Methane Emissions from Gas Residential Meter Set

Andres Beltran, Stephen Ramos

January 2021

PG&E

Together, Building
a Better California

Current Reporting

- Population-based emission factor from GRI 1996 study "Methane Emissions from Natural Gas Industry"
- Meter set leaks emissions account for 20% of PG&E's overall emissions
- Limitation does not support potential progress/improvement by the utility in order to reach methane abatement targets

Meter Type	Number	Emission factor (scfh)	Annual Emissions (Mscf)
Residential	4,261,168	0.0169	630,653
Commercial/ Industrial	232,216	0.0058	11,843

Note: We don't address commercial/industrial methane emissions calculation at this point because they are minimal.
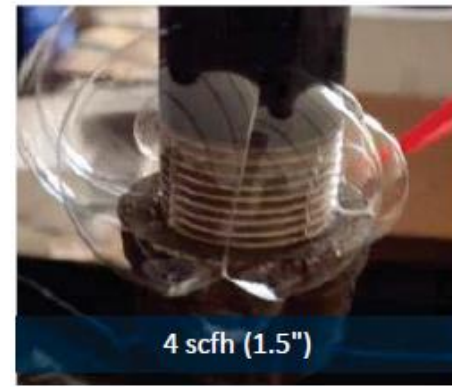
GTI – Bubble Size Classification

- GTI completed project 7.17.d Methodology to Estimate Flow Rate of Above Ground Leaks Using a Soap Test in July 2019
- Based on GTI's study, various classification bins (A, B, C, and D) were created with their associated emission ranges
- The mean leak rate of each category can be used as the representative flow rate
- The calculated flow rate is calculated using the simulated lognormal distribution

Classification	Description	Thresholds (scfh)	Mean Emission Rate (scfh)
A	Soap solution is blown off the facility providing no opportunity for bubbles to form and "hold"	> 4	9.5
B	Soap solution can hold a cluster of bubbles	>0.1 to $\leq$ 4	0.53
C	Soap solution forms a cluster of small bubbles	>0.014 to $\leq$0.1	0.041
D	Soap solution creates foam with few or no visible bubbles	$\leq$0.014	0.0032

Notes:
1) Classifications and description per PG&E procedure TD-4110P-01 JA-01
2) Thresholds were determined using GTI's lab experiment data based on behavior of soap bubbles
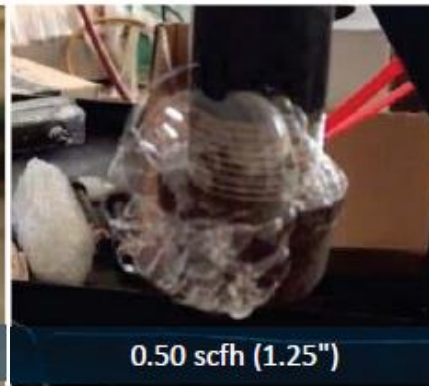
GTI - Residential Meter Thresholds

0.014 scfh (foam)

0.10 scfh (0.25")

4 scfh (1.5")

Smaller leaks

Bigger leaks

D	C	B	A

Representative flow rates:

0.003 scfh (foam)

0.046 scfh (bubble)

0.50 scfh (1.25")

