METHANE EMISSIONS AND LEAK DETECTION

Analysis

Upon analysing the data of 6702 facilities we have the following analysis.

As summarized below in Table 1 and 2 the mean number of active days that methane leaked was 157 in case no leakage was detected and 62 in case leakage was detected using OGI cameras. The maximum days a leak continued was 164 when no OGI cameras were employed to detect leaks as compared to 64 days which is the maximum numbers of days the leak went undetected when OGI cameras were employed. So, from the following two tables it is evident that employing OGI cameras reduced the number of days of any active leaks goes undetected by more than half.

Table 1: Summary of information in case of leak detection

	emission_rate_g_per_sec	lat	lon	days_active
count	6702.000000	6702.000000	6702.000000	6702.000000
mean	0.105448	53.510904	-115.549408	61.611907
std	0.702791	1.262291	2.364046	9.397231
min	0.000000	49.390000	-119.950000	1.000000
25%	0.006643	52.780000	-116.390000	64.000000
50%	0.016985	53.140000	-115.400000	64.000000
75%	0.052208	54.440000	-114.270000	65.000000
max	10.053356	57.600000	-110.270000	65.000000

Table 2: Summary of information in case of no leak detection

	emission_rate_g_per_sec	lat	lon	days_active
count	6770.000000	6770.000000	6770.000000	6770.000000
mean	0.099106	53.418152	-115.652529	157.311521
std	0.614636	1.243948	2.320928	26.319401
min	0.000000	49.060000	-119.990000	0.000000
25%	0.006643	52.700000	-116.690000	164.000000
50%	0.016587	53.120000	-115.480000	164.000000
75%	0.054277	54.390000	-114.380000	164.000000
max	10.053356	57.690071	-110.270000	164.000000

Table 3: Summary of methane emissions in active cases in case of leak detection

	emission_rate_g_per_sec	lat	lon	days_active
count	205.000000	205.000000	205.000000	205.000000
mean	0.056161	53.528537	-115.724585	32.131707
std	0.098430	1.144319	2.126716	18.150709
min	0.000000	50.200000	-119.900000	1.000000
25%	0.006882	52.830000	-116.300000	16.000000
50%	0.017184	53.130000	-115.640000	34.000000
75%	0.052208	54.120000	-114.450000	47.000000
max	0.564586	57.600000	-110.450000	63.000000

Table 4: Table 3: Summary of methane emissions in active cases in case of no leak detection

	emission_rate_g_per_sec	lat	lon	days_active
count	542.000000	542.000000	542.000000	542.000000
mean	0.132466	53.364576	-115.546089	80.455720
std	0.866124	1.342344	2.350445	47.270262
min	0.000000	49.390000	-119.980000	0.000000
25%	0.006484	52.560000	-116.270000	39.250000
50%	0.017035	53.055000	-115.270000	79.000000
75%	0.061437	54.387500	-114.315000	123.000000
max	10.053356	57.690000	-110.320000	163.000000

As depicted above in Tables 3 and 4, in case of active wells where no optical gas imaging (OGI) cameras were used to inspect for leaks, the number of methane emissions are twice as compared to active facilities where optical gas imaging (OGI) cameras were employed. Also, the mean methane leakage rate for active facilities is 0.132 g/s as compared to 0.056 g/s when no OGI cameras were employed for leak detection. It shows that the methane emissions increased by an average of approximately 140 % when no leak detection was employed in active facilities. Additionally, the maximum methane emission rate in case of leak detection using OGI cameras in active facilities is 0.56 g/sec as compared to facilities with no OGI detection where it is 10.05 g/sec. Also, as expected the active days of emissions is 542 in case of active facilities with no leak detection as compared to 205 facilities expected in case of active facilities where leak detection was employed using cameras.

This analysis is very well evident by the bar plots below as well.

