of the MSW guideline value. The average computed DOC value for bulk waste using state data was 0.167, 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.[22]

Based on this review of the DOC values for MSW landfills, the waste sector concludes that the long-standing DOC values developed in the past over-estimate both landfill gas generation and methane emissions. The data provided by EREF confirms that two trends are driving the changes in waste composition at MSW Landfills. First, many MSW landfills are handling less organic matter now, and we anticipate this trend will continue due to state and local organics diversion goals. Second, the increase of Subtitle D non-MSW waste disposed of in MSW landfills has altered the DOC for all waste deposited in MSW Landfills. EPA validates these trends in the GHG Inventory's Chapter 6 discussion of carbon sequestration of harvested wood products, yard waste and food waste, as Table 6-85 shows a significant reduction in sequestered carbon since 1990 due to reduced volumes of organic wastes disposed in 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 past 20 years. The values now in use

[19] Ibid., p. 11.
[20] Ibid., p. 13.
[21] Ibid., p. 14.
[22] Ibid., p. 15.

are inaccurate and should not be used going forward. We recommend that EPA review and update the DOC values for the entire 1990-2018 time series of the GHG Inventory and prioritize updates of the DOC values used in calculating GHG emissions under Subpart HH of the GHGRP.

Methane Oxidation Factor

Our previous years' comments on methane oxidation factor used for the 1990 to 2004 Inventory time series remain unchanged and are repeated below. EPA calculates a national estimate of methane generation and emissions using a combination of secondary data sources that detail the annual quantity of waste landfilled and the annual quantity of methane recovered from facilities with landfill gas collection and control systems. EPA applies a 10% oxidation factor to all facilities for the years 1990 to 2004. This 10 percent default factor contrasts significantly with the average methane oxidation factor of 19.5 percent applied through use of GHGRP data, to the later years of the time series (2005 to 2018). Importantly, the 19.5 percent average oxidation rate incorporated in the GHGRP, subpart HH, emissions data is premised on a more detailed and up-to-date estimation approach than is the default value of 10 percent. It is also a conservative average value, as the GHGRP methodology restricted the maximum oxidation rate to 35 percent.

In its work to review and revise the method for calculating methane oxidation under subpart HH of the GHGRP, EPA acknowledged the need to update the default 10 percent oxidation value. The default value was based on only one field study, at a landfill without gas collection and control, and did not reflect the much higher oxidation values found in numerous subsequent, peer-reviewed field studies. Given the plethora of scientific studies showing methane oxidation to be several times higher than the EPA and IPCC default value,[23] we strongly recommend EPA apply a revised value (perhaps the average oxidation value from the GHGRP) to the earlier years of the time series.

The k Factor (Methane Generation Rate Constant)

As discussed above, we are encouraged that EPA is evaluating stakeholder input on k value for both the 1990 to 2004 Inventory series and for 2005 to the present. We also are pleased that EPA is investigating k values for different climate types against new data and other landfill gas models, as well as assessing the uncertainty factor applied to these k values in the Waste Model, and we offer our support to EPA in collecting and evaluating this information. As noted in previous years' submissions, the waste sector is 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 CH4 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.[24]

[23] Solid Waste Industry for Climate Solutions, 2.2 Methane Oxidation Addendum 2012, November 19, 2012.

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

The waste sector has previously highlighted the significant issues with the k values used in the *Draft AP-42 Section 2.4: Municipal Solid Waste Landfills*. In fact, EPA has never finalized AP-42 for MSW landfills, despite the k-value issues identified by EPA in both AP-42 and the Background Information Document. With uncertainties in CH4 emissions ranging from -30% to 400% under EPA's assessment of the LandGEM model, it is difficult to rely on these data. For this reason, we support EPA's plan to review and resolve the significant problems in the k value data set. However, we also suggest that the agency review L0 value. Although an independent variable, L0 should be considered in conjunction with k value modifications because it is related to fitting the curve, where the results will be dependent on the assumptions used for the L0/DOC.

Chapter 6: Land Use, Land-Use Change, and Forestry - Carbon Stocks

In Chapter 6: Land Use, Land-Use Change, and Forestry of the GHG Inventory, carbon stocks from yard trimming and food scrap in landfills are discussed starting on page 6-136. The carbon stocks are calculated according to Equation 1 on page 6-139. However, Equation 1 reduces the persistent carbon by the carbon content twice, effectively reducing the carbon storage value. Rather than the formula shown, it should be:

$$LFC = W \times (1-MC) \times ICC \times \{CS + (1-CS) \times e^{-k(t-n)}\}$$