CANADA EMISSIONS REDUCTION INNOVATION NETWORK (CERIN) PUBLIC REPORT

1. PROJECT INFORMATION:

Project Title:	Methods for Estimating Emissions from Tanks – Part 2
Emissions Reduction Scope/Description:	Deploy relevant measurement and monitoring techniques for methane vents from uncontrolled hydrocarbons storage tanks, to understand the magnitude of tank emissions, and recommend alternative methods, techniques, and technologies to estimate tank emissions
Applicant (Organization):	Modern West Advisory Inc
Project Completion Date:	March 31st 2023

2. EXECUTIVE SUMMARY:

The magnitude of tank vent rates, the temporal nature of tank vents, the root cause of tank venting, the difference between actual vent rates and reported vent rates, and the viability of emerging technologies to detect and quantify tank vent rates, are not widely understood or known.

Previous work led by Modern West Advisory (MWA) studied tank venting in Alberta. Components of this work included:

- Installation of (temporary) meters to directly measure tank vent rates.
- Perform aerial surveys to categorize methane releases by process block, including emissions from uncontrolled and controlled hydrocarbon storage tanks.
- Compare direct measurement of tank vents with aerial surveys by concurrent deployment.

Key observations from previous work that steered this project included:

- Aerial surveillance is an effective way of identifying emissions by process block, including uncontrolled hydrocarbon storage tanks.
- Direct measurement of tank vents demonstrated the intermittent nature of tank venting. Non-continuous measurement can be challenged to detect and quantify intermittent releases.

- Oil single-well batteries without separators have a disproportionate contribution to province-wide methane despite their relatively small population.

The original Project Scope for Methods for Estimating Emissions from Tanks – Part 2 was developed in August 2022 and included two key components:

1. Field work that included aerial surveillance with follow-up by ground crews to directly meter tank vents.
2. Desktop review of 2022 Bridger Surveys in a different area of AB than previously studied, to inventory emissions by process block, including uncontrolled hydrocarbon storage tanks.

Field work was delayed until March 2023, which presented unique challenges and opportunities.

Lidar Services International (LSI Inc) and Telops Inc had recently commercialized a passive, infrared hyperspectral imaging system for aerial methane detection and quantification. Unlike other infrared and aerial systems, water and snow does not interfere with methane detection. This would enable year-round deployment.

The LSI/Telops team deployed to 72 sites south of Edson on March 16th, 17th, and 18th 2023. Sites were a combination of oil and gas batteries pre-screened for hydrocarbon storage tanks, and gas plants and gathering systems with condensate storage tanks. Six (6) sites had meters temporarily installed ahead of LSI/Telops deployment for concurrent quantification.

Key observations and conclusions from the LSI/Telops aerial surveys include:

- LSI/Telops aerial deployment can detect and quantify methane releases during winter months with snow cover on the ground.
- Uniquely, LSI/Telops can calculate the Lower Detection Limit (LDL) on each aerial pass for each facility. This is very useful, particularly for sites without methane detections, since the LDL becomes the maximum single-point release rate the site can expect.
- LSI/Telops currently states that the Probability of Detection (PoD) is 85% when the actual release rate is above the calculated LDL.
- LDL was seen to vary significantly between days, which should be expected. Changing wind, light, shadows, ground reflectivity, and temperature all impact the calculation of LDL as well as the probability of detection and the quantification of releases.
- Twenty (20) of 72 sites had methane releases detected by LSI/Telops, with 100 detections in total. Of the 100 detections, only 50% were quantified. LSI/Telops expects quantification, LDL, and PoD estimates to improve with more field testing and controlled release studies.

- LSI/Telops results aligned reasonably well with direct measurement. Tanks, compressors, and separator buildings all had detections. However, quantification was challenged, typically well below large, metered releases.
- Tanks at one of the surveyed gas plants was venting due to upstream well operations. During spring breakup, road access is limited, and liquids-hauling trucks cannot get to certain well sites to truck away water and oil. This is a recurring problem and was flagged in previous studies.

Other key observations from Direct Measurement include:

- Deploying direct measurement is best done in dry and above-freezing conditions. Snow conditions made site access challenging at times, and there is some evidence of meter freezing as evening ambient temperatures drop.
- Oil and Gas batteries with separators have shown again to have intermittent venting with the occasional large spikes in vent rates, but overall, a low average vent rate. One battery showed temporal effects, with venting increasing with the daytime increase in ambient temperature. See Figure ES-1 and ES-2, following.
- Intermittent venting remains a challenge for any non-continuous detection technology, including aerial surveillance.

