

Summary of the Stakeholder Workshop on EPA GHG Data on Petroleum and Natural Gas Systems- Held November 19, 2015 in Pittsburgh, PA

On November 19, 2015 the EPA held a stakeholder workshop on greenhouse gas emissions data from petroleum and natural gas systems, with a focus on the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (GHG Inventory). At the workshop, the EPA presented options under consideration for updating the GHG Inventory, based on review of recent publications of emissions studies and Greenhouse Gas Reporting Program (GHGRP) data. Stakeholders also presented information on recently published studies and upcoming data and analyses related to the GHG Inventory emission estimates. Each session of the workshop focused on specific industry segments from the GHG Inventory. This summary report follows the workshop program and is organized as follows:

- 1.0 Background on the GHG Inventory and GHGRP
- 2.0 Distribution Segment
- 3.0 Transmission and Storage Segment
- 4.0 Processing and G&B Segments
- 5.0 Onshore Production Segment
- 6.0 Upcoming Studies and Other Analyses
- 7.0 Closing Remarks

The workshop agenda and presentations are available on the EPA website:
<http://www3.epa.gov/climatechange/ghgemissions/Nov2015Workshop.html>.

1.0 Background on the GHG Inventory and GHGRP

The EPA opened the workshop with a brief introduction of the GHG Inventory. The EPA stated that in the most recent GHG Inventory, petroleum and natural gas systems emit about 29 percent of total U.S. CH₄ emissions, based on year 2013 data. The EPA also noted that in the GHG Inventory, emissions are calculated at the national scale for most industry segments, but at a regional level for onshore natural gas production. The EPA also generally discussed the criteria that are considered when evaluating new data for the GHG Inventory: representativeness (data on controls, practices, and other relevant information); relevant activity data (AD); the ability to develop emission factors (EF) and AD for the time series; a robust and transparent sampling approach and measurement method; and key background data. It was noted that incorporating new data requires information or assumptions on activities from 1990-2014 to properly apply to EF and AD. Responding to a stakeholder question, the EPA stated that current GHG Inventory emission calculations use Gas STAR data by subtracting the reported Gas STAR reductions from calculated emissions for certain emission sources.

Overview information on GHGRP's subpart W (40 CFR Part 98, Petroleum and Natural Gas Systems) was presented by the EPA. The EPA stated that substantial new subpart W data are available this year, due to the reporting of previously deferred data elements with the 2014 annual reports, and that the new data available through the reporting of this deferred data will be emphasized throughout the workshop. GHGRP data is published in FLIGHT and Envirofacts, and presented on a data highlights page that provides overview information for this sector. The EPA also emphasized that the GHG Inventory presents total national emissions and trends over time (beginning in 1990), while GHGRP provides facility-specific data for facilities above the applicable reporting threshold.

2.0 Distribution Segment

The EPA started the distribution segment session by presenting GHGRP subpart W data. The EPA noted that a subpart W distribution “facility” is defined by its service territory. For reporting year (RY) 2014, 181 facilities reported with total reported GHG emissions of approximately 15 MMT CO₂e, including over 14 MMT CO₂e of methane. Newly reported (previously deferred) data elements for distribution facilities include:

- Leak factor for a meter/regulator run
- Miles of distribution mains, by material
- Miles of distribution services, by material

Responding to a stakeholder question, the EPA noted that GHGRP subpart W does not consider pipes with specific coatings as separate categories of materials; however, “protected steel” and “unprotected steel” are reported as separate categories of materials for the distribution segment.