Soap is blown-off

Source: GTI 7.17.a Estimate Flow Rate Using Soap Test
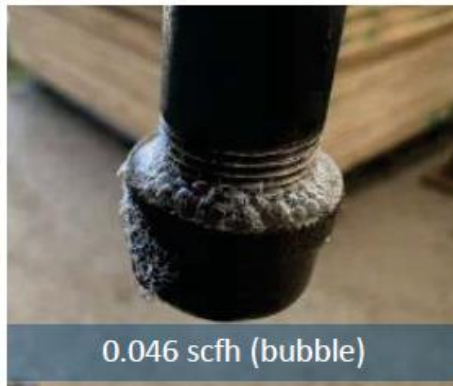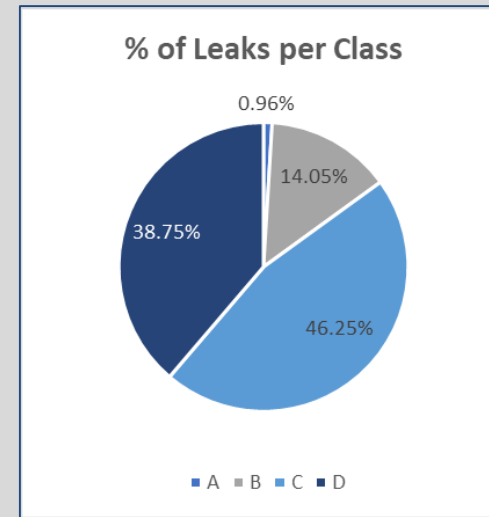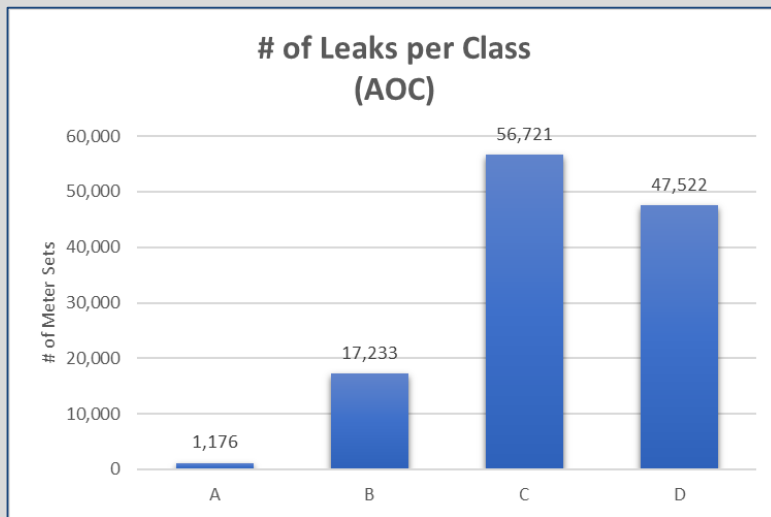
4

PG&E New Leak Grading and Response

- PG&E Procedure **TD-4110P-09 "Leak Grading and Response"** was published in December 2019 and made into effect in February 2020. The update includes bubble size classifications.

- TD-4110P-09 standard evaluates non gradable meter set leaks that are above the shutoff valve with a soap test and bubble size classification.

- However, the standard evaluates a meter set leak below the shutoff valve differently.
    - A soap test is performed on meter set leaks below the shutoff valve, but leak survey *grades* the leak based on location of leak and size of bubbles.

- To calculate total meter set emissions, PG&E will evaluate all above ground leaks related to the meter set.

2020 Survey Year

- PG&E leak survey performed soap tests on meter sets and recorded the results in the **Abnormal Operating Conditions (AOC)** database for leaks above the shutoff valve.

- Surveyors classified the bubble size into the A, B, C and D bins

- In 2020 leak survey evaluated **1/3 of the PG&E service territory,** Surveying approximately **1.4-million** meter sets.

- Of the 1.4-million meter sets, leak survey reported **123,000** meter sets leaks.

of Leaks per Class (AOC)

Class	# of Meter Sets
A	1,176
B	17,233
C	56,721
D	47,522

% of Leaks per Class

Class	%
A	0.96%
B	14.05%
C	46.25%
D	38.75%

- Meter sets are repaired over a 3-year cycle, repairs completed in 2020 are for leaks surveyed in 2017.

- GSR repaired **79,000** meter set leaks in 2020.

