



UNDER THE PATRONAGE OF



सत्यमेव जयते
MINISTRY OF PETROLEUM
AND NATURAL GAS
Government of India

6-9 February 2024, Goa, India

GROWTH. COLLABORATION. TRANSITION

Session Number 18, Methane Monitoring and Abatement

Improving Methane Emission Detection and Quantification with a Holistic Top-down Approach

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The Magnitude?



Satellite-detected methane leaks from human activities, 2021



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Source: Kayrros analysis based on modified Copernicus data.

- Methane's GWP is 86 times worse than CO_2
- 40% of methane emissions are unaccounted for
- The oil & gas industry globally flares over 14.5 billion cubic feet per day¹ of associated gas
- Satellite imagery shows that over 1 Gt CO_2e annually comes from non-routine flaring²
- Over 79 million Tonnes of methane is emitted, from routine flaring³ (> 2 billion Tonnes of CO_2e)

1. Global Gas Flaring Tracker Report, GGFR, The World Bank, July 2020
2. Kayrros flaring report
3. IEA 2022 Global Methane Tracker report,


The Elephant In The Room

- Assumption that a flare is 98% efficient
- Non-routine flaring and venting ignored
- Maintenance, equipment failure and well unloading emissions not accounted for
- Emission factors incorrect – top down bottom up discrepancy



3X HIGHER

Over the course of the project, aircraft measurements have revealed Permian emissions are **2-3 times higher** than what the Environmental Protection Agency estimates in their inventory of greenhouse gas emissions.



“ I knew we would find a lot of pollution, but I had no idea flaring emissions would be this bad. ”

David Lyon

Senior Scientist
Environmental Defense Fund

Satellites, Airplanes, Drones, Sensors, Handhelds....

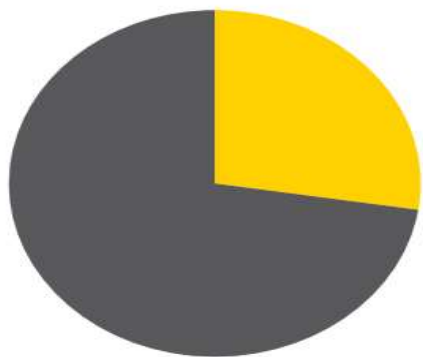


FLARING INSIGHTS

8

Total surveys

1,320 Emission
sources detected



- 362 Malfunctioning Flares
- 958 Other sources (Tanks, vents, valves)

50%

of super emitters
come from midstream
operations.

Super emitters are sites that produce a disproportionate amount of methane pollution, releasing 10 kilograms of methane an hour or more.

Gathering and boosting

Transmission and storage

Pipelines and compressors



Mobile laboratory measurements indicate low-producing “marginal wells” are responsible for half of the Permian Basin’s well pad emissions. More than 75% of these are owned by major corporations.

Sources Of Methane Emissions

Oil and Gas production, Gas processing, Oil processing, Refining and Petrochemical, Pipelines and Utility distribution

- Tank vapours, Valves, Pneumatics and Compressor seals
- Process units – dehydration, amine, etc.
- Well unloading, Flow backs, well testing and workovers
- Compressor, Facility and Pipeline maintenance
- Truck, Rail and Ship loading
- Emergency Shut Downs - ESD's, PSV's
- Abandoned and Suspended wells



