City of Palo Alto (ID # 11336)

Utilities Advisory Commission Staff Report

Report Type: Agenda Items **Meeting Date: 5/20/2020**

Summary Title: Accounting for Leaked Natural Gas in Palo Alto Greenhouse Gas Emissions

Title: Discussion of Accounting for Leaked Natural Gas in Palo Alto Greenhouse Gas Emissions

From: City Manager

Lead Department: Utilities

Executive Summary

Staff is transmitting a colleague's memo received by the Department from Commissioners Forssell and Segal for discussion by the full Utilities Advisory Commission (UAC). The memo is intended to prompt a discussion of natural gas emissions by the UAC. The memo advocates for reporting on emissions of production of natural gas and its transmission to Palo Alto ("upstream emissions") in addition to the emissions from combustion of that gas within Palo Alto and any leakage from Palo Alto's distribution system. It acknowledges the challenges of including this in the greenhouse gas (GHG) inventory update for the 2020 Sustainability and Climate Action Plan (S/CAP). It does recommend internal reporting of upstream natural gas emissions.

If the Council, at the UAC's recommendation, directs Utilities Department staff to begin internal reporting of upstream natural gas emissions for informational purposes, Utilities Department staff can accommodate that request. Staff would provide that report to the UAC and Council in the form of an informational report by the end of 2020 and would update the report annually going forward. Staff also recommends including the upstream emissions for gasoline as a way of assessing the full GHG impacts of the Utilities Department EV-related programs and customer activities to purchase EVs. This report would not be incorporated into the 2020 S/CAP, and any request to do so would have to involve a broader discussion with the entire City sustainability team and the City Manager.

While the memo does not advocate for inclusion of upstream emissions in the upcoming S/CAP Update, this idea has been raised by some community members, so staff has also included the following notes related to the S/CAP for background and context:

- Emissions beyond Palo Alto's boundaries are not included in the GHG inventory protocol the City uses. Using a defined protocol rather than a custom GHG inventory definition allows the City's GHG inventory to be accepted by experts and to be benchmarked against other cities. While there are other protocols that include upstream emissions, using them would require assessment of a range of other unrelated emissions sources outside Palo Alto boundaries ("Scope 3 emissions") that would

complicate the 2020 S/CAP. The City's Sustainability Team has expressed a preference not to include any additional Scope 3 emissions beyond those few already included in the City's adopted reporting protocol.

- There are budgetary and contractual considerations to incorporating upstream emissions into the City's S/CAP update. The Sustainability Team would have to evaluate the cost and time to do so given the state of the City's budget and the major workload already required by the S/CAP update.
- Some commenters on the S/CAP have stated that the inclusion of upstream emissions from natural gas will result in significant changes to activities required to meet the S/CAP 80% by 2030 goal (e.g. a much greater focus on building electrification). However, if upstream emissions are included both from production and transmission of natural gas and gasoline production and transportation, the impact on the mix of activities required to achieve the goal is likely to be less significant.
- The use of a 20-year global warming potential (GWP) may create some additional challenges when assessing upstream emissions. While the 2019 IPCC report talks about either the 20-year or 100-year GWP numbers being appropriate for GHG planning, and there does seem to be some debate in the academic world about making more use of the 20-year GWP, both the Federal Environmental Protection Agency and the California Air Resources Board use the 100-year number when they assess California's emissions. More research would be required to see whether benchmarking GHG protocols accommodate the use of either GWP number.

Attachments:

- Attachment A: Commissioner's Memo

Accounting for Leaked Natural Gas in Palo Alto Greenhouse Gas Emissions

Commissioner Memo

Lisa Forssell and Lauren Segal

For discussion at the May 20, 2020 meeting of the Utilities Advisory Commission

As the City updates the Sustainability and Climate Action Plan (S/CAP) for 2020, we submit this memo to raise awareness in the Utilities Advisory Commission and City Council of a more rigorous way for the City of Palo Alto to consider the full impact of leaked natural gas. We propose that the City consider whether to factor this into the City's internal Greenhouse Gas (GHG) accounting. We acknowledge that while the City focuses on COVID and all of the health, economic and social impacts it has brought, this is an awkward time to raise these issues. However, the revised S/CAP is moving forward and this information is important for that discussion.