- Using GSR field service data, we calculated the distribution of repairs per leak classification and estimated the average time a leak was open.

of Repairs per Class

A	B	C	D
1,188	13,629	35,069	28,894

% of Repairs per Class

- A: 36.7%
- B: 1.5%
- C: 44.5%
- D: 17.3%
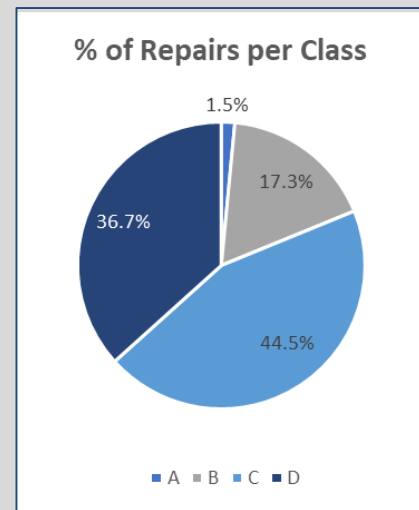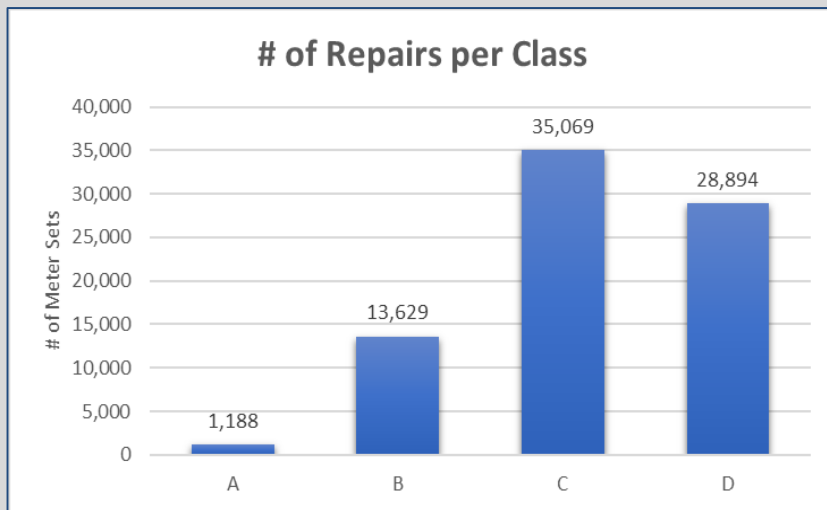
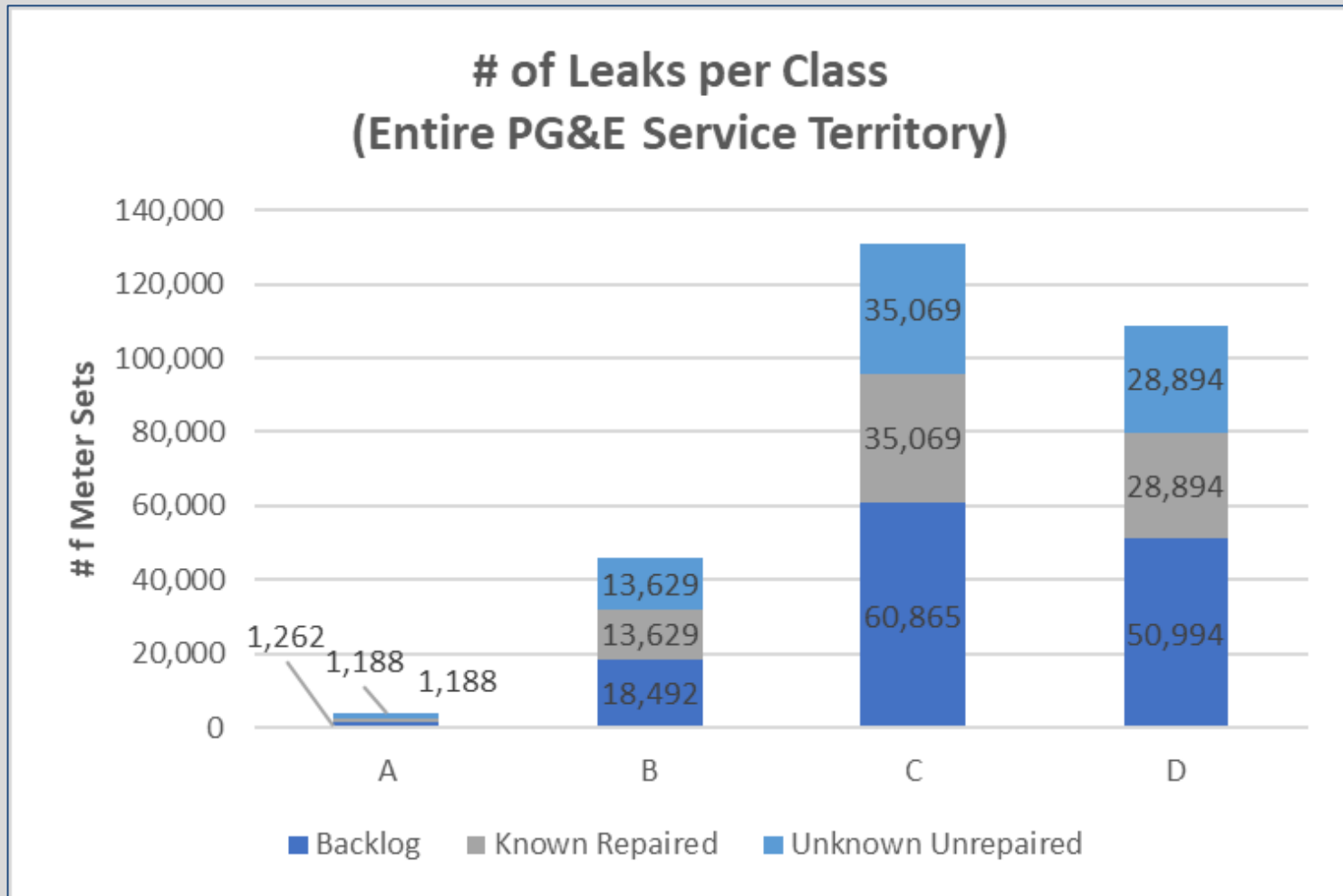| Bin	Average Repair Time (hr)
A	5243
B	5687
C	5628
D	5640