Jambi Merang - Indonesia



Loading - Canada



**Well drilling, completions
and production - Europe**

EUROPE

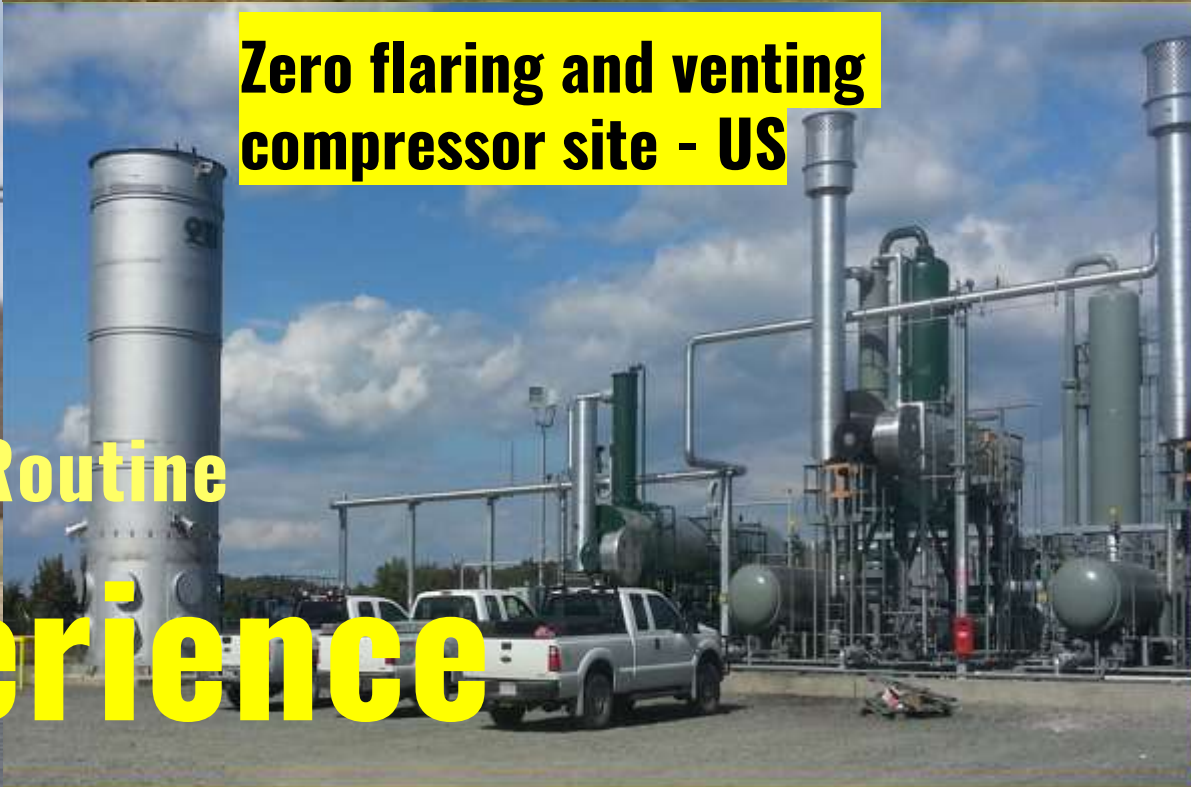


Zohr H₂S- Egypt



Dehy - US

Routine and Non-Routine



**Zero flaring and venting
compressor site - US**

Global Experience

From Well to Wheel

- Emission profiles are different at each stage of the oil and gas value chain
- Wellsite is different from a oil battery which is different from a compressor station
- We cannot lump them all together and use emission factors thinking our job is done.
- Proactive approach along the whole value chain recognizing the uniqueness of each stage and designing to reduce the fugitives, flaring and venting



Zero Flaring And Venting Facilities



One unit can handle multiple streams of varying pressure

Non-Routine and Maintenance

- Maintenance – pipeline, engines,
- Pipeline blowdowns and pigging
- Soft starts
- Equipment failure

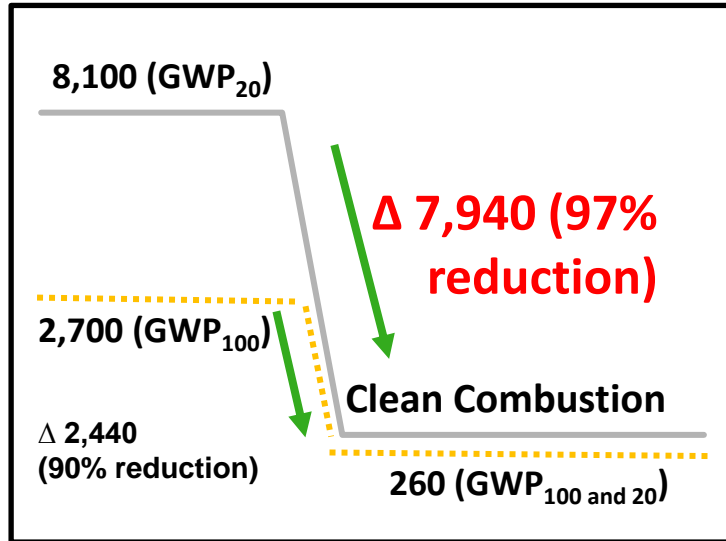
Routine Process

Dehy Still Column, Tank, Amine, Process Units, PSV's, etc.



