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Oil and Gas Inventory Analysis

Project Understanding

Accurate O&G emission inventories are imperative to the development of effective greenhouse gas control programs and for effective air quality planning. In recent years there have been numerous efforts to develop and refine O&G inventories at national, state and local levels. EPA recently released the Draft Information Collection Request for the Oil and Natural Gas Industry[1] (ICR) which is part of EPA's effort to gather additional data necessary for developing regulations to reduce emissions from existing oil and gas sources. In this letter of proposal, we discuss criteria air pollutant (CAP) and greenhouse gas (GHG) emission inventories. The GHG and CAP inventory sources are essentially the same, though with differing emission source contributions, and thus it is essential that the CAP and GHG inventory efforts take advantage of synergies and become more integrated over time. This proposal describes methods to evaluate both national CAP and GHG emissions inventory efforts in order to understand the most important data gaps in O&G inventory efforts which could benefit from additional data gathering efforts.

Oil and gas emission sources are typically divided into nonpoint and point sources. Upstream well sites are generally considered nonpoint sources (though well-site sources in certain states are inventoried as point sources) while midstream gathering and treating facilities (e.g. compressor stations and gas plants) are considered point sources. For nonpoint sources, representative process-specific inputs across numerous well sites are generally used to estimate emissions by source category. For point sources, companies estimate facility level emissions which are submitted to the permitting authority.

Recent studies have shown (e.g. Lyon et al. 2015) that current O&G emission inventories may underestimate actual O&G emissions and that the role of "fat-tail" sources (i.e. sources that statistically represent a substantial fraction of emissions, but a small fraction of the emitting source population) is prominent in these differences. While a national inventory cannot query operators for data to describe the prevalence or distribution of fat-tails, accurate equipment and event counts are critical to developing an inventory that can be adapted to the evolving science and emission rates associated with O&G emission inventory development.

Volatile organic compounds (VOCs) and methane emissions from vent and leak sources are typically estimated based on a total volume of gas vented/leaked and the fraction of VOCs or methane in the released gas. The fraction of VOCs or methane in a gas stream should be estimated based on a measured gas composition that is representative of the emissions gas stream. The US Environmental Protection Agency's (EPA) Greenhouse Gas Reporting Protocol (GHGRP) Subpart W[2] requires oil and gas operators that meet reporting criteria to report their GHG emissions annually. Subpart W reporting includes reporting of methane fractions that are used to estimate methane emissions based on operator specific composition measurements. In nonpoint source CAP emission inventories, the gas compositions used to estimate VOC emissions are based on inventory specific considerations; in many cases applied gas compositions are estimated by basin and well type rather than by operator and well type as is the case in the GHGRP. To accurately estimate VOC and methane emissions the gas compositions used in current inventories need to be evaluated and additional gas composition data is likely needed to enhance inventory accuracy.

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[1] https://www3.epa.gov/airquality/oilandgas/methane.html
[2] https://www.epa.gov/ghgreporting/subpart-w-petroleum-and-natural-gas-systems

Technical Approach

As part of this work we would assess the available national O&G inventory input sources, how each source is assembled, and analyze the input sources. Task 1 is an evaluation of the 2014 national inventory with the purpose of enhancing understanding of the data available in the national inventory, its representativeness, and completeness and prioritizing national data needs. Task 2 would add detailed basin-level analyses to provide further insight into O&G inventory inputs and emissions for the chosen basins. Based on our analysis, we would make prioritized recommendations of which input data sources could be improved to enhance inventory accuracy.

Task 1. National Inventory Analysis

This task would focus on developing analyses of point source and nonpoint source oil and gas emissions inventories and emission inventory inputs to characterize and prioritize potential data gaps and would be completed in two subtasks. In the first subtask (1a) we would provide an analysis of data already available from EPA efforts that could fulfil parts of the data requested in EPA's draft ICR. In the second subtask (1b) we would assess the completeness, representativeness, and key gaps in the 2014 National Emission Inventory (NEI) O&G inventory.