Key observations from the review of 2022 Bridger data include:

- Bridger Photonics performed aerial campaigns in the Edson area in 2022. Operators shared the results of these campaigns for analysis and reporting in aggregate. Surveys occurred in May and June 2022.
- Total facilities surveyed and reviewed for this project is 632. However, gas facilities dominated the inventory. This was not by design. This is simply a combination of area of interest and operators who volunteered 2022 Bridger data.
- Only 24 hydrocarbons storage tanks were identified, with only 2 releases, both Oil Single Well Batteries.
- Water tanks outnumbered oil tanks. Sixty-nine (69) water tanks, with 4 releasing methane
- Releases from separator buildings and associated equipment make up 60% of the study's emissions, dominating the inventory.
- Releases from compressors make up 32% of the study's emissions.
- Combined, releases from separators and compressors are over 90% of the total methane inventory.
- Intermittent releases make up just over 50% o the releases by volume, and 60% by count. This is important from a detection technology point of view.

Key observations from the review of oil single-well batteries without separators include:

- Previous work concluded that 66% of emissions from uncontrolled tanks came from oil single-well batteries without separators.

- This project identified and located 1,177 oil single-well batteries without separators. Figure 1, following, show these locations and can be the basis for further field work in 2023.

3. KEY WORDS

Methane

Oil and Gas

Tanks

Detection

Quantification

4. APPLICANT INFORMATION:

Applicant (Organization):	Modern West Advisory Inc
Address:	Suite 400 505, 2nd St SW Calgary AB T2P 1N8
Applicant Representative Name:	Wayne Hillier
Title:	VP Technology
Applicant Contact Information:	whillier@modernwestadvisory.com

5. LEAD CONTRIBUTING PARTNER INFORMATION:

Organization:	Modern West Advisory Inc
Address:	Suite 400 505, 2nd St SW Calgary AB T2P 1N8
Representative Name:	Wayne Hillier
Title:	VP Technology

6. PROJECT PARTNERS

Calscan Solutions Inc

LSI Inc.

A. INTRODUCTION

The magnitude of tank vent rates, the temporal nature of tank vents, the root cause of tank venting, the difference between actual vent rates and reported vent rates, and the viability of emerging technologies to detect and quantify tank vent rates, are not widely understood or known.

Methods for Estimating Emissions from Tanks – Part 1 was jointly funded by CanERIC, CRIN, and PTAC AUPRF. **Methods for Estimating Emissions from Tanks – Part 2** was funded by NRCan thru CERIN's CanERIC. Both projects sought answers to many of these questions.

Key Objectives included:

1. Deploy relevant measurement and monitoring techniques for methane vents from uncontrolled fixed-roof liquid storage tanks in Alberta.
2. Understand the magnitude of tank emissions and the reasons for variability in emission rates.
3. Recommend alternate methods, techniques, and technologies to estimate tank emissions.

B. METHODOLOGY

Methods for Estimating Emissions from Tanks – Part 2 had 3 main components:

- Evaluate LSI/Telops new hyper-spectral infrared camera for methane detection and quantification,
- Access historical Bridger surveys to develop a methane inventory by asset type, process block, and to assess whether releases were persistent or intermittent.
- Identify and locate oil single-well batteries without separators.

LSI/Telops hyper-spectral infrared camera can work with snow on the ground. Seventy three (73) facilities, many with hydrocarbon storage tanks, were identified in the Edson area. Six (6) sites had meters installed on tank vents, to directly compare LSI/Telops quantification.