The EPA then presented GHG Inventory data for the distribution segment, noting the segment emits 33.3 MMT CO₂e of CH₄, which accounts for 21 percent of natural gas systems emissions. The EPA reviewed recent studies and data (Lamb et al., Clearstone, GTI, and AGA’s *Gas Facts*) and subpart W data for GHG Inventory AD and EF improvements for the following emission sources: M&R stations, pipeline leaks, customer meters, PRVs, pipeline blowdowns, and mishaps/dig-ins. The EPA stated they were considering the following revisions for AD:

- M&R station counts: use subpart W data, assuming 84 percent of stations report to subpart W
- Customer meters: use *Gas Facts* data
- Blowdowns and mishaps: use PHMSA total miles of mains and services

The EPA stated they were considering the following revisions for EFs:

- M&R stations: use of linear interpolation from GRI EFs in early years to Lamb et al. EFs in recent years
- Pipeline leaks: use of linear interpolation from GRI EFs in early years to Lamb et al. EFs in recent years
- Customer meters: multiple options under consideration, including using data from GTI, Clearstone, and GRI/EPA
- Blowdowns/mishaps: use of GRI/EPA with Lamb et al. data

One stakeholder, who was involved with the Lamb et al. emissions study, commented that some of the same stations that were measured for the 1996 GRI/EPA report were also measured by Lamb et al. and emissions were lower. Another stakeholder commented they would survey industry association members to determine when certain changes were made that would impact emissions rates from this segment.

Two stakeholders (MJ Bradley & Associates and the American Gas Association (AGA)) presented on the Lamb et al. study, with both emphasizing their preference for using Lamb et al. data in the GHG Inventory. The presenters noted that Lamb et al. analyses were much more robust, included a larger sample pool, an advanced statistical analysis, an improved measurement methodology, and incorporated superemitters. They also noted that because Lamb et al. data were collected in the past few years, they are more representative of current operations. Tables comparing the current GHG

Inventory distribution segment EFs to those from the Lamb et al. study were provided. The presenters recommended changes for M&R stations and distribution mains (pipeline leaks). For distribution mains, their recommendations included an activity factor that is based on the number of leaks, rather than miles of pipe.

Stakeholders discussed the segregation of vintage plastic versus modern plastic pipe. The EPA commented that specific AD would be needed in order to include this type of revision. Certain stakeholders stated interest in providing such data.

Stakeholders discussed the use of the number of leaks versus miles of pipe for pipeline leaks. Certain stakeholders noted that leak data is reported to a variety of local authorities and should be available. It was also noted that equivalent leaks, used in the current GHG Inventory methodology, considers leaks that are not identified and reported as this was incorporated into the development of the emission factors used in the current GHG Inventory.

3.0 Transmission and Storage Segment

The EPA presented GHGRP subpart W data from the relevant transmission and storage segments. In subpart W, “transmission and storage” includes four separate reporting segments: transmission compressor stations, underground natural gas storage, liquefied natural gas (LNG) storage, and LNG import-export equipment. For RY 2014, 520 transmission compressor stations and 53 underground natural gas storage facilities reported, with total combined reported GHG emissions from these two segments of approximately 24 MMT CO₂e, including approximately 5 MMT CO₂e of methane. The largest methane sources were reciprocating and centrifugal compressors, pneumatic controllers, blowdowns, and equipment leaks. Newly reported (previously deferred) data elements for transmission and storage facilities include:

- Count of pneumatic controllers by type (high, low, intermittent)
- Hours spent in each compressor mode
- Compressor reported leakage emission factors by vent type (wet seals, blowdown vents, and isolation valves)

The EPA also noted that reporting for transmission pipelines will begin for RY 2016.

The EPA presented GHG Inventory data for the transmission and storage segment. The segment emits 54.5 MMT CO₂e of methane, which is approximately 35 percent of total natural gas system methane emissions. The EPA stated that the presentation would focus on only emissions from transmission and storage compressor stations, reciprocating and centrifugal compressors, and pneumatic controllers for GHG Inventory methodology improvements. The EPA reviewed recent studies and data (Subramanian et al., Zimmerle et al., FERC, and EIA) and subpart W data for GHG Inventory AD and EF improvements. The EPA stated they were considering the following revisions for AD:

- Transmission stations: use of Zimmerle et al. data for AD and EF
- Storage stations: use of EIA storage data for AD and Zimmerle data for EF
- Centrifugal and reciprocating compressors: use of Zimmerle et al. data for EF and compressor counts, and the distribution of wet and dry centrifugal compressors from subpart W
- Pneumatic controllers: use of Zimmerle et al. data or use GHGRP subpart W data for the number of controllers per station, potentially GHGRP data for EF and fraction of high, low, and intermittent bleed controllers.