Pipeline Maintenance Operations

Questor unit eliminating the venting of 5MMSCF/D Methane



tonne CO₂e/day

Methane:

— GWP₂₀ = 84 tonne CO_{2e}

.... GWP₁₀₀ = 28 tonne CO_{2e}

Ref: (IPCC-AR5)

\$0.10 / tCO_{2e}



PIPELINE BLOWDOWN – COLLEGE STATION, TX.
5MMSCF/D

Advantages Of Enclosed Clean Combustion



Power Generation

- ✓ Directly with an internal heating coil
- ✓ Slip stream of flue gas

Heat Recovery for Process



POWER, PROCESS OR WATER EVAPORATION

Opportunity to utilize the Heat;

- ✓ Process heat
- ✓ Break the oil/water emulsion
- ✓ Produced water evaporation
- ✓ Power generation



Water Evaporation

Post combustion gas capture for Carbon Capture, Utilization or Storage (CCUS)

Proven Performance Certified

NORTH DAKOTA FIELD TESTING

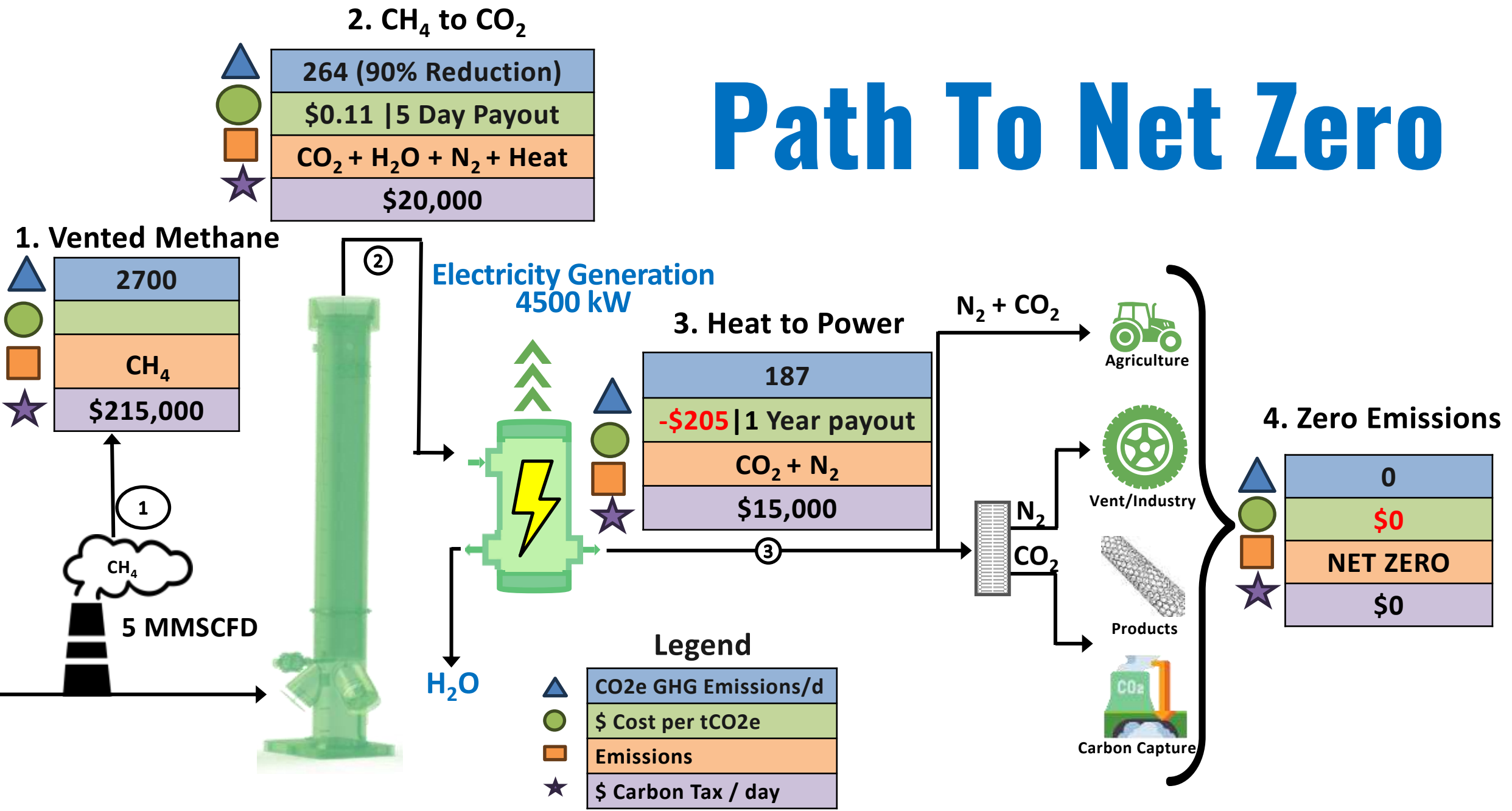


Combustor	Parameter	Test Result				Average
		Test 1	Test 2	Test 3	Test 4	
SITE 1 Q5000-17-164 (west)	VOC DRE %	99.997%	99.998%	100%	100%	100%
	NOx (lb/MMBtu)	0.158	0.200	0.233	0.232	0.206
	CO (lb/MMBtu)	0.110	0.074	0.017	0.067	0.067
	Stack Temperature (°F)	1125	1412	1649	1823	1502
SITE 1 Q5000-17-173 (west)	VOC DRE %	100%	100%	100%	100%	100%
	NOx (lb/MMBtu)	0.140	0.182	0.220	0.287	0.207
	CO (lb/MMBtu)	0.049	0.008	0.002	0.011	0.018
	Stack Temperature (°F)	1046	1348	1522	1852	1442

Combustor	Parameter	Test 1	Test 2	VERIFIED ISO 14034	Average
		Test 1	Test 2		
SITE 2 Q5000-17-183 (east)	VOC DRE %	100%	100%		100%
	NOx (lb/MMBtu)	0.279	0.258		0.263
	CO (lb/MMBtu)	0.001	0.002		0.001
	Stack Temperature (°F)	1758	1860		1792
SITE 2 Q5000-17-173 (west)	VOC DRE %	100%	100%	100%	100%
	NOx (lb/MMBtu)	0.244	0.279	0.281	0.268
	CO (lb/MMBtu)	0.002	0.004	0.002	0.003
	Stack Temperature (°F)	1743	1763	1775	1760