Palo Alto currently takes into account fugitive emissions (leaked natural gas) from the gas distribution system within the City, but ignores upstream emissions of gas delivered to Palo Alto.[1] This is in line with the current GHG inventory the City uses and how the City evaluates its GHG reduction success relative to state and federal requirements, other utilities, and to the current S/CAP goals. However, it significantly understates the full GHG impact of using natural gas, because methane leaks from natural gas along the entire natural gas system, which includes not only distribution but also production, storage, and transmission. In fact, the majority of the fugitive emissions from leaked natural gas occur before the gas reaches Citygate for distribution.

Distribution leaks are currently estimated to be approximately 0.4% of total gas usage in Palo Alto.[2] Recent studies indicate that *upstream* leakage is probably around 2-7% of total gas usage for Bay Area cities.[3] While PG&E has certain reporting obligations for transmission system leaks[4], the point here is to identify Palo Alto's contribution to those system leaks, regardless of where the reporting obligation lies.[5]

Further, we note that the City has used a 100-year time horizon for the global warming potential (GWP) of methane in its past accounting. In this memo, we explore using a 20-year time horizon and how that would impact GHG emissions estimates. We further note estimates of global warming potential from a more recent report from the Intergovernmental Panel of Climate Change (IPCC). This change in the time horizon and the IPCC update combined would result in a revision of the Global Warming Potential value in the City's methodology from 21[6] to 86.[7]

Why it matters in Palo Alto

Palo Alto has been a leader in sustainability, including adopting a goal of reducing the City's GHG emissions 80% below 1990 levels by 2030, under the Sustainability and Climate Action Plan (S/CAP). In 2012, the City set mandates for greenhouse gas reduction far ahead of California and the country. In 2020, City Council plans to adopt an updated S/CAP.

Palo Alto uses greenhouse gas emissions estimates to measure its progress on the "80 by 30" goal. The City has been measuring GHG emissions, including fugitive methane emissions, since at least 2007 with the first Climate Protection Plan.[8] It is helpful to continue to use the same standard for comparison purposes; however, the knowledge surrounding GHG impact has expanded since the City first determined which measurements to use. The City should factor in this updated information, even if for internal purposes only. This way, the true carbon footprint due to City activities is as accurate as possible and reflects the most current science.

The Utility currently is developing the 2019 GHG inventory. We understand from the Utilities' staff that making these accounting changes would make it difficult to use some current utility protocols, which may have benchmarking implications and may add time and costs. We recognize that now is not the time to implement these changes in the City's external reporting. However, for internal purposes it is important for the City to understand and account for the full GHG impact of natural gas used.

Methane, the primary constituent of natural gas, is a potent greenhouse gas, with a global warming potential 86 times that of CO_2 when calculated at a 20 year time horizon.[9] Put another way, ton for ton, methane traps about 86 times more heat radiation than does carbon dioxide when measured over a 20-year period.[10]