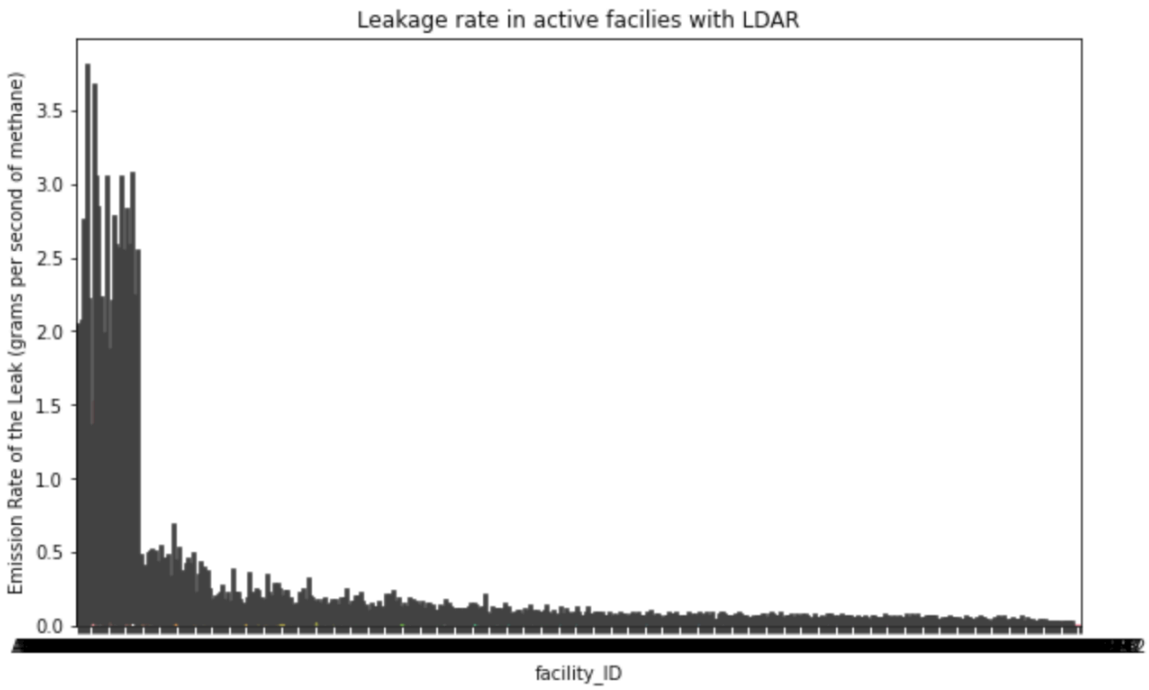

Figure 1: Methane emissions in active facilities with LDAR

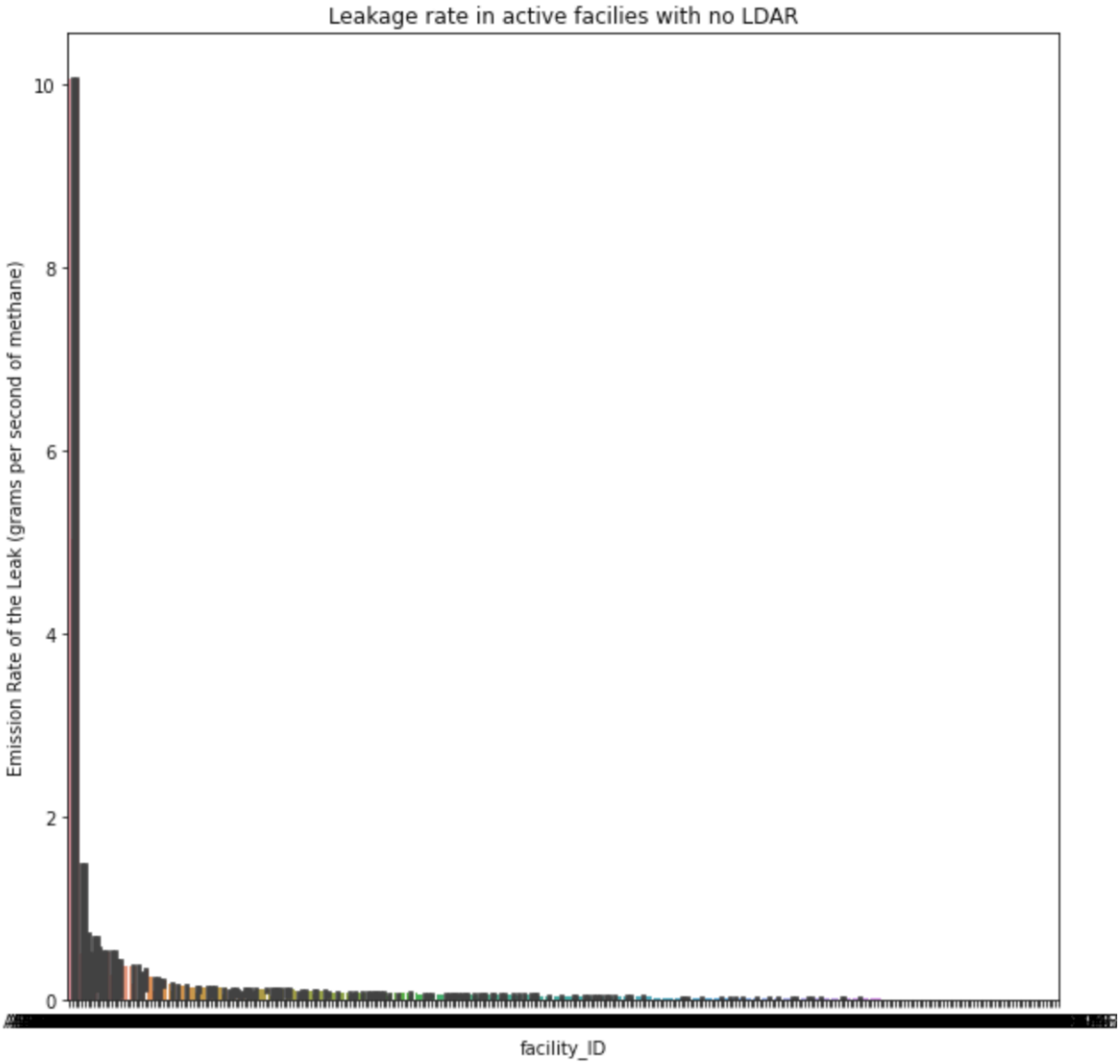

Figure 2: Methane emissions in active facilities with no LDAR

As evident by the graphs above the methane emissions increase almost 3 times no case no leak detection.

Table 5: Summary of methane emissions in case of repaired facilities with leak detection

	emission_rate_g_per_sec	lat	lon	days_active
count	6497.000000	6497.000000	6497.000000	6497.000000
mean	0.107004	53.510348	-115.543880	62.542096
std	0.713526	1.265911	2.371085	7.242721
min	0.000000	49.390000	-119.950000	16.000000
25%	0.006643	52.780000	-116.390000	64.000000
50%	0.016985	53.140000	-115.380000	64.000000
75%	0.052208	54.450000	-114.270000	65.000000
max	10.053356	57.600000	-110.270000	65.000000

Table 6: Summary of methane emissions in case of repaired facilities with no leak detection

	emission_rate_g_per_sec	lat	lon	days_active
count	6228.000000	6228.000000	6228.000000	6228.0
mean	0.096203	53.422815	-115.661792	164.0
std	0.587689	1.235019	2.318301	0.0
min	0.000000	49.060000	-119.990000	164.0
25%	0.006703	52.700000	-116.810000	164.0
50%	0.016587	53.129983	-115.490000	164.0
75%	0.054277	54.390000	-114.390000	164.0
max	10.053356	57.690071	-110.270000	164.0

- As evident by Tables 5 and 6 above, in case repaired facilities the maximum and mean methane emissions are the same irrespective to whether emission leakage is employed or not. There is no need to employed leak detection in repaired facilities the methane emissions are almost same no matter whether leak detection is employed or not.

