SCAQMD NEAT Working Group #3

Lifecycle Natural Gas Leakage Quantification Recommendation
20 February 2018

Thank you for the opportunity to comment on the Net Emissions Analysis Tool. Provided below is background research and resources to help inform lifecycle emissions quantification for natural gas use within the Tool. The recommendations given in this letter are the result of methane leakage research from natural gas systems conducted in partnership with the City of Oakland and City of San Francisco and observed by local governments throughout North America. After conducting this research, it is clear that natural gas is not a recommended fuel source for end-use appliances nor electricity generation.

One step SCAQMD can take through the Net Emissions Analysis Tool to better represent and promote mitigation of emissions is to quantify lifecycle emissions of all energy sources, including from methane leaks along the natural gas system within the Tool. This letter outlines the best available science to quantify natural gas lifecycle leakage rate specific to California end-users. **The lifecycle rate of leakage was determined to be 5.1% for California end-users;** the process by which this was found is outlined in this letter.

Fugitive Methane Emissions

Natural gas has long been touted as an environmentally-friendly bridge fuel for the United States as it transitions to renewable sources. However, increasing natural gas infrastructure and end-use appliances economically locks the state into using the fossil fuel for decades to come and delays the widespread integration of renewable infrastructure. Additionally, as research catches up to changing industry practices, this "bridge-fuel" idea is found to be dependent on a certain threshold of fuel leakage along the lifecycle of the product. For comparison, unless leakage rates for natural gas can be kept below 2%, substituting coal with gas is not an effective long-term method for reducing climate change.[1]

Natural gas is comprised of 70-90% methane (CH_4), which is an extremely potent climate pollutant. On a 20-year time frame, methane warms the planet 86 times more effectively than carbon dioxide (termed the gas's "global warming potential").[2] Besides having a high global warming potential, methane in the atmosphere also effects the ability of the atmosphere to oxidize other pollutants,[3] increases water formation in the stratosphere which leads to additional surface temperature warming and decrease in stratospheric ozone,[4] and also contributes to the formation of low-level smog.[5]

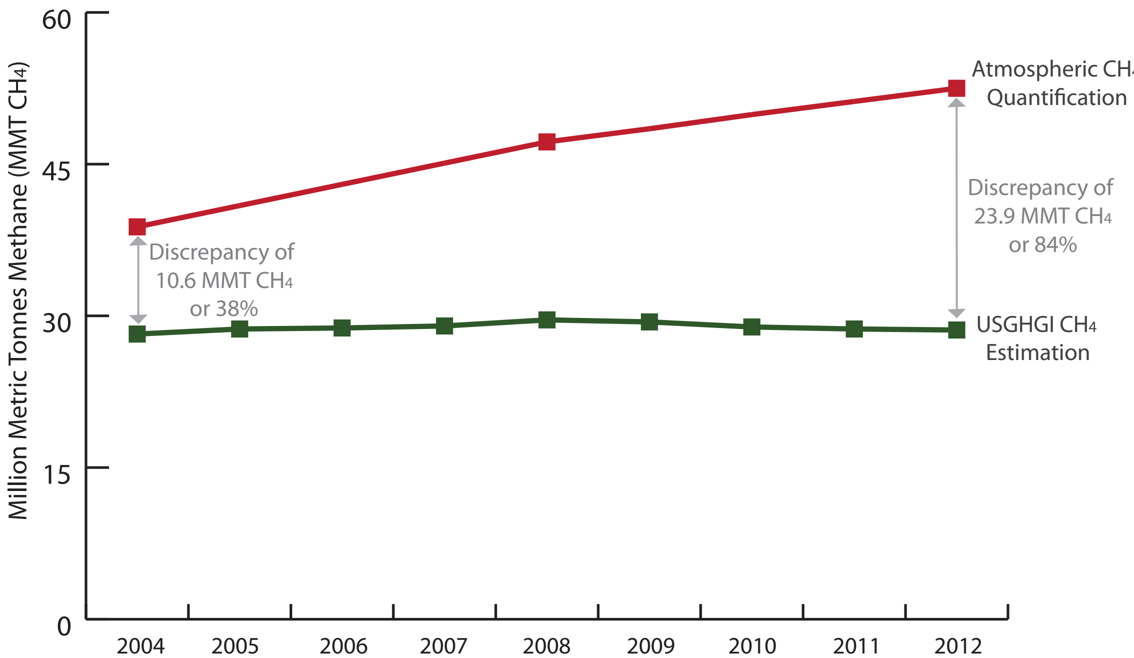
In the current state of the climate, global action now dictates whether the world will see "dangerous", "catastrophic", or "existential" threats due to climate change.[6] Not only will California continue feel those impacts economically and socially by means of drought, sea-level rise, and water scarcity, but other impacts such as health impacts due to high heat and humidity in desert regions, increased vector-borne diseases, impacts to food security will also increase,[7] and impacts will likely be felt at an accelerated pace.[8] California needs to act now not only to protect the State, but also to act as a leader for the world to drastically reduce emissions.