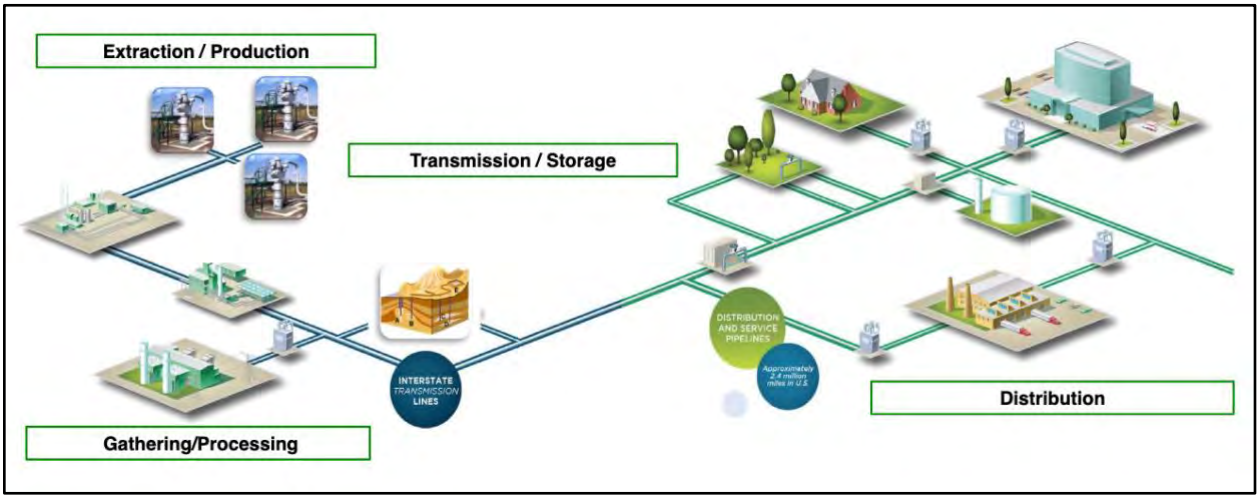

Figure 1. Illustration of the natural gas system.[11]

One important source of methane in the atmosphere comes from natural gas leakage (fugitive emissions) at every stage of the gas supply chain: extraction and production, gathering and processing, storage and transmission, and distribution. See Figure 1. above for an illustration. Studies have estimated the average leak rate of methane gas through its lifecycle (from well to fixture) ranges from 2% to 7%[12] of total gas usage in the Bay Area. The range of estimates is broad, due to the difficulty of measuring fugitive emissions and the variability of leaks across the entire system.

Palo Alto includes some of the greenhouse gas impact of methane in its GHG calculations. It does this in two ways: 1) it assumes that all the natural gas that is delivered to Citygate is combusted[13] when it purchases allowances to comply with the State's Cap and Trade Program[14]

and 2) it estimates GHG emissions from leaks in the distribution system (within the City) when it calculates its greenhouse gas inventory. An example of this GHG inventory is in the 2019 Earth Day report.[15]

A more complete measure of the GHG impact of the City's gas usage is to consider leakage along the upstream gas system, in addition to emissions from leakage within the distribution system and combusted gas within the City. This would require the City to calculate the GHG impact based on estimated fugitive emissions as the gas is delivered to Citygate, in addition to the GHG impact of natural gas used within the city.

Discussion

There are two components to a revised calculation: 1) estimating fugitive emissions from the entire natural gas system and 2) choosing a value for the global warming potential of methane. We discuss each here.

Estimating fugitive emissions

The Utility reviews the natural gas distribution system for leakage regularly and uses a 3-grade ranking system to determine when or whether to fix leaks.[16] Palo Alto has a proactive replacement program for aging distribution infrastructure that is beyond the regulatory requirements.

However, no natural gas distribution system is leak-free, and not all gas leaks are big enough to be detected. The Utilities Engineering Department calculates fugitive gas emissions using methodology from the American Gas Association (AGA), to report to the Federal Department of Transportation. This calculation uses different emissions factors, depending on the kinds of pipe and pipeline services, to arrive at an overall estimate of leaked CH_4. When this calculation was last done, in 2012, it estimated an annual leakage of 501,092 lbs. of CH_4, which equates to an overall distribution system leakage of 0.4% for 2018.[17] We have used 0.4% in this memo to illustrate some examples.

The City's natural gas consumption does not leak only in the distribution system, however. Natural gas leaks everywhere in the system, as illustrated above.[18] While it is not feasible for the Utility to directly measure fugitive emissions upstream of Palo Alto, there are many possible ways to estimate these emissions.[19] Values that could be attributed to upstream emissions range from 2% to 7%, as discussed above, and CARB provides some guidance.[20]

The change to the City's current methodology is to look at upstream emissions; these are not included in the 2019 Earth Day Report, which most recently estimated the City's GHG emissions. Below, we illustrate how the City's greenhouse gas emissions profile changes when upstream emissions are included, assuming 3% upstream leaks.

Global warming potential of methane

The other component of estimating the impact of leaked natural gas is estimating the global warming potential (GWP) of methane, the main component of natural gas. GWP is typically expressed in units of carbon dioxide equivalence, or CO_2e.

