

MEMORANDUM

TO: UTILITIES ADVISORY COMMISSION

FROM: UTILITIES DEPARTMENT

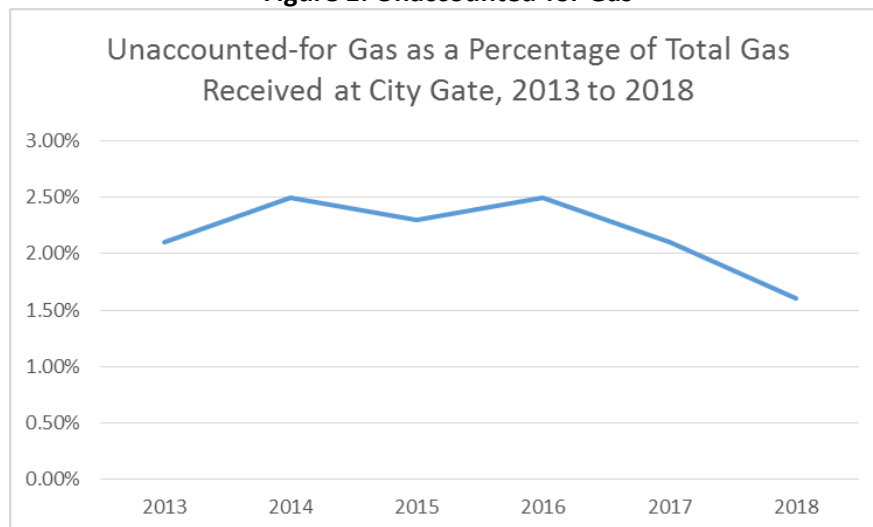
DATE: JUNE 5, 2019

SUBJECT: Discussion of Natural Gas Leakage from the City of Palo Alto’s Gas Distribution System

This report is provided to inform the discussion of the Utilities Advisory Commission about natural gas leakage from the City of Palo Alto Gas Distribution System and its impact on carbon emissions. The City currently purchases carbon offsets to mitigate the impact of natural gas use in Palo Alto on greenhouse gas emissions. The City purchases offsets based on its load as measured at the gas receiving stations at the edge of its distribution system, which means the City’s offset purchases account for all gas received within Palo Alto’s service territory if it is combusted. However, some of that natural gas is released to the atmosphere due to leakage. There is great uncertainty in the amount of gas released, and estimating it would require additional study. However, there are two data sources that may be helpful in beginning the discussion:

1. **Unaccounted-for Gas:** The City tracks “unaccounted-for gas” annually in its reports to the Federal Department of Transportation. This number is the difference between gas metered and sold to customers and gas received from PG&E’s transmission system at the edge of the City’s distribution system. Unaccounted-for gas from 2013 to 2018 was roughly 1.5% to 2.5% of total gas received (1100-1700 metric tons of natural gas each year). Unaccounted for gas is comprised of emissions to the atmosphere and metering errors. Metering errors do not represent direct natural gas emissions to the atmosphere – this gas is combusted, but escapes measurement due to meter inaccuracy. Natural gas that is emitted to the atmosphere occurs due to a variety of reasons including: system operational procedures to ensure safe operation of the system (which might involve actions that require venting some gas to the atmosphere), leaks on the system, overpressure events, and excavation damage. Staff does not know what percentage of the City’s unaccounted-for gas represents metering errors and what represents natural gas emissions to the atmosphere. This would require additional study.

Figure 1: Unaccounted-for Gas



Palo Alto bases its GHG reporting to the US EPA and the California Air Resources Board on the amount of gas received at its receiving stations, not the amount sold. Therefore, it purchases carbon allowances and offsets based on numbers that include all of its unaccounted-for gas, assuming all of that gas is combusted. This represents 2,500 to 3,900 MT CO₂-e. If one were to assume that the “unaccounted for gas” was released 100% to the atmosphere, however, it would have a greater impact on emissions than if the gas were assumed to be 100% combusted, since methane has a global warming equivalent of 21 times CO₂ on a 100 year basis. The upper limit of 2013 to 2018 fugitive emissions, assuming 100% of unaccounted for gas was leaked, would have been between 23,300 and 35,500 metric tons of carbon dioxide equivalent (MTCO₂-e). This is an upper limit, and real fugitive emissions are lower. For context, total reported gas system GHG emissions over that time were between 140,000 and 160,000 MTCO₂-e.