Tracking Open Leaks

- The **number of repairs** completed in 2020 is **equal** to the **number of new leaks found**.

- Extrapolating the number of new leaks found to the rest of the service territory, we assumed that *the number of known leaks is equal to the number of unknown leaks*; **79,000 x 2 = 148,000** *new meter set leaks.*

- Of the **123,000** meter set leaks reported in the surveyed territory, **79,000** were repaired, leaving a backlog of **44,000** that will carry over in the 3-year repair cycle.

- Interpolating that backlog of leaks over the rest of the territory, the total number of open leaks at the end of 2020 is *3 x 44,000 =* **132,000** *backlogged leaks.*

Measured Meter Set Leak Population			
Backlog	New Known Repaired	New Unknown Unrepaired	Total
131,613	78,780	78,780	289,173

- Applying the percent distribution from the classified meter set leaks produces the following measured leak population per class.

# of Leaks per Class (Entire PG&E Service Territory)

Legend: ■ Backlog ■ Known Repaired ■ Unknown Unrepaired

Class A: Backlog 1,262, Known Repaired 1,188, Unknown Unrepaired 1,188
Class B: Backlog 18,492, Known Repaired 13,629, Unknown Unrepaired 13,629
Class C: Backlog 60,865, Known Repaired 35,069, Unknown Unrepaired 35,069
Class D: Backlog 50,994, Known Repaired 28,894, Unknown Unrepaired 28,894

No Bubble Leaks

- Based on the *CARB* ***Quantifying Methane Emissions from Natural Gas Residential Customer Meters in California study***, PG&E will count emissions on meter sets that do not display a bubble indication.

- CARB evaluated **166** leaking meter sets:
  - **77** were classified as having bubbles **89** displayed no bubbles

- Of total number of leak indications, **54%** displayed no bubbles, **46%** displayed a bubble indication. PG&E will apply the percentage of no bubble indications in the CARB study to the total number of open meter set leaks.

