Gaps in Knowledge for Quantifying Methane Emissions

Presentation to

The National Academies of Sciences, Engineering, and Medicine's Study Cmte on

Anthropogenic Methane Emissions in the United States

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Disclaimer

This presentation is simply based upon the limited experience and opinion of the author.

My goal is merely to open a discussion for the NAS Methane Committee members, not to state an indisputable end-point.

This is not the official position of AECOM, and does not represent the position of any of our clients.

Quick History of O&G Industry CH4

- **Estimates have been made for 25+ years for Oil & Gas industry methane emission inventories**
  - 1990 amendments to the CAA require EPA to provide to Congress anthropogenic methane emission in the U.S. Start of the GHGI.
  - GRI/EPA original Gas Industry report 1996 (1992 basis)
  - EPA National Inventory is the US Benchmark
    - Uses simple AF*EF model, “Bottom-Up” method source by source
    - Characterizations must make reasonable assumptions based on limited field measurements and other larger AF data sets
    - Some new reported data available from the EPA GHGRP since 2010 (but using EPA protocol, and not always based on measurements)
  - Additional field research has exploded in the last 5 years
    - Targets: sector updates and sources expected to be significant

Results in Past 5 Years

New Instruments, New Approaches, New Studies

- Smart Science
- Emissions can vary by geography, company
- Some studies do not provide data useful to an inventory

New Practices

- Some voluntary measurement data, esp on LDAR upstream

Non-normal distributions often encountered

- Requires careful extrapolation
- Non-normal distributions aka “the Significant Minority” aka “Super Emitters”
- Operator practices and adaptation can quickly change these non-normal profiles, therefore it is important for an inventory system to be able to use the latest measured data

Gaps in Knowledge

Difficult Sources

- **Examples of well known sources:**
  - Equip leak fugitives for above ground
- **Examples of sources not very well known:**
  - Abandoned wells
  - Compressor Exhaust
  - Sources downstream of customer meters
- **Examples of Intermittent Sources**
  - Some Pneumatics
  - Sources that emit through Atm Tanks (stuck dump valves, gas blankets, well venting)
- **Sources Difficult to measure, so other approaches have been used**
  - Flares (98% combustion assumed, but see recent Bakken study)
  - Tank Flash (Model, but errors can persist with bad data: i.e. Noble CD)
  - AGR's and Dehy's (model)

Gaps in Knowledge for Quantifying Methane Emissions

Very little continuous data, so assumptions are made

- Extremely Expensive to measure everything, all the time
- Initiatives to lower the price and improve continuous monitoring technologies are aspirational, and have not yet delivered cost-effective approaches

What is measured in a limited field sample is often assumed to represent emissions for the rest of the year

- This is accurate when the source is well understood, and the measurements are limited to known aspects of the source (example: compressor OEL line leakage in different operating modes).
- This can be inaccurate if the source is not well characterized
  - Characterization is especially difficult at macro scales

Macro Level Data used as a check

- **Top-Down (or Downwind) studies at various scales**
  - Advantages:
    - Useful as check of bottom up approach (can ID issues with sources ignored or improperly characterized in bottom up)
    - Not solely useful for an inventory, as actions/mitigation usually require more details on sources
  - Disadvantages:
    - Atmospheric limitations may limit number of measurements (few total measurements)
    - Source attribution issues and assumptions
    - Temporal changes

- **Drive by or fly by data can be useless without characterization and ground operations data**
  - For example: These macro methods overpredict where there are temporally limited emissions (example: daytime well unloadings, daytime equipment maintenance)

- **Work Reconciling Bottom Up and Top Down is important**

Macro Level Data used as a check

- Examples of Fly By, Drive By Issues:
  - EDF helicopter flyover survey in 2015 ID'd wellsite sources visible to a FLIR GF320, ***but has no idea of emission rate nor cause nor duration***
  - Many vehicle based Picarro drive by surveys show plots of elevated concentration with location, ***but do not determine emission rate, emission location, cause nor duration***

Quantification Challenges: What Measurement Tools do we have?

- **Available techniques for finding equipment leaks and quantifying them** (OGI Cameras, HiFlow)
  - OGI good only for screening
  - Need to replace the discontinued HiFlow Sampler, and add reliability
- **Lots of R&D measurement approaches**
  - These are often expensive, and only sometimes commercially deployed
- **No "plug and play" commercially available simple devices for measuring large emission sources** like tanks, flares, elevated vents.
  - These often require one-off and expensive measurement plans.
  - Where is this an issue?: Bottom Up Measurement plans or Screening plans that can quantify the small sources but ironically are unable to quantify the largest sources found.
  - Attempts: Providence qOGI Q100, OTM 33A
- **No "plug and play" commercially available simple devices** for measuring discontinuous sources like pneumatics, CIPs