2. **Other Historical Emissions Estimates:** The City has also estimated its emissions using an estimating methodology established by the American Gas Association based on United States Environmental Protection Agency surveys and other data. The last time this estimate was done was in 2012 (Attachment A). This methodology uses estimated emissions rates for each mile of main, each meter, and each service the utility owns. The estimated emissions rates were developed based on research performed by various entities and are not specific to Palo Alto. In 2012 staff estimated emissions of 4,781 MTCO₂-e. Since then, a number of pipeline replacements have been made of older, less resilient pipe materials, so the emissions of the current system under this methodology is likely lower than the 2012 report.

The City works to find and control leakage for safety reasons as well. The City’s natural gas distribution system is regulated by the Federal Department of Transportation, Pipeline and Hazardous Materials Administration (PHMSA). PHMSA mandates all utilities perform leak surveys of their natural gas distribution pipelines once each calendar year for pipelines in business districts, and a minimum of once each five calendar years for pipelines outside of business districts. CPAU has taken an aggressive approach to complete extensive leak surveys of the entire natural gas distribution system every two calendar years instead of five years, while maintaining annual leak surveys for pipelines within business districts. These surveys are performed using a combination of mobile and walking surveys of the City. This increased leak survey frequency allows the City to locate, grade and repair natural gas pipeline leaks as soon as possible, minimizing the hazards of leaking natural gas.

Please note that these leakage estimates do not include upstream emissions from the City’s receiving stations. Some have estimated that leakage from the gas transmission system and from gas extraction is substantial relative to the emissions from natural gas end-use consumption. If leakage from these sources were also included, leakage emissions related to the community’s gas use could be considerably higher. Estimation of this total leakage can be challenging, and estimates vary, but in August 2015 the National Renewable Energy Laboratory, while acknowledging the high uncertainty in their analysis, estimated nationwide fugitive emissions from natural gas production, transmission, and related activities could be as much as four times as high as fugitive emissions (leakage) from gas distribution systems (see [Estimating U.S. Methane Emissions from the Natural Gas Supply Chain: Approaches, Uncertainties, Current Estimates, and Future Studies, National Renewable Energy Laboratory Technical Report NREL/TP-6A50-62820, August 2015](#)).

Figure 2: Nationwide Natural Gas Production, Transmission, and Distribution System Emissions

Production, Gathering and Boosting

(50 MMt CO₂e yr⁻¹ [33%])

- 1) Drilling and Well Completion
- 2) Producing Wells
- 3) Gathering Lines
- 4) Gathering and Boosting Stations

Processing (22 MMt CO₂e yr⁻¹

[14%])

- 5) Gas Processing Plant

Transmission and Storage

(52 MMt CO₂e yr⁻¹ [33%])