The IPCC estimates the GWP of various greenhouse gasses. It provides estimates on a 20-year and a 100-year time horizon. Because methane breaks down more quickly in the atmosphere than carbon dioxide, its 100-year GWP is less than its 20-year GWP.

The IPCC continues to update its estimates of the global warming potential of various greenhouse gasses every few years since its first Assessment report in 1990. The table below, from the Fifth Assessment Report, gives a value of 86 for the 20-year GWP of methane. The IPCC plans to release a Sixth Assessment Report in 2021.[21]

	Lifetime (years)		GWP_{20}	GWP_{100}
CH_4[b]	12.4[a]	No cc fb	84	28
		With cc fb	86	34
HFC-134a	13.4	No cc fb	3710	1300
		With cc fb	3790	1550
CFC-11	45.0	No cc fb	6900	4660
		With cc fb	7020	5350
N_2O	121.0[a]	No cc fb	264	265
		With cc fb	268	298
CF_4	50,000.0	No cc fb	4880	6630
		With cc fb	4950	7350

Figure 2. The global warming potential of various gasses at a 20- and 100-year time horizon. From the IPCC Fifth Assessment Report.[22]

Palo Alto Utilities, like many other government agencies, uses a 100-year time horizon when estimating the GWP of methane. This is appropriate when thinking about climate change as a long-term problem, which it is. However, it is also an urgent problem, and in recent years it has become clear that climate change is happening right now. Palo Alto's S/CAP goal is to reach an aggressive GHG reduction goal by 2030, ten years from now. Therefore, also considering the 20-year time horizon is appropriate.

Insights

The City of Palo Alto uses estimates of leaked natural gas from the distribution system in its annual Earth Day Report. For the 2019 report, 4,718 MT of CO_2e were estimated as emissions from the natural gas distribution system, using the AGA method of estimating fugitive emissions from 2012. It did not include any estimates of upstream emissions from production, processing, storage, or transmission.

The charts below illustrate how using the proposed methodology changes the City's estimates of greenhouse gases due to the natural gas system. The impact of the City's natural gas usage is shown to be much more significant than currently accounted for.

Figure 3a uses data from the 2019 Earth Day report.[23] In 2018, for example, combusted natural gas emitted 151,143 MT of CO_2 and was "neutralized" with the purchase of carbon offsets. Using a 100-year GWP of 21, an estimated 4,781 additional MT of CO_2e reported as leakage from the distribution system. These 4,781 MT of CO_2e are taken from a DOT report using the AGA method and amount to approximately 0.4% of gas consumed within the City.

Figure 4a uses the gas consumption and carbon offset purchase data from the 2019 Earth Day report, but estimates the natural gas system leakage including both upstream and distribution systems. For illustration purposes, it assumes 3% upstream leakage and 0.4% distribution leakage. It also uses a GWP of 86 for methane. With these assumptions, fugitive natural gas emissions for 2018 total 157,563 MT of CO_2e - significantly higher than the 4,781 MT from the Earth Day report.

As we can see comparing the two charts, regardless of whether offsets are purchased, with an assumption of 3% upstream leakage and a 20-year GWP, the emissions due to the natural gas system (combustion plus fugitive emissions) are approximately double what was previously accounted for.