Class	% of Total Leak Indication	# of Leak Indications	Total Leak Count	% of Meter sets with Leak Indications
Bubbles	46%	289,173	628,637	14.7%
No Bubbles	54%	339,464		

- Of the 4.2 million residential meter sets in the PG&E service territory, **15%** of the meter sets are leaking. CARB estimates that **25%** of meter sets are leaking, our calculation is close to that estimation.

- **OTD** conducted an uncertainty analysis to determine the probability that a surveyed leak is placed in the correct classification. The OTD study evaluated **41** meter set leaks and produced the following distribution:

OTD MEASURED V ACTUAL			
100.0% 0.0% chance 0.0% that 0.0%	>4 scfh size leak	will be measured as a	□ >4 ✠ 0.1-4 ✿ 0.014-0.1 ○ 0-0.014
5.0% 55.0% chance 40.0% that 0.0%	0.1-4	will be measured as a	□ >4 ✠ 0.1-4 ✿ 0.014-0.1 ○ 0-0.014
1.5% 24.0% chance 40.5% that 34.0%	0.014-0.1	will be measured as a	□ >4 ✠ 0.1-4 ✿ 0.014-0.1 ○ 0-0.014
0.0% 5.0% chance 50.0% that 45.0%	0-0.014	will be measured as a	□ >4 ✠ 0.1-4 ✿ 0.014-0.1 ○ 0-0.014

GTI-OTD Project 7.17.d: Methodology to Estimate Flow Rate of Above Ground Leaks Using a Soap Test

- We applied the probability analysis and calculated the actual distribution of open leaks in the PG&E service territory.

Uncertainty Analysis Application

- Using the number of meter set leaks reported in the AOC database, we calculated the probability of a leak to be in the correct category.

- The uncertainty analysis indicates that leak survey is overestimating the size of the leak.

- Applying the uncertainty analysis to how leak survey investigates meter set leaks can help increase the accuracy of meter set repairs and reduce overall emissions.

- For the 2020 survey year, we applied the uncertainty analysis to meter set emissions counting by applying an emission correction factor:

- $EF_{i\_new} = [True\ Positive\ \%\ for\ Group\ i] * EF_i + \sum_{j}^{not\ i} False\ Positive\ \%\ for\ Group\ j] * EFj)$

- True positive rate is the percentage that a leak was assigned the correct class; False positive rate is the percentage that a leak is classified as another category. The term on the right is the summation of the product of each false positive rate with the EF for that group. If there are x number of categories, there should be x-1 number of false positive groups.