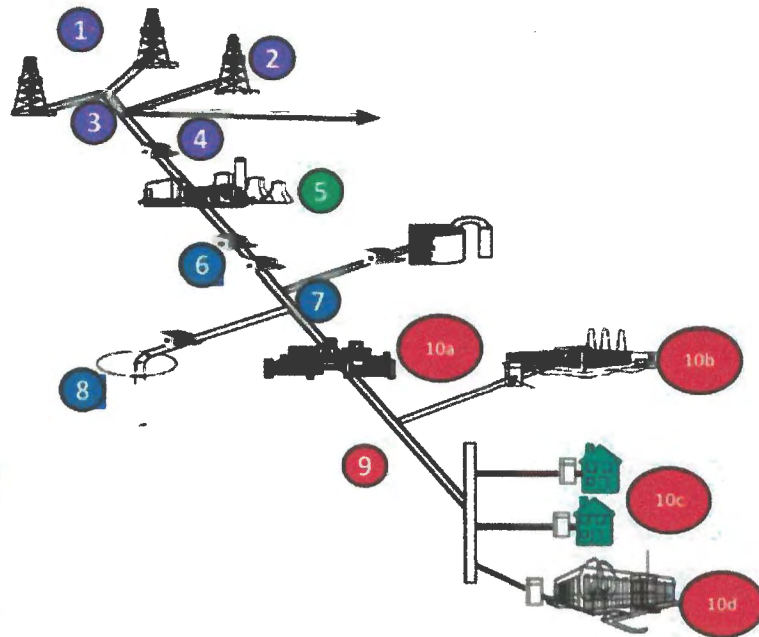
- 6) Transmission Compressor Stations
- 7) Transmission Pipeline
- 8) Underground Storage

Distribution (31 MMt CO₂e yr⁻¹ [20%])

- 9) Distribution Mains

- 10) Regulators and Meters for:

- a. City Gate
- b. Large Volume Customers
- c. Residential Customers
- d. Commercial Customers



Source: National Renewable Energy Laboratory Technical Report NREL/TP-6A50-62820, August 2015

Attachment:

Attachment A: 2012 Natural Gas Distribution System Greenhouse Gas Emission Report

PREPARED BY: JONATHAN ABENDSCHEIN, Assistant Director, Utility Resource Management

APPROVED BY: 
DEAN BATCHELOR
 Utilities Director



CITY OF PALO ALTO
UTILITIES

City of Palo Alto

Utilities Engineering Department

Water-Gas Wastewater

Natural Gas Distribution System

Greenhouse Gas Emission Report

Based on (DOT Report 2012)

**City of Palo Alto - Utilities Engineering Department
Fugitive Gas Emissions Calculations
Gas Distribution System Meters and Piping (DOT Report 2012)**

Source	Emission Factor	Units	CPAU-Units	Extended Units	lb of CH4	lb of CO2
Commercial/Industrial Meters	2.02	lb CH4/meter-year	2350	gas meters	4747	
Residential Meters	5.85	lb CH4/meter-year	21650	gas meters	126652.5	
Plastic Pipe, Main Length	693	lb CH4/meter-year	143.8	miles	99653	
Plastic Pipe, Main Length (Oxidation)	38.89	lb CO2/mile-year	143.8	miles		5592
Plastic Pipe, Main (Leaks)	41.64	lb CO2/mile-year	143.8	miles		5988
Protected Steel Pipe, Main Length	129.5	lb CH4/meter-year	65.62	miles	8498	
Protected Steel Pipe, Main Length (Oxidation)	11.01	lb CO2/mile-year	65.62	miles		722
Protected Steel Pipe, Main (Leaks)	7.86	lb CO2/mile-year	65.62	miles		516
Copper Pipeline Services	10.74	lb CO2/service-year	48	services	516	
Copper Pipeline Services (Oxidation)	0	lb CO2/service-year	48	services		0
Copper Pipeline Services (Leaks)	0.63	lb CO2/service-year	48	services		30
Plastic Pipeline Services	0.39	lb CH4/service-year	18147	services	7077	
Plastic Pipeline Services (Oxidation)	0.29	lb CO2/service-year	18147	services		5263
Plastic Pipeline Services (Leaks)	0.03	lb CO2/service-year	18147	services		544
Protected Steel Pipeline Services	7.45	lb CH4/service-year	1126	services	8389	
Protected Steel Pipe, Pipeline Services (Oxidation)	0.55	lb CO2/service-year	1126	services		619
Protected Steel Pipeline Services(Leaks)	0.45	lb CO2/service-year	1126	services		507
Total piping/meters CH4 Emission/year (lb of CH4)					255532	
Total piping/meters CO2 Emission/year (lb of CO2)						19782
Gas Stations Emissions Calculations						
Gate Stations	61390	lb CH4/station-year	4	stations	245560	
Total CH4 Emission/year (lb of CH4)					501092	
Total CO2 Emission/year (lb of CO2)						19782
Converted CH4 to CO2 (lb of CO2)					CH4 21 times the potential of CO2	10522937
Total CO2 equivalent emission (lb of CO2)						10542719
Total CO2 equivalent emission (Metric Tons of CO2)					1 metric ton = 2205 lbs	4781.3