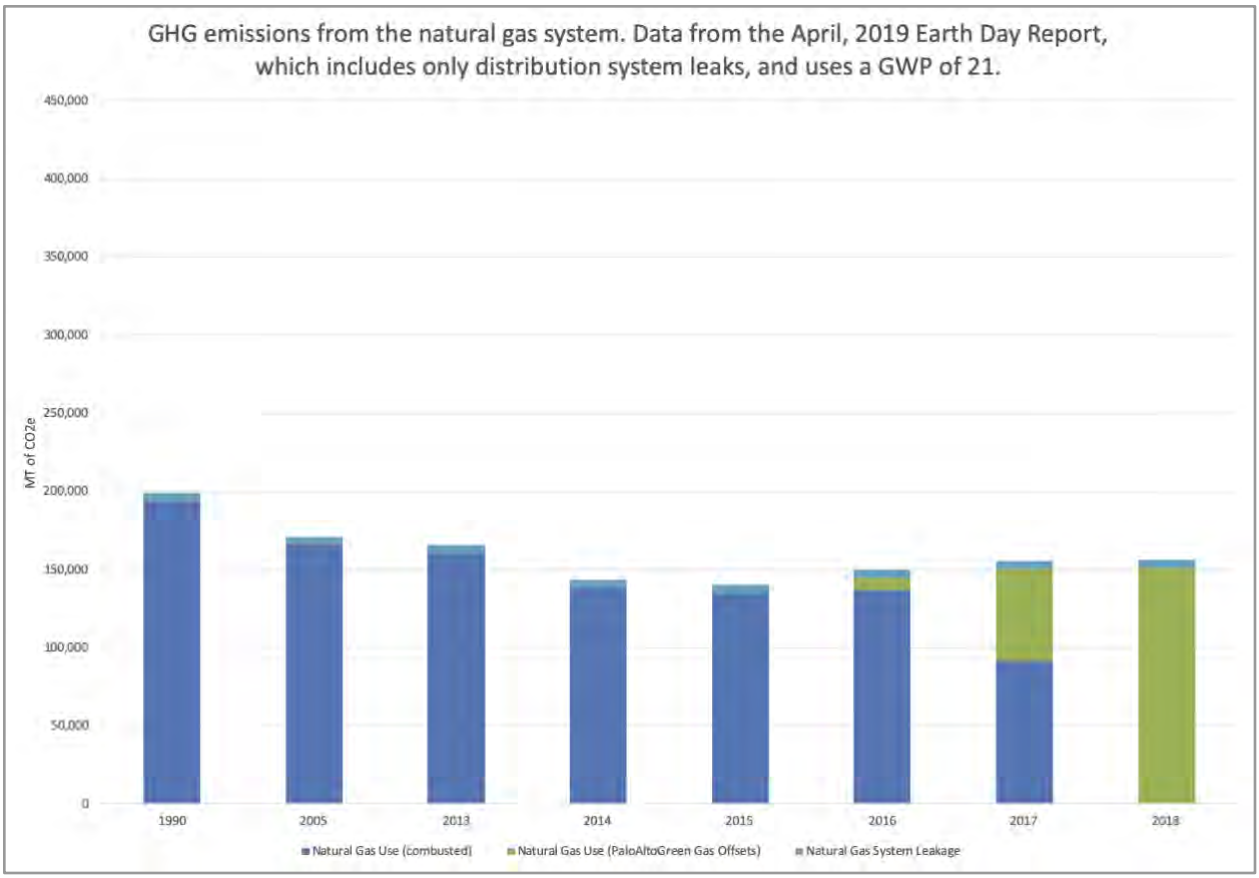

Figure 3a. GHG emissions from the natural gas system for 1990, 2005, and 2013-2018, as reported in the Earth Day Report in April 2019. This report used a GWP of 21 for methane. It accounted for natural gas distribution system leaks of 4781 MT of CO_2e (~0.4%) and did not account for upstream system leaks. Note that the City allowed customers to purchase offsets for their natural gas use starting in 2016, and switched to a City-wide "green gas" program in July of 2017. In 2018, the City purchased carbon offsets for all natural gas consumed in Palo Alto.

	1990	2005	2013	2014	2015	2016	2017	2018
Natural Gas Use (therms)	36,589,986	31,374,970	30,336,076	26,103,713	25,491,698	27,323,498	28,413,515	28,517,510
Natural Gas Use (combusted, MT of CO2e, net of offsets)	194,000	166,350	160,842	138,402	135,153	137,147	91,901	0
Natural Gas Use (PaloAltoGreen Gas Offsets, MT CO2e)						7,832	58,691	151,143
Natural Gas System Leakage (MT CO2e, AGA method, GWP=21)	4,781	4,781	4,781	4,781	4,781	4,781	4,781	4,781

Figure 3b. Data Table for Table 3a. All data from the 2019 Earth Day Report.[24]