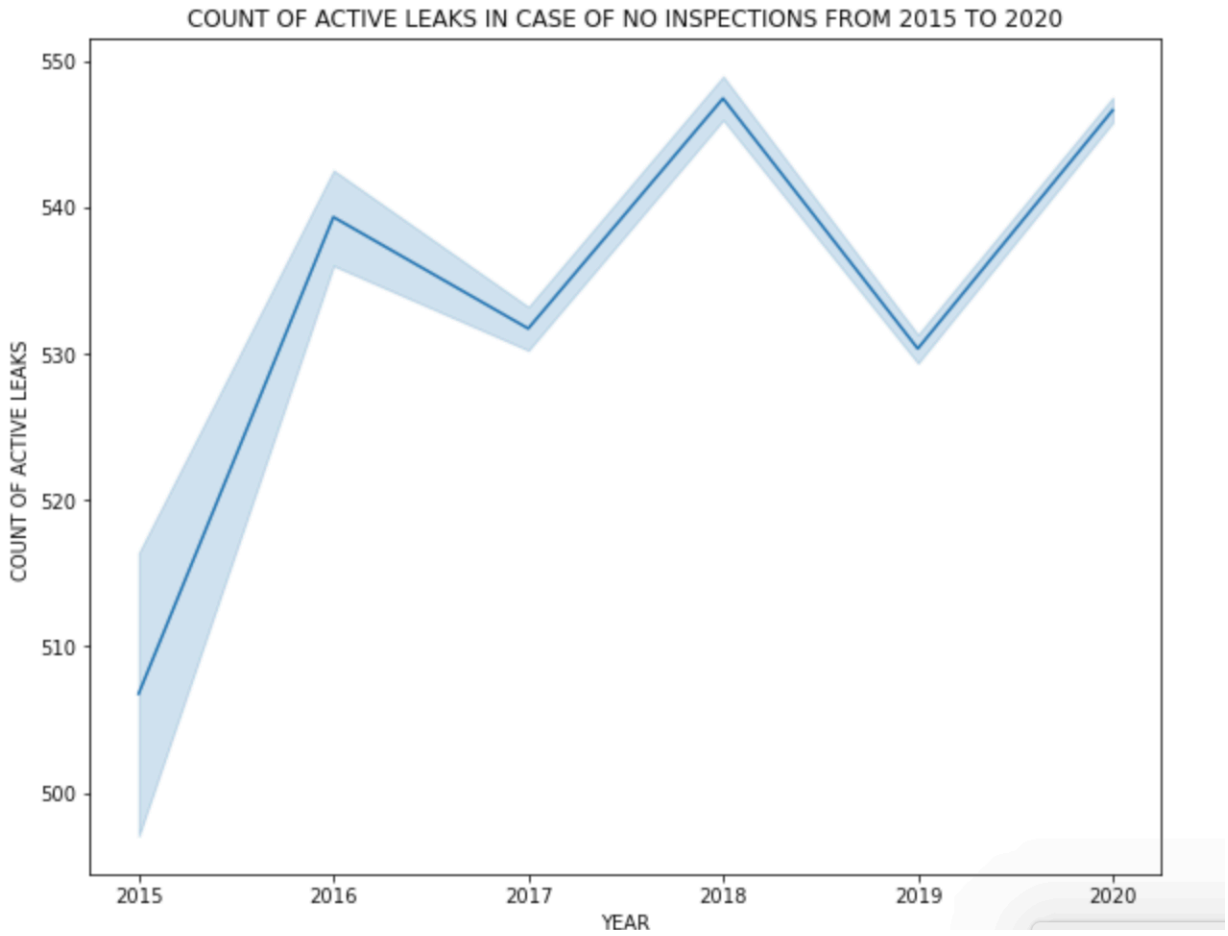

Figure 3: Line chart of number of active leaks in case of no inspections

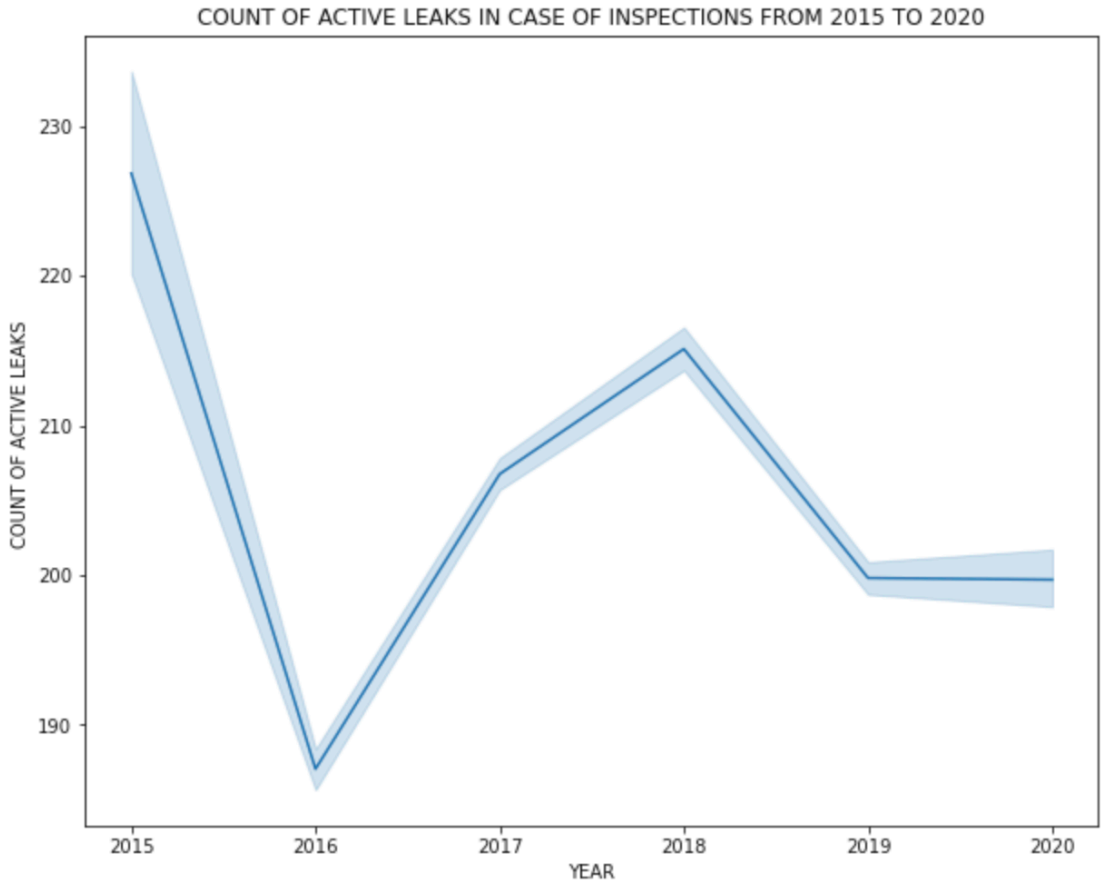

Figure 4: Line chart of number of active leaks in case of inspections

In case of no leak detection, the number of methane leaks have been increasing ever since 2015 and they have number of leaks were 510 in 2015 and now they are 550 are in 2020. The number of active leaks decreased considerably in 2016 and then increased slightly in 2018 followed by a decrease in 2019 and 2020. So, implementation of leak detection using OGI cameras is useful in reducing the number of active leaks by more than half for all the five years from 2015 to 2020. This result is in line our analysis from the other two spreadsheets.