Combustor	Parameter	Test 1	Test 2	Test 3	Average
		Test 1	Test 2	Test 3	
SITE 3 Q5000-17-123 (east)	VOC DRE %	100%	100%	100%	100%
	NOx (lb/MMBtu)	0.178	0.173	0.202	0.184
	CO (lb/MMBtu)	0.092	0.013	0.005	0.037
	Stack Temperature (°F)	1737	1706	1688	1710
SITE 3 Q5000-17-164 (west)	VOC DRE %	100%	100%	100%	100%
	NOx (lb/MMBtu)	0.205	0.198	0.204	0.202
	CO (lb/MMBtu)	0.046	0.049	0.042	0.046
	Stack Temperature (°F)	1735	1754.000	1745	1745

Path To Net Zero



Assumptions:
CH₄ GWP₁₀₀ = 28 tCO₂e; Carbon Tax: \$80/tCO₂e; Heat to power: USEPA eGrid2018 emission factors for power generation; Generation capacity of 4.5 MW; Carbon capture cost \$30/tCO₂e;
Cost of electricity: \$0.16/kWh (AESO average pool cost 2022); \$/tCO₂e for purchase option excludes carbon credits, includes power savings; Payout time includes carbon credits

Continuous Emissions Monitoring



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Detection with Drones,
Satellite, Handheld and
fixed monitors

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BTEX

HAP's

VOC's

Methane

Hydrogen
Sulphide

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Questor Unit
Sensors
monitor

Pressure
Flow
Temperature
BMS
Pilot Status

Predictive
Emissions
monitoring



Transmitting on
30-sec intervals



Continuous monitoring
for zero emissions
using detection tech



Emissions
Excellence Center

Quantification of Carbon offsets for trading

Community Wins

NEWS

Silently sour

Extensive planning helped well workover on Calgary

WITH THE RECENT GAS LEAK in the west of Edmonton, the idea of sour gas makes many people very anxious. So when it comes to a sour gas well workover, no news is good news.