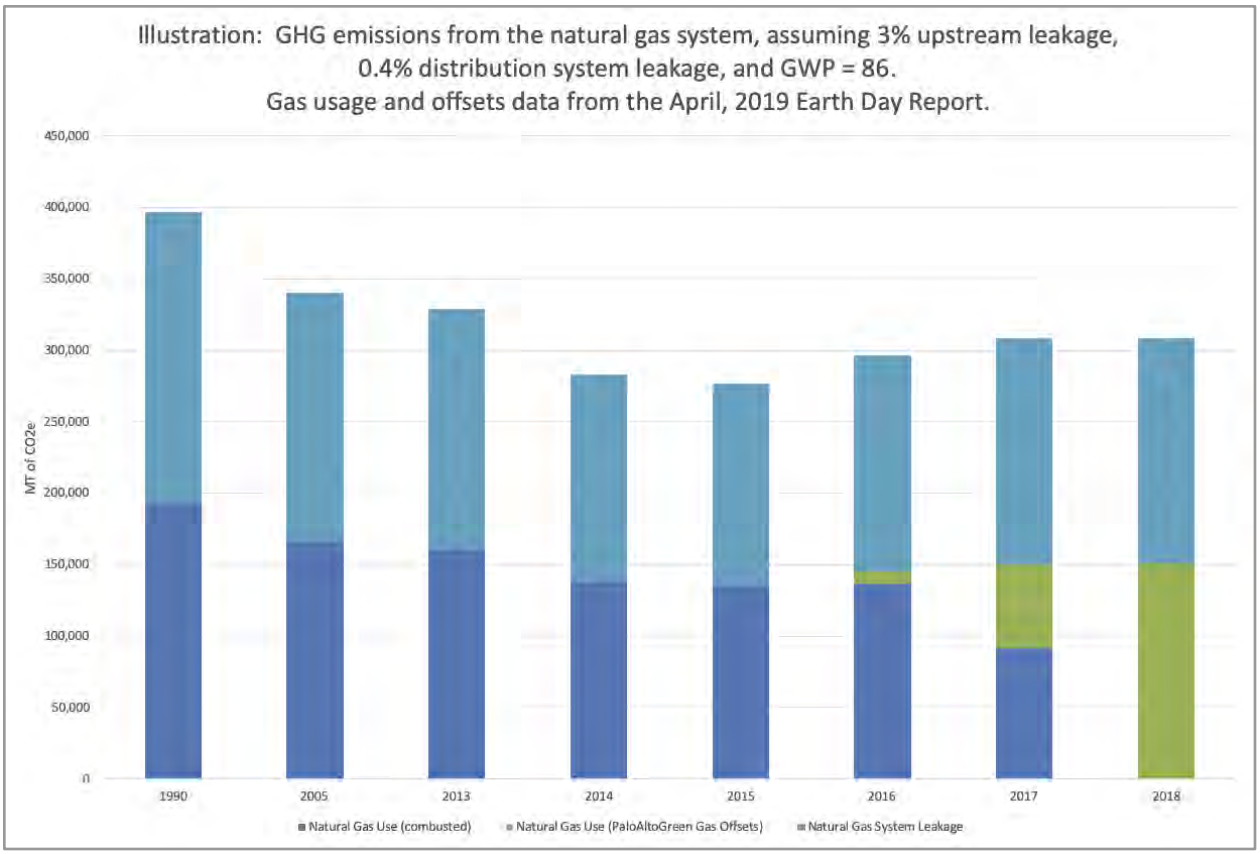

Figure 4a. Illustration of GHG emissions from the natural gas system, if an estimate of 3% upstream leakage 0.4% distribution leakage were used, along with a GWP of 86 for methane.

	1990	2005	2013	2014	2015	2016	2017	2018
Natural Gas Use (therms)	36,589,986	31,374,970	30,336,076	26,103,713	25,491,698	27,323,498	28,413,515	28,517,510
Natural Gas Use (combusted, MT of CO2e, net of offsets)	194,000	166,350	160,842	138,402	135,153	137,147	91,901	0
Natural Gas Use (PaloAltoGreen Gas Offsets, MT CO2e)						7,832	58,691	151,143
Natural Gas System Leakage (estimated 3.4% at GWP=86)	202,905	173,986	168,225	144,755	141,361	151,519	157,563	158,140

Figure 4b. Data Table for Table 4a. Natural gas use and offsets from the 2019 Earth Day Report.[25] Natural gas system leakage calculated as follows: given X therms of natural gas use, system leakage equals ((X/.97)*0.03 + X * 0.004 therms) * (4.07 lbs/therm of natural gas at 1.013 bar and 12˚C) ÷ (2205 lbs/MT) * (86 MT CO_2e/MT CH_4).