Point Source Assessment

A national O&G CAP emission inventory is compiled under the National Emission Inventory (NEI) Program[3] on a triennial basis. NEI point source emissions are based on what state/local/tribal agencies (S/L/T) provide to EPA. Point sources meeting Title V permitting thresholds are included across the nation; however, Title V emission thresholds are too high to capture all O&G point sources (small to medium compressor stations are the primary omission candidates). For O&G point sources with emissions under Title V thresholds, inclusion in the NEI is dependent on whether a facility's emissions were reported to the NEI by S/L/T's. There is a potential for data gaps based on S/L/T permitting levels. Such data gaps present a challenge to developing accurate emission inventories and to characterizing the regulated level of existing point sources.

For the point source inventory assessment, we would perform the following analyses by subtask:

Subtask A
1. Determine which O&G source types are counted as point sources in the 2014 NEI. If it is found that the O&G source type assignments vary by state, we would focus our efforts on a limited number of states.
2. Assess the extent of data available in the NEI and/or Subpart W to inform an analysis of the level of control for existing point sources. We would focus our efforts on a limited number of states on the basis of which we would attempt to draw general conclusions about the extent of information available to characterize existing source control.

Subtask B
3. Identify the O&G point source emissions by state and compare state-level point source emissions magnitude to gas production magnitude.
4. Determine the applicable point source reporting thresholds, for a limited number of states.
5. For a limited number of inventory inputs, analyse methodology for developing projection forecasts with respect to emission control assumptions.

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[3] https://www.epa.gov/air-emissions-inventories/national-emissions-inventory

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Based on the above analysis, we expect to be able to assess the potential for missing sources in the NEI and information available to characterize control of existing point sources.

Nonpoint Source Assessment

Nonpoint emissions in the NEI are a combination of S/L/T submissions and EPA O&G Emission Estimation Tool (O&G Tool) estimates. The O&G Tool includes GHG emission estimates, but lacks complete local process level input data. S/L/T's that provide their own emissions presumably use local inputs, however, the extent of the reporting of GHG emissions as part of the NEI is unknown. Given the individual submissions provided by the states and the varied process level input data sources in the O&G Tool, characterizing the level of control of existing sources may be difficult. In this analysis we will begin by examining the EPA O&G Tool that includes the most recent state submitted updates.

The proposed nonpoint source inventory assessment would include an evaluation of the data in the NEI, an evaluation of the O&G Tool, and recommendations for prioritized data needs by subtask based on the steps listed below.

Subtask A
1. Determine which source types are counted as nonpoint sources in the NEI and compare reporting by source type in the O&G Tool with Subpart W reporting, leveraging previous analyses conducted by EPA staff. If it is found that the O&G nonpoint source assignments vary by state, we would focus our efforts on a limited number of states.
2. Determine the basis of emissions by state in the NEI (S/L/T and/or O&G Tool).
3. Determine through analysis of O&G production data from IHS Enerdeq which major companies are not being inventoried by S/L/T's; this analysis will be performed for a limited number of states for which emissions are based on the O&G Tool.

Subtask B
4. For a limited number of states, evaluate the O&G Tool inputs to determine whether generalized emission rates and input parameters are being used, both of which increase uncertainty in O&G Tool emission estimates.
5. For a limited number of states, evaluate oil and gas well type definitions in Subpart W, NSPS Subpart OOOO, and state oil and gas commission reporting. Well type definition affects the suite of equipment and emissions estimated at well-sites.
6. For a limited number of states, perform limited reality checks on O&G Tool inputs for key input parameters (e.g. emission factors, speciation profiles). Since methane emissions from O&G sources are an important and evolving regulatory consideration, we would specifically look at the source of gas composition data used to derive methane emissions in the O&G Tool.
7. Compare HPDI O&G activity data included in the O&G Tool for a limited number of states (e.g. Texas and Kansas) to O&G commission and/or IHS Enerdeq estimates to understand differences in oil and gas activity levels estimated in these datasets.
8. Assess the quality of the Subpart W data already incorporated into the tool and make recommendations about whether additional Subpart W data could be incorporated into the tool.
9. For a limited number of inventory inputs, analyse methodology for developing projection forecasts with respect to emission control assumptions.