R. Subramanian presented an overview of the Subramanian et al. study, discussing the measurement methods and resulting emissions, and providing figures from the report that compare emissions to the GHGRP and GHG Inventory. Dr. Subramanian also noted that better quantification of superemitters was necessary.

Dan Zimmerle presented an overview of the Zimmerle et al. study, including the model inputs (emissions and activity data). Mr. Zimmerle compared emissions and activity data from the study to those used for the GHG Inventory, for year 2012. One stakeholder asked Mr. Zimmerle for any observations of the duration of superemitters; Mr. Zimmerle noted they simply have a snapshot of superemitters. However, for purposes of their study, Zimmerle et al. assumed that all observed data were characteristic of the industry.

Stakeholders and the EPA continued with discussion of superemitters, including how the data could be incorporated into the GHG Inventory. One stakeholder stated that with substantial subpart W data, superemitters may be able to be identified. This stakeholder also suggested the frequency of superemitters is decreasing due to repairs. Another stakeholder suggested that certain superemitters may be reported under blowdown vent stack emissions.

4.0 Processing and Gathering and Boosting (G&B) Segments

The EPA presented GHGRP subpart W processing segment data. For RY 2014, 464 natural gas processing facilities had a GHG emissions total of 59 MMT CO₂e, including over 3 MMT CO₂e of methane. Newly reported (previously deferred) data elements for processing facilities include:

- Acid gas recovery (AGR) unit throughput
- Feed natural gas flow rate for certain dehydrators
- Operating time for certain dehydrators
- Hours spent in each compressor mode
- Compressor leakage emission factors by vent type (wet seals, blowdown vents, and isolation valves)

The EPA stated that reporting for the gathering and boosting (G&B) segment will begin in RY 2016.

The EPA discussed in general terms the GHG Inventory processing segment, including the current methodologies. The EPA stated they will be evaluating data from subpart W and the Marchese et al. report for improvements to AD and/or EFs.

The EPA discussed in general terms G&B emissions for the GHG Inventory. The EPA emphasized that G&B is integrated with well pad activities in the production segment of the GHG Inventory. Therefore, certain sources in the GHG Inventory can be identified as G&B related, while other sources cannot be easily distinguished between production and G&B. The EPA stated they will be evaluating data from the Marchese et al. report for improvements to AD and/or EFs.

AECOM presented data for processing facilities, focusing on emissions data. AECOM calculated an equipment leak EF using GHGRP subpart W data (tons CH₄/plant) and compared this to the GHG Inventory; the GHG Inventory EF was much higher. AECOM also compared compressor EFs between the

GHG Inventory and GHGRP subpart W; again, the GHG Inventory EF was substantially higher. AECOM continued that the subpart W EFs are better and should be incorporated into the GHG Inventory.

Anthony Marchese presented data from the Marchese et al. study. This study evaluated both processing facilities and G&B facilities. The Marchese et al. study used data from tracer flux measurements to estimate facility level emissions; emissions for specific components were not evaluated. Dr. Marchese stated that substantial superemitter emissions were observed. The Marchese et al. study calculated national emissions using Monte Carlo simulations and estimated that G&B emissions were significantly underestimated in the GHG Inventory, while processing emissions were overestimated in the GHG Inventory.

5.0 Petroleum and Natural Gas Production Segments

The production segment discussion started with the EPA presenting GHGRP subpart W data for onshore petroleum and natural gas production. The EPA discussed the unique “facility” definition for the onshore petroleum and natural gas production segment, which is at a basin level. For RY 2014, the total reported onshore production GHG emissions was approximately 103 MMT CO₂e, including 48 MMT CO₂e of methane. Newly reported (previously deferred) data elements for onshore production facilities include:

- Count of pneumatic pumps and pneumatic controllers by type (high, low, intermittent)
- Count of each type of major equipment
- Flow rate of backflow during completions and workovers that use hydraulic fracturing
- Number of days of backflow during completions and workovers the use hydraulic fracturing
- Count of compressors

The EPA then presented GHG Inventory data for the production segment; emissions account for approximately 39 percent of petroleum and natural gas systems methane emissions. The EPA focused on subpart W activity data, and discussed subpart W scale-up considerations. The EPA discussed a simple scale-up approach, based on the number of wells reported to subpart W versus the total national well count in the GHG Inventory. The EPA then compared the scaled-up AD for certain production emission sources to the current GHG Inventory AD. The EPA also noted that other sources are under consideration for EF revisions.