NOTICE: This report is required by 49 CFR Part 191. Failure to report can result in a civil penalty not to exceed 100,000 for each violation for each day that such violation persists except that the maximum civil penalty shall not exceed \$1,000,000 as provided in 49 USC 60122.

OMB NO: 2137-0522
EXPIRATION DATE: 01/31/2014



U.S Department of Transportation
Pipeline and Hazardous Materials Safety Administration

Form Type: INITIAL

Date Submitted: 3/5/2013

(DOT use only) 20130562-17651

**ANNUAL REPORT FOR
CALENDAR YEAR 2012
GAS DISTRIBUTION SYSTEM**

A federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a current valid OMB Control Number. The OMB Control Number for this information collection is 2137-0522. Public reporting for this collection of information is estimated to be approximately 16 hours per response, including the time for reviewing instructions, gathering the data needed, and completing and reviewing the collection of information. All responses to this collection of information are mandatory. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to: Information Collection Clearance Officer, PHMSA, Office of Pipeline Safety (PHP-30) 1200 New Jersey Avenue, SE, Washington, D.C. 20590.

PART A - OPERATOR INFORMATION

1. Name of Operator	PALO ALTO, CITY OF
2. LOCATION OF OFFICE (WHERE ADDITIONAL INFORMATION MAY BE OBTAINED)	
2a. Street Address	3201 EAST BAYSHORE ROAD
2b. City and County	PALO ALTO,SANTA CLARA
2c. State	CA
2d. Zip Code	94303
3. OPERATOR'S 5 DIGIT IDENTIFICATION NUMBER	15084
4. HEADQUARTERS NAME & ADDRESS	
4a. Street Address	250 HAMILTON AVENUE
4b. City and County	PALO ALTO,SANTA CLARA
4c. State	CA
4d. Zip Code	94301
5. STATE IN WHICH SYSTEM OPERATES	CA

PART B - SYSTEM DESCRIPTION

1.GENERAL

	STEEL				DUCTILE IRON	COPPER	CAST/ WROUGHT IRON	PLASTIC	OTHER	TOTAL
	UNPROTECTED		CATHODICALLY PROTECTED							
	BARE	COATED	BARE	COATED						
MILES OF MAIN	0.000	0.000	0.000	65.620	0.000	0.000	0.000	143.800	0.060	209.480
NO. OF SERVICES	0.000	0.000	0.000	1126.000	0.000	48.000	0.000	18147.000	0.000	19321.000

2.MILES OF MAINS IN SYSTEM AT END OF YEAR

MATERIAL	UNKNOWN	2' OR LESS	OVER 2' THRU 4'	OVER 4' THRU 8'	OVER 8' THRU 12'	OVER 12'	TOTAL
STEEL	0.000	38.970	17.390	6.890	2.370	0.000	65.620
DUCTILE IRON	0.000	0.000	0.000	0.000	0.000	0.000	0.000
COPPER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CAST/WROUGHT IRON	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PLASTIC PVC	0.000	22.800	12.090	2.190	0.000	0.000	37.080
PLASTIC PE	0.000	49.440	20.100	24.830	0.000	0.000	94.370
PLASTIC ABS	0.000	4.100	6.290	1.960	0.000	0.000	12.350
PLASTIC OTHER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OTHER	0.060	0.000	0.000	0.000	0.000	0.000	0.060
TOTAL	0.060	115.310	55.870	35.870	2.370	0.000	209.480