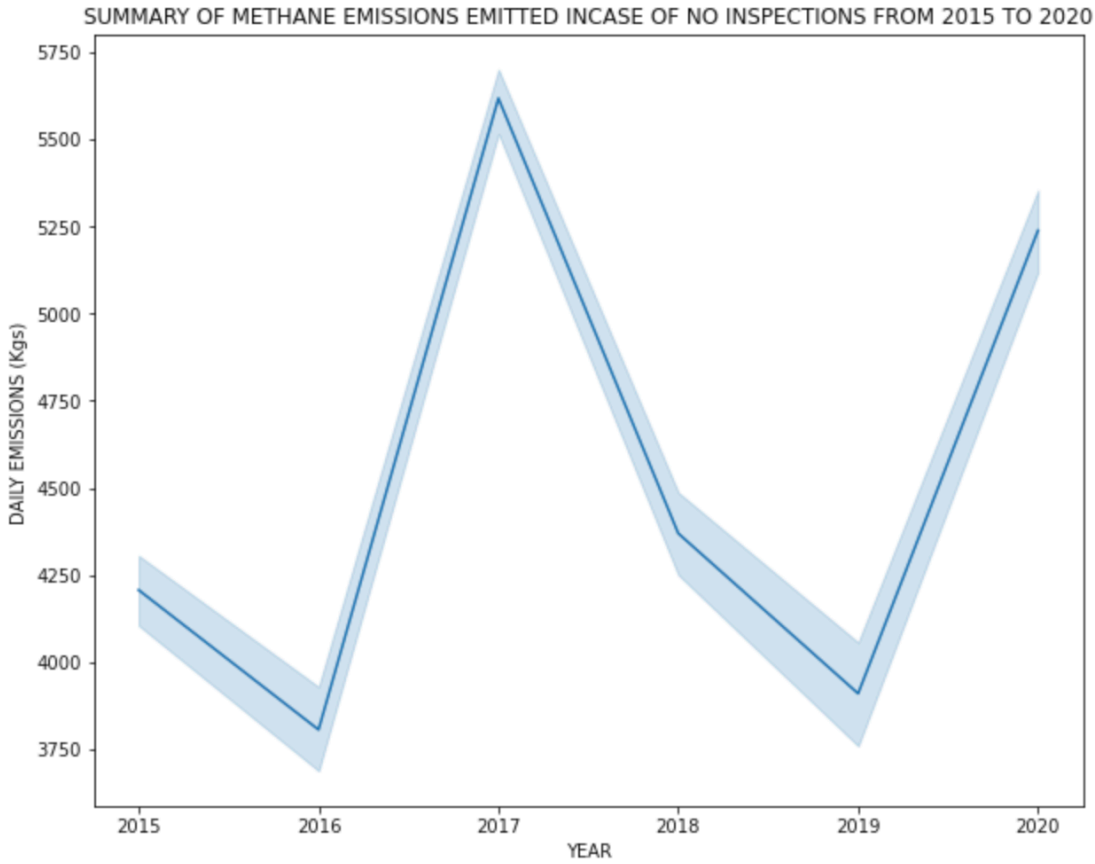

Figure 5: Summary of methane emissions in case of no inspections from 2015 to 2020

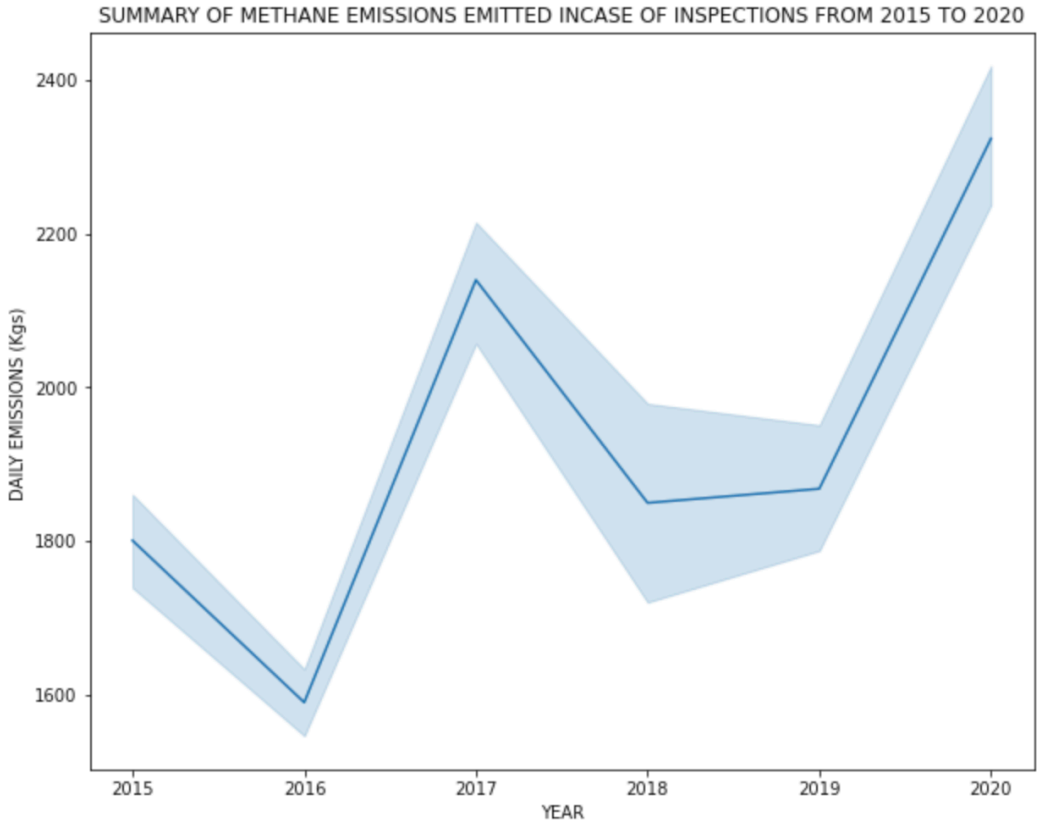

Figure 6: Summary of methane emissions in case of no inspections from 2015 to 2020

Table 7: Average methane emissions

Year	Average Emissions In Case Of No Inspections (kgs)	Average Emissions In Case Of Inspections (kgs)	Average Decrease in Methane Emissions %
2015	4250	1800	58
2016	3750	1600	57
2017	5725	2200	62
2018	4250	1850	56
2019	3800	1850	51
2020	5250	2300	56
Avg.			57

As evident by both the graphs above and also by the table above, it is evident from 2015 to 2020, on an average leak detection resulted in approx. 60% lower methane emissions.