Background: National Studies and Emission Factors

There is growing consensus that current methods for quantifying methane emissions are outdated. Emission factors from the pre-fracking era are still used in national and sub-national greenhouse gas inventories, which grossly underestimate the climate impacts of methane leakage. Until a series of disputed updates in 2013, emission factors were based off of data from 1996, the pre-fracking era.[9] In 2011 the EPA updated certain portions of the emission factor calculation to reflect changes in industry practice from the advent of hydraulic fracturing. By 2013, the American Petroleum Institute and the American Natural Gas Association called for emission factors to be cut approximately in half.[10][11] This re-analysis has been heavily criticized by the Inspector General of the EPA.[12] Additionally, the Inspector General of the EPA rates about half of the EPAs emission factors “below average” or are unrated as they are based on insufficient or low-quality data, and stated that the limited or lack of data could adversely affect decision-making and negatively impact both human health and the environment.[13] Although the SCAQMD may want to use emission factors approved by other government agencies, applying the EPA’s analysis would be a mistake and impact the credibility of the NEAT tool.

This lack of understanding and accuracy in emission factor estimations led to a profound discrepancy between our atmosphere and our greenhouse gas inventories, as shown in **Figure 1** below. On a national scale, atmospheric measurements have found that inventories underestimated methane emissions by 84%.[14][15] This equates to a 25% increase in total national emissions per the US Greenhouse Gas Inventory.[16]

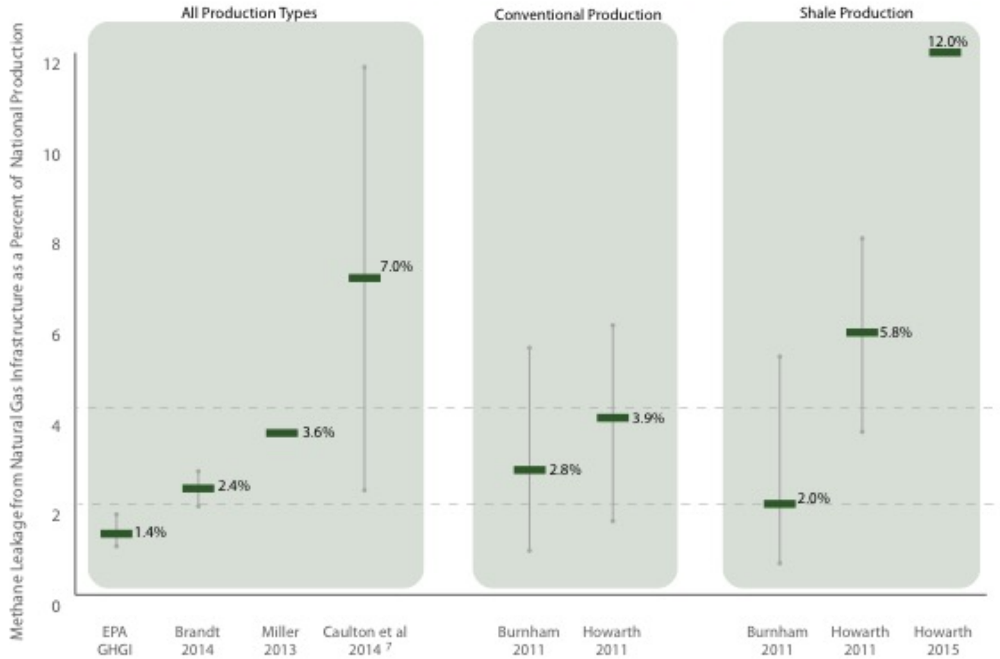
Figure 1: Atmospheric – Inventory Discrepancy



While the source of methane has been argued, NASA recently confirmed that the increase in methane emissions is linked primarily to natural gas extraction.[17] This conclusion generally agrees with changes in methane-producing industries over the same time period. Atmospheric methane (CH_4) quantification increased by 35% from the study years of 2004 to 2012[18] while natural gas production increased 30%,[19] livestock production increased 9%,[20] and compost, wastewater treatment plants, and landfill emissions decreased by 2%.[21]

The U.S. Environmental Protection Agency estimates leak rates of methane from natural gas along the lifecycle of the gas to be approximately 1.4%, recent scientific studies using a variety of techniques including air campaigns, literature reviews, bottom-up studies, and mass-balance approaches have estimated leak rates on a national scale to be between 2.0 – 12% as shown in **Figure 2** on the following page.[22][23][24][25][26][27][28][29][30]

Figure 2: Natural Gas Leak Rate Studies – National Level



Federal rules to reduce methane leakage are held up in court by oil companies and do not have good prospects under the Trump Administration. The U.S. Government Accountability Office – Natural Resources and Environment, understood that this issue is vastly underestimated and, from a loss-of-royalties perspective, provided recommendations to the Department of the Interior and Bureau of Land Management to better track and prevent losses of methane during extraction of the fuel through the Methane and Waste Prevention Rule – a rule which would update the industries three decade old venting and flaring rules to better account for losses recognizing technological advances through fracking.[31] However, the Western Energy Alliance, Independent Petroleum Association of America, and the states of Wyoming, North Dakota, and Montana brought the Rule to judicial review and litigation is still pending.[32]