- Emission factors are weighted by the probability of a leak being classified in the specific category. The percentages are based on the measured leak size result calculated by the input distribution from the known meter set leaks and repairs.
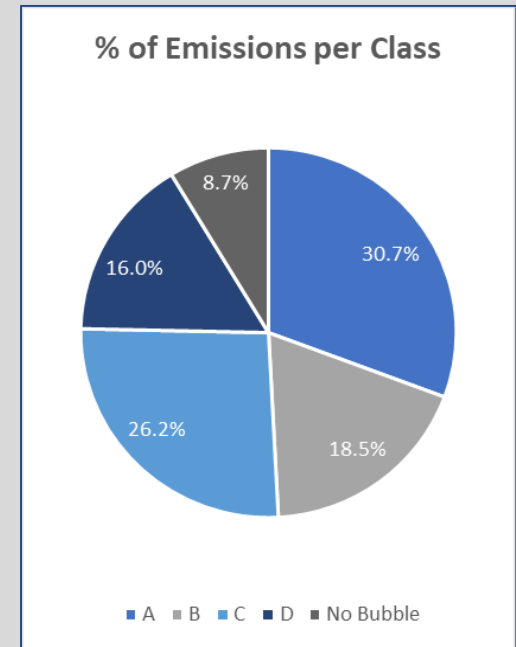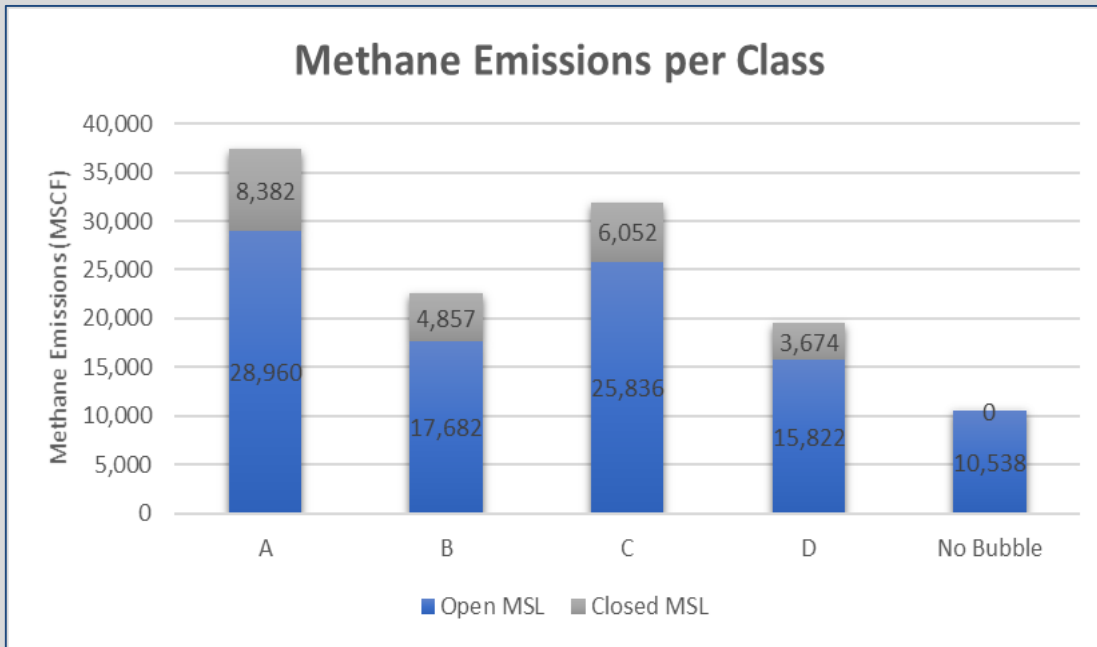
Result			0	0.014	0.1	4
		A	0%	0%	0%	13%
Actual Leak Size		B	0%	1%	5%	8%
		C	51%	52%	82%	79%
		D	49%	46%	12%	0%
			D	C	B	A
				Measured Leak Size		

- We applied the uncertainty calculation by correcting the emission factors to reflect the actual distribution of leaks in the service territory.
- Example calculation: $EF_{A\_Applied} = 0.13*EF_A + 0.08*EF_B + 0.79*EF_C + 0*EF_D$

Class	EF [SCFH]	EF Applied [SCFH]
A	9.5	1.3
B	0.53	0.063
C	0.041	0.031
D	0.0032	0.023

Meter Set Emissions Calculation

- *OPEN Emissions = # of Leaks per Class X Class Emission Factor X 1 Year*

- *CLOSED Emissions = # of Leaks per Class X Class Emission Factor X (Average Repair Time per Class)*

- *TOTAL = OPEN + CLOSED = 98,800 + 23,000 = **121,800 MSCF Total MS Emissions***

Methane Emissions per Class

Class	Open MSL	Closed MSL
A	28,960	8,382
B	17,682	4,857
C	25,836	6,052
D	15,822	3,674
No Bubble	10,538	0