Based on the analysis described above, we expect to be able to make assessments of the quality of key input data included in the O&G Tool and reporting consistency between Subpart W and the NEI. We will

recommend prioritized data needs and include discussion of the extent to which existing source control can be characterized based on the reported data.

Deliverables

Two technical memoranda would be prepared, each documenting the results of a subtask . The subtask 1a memo would identify data already collected by EPA that could fulfil the ICR and would include a summary spreadsheet documenting existing data sources by emissions category. The subtask 1b memo would discuss the completeness, representativeness, and key gaps in the 2014 NEI O&G inventory and include a summary spreadsheet documenting key inputs to the 2014 NEI and rate them with respect to completeness and representativeness, and assign priority to inventory input improvements; a listing of the "top 10" emission rates that should be improved would be provided.

Task 2. Regional Analysis

For the regional analysis we would perform detailed assessments of well-site and point source emissions data at the basin level for a limited number of basins. The analysis would be supported by state agency personnel who would provide input on oil and gas emission data sources, point source data sets, and other support as needed/feasible.

- Wyoming (Green River or other basin)
- New Mexico (San Juan or other basin)
- Oklahoma (Anadarko or other basin)
- Pennsylvania or West Virginia (Appalachian or other basin)
- Ohio (Utica or other basin)

Point Source Assessment

The point source inventory assessment subtasks would be performed for each state as follows:

1. Compare how the suite of facilities included in the NEI as point sources compare to GHGRP Subpart W reported facilities.
2. Based on the point source permitting thresholds, analyze the potential for missing point sources.
3. Work with state agency personnel to determine the data available to characterize the extent of control for existing point sources.
4. Work with state agency personnel to determine the data available to characterize methane emissions from point sources.

Based on the analysis described above, we expect to be able to assess reporting consistency between Subpart W and the NEI and assess the extent of the potential for missing sources. For each basin we will discuss the completeness of the data available in the NEI, data available to characterize methane emissions, and data available to characterize the extent of control for existing point sources.

Nonpoint Source Assessment

The proposed basin-level nonpoint source inventory assessment would include a detailed evaluation of the data in the NEI, an evaluation of the EPA O&G Tool, and recommendations for prioritized data needs based on the steps listed below.

1. Compare S/L/T emissions to emissions generated with the O&G Tool by source category. This will help to inform the uncertainty in emissions associated with area sources using the O&G Tool.
2. Compare O&G Tool GHG emissions to Subpart W GHG emissions, focusing on the most important GHG sources. This will help to inform consistency between the O&G Tool and Subpart W emissions estimates. Based on such comparisons, we may be able to understand more about the effect of missing operators in Subpart W given the 25,000 metric tonne CO_2e reporting threshold and the effects of different inputs in the two inventories.
3. Evaluate the O&G Tool inputs to determine whether default emission rates and input parameters are being used for key emission rates and input parameters (including gas compositions) rather than basin-specific estimates.

Based on the analysis described above, for each basin we expect to be able to make assessments of the quality of key input data included in the O&G Tool and reporting consistency between Subpart W and the NEI. For each basin, we would prepare a summary spreadsheet comparing by source category emissions estimated in the Tool versus those available from S/L/T data and would note the source of the Tool emission rates and assign a quality rating.

Deliverables

Technical memorandum documenting the results of the Task 2 analysis including a detailed by basin assessment of potential missing point sources, potential improvements to area sources including prioritization of the importance of source categories for which generalized emission rates are in use and a prioritized listing of the emission rates that should be improved. We would also include a summary spreadsheet for each basin documenting emissions and emission rates as described above.

Optional Task 3. Analysis of Modeling Platform Inputs

Tasks 1 and 2 focus on analysis of emission inventories and the methods and data upon which emissions are estimated. The emission inventories must be spatially allocated, temporally allocated, speciated, etc. to develop air quality model-ready emission files. The process of converting flat emission inventory files to model-ready files requires another set of assumptions that are rolled into EPA's modeling platforms[4]. If desired, Ramboll Environ can perform additional analyses of modeling platform data (e.g. speciation profiles, spatial allocations) to evaluate potential improvements to these data.

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[4] https://www.epa.gov/air-emissions-modeling