AECOM provided two presentations, for liquids unloading and pneumatic controllers at production sites. AECOM compared liquids unloading emissions per well from the GHG Inventory versus subpart W versus an API/ANGA study. AECOM noted further analysis is required for this source. The default pneumatic controller EFs used in the GHG Inventory and subpart W were compared, and differences noted. AECOM stated that both the GHG Inventory and subpart W use outdated EFs, and that new EF data are available and should be considered. New pneumatic controller EF data are available in EDF/UT phase 1 and phase 2 studies.

Mark Omara presented results of a study that measured well pad emissions in 3 basins (Marcellus, DJ, and Uintah basins). Dr. Omara discussed study measurement techniques, the sites measured, and how they were selected. Preliminary results from the tracer flux measurements were then presented; there were differences in the emissions data when comparing between basins. Dr. Omara stated the study paper is currently under review, and will be published in the future.

6.0 Upcoming Studies and Other Analyses

NREL presented the recommendations from a report that reviewed the natural gas systems sector of the GHG Inventory. NREL discussed top-down versus bottom-up studies and stated that top-down studies can be used to verify GHG Inventory emissions while bottom-up studies can be used to update EFs. NREL stated that new studies need to have robust methods and quantify uncertainty, and that enhanced coordination amongst studies would help. NREL recommended that GHG Inventory AD be improved with new data sources to improve accuracy. NREL noted there are certain gaps in the current GHG Inventory, including abandoned wells, gathering pipelines, “after the meter” leaks at site of end use, and well workovers that are not recompletions. NREL also suggested the GHG Inventory structure could be improved, such as the grouping of G&B and production, and recommended future studies to review the structure.

EDF gave a presentation on their Barnett shale measurement campaign that included different measurement methodologies and approaches: top-down region-level emissions, facility-level emissions, and component-level emissions. EDF stated that each method does result in different emissions and a chart comparing the emissions was presented. The component-level estimate resulted in the lowest emissions, and superemitters may explain some of the differences.

The EPA presented the methodology for the CAP/HAP national emission inventory (NEI). The EPA noted the NEI estimates emissions for similar sources as the GHG Inventory, but the NEI is developed every three years. States, local agencies, and tribes are required to submit criteria pollutant data, but HAP data is submitted voluntarily. When these emissions are not reported, the EPA fills in data gaps. The EPA stated the 2008 nonpoint emissions in the NEI were severely lacking data, and as a result the EPA developed an oil and gas emission estimation tool. The oil and gas emission estimation tool provides EFs that are specific to process and county.

WESTAR presented a case study that estimated NEI criteria pollutant emissions for the San Juan Basin, focusing on the use of subpart W data. WESTAR discussed how they previously provided detailed surveys for oil and gas companies to complete, but have minimized this task due to the reporting requirements of subpart W. The subpart W reporting now provides data for more than 70 percent of the operators in the San Juan basin. WESTAR stated they also review permit data to help estimate criteria pollutant emissions.

7.0 Closing Remarks

The EPA closed the workshop with a brief discussion of future steps for the GHG Inventory. The EPA stated that memoranda will be released for each GHG Inventory segment that discusses the proposed revisions to EFs and AD. Each memorandum will contain stakeholder questions that the EPA requests feedback on. Feedback should be submitted via email (ghginventory@epa.gov). The EPA stated the goal is to include EF and AD revisions in the upcoming 2016 GHG Inventory.

The EPA noted the GHGRP RY 2015 draft reporting forms are out for review. The EPA suggested that a webinar or implementation session may be held to address the recent subpart W revisions and asked that questions on those revisions be submitted via email (ghgreporting@epa.gov).