In late October 2004, Nexen Canada Ltd. moved a service rig on to its sour gas wellsite facility, located on the east side of 84 Street NE just north of 16 Avenue NE, to complete maintenance on the well.

Nexen had suspended and isolated the wellsite in October 2003 following a routine inspection that identified a maintenance requirement. The workover entailed inspecting the casing, running new production tubing and sub-surface safety landing nipple and valve to ensure the continued safe operation of

“We used Questor because of the quality of the units. They're the most effective with almost 100 percent efficiency in burning all the gas off. It's a proven unit”

under conditions. Using Questor, we knew where the H2S or CO2 plume would travel.”

The use of the Questor Incinerator for combusting the sour gases (35 per cent H2S) vented from the well and the inclusive method that Nexen used when planning the project allowed for smooth passage of the workover with the EUB, the City of Calgary, the Municipal District of Rockyview and the many residential stakeholders.

“We used Questor because of the quality of the units. They're the most effective with almost 100 per cent efficiency in burning all the gas off. It's a proven unit,” said Seredynski.

Although no sour gas was released during the workover,

Compton Petroleum
Suite 3100, 150-6 A
Petro Canada Centre
Calgary, Alberta
T2P 3Y7

June 13, 2001

To Whom It May Concern

I live one kilometer downwind of a natural gas plant owned by Compton Petroleum. When this company wanted to expand their operations and applied for a permit to incinerate sour gas I was concerned about air quality and bad smells that may result. Not after several months of operations can say that I have never detected any smells from the plant from where I live.

The noise level coming from the plant is such that I can hear it while outside at night if I listen for it, but it is not at a level that would bother anything. I am unable to hear the plant while in the house. The noise might be comparable to that of a large farm tractor working the same distance away – one-kilometer.

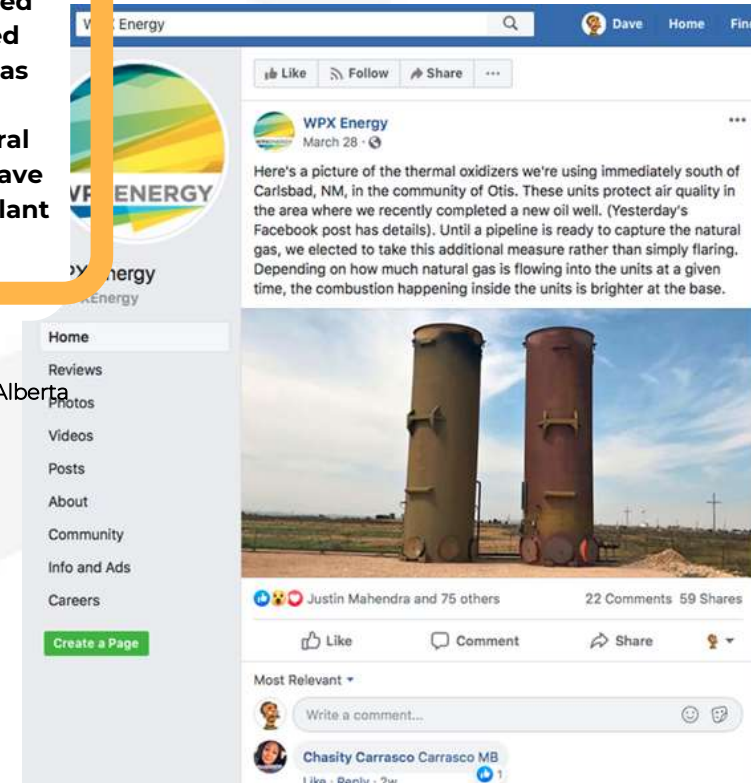
Compton is monitoring air quality in the area on an ongoing basis.

Thank you,

Nelson Ferris
Hines Creek, Alberta

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Nelson Ferris, Hines Creek, Alberta





Clear Solutions. Clean Skies

PRESENTER

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President and CEO

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