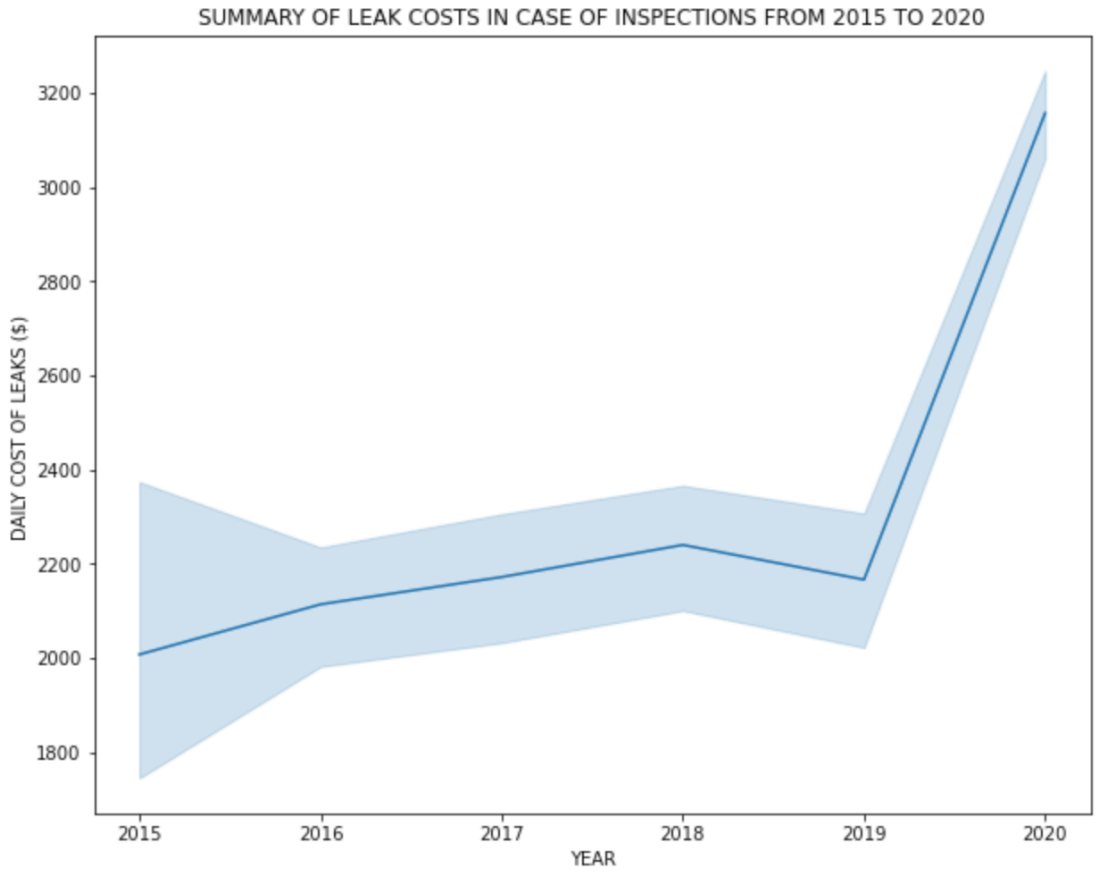

Figure 7: Summary of leak detection in case of leakage from 2015 to 2020

The daily leak detection cost has been pretty much constant from 2015 to 2020. However in 2020 it has increased sharply. This may be probably because of COVID.