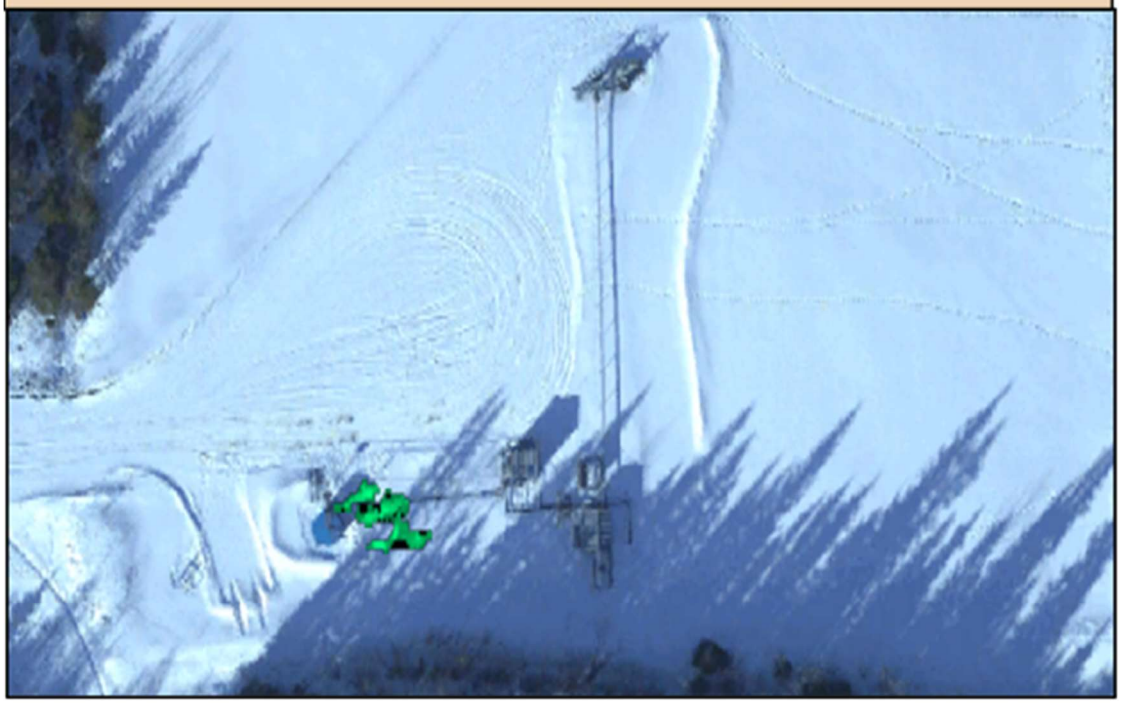
Participating operators provided Bridger surveys from spring 2022 for the Edson area. A total of 632 gas facilities were compiled, including multiwell pads, batteries, gas gathering systems, compressor stations, and gas plants.

Oil single-well batteries are identified from monthly Petrinex volumetric reports. Oil single-well batteries with oil and gas production, but no gas disposition and no gas flaring, will likely not have an operating separator. Lack of a produced gas pipeline confirms the lack of an operating separator.

C. PROJECT RESULTS AND KEY LEARNINGS

- LSI/Telops aerial deployment can detect and quantify methane releases during winter months with snow cover on the ground. LSI/Telops results aligned reasonably well with direct measurements. Tanks, compressors, and separator buildings all had detections. However, quantification was challenged, typically well below large, metered releases.
- See Figure A2-10a, following, for an example of LSI/Telops detections at a Gas Single Well Battery.
- Four-season aerial deployment capability will become increasingly important. Forest fires and floods are the new normal, impacting the ability for aerial surveys in the summer and fall.
- Uniquely, LSI/Telops can calculate the Lower Detection Limit (LDL) on each aerial pass for each facility. This is very useful, particularly for sites without methane detections, since the LDL becomes the maximum single-point release rate the site can expect.
- LSI/Telops currently states that the Probability of Detection (PoD) is 85% when the actual release rate is above the calculated LDL.
- LDL, PoD, and Quantification will improve as LSI/Telops performs more field work and controlled release studies. LSI/Telops will benefit from Alberta's testing facilities including NGIF ETC in Edson area and CMC in Brookes.
- Direct measurement of Tank Vents with Calscan's portable turbine meter continues to expand our knowledge of tank vents. Batteries with well run separators will exhibit intermittent venting, with short-duration spikes to 500 m3/day, but an average vent rate of less than 10 m3/day. See Figure ES-2 below.
- Bridger Photonics performed aerial campaigns in the Edson area in 2022. Operators shared the results of these campaigns for analysis and reporting in aggregate. Surveys occurred in May and June 2022. Total facilities surveyed and reviewed for this project is 632.
- Only 24 hydrocarbons storage tanks were identified, with only 2 tanks with releases, both Oil Single Well Batteries.
- Combined, releases from Separators ands compressors are over 90% of the total methane inventory. Intermittent releases make up just over 50% o the releases by volume, and 60% by count. Table 2.3a below summarizes Bridger Releases by process block and persistency.
- Previous studies have identified oil single-well batteries without separators as a major contributor to methane inventories in the province, however, none of the 600+ Edson-area sites surveyed by Bridger in 2022 were oil single-well batteries without separators.
- From Petrinex Volumetric Reports, a total of 1,177 oil single-well batteries without separators were operating in 2022. These are mapped in Figure 1, following. This map can support future studies to confirm vent rates and identify conservation opportunities.