California-Specific Emissions Estimation

Production Leak Rates Providing for California

California gas production only supplies about 10% of State gas consumption. Several interstate pipelines bring the remaining needed natural gas into California from the Southwest, the Rocky Mountain region, Western Canada, and the Western region with the most recent pipeline addition flowing from Wyoming.[33]

This analysis brings together the most recent studies of production-zone leakage for production sites which supply California, tower measurements in California to estimate leakage from in-State production, storage, and transmission lines, as well as estimate on residential meter leakage. **Table 1** on the following page outlines the leak rates of production sites that have been studied and supply California.

Table 1: Production Zones Supplying California

Region	Study	Study Dates	Leak Rate	% of Total Production Studied
Montney Development, Canada [34]	Atherton 2017	2015	0.62%	0.01%
4-Corners Region [35]	Frankenburg (2016)	2015	3.1%	6.3%
Uintah County, Utah [36]	Karion (2013)	2012	9.0%	1.9%
4-Corners Region [37]	Kort (2014)	2004-2011	3.1%	6.3%
Barnett Shale in Texas [38]	Zavala-Araiza (2015a)	2011	1.50%	11.3%
Rocky Mountain Wells [39]	Zavala-Araiza (2015b)	2011	1.4%	0.1%
Mid-Continent Wells [40]	Zavala-Araiza (2015b)	2011	2.1%	0.9%
South-Central US - Texas, Oklahoma, Kansas [41]	Miller (2013)	2007-2008	2.1%	56.9%
Denver-Julesburg Basin Northeast Colorado (Weld County)[42]	Petron (2012)	2007-2009	4.0%	1.1%
Bakken formation (Montana, Wyoming, North Dakota) [43]	Schneising (2014)	2006-2008, 2009-2011	10.1%	3.2%
Eagle Ford formation (South Texas)[44]	Schneising (2014)	2006-2008, 2009-2012	9.1%	1.9%
Los Angeles Basin [45]	Peischl (2013)	2010	17%	3.8%
San Joaquin Valley [46]	LBNL (2016)	2014	4%	6.2%

It is recommended to use a 3.4% leak rate for out-of-state well-leaks. This is a weighted average based on the total gas produced in each basin during the study year for all U.S. wells outside of California. California well-leaks were assigned a breakdown of well-production capacity in each well during study years and assigned to 10% of the total production. Data on imports was also available from Canada, and the appropriate percentage of total production used in California was used from Canada.

Storage and Distribution Emissions in California

Due to the variability of leak potential from storage sites,[47] and the lack of a comprehensive study to analyze data from transmission and distribution lines, the more comprehensive Lawrence Berkeley National Lab (LBNL) studies are recommended to use for emissions from leakage within California. LBNL conducted a bottom-up model in 2014 and a multi-tower air pollutant study in 2016 to estimate natural gas leak emissions as well as total state-wide methane emissions with natural gas tracers for source attribution. The 2016 study verified the results of the 2014 estimate, though found that the 2014 estimate is on the lower end of the range of possible emissions attributed to natural gas systems. Regardless, emissions from the 2014 study will be used as they are more comprehensively attributed to natural gas sources by the use of trace elements and proven reliable through the 2016 multi-tower air pollutant study.[48][49]

Table 2: Leak Rates from all in-State Natural Gas Sources

Study	Leakage Rate for All In-State Sources
Associated Production [50]	4.7%
Dry Gas Production [51]	1.8%
Gathering Facilities[52]	0.7%
Processing and Storage[53]	0.1%
Transmission and Distribution [54]	0.7%
Residential Meter [55]	0.2%

Leak rates from associated production are to be used as an informational item only, as it can be easily argued that emissions from associated production would be primarily attributed to oil production. Similarly, leak rates from dry gas production is also listed as an informational item only as well-leaks have been accounted for already. To compute lifecycle leakage rates attributed to natural gas end-use, it is recommended to add leaks of 3.4% from gas wells with leaks from in-state gathering, processing, and storage facilities, transmission and distribution lines, and residential meter leaks, giving a 5.1% lifecycle leak for the use of natural gas.

Recommendation for SCAQMD:

It is recommended that SCAQMD incorporates the 5.1% percent lifecycle leak rate into the Net Emissions Analysis Tool. Further, it is recommended that SCAQMD use a global warming potential (GWP) over a timeline of 20-years for methane as to better account for the actual atmospheric lifespan of methane (12-years) and therefore real-time impact. This equates to a GWP of 86 for methane as opposed to the typically used GWP of 28 - 34 which artificially stretches the impact of methane over 100-years.[56]

As leak mitigation has been stagnated on the federal level, it is the duty of air districts within California to motivate residents to reduce emissions through demand side reductions. In order to see the potential from this sort of reduction, it is imperative that our emissions calculators incorporate upstream emissions.

Thank you for your consideration,

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Citations:

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