Methane Emissions (MSCF) — Y-axis scale: 0 to 40,000

% of Emissions per Class

- A: 30.7%
- B: 18.5%
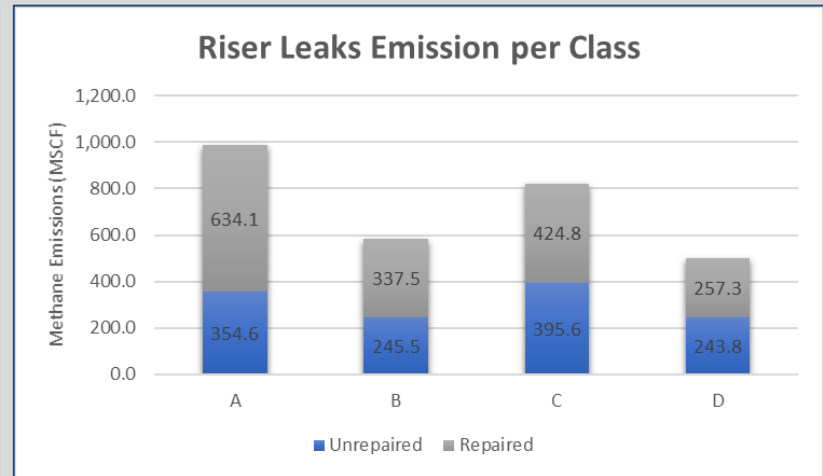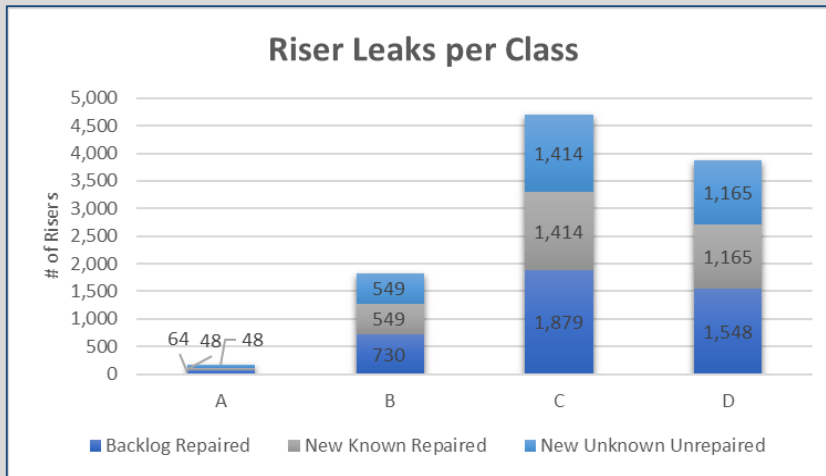- C: 26.2%
- D: 16.0%
- No Bubble: 8.7%

Riser Leak Population

- PG&E evaluated leaks below the shut off valve that are above ground and add those fugitive emissions to the total meter set emissions count.

- These leaks are related to the riser, they are surveyed with a soap test, graded based on the location and size of the bubble and are recorded in SAP.

- In 2020, leak survey found and repaired **3,200 new known** riser leaks, applying a similar methodology from the meter sets, the number of unknown unrepaired risers' leaks is equal to **3,200 new unknown unrepaired** riser leaks

- PG&E reported **4,200 backlogged** leaks, M&C targeted these riser leaks and repaired the entire backlog. The leak population is listed below:

Riser Leak Population			
Backlog Repaired	New Known Repaired	New Unknown Unrepaired	Total
4,222	3,176	3,176	10,574

Riser Leaks Emissions

- Since riser leaks are graded and not evaluated using the classifications bins, there is not a direct way to calculate emissions.

- We elected to use the measured percent distribution of the leaks per class in both unrepaired & repaired categories from the classified meter sets data.

- Applying the percent distribution per category produces the following riser distribution:

Riser Leaks per Class

Class	Backlog Repaired	New Known Repaired	New Unknown Unrepaired
A	64	48	48
B	730	549	549
C	1,879	1,414	1,414
D	1,548	1,165	1,165

Riser Leaks Emission per Class (Methane Emissions (MSCF))

Class	Unrepaired	Repaired
A	354.6	634.1
B	245.5	337.5
C	395.6	424.8
D	243.8	257.3

- On average, riser leaks were repaired in **4,200 hrs.,** applying the *OPEN & CLOSED* calculation in meter emissions produces a total riser emission of **_2,900 MSCF_**

Total Emissions = Meter Set Leaks + Riser Leaks

PG&E 2020 AG MS Emissions = **124,700 MSCF**

Thank you!

Andres Beltran, Stephen Ramos
aabs@pge.com, s3rc@pge.com