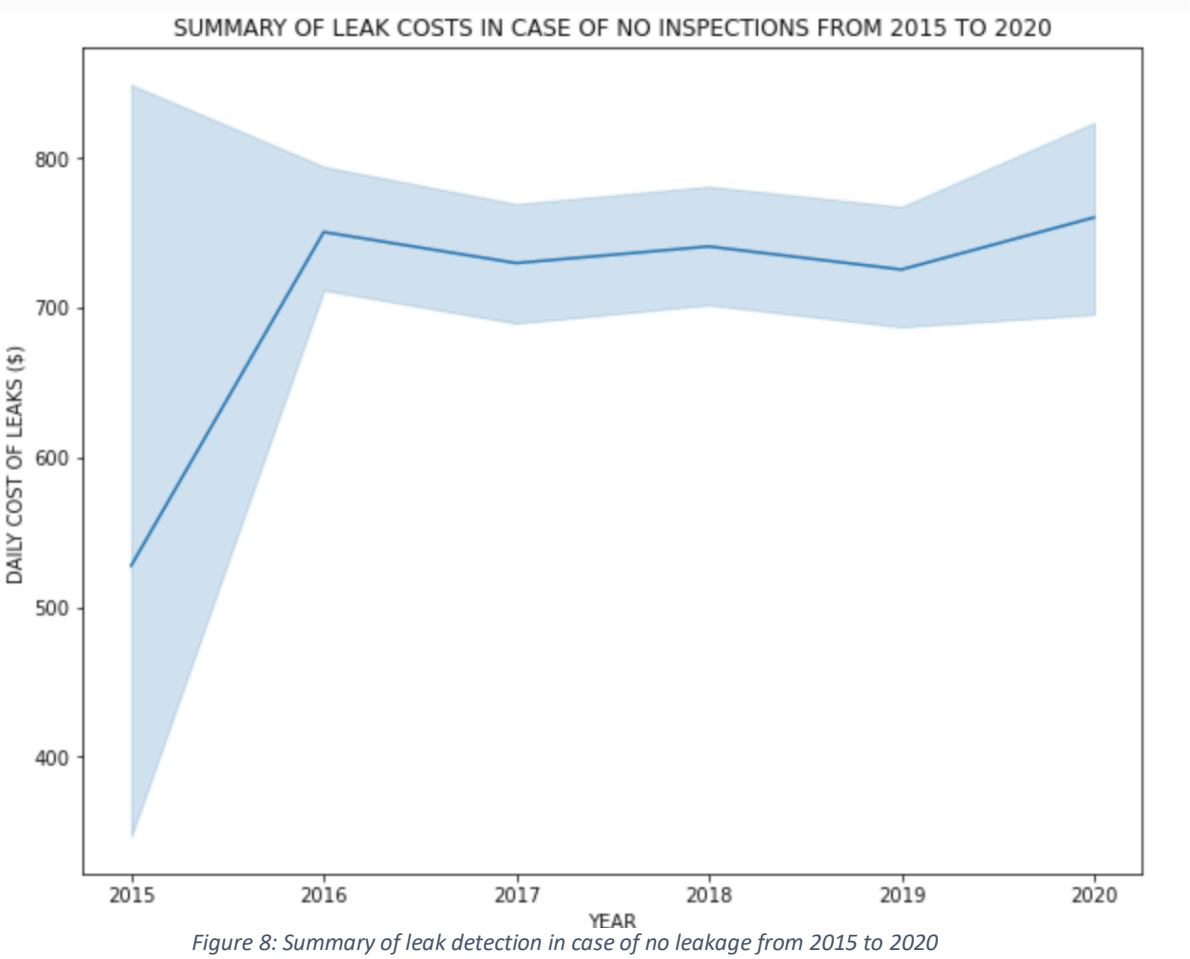

Figure 8: Summary of leak detection in case of no leakage from 2015 to 2020

In case of no leak detection, the daily cost of no leak detection is much lower as compared to facilities with leak detection is performed on a daily basis.

Table 8: Average increase in daily cost of methane leakage detection

Year	Average Cost In Case Of No Inspections ($)	Average Cost In Case Of Inspections($)	Average Increase in Cost of Leak Detection %
2015	550	2000	264
2016	750	2100	180
2017	750	2150	187
2018	750	2200	193
2019	750	2100	180
2020	750	3200	327
Avg.			222

As demonstrated by the Table 8 and Figures 7 and 8 above, daily leak detection cost has increased on an average by 220% as compared to facilities where there is no leak detection.

SUMMARY OF ANALYSIS

- Employing OGI cameras reduced the number of days of any active leaks goes undetected by more than half.
- Methane emissions increased by an average of approximately 140 % when no leak detection was employed in case of active facilities.
- There is no need to employed leak detection in repaired facilities the methane emissions are almost same no matter whether leak detection is employed or not.
- Leak detection resulted in 60% less methane emissions on an average over the span of 6 years i.e. from 2015 to 2020.
- Daily leak detection cost has increased on an average by 220% as compared to facilities where there is no leak detection.

RECOMMENDATION

In case of **active facilities** only, leak detection should be employed. Daily leak detection will cost the company on an average 220% more but it will also result in a reduction of the methane emission by almost 60%. Also, leak detection will also result in the number of days an active leak goes undetected by more than half on an average. Needless to say this will also benefit the environment and help the company's reputation in the long run.