Figure A2-10a: Site #10 Gas Single Well Battery with LSI/Telops Detections



LSI Detection Parameters

Date	Process Block	# of Detections	# of Detections Quantified	Thermal Contrast ΔT°C	Wind Speed (m/s)	Detection Limit (m^3/day)	Release Rate (m^3/day)
16-Mar	Tanks	3	3	8.5	2.3	168	149
17-Mar		0		7.0	0.7	47	
18-Mar		0		5.2	1.0	118	

Figure ES-2: Oil Single-well Batteries with Separator – Direct Measurement of Tank Vent

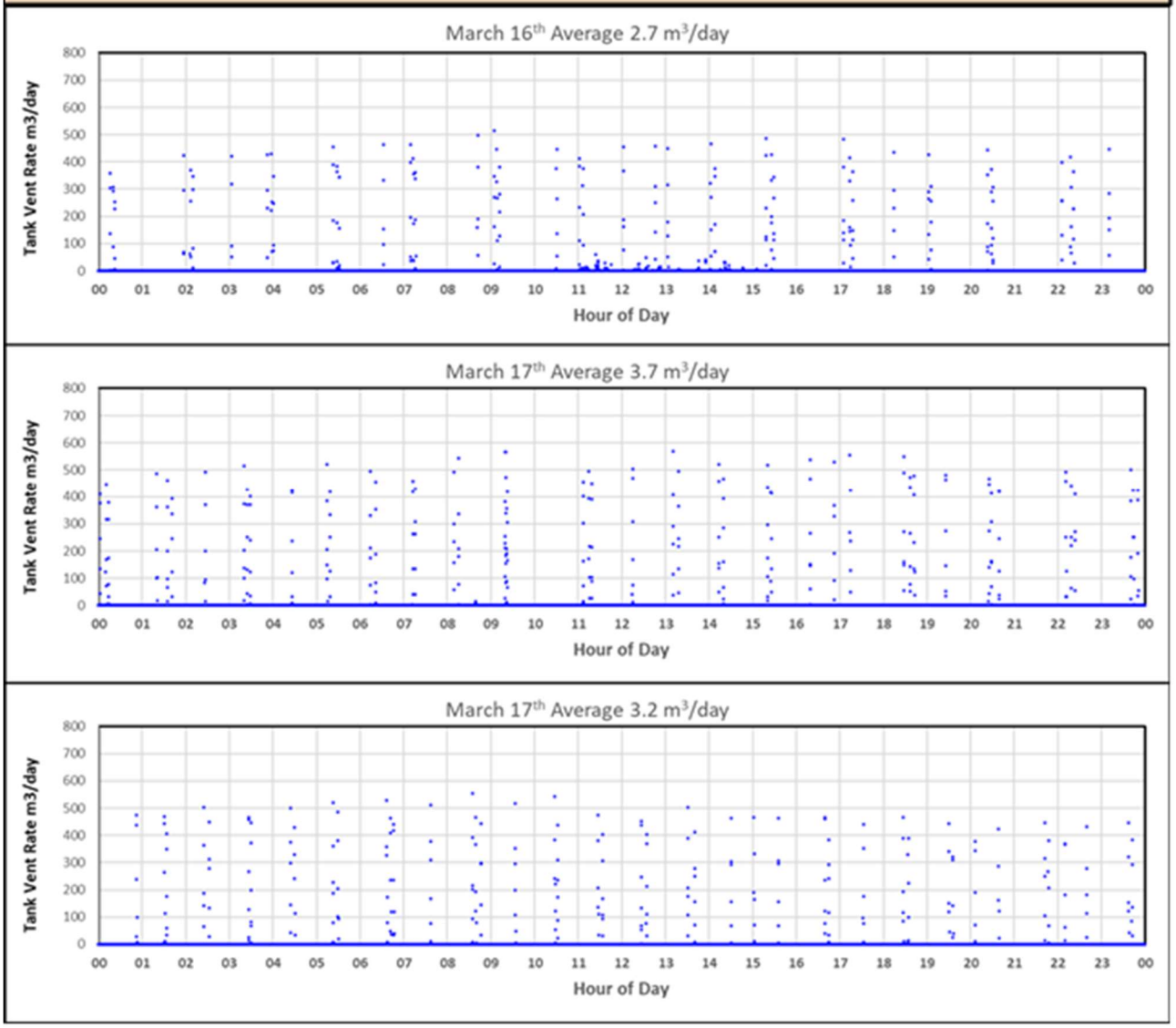
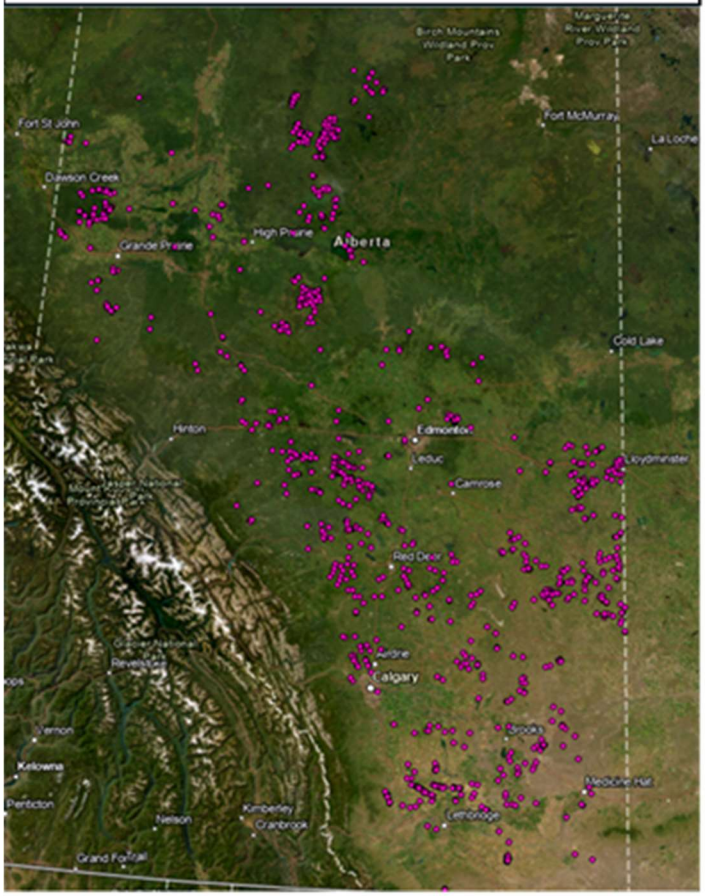


