GAP Rulemaking in regard to Methane Emissions

comments by Tad Anderson, PhD[1], Oct 29, 2020

About me: I am a retired Atmospheric Scientist with expertise in the general area of climate forcing and the global energy balance. During my 25 year career, mostly at the University of Washington, my research focused on climatic forcing by anthropogenic aerosol particles.

The role of methane in addressing global warming: Like carbon dioxide (CO2), methane is a powerful greenhouse gas that has increased dramatically over the industrial era. At present, methane represents about 30% of the total climate forcing due to long-lived greenhouse gases[2]. In sharp contrast to CO2, methane has a relatively short atmospheric lifetime of about 10 years. This means that the atmospheric concentration of methane responds relatively rapidly to a change in methane emissions. For this reason, methane represents one of the most powerful climate-control knobs we have on the 20-year time frame.

Is the 20-year time frame important? In the long term, reducing CO2 emissions is the most important way to minimize the dangers of global warming, since CO2 constitutes the dominant anthropogenic climate forcing[3]. However, this is necessarily a slow process. Because of its long atmospheric lifetime, it takes decades-to-centuries for reduced CO2 emissions to translate into reduced climate forcing. Meanwhile, global temperatures are rapidly approaching what many scientists consider to be irreversible "tipping points"[4]. If those analyses are correct, then preserving the long-term habitability of our planet may hinge on our ability over the next few decades to slow the current rate of global warming. Because of its short atmospheric lifetime, methane represents one of the best tools we have for doing that.

How does this affect GAP Rulemaking? To estimate the climate impact of a project involving emissions of both methane and CO2, the two must be put on a common basis. Specifically, methane emissions are converted to "equivalent CO2 emissions" using a factor called the Global Warming Potential (GWP). However, the value of GWP depends strongly on the time frame being considered. Current values of GWP are 28 and 84 for the 100-year and 20-year time frames, respectively[5]. The Governor's directive requires that the GAP Rule incorporate both time frames, but that leaves open the question of which one will be given priority in project evaluation. The importance of slowing global warming over the next few decades provides a strong argument for giving priority to the 20-year time frame.

How and why are methane concentrations changing at present? After leveling off from about 2000 to 2007, the atmospheric concentration of methane has been rapidly increasing, almost certainly due to human activity[6]. The main anthropogenic sources of methane are agriculture (livestock and rice cultivation), waste management (landfills and wastewater), and fugitive emissions from fossil-fuel extraction and delivery (i.e. methane leaks). Each of these sources is difficult to quantify, although great progress is being made using a combination of laboratory, ground-based, airborne, and satellite measurements combined with isotopic tracers and increasingly sophisticated modeling. A recent study by an international team of leading methane researchers estimates that

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1. I live in Seattle and can be reached by email at tadand99@gmail.com.
2. The exact value is 32% based on Table SPM.5 of IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, available at: https://www.ipcc.ch/report/ar5/wg1/. Specifically, forcings by long-lived GHGs are 1.68 for CO2, 0.97 for CH4 (methane), 0.18 for Halocarbons, and 0.17 for N2O, yielding a total of 3.00, all in units of W/m2.
3. 56% according to the IPCC numbers cited above.
4. See the recent review by T.M. Lenton et al. (2019): "Climate tipping points - too risky to bet against," Nature, 575, p. 592-595, available at: https://media.nature.com/original/magazine-assets/d41586-019-03595-0/d41586-019-03595-0.pdf
5. See Chapter 8, Table 8.7, p.714 of Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, available at: https://www.ipcc.ch/report/ar5/wg1/.
6. Turner, A. J, Frankenberg, C. and Kort, E. A. (2019): Interpreting contemporary trends in atmospheric methane, Proc. Natl. Acad. Sci.,116, 2805-2813, available at: https://www.pnas.org/content/pnas/116/8/2805.full.pdf

agriculture was the largest anthropogenic source of methane over the past decade (about 50%), followed by fossil fuels (about 25%) and waste management (about 20%)[7]. This same paper finds that "oil/gas emissions in the US and Canada are underestimated [by about 20%] relative to the values reported by these countries".

Fossil-fuel methane emissions come from leakage: Refined natural gas is more than 90% methane and is valuable both as a clean-burning fuel (relative to gas, diesel, or coal) and a chemical feedstock. Neither of these end uses emit significant amounts of methane to the atmosphere. (Burning natural gas mostly emits CO2.) Rather, methane emissions from the natural gas industry occur upstream of its intended uses, as "fugitive emissions" (i.e. leakage) during the extraction, refining, storage, and delivery of the product. Similarly, there are large fugitive emissions of methane associated with both oil extraction and coal mining because methane gas is often present in the same geological formations. Quantifying and controlling this leakage is an active area of research by scientists and engineers alike. Arguably the best current estimate of the leakage rate associated with oil and gas production in the US is 2.3%[8], a number that is highly significant from a climate perspective and about 60% higher than official estimates by the US Environmental Protection Agency.

Leakage rate is the master variable for understanding methane emissions: Good policy requires good communication, yet existing reports on methane emissions are difficult to understand due to a bewildering array of terms and units. Although imperfect in some ways, the concept of leakage rate cuts through all this. Its definition is easy to understand - the amount of methane leaked to the atmosphere per unit of natural gas delivered to the end user, expressed in percent. For the industry, it is a valuable metric that can be tracked over time and compared from one company or industrial practice to another. For policymakers and the public, it allows projects to be easily evaluated and compared in terms of both methane emissions (the leakage rate times the amount of natural gas product) and equivalent carbon emissions (the methane emissions times methane's Global Warming Potential). Moreover, leakage rate is the key variable for comparing natural gas to other fossil fuels in terms of climate impact. (For example, at a leakage rate of about 4%, natural gas has the same climate impact as coal when evaluated on a 20-year time frame[9].)

Recommendations for GAP Rulemaking:

1. All projects involving natural gas should be required to clearly state the methane leakage rate used in their emission estimates as well as the scientific basis for that rate.

2. Ecology needs to have a plan for assuring the accuracy of the methane leakage rate used by proposing entities. Given the scientific complexities and uncertainties surrounding this quantity, Ecology should hire an independent scientist with expertise in this area to help craft the rules for assuring this accuracy. [Note: I am definitely not that person, but I could help with recommendations.]

3. In general, proposing entities should be required to use a conservative (i.e. worst case) leakage rate to provide high confidence to the public that the actual leakage rate is not greater than the value assumed. However, lower leakage rates should be permitted to the degree that the proposing entity can demonstrate that these are based on rigorous and independent measurements, with strict third-party verification. This is important to encourage best-practices and leakage reduction by the industry.

4. While it is worthwhile to examine methane in terms of both its 20-year and 100-year global warming potential, priority should be given to the 20-year value. This stems from the critical need to slow the rate of global warming over the next few decades (to avoid tipping points) and the fact that methane reductions are one of humanity's best tools for achieving this (due to its short atmospheric lifetime).

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7. Lu et al. (2020), "Global methane budget and trend, 2010-2017," Atmos. Chem. Phys. Discuss., preprint, available at: https://doi.org/10.5194/acp-2020-775. See Table 1.
8. Alvarez RA, et al. (2018): "Assessment of methane emissions from the U.S. oil and gas supply chain," Science, 361, 186–188., available at: https://science.sciencemag.org/content/sci/361/6398/186.full.pdf.
9. see Fig 2c of Alvarez, RA, et al. (2012): "Greater focus needed on methane leakage from natural gas infrastructure," Proc. Natl. Acad. Sci.,109, 6435–6440, available at: https://www.pnas.org/content/pnas/109/17/6435.full.pdf