As the City moves forward with the revisions to the S/CAP, we hope this memo will provide additional insight into the true impact of natural gas usage. This proposed methodology challenges the City's ability to claim "carbon neutral natural gas,"[26] and provides a bleaker picture of Palo Alto's GHG impact. However, having more complete information will allow City Council, the Utility and customers to make better-informed choices. Providing a clearer picture of Palo Alto's GHG impact from natural gas usage can help the City Council determine the new S/CAP goals and incentivize, recommend and/or legislate the actions necessary to meet those goals.

1 City of Palo Alto Staff Report, "Earth Day Report 2019 (EDR19)", Attachment B, Page 1. https://www.cityofpaloalto.org/civicax/filebank/documents/70178

2 Staff Memorandum to the Utilities Advisory Commission, June 5, 2019. "Discussion of Natural Gas Leakage from the City of Palo Alto's Gas Distribution System." http://cityofpaloalto.org/civicax/filebank/documents/71699 (p 5 of the pdf). 501,092 lbs of leaked natural gas amounts to approximately 0.4% of the city's total gas consumption.

3 Goodfriend, Pac, and Huertas, "Methane Math: How Cities Can Rethink Emissions from Natural Gas." November 2017. Literature review on methane leaks from natural gas systems, p18.

4 PG&E-reported leakage in its entire system would include the portion of leakage attributable to Palo Alto, since the City uses PG&E's transmission system.

5 See, eg, California Air Resources Board, Regulation for the Mandatory Reporting of Greenhouse Gas Emissions, Subarticle 5, "Reporting Requirements and Calculations Methods for Petroleum and Natural Gas Systems. (pp 206-263). https://ww3.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr-2018-unofficial-2019-4-3.pdf

6 Ibid (2) - staff memo to the UAC about methane leaks.

7 "Anthropogenic and Natural Radiative Forcing," p714 Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter08_FINAL.pdf

8 Palo Alto Climate Protection Plan 12/3/2007 https://www.cityofpaloalto.org/civicax/filebank/documents/9946

9 *Ibid (7)*

10 *Id.*

11 See https://www.eia.gov/conference/2015/pdf/presentations/skone.pdf, slide 8, or https://www.aga.org/natural-gas/delivery/.

12 *Ibid (3).*

13 The Utility accounts for CH_4 combusted by customers. When CH_4 is combusted it converts to CO_2 and H_2O. The mass of the resulting CO_2 is 2.74 times that of the original CH_4. Thus 1 MT of combusted CH_4 results in 2.74 MT of CO_2.

14 Assistant Director of Resource Management, J. Abendschein (email communication May 7, 2020).

15 *Ibid (1).*

16 https://www.cityofpaloalto.org/civicax/filebank/documents/63863 Title: Approval of a 5-Year Contract With Manesco Corporation to Conduct Annual Walking and Mobile Gas Leak Surveys, Including Resurveys of Existing Leaks, for a Total Not-To-Exceed Amount of $437,710 at Table 1, p. 19.

17 Staff is currently re-calculating this leak estimate to reflect new emissions factors issued by AGA, as well as updated data reflecting infrastructure improvements such as pipeline replacements.

18 We do not address leaks at the customer site such as those from water heaters and gas stoves.

19 A discussion of the various methodologies used to measure life-cycle gas emissions is beyond the scope of this memo.

20 *Ibid (5).*

[21] "IPCC Updates Methodology for Greenhouse Gas Inventories." IPCC Newsroom Post, May 13, 2019. https://www.ipcc.ch/2019/05/13/ipcc-2019-refinement/

[22] *Ibid (7).*

[23] *Ibid (1)*

[24] *Id*.

[25] *Id*.

[26] https://www.cityofpaloalto.org/gov/depts/utl/pathway_to_sustainability/carbon_neutral/default.asp