3.NUMBER OF SERVICES IN SYSTEM AT END OF YEAR

AVERAGE SERVICE LENGTH: 40

MATERIAL	UNKNOWN	1' OR LESS	OVER 1' THRU 2'	OVER 2' THRU 4'	OVER 4' THRU 8'	OVER 8'	TOTAL
STEEL	0.000	1104.000	22.000	0.000	0.000	0.000	1126.000
DUCTILE IRON	0.000	0.000	0.000	0.000	0.000	0.000	0.000
COPPER	0.000	48.000	0.000	0.000	0.000	0.000	48.000
CAST/WROUGHT IRON	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PLASTIC PVC	0.000	3021.000	319.000	73.000	1.000	0.000	3414.000
PLASTIC PE	0.000	12593.000	297.000	67.000	63.000	0.000	13020.000
PLASTIC ABS	0.000	1390.000	262.000	61.000	0.000	0.000	1713.000
PLASTIC OTHER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OTHER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	18156.000	900.000	201.000	64.000	0.000	19321.000

4.MILES OF MAIN AND NUMBER OF SERVICES BY DECADE OF INSTALLATION

	UNKNOWN	PRE-1940	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	TOTAL
MILES OF MAIN	10.000	13.000	11.200	14.000	23.000	33.280	18.500	40.000	43.000	3.500	209.480
NUMBER OF SERVICES	395.000	446.000	330.000	354.000	1345.000	2233.000	2945.000	5197.000	5811.000	265.000	19321.000

PART C - TOTAL LEAKS AND HAZARDOUS LEAKS ELIMINATED/REPAIRED DURING THE YEAR

CAUSE OF LEAK	MAINS		SERVICES	
	TOTAL	HAZARDOUS	TOTAL	HAZARDOUS
CORROSION	3	0	8	4
NATURAL FORCES	0	0	3	1
EXCAVATION DAMAGE	3	3	44	44
OTHER OUTSIDE FORCE DAMAGE	0	0	0	0
MATERIAL OR WELDS	10	5	6	2
EQUIPMENT	8	0	0	0
INCORRECT OPERATIONS	0	0	0	0
OTHER	2	0	8	3

NUMBER OF KNOWN SYSTEM LEAKS AT END OF YEAR SCHEDULED FOR REPAIR : 111

PART D - EXCAVATION DAMAGE

PART E-EXCESS FLOW VALUE(EFV) DATA

NUMBER OF EXCAVATION DAMAGES: 47

NUMBER OF EFV'S INSTALLED THIS CALENDER YEAR ON SINGLE FAMILY RESIDENTIAL SERVICES: 180

NUMBER OF EXCAVATION TICKETS : 4151

ESTIMATED NUMBER OF EFV'S IN SYSTEM AT THE END OF YEAR: 4762

PART F - LEAKS ON FEDERAL LAND

PART G-PERCENT OF UNACCOUNTED FOR GAS

TOTAL NUMBER OF LEAKS ON FEDERAL LAND REPAIRED OR SCHEDULED TO REPAIR: 1

UNACCOUNTED FOR GAS AS A PERCENT OF TOTAL INPUT FOR THE 12 MONTHS ENDING JUNE 30 OF THE REPORTING YEAR.

INPUT FOR YEAR ENDING 6/30: 3.1%

PART H - ADDITIONAL INFORMATION

PART I - PREPARER AND AUTHORIZED SIGNATURE

Alicia Easton, Utility Projects Coordinator
(Preparer's Name and Title)

(650) 496-5944
(Area Code and Telephone Number)

alicia.easton@cityofpaloalto.org
(Preparer's email address)

(650) 496-6924
(Area Code and Facsimile Number)

Attachments:

2012 DOT Annual Report

Page 79, Table VII-4. More Detailed Fugitive Emission Factors for Transmission Equipment, World Resources Institute, June 6, 2007

Page 80, Table VII-5. More Detailed Fugitive Emission Factors for Transmission Equipment, World Resources Institute, June 6, 2007