Table 2.3a: 2022 Bridger Surveys–Emission Rate by Process Block and Persistency

Process Block	Persistent m^3/day	Intermittent m^3/day	Total m^3/day
Separation	8,135	14,534	22,669
Compression	6,577	5,745	12,321
Tank – Water	583	636	1,219
Tank – Oil	417	61	478
Flare	294	95	389
Misc	158	366	524
tbd	602	199	801
Total	16,766	21,636	38,402

Figure 1: AB Oil Single-well Batteries without Separators



D. PROJECT AND TECHNOLOGY KEY PERFORMANCE INDICATORS

Organization:	Current Study	Commercial Deployment Projection
Project cash and in-kind cost ($)	$500K	n/a
Technology Readiness Level (Start / End):	9	n/a
GHG Emissions Reduction (kt CH4/yr):	n/a	n/a
Estimated GHG abatement cost ($/kt CH4)	n/a	n/a
Jobs created or maintained:	n/a	n/a

E. RECOMMENDATIONS AND NEXT STEPS

Continue to evaluate Telops/LSI aerial technology. Provide LSI with a comprehensive data set of controlled and metered releases, allowing LSI/Telops to improve the accuracy and confidence in detection limits and quantification. LDL, PoD, and Quantification will improve as LSI/Telops performs more field work and controlled release studies. LSI/Telops will benefit from Alberta's testing facilities including NGIF ETC in Edson area and CMC in Brookes.

Recommend additional Area-based Aerial Detection and Quantification surveys across Alberta to establish methane inventories of persistent and intermittent release by facility type and equipment, including tanks. Incorporate local wind measurement to improve quantification. Integrate with other detection technologies. Repeat area surveys annually to identify emission trends.

Oil Single-well Batteries without Separators should be investigated further to confirm persistent tank vents and to identify vent reduction opportunities.