

# GreenPath Energy Ltd. Alberta Field Methane Survey August-December 2016

EERL Methane Symposium  
Carleton University, Ottawa  
November 21, 2017

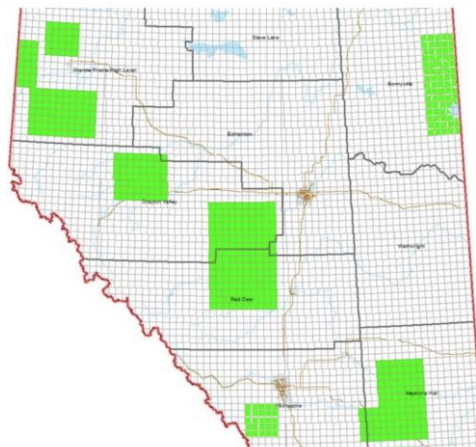


## About GreenPath Energy Ltd.

Founded in 2007, GreenPath Energy offers a range of Oil and Gas methane emission detection, measurement, and inventory development services for regulatory compliance and elimination programs. We engage regularly with governments, regulatory agencies, industry associations and emission reduction technology providers to ensure leading edge, cost effective methane emission management solutions.

## Emission Field Survey & Inventory Overview

- Emission leak & inventory development survey in Alberta to help refine emission estimates for regulatory development
- Project focus on wells and batteries facility types due to gaps in previous industry studies.
- 1st Stage - Over 5 weeks during summer months;
  - 300+ wellsite and battery locations were surveyed and inventoried
  - OGI for leaks
  - Inventory of pneumatics controllers and chemical injection pumps, tanks, etc
- 2nd Stage - Over 3 weeks in November/ December:
  - 279 Wells & batteries inspected by OGI for production surface casing & tank top vents
  - A further 60 wells and batteries emission surveys and equipment inventory completed
- Total of 676 producing assets surveyed and inventoried.



## Targeted Facility Types Within Survey

Facility Type	BV	DV	FM	GP	MH	MR	RD	SL	ED	WW	Total	Survey Area Total	% of total
Gas Well	2,465	7,869	71	8,082	52,347	16,401	16,018	623	2,981	4,722	111,579	100,717	90%
Oil Well	32	5,140	0	4,098	4,772	1,440	4,048	1,403	2,912	7,161	31,006	19,498	58%
Crude Oil Group	1	30	0	33	27	19	50	27	27	155	369	159	38%
Crude Oil Single	26	597	0	490	407	486	791	198	296	1,082	4,373	2,771	52%
Gas Group	133	399	4	314	246	217	780	20	233	202	2,548	1,956	68%
Gas Group NLR	0	2	0	3	2	4	37	0	5	1	54	48	81%
Gas Proration Not SE AB	10	1	2	36	99	185	303	2	10	49	697	624	63%
Gas Proration SE AB	2	1	0	0	313	109	10	0	0	5	440	433	74%
Gas Single	22	885	0	507	209	257	1,620	5	366	165	4,036	3,478	80%
<b>Total</b>	<b>2,691</b>	<b>14,924</b>	<b>77</b>	<b>13,563</b>	<b>58,422</b>	<b>19,118</b>	<b>23,657</b>	<b>2,278</b>	<b>6,830</b>	<b>13,542</b>	<b>155,102</b>	<b>129,684</b>	<b>84%</b>

## # Locations & Well Surveyed

# Locations Surveyed (LSD)	BV	DV	GP	MH	MR	RD	TOTAL
Gas	0	79	38	52	32	34	235
Oil-Bit	102	11	1	8	6	16	144
Unknown	0	2	1	1	0	3	7
<b>TOTAL</b>	<b>102</b>	<b>92</b>	<b>40</b>	<b>61</b>	<b>38</b>	<b>53</b>	<b>386</b>

# Wells surveyed	BV	DV	GP	MH	MR	RD	TOTAL
Gas	0	118	76	54	32	49	329
Oil-Bit	0	16	1	8	6	29	60
CHOPS	279	0	0	0	0		279
Unknown	0	2	1	1	0	3	7
<b>TOTAL</b>	<b>279</b>	<b>136</b>	<b>78</b>	<b>63</b>	<b>38</b>	<b>81</b>	<b>675</b>

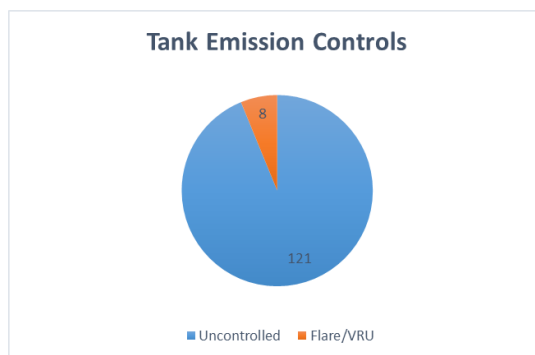
## Emission Detection Method



- Project emission technologists utilized FLIR GF320 OGI Camera
- Potential to emit components were screened from 3-5ft
- Tank tops visualized from a close distance while ensuring tank top could be seen. Typically 20-30ft
- HSX mode utilized

## Leaks / Vents Findings

- Most tanks vents are uncontrolled
- CHOPS wells commonly venting from tank tops/ casing. 22 non-pneumatic emission sources for every 10 sites.
- Oil sites more were more emission prone than gas production sites. Approximately 7 non-pneumatic emission sources (Leaks + Vents) for every 10 sites
- Gas sites approx. 3 non-pneumatic emission sources (Leaks + Vents) for every 10 site



Average # of Emission Sources (non-pneumatic) per Land Location by Commodity type	BV	DV	GP	MH	MR	RD	All Areas
Gas		0.23	0.53	0.1	0.03	0.47	0.26
Oil		0.18	3.00	0.25	-	1.31	0.67
CHOPS	2.21						2.21
TOTAL	2.21	0.22	0.58	0.11	0.02	0.70	0.79

## Pneumatic Findings

- Most pneumatic devices utilized methane fuel gas 1608 of total 1688 devices censused
- Several zero emission well packages (solar / electric dump valves) found at northern latitudes
- Higher average # of pneumatic devices per site than previously thought
- Level Controllers the most common pneumatic device
- Further level controller emission rates research being completed by GreenPath to refine emission factor and emission contributions
- No pneumatic inventory development in Bonnyville area

Average # Of Devices Per Well	DV #3	GP #1	MH #5	MR #4	RD #2	Total
Pump	1.22	1.90	0.38	0.64	1.31	1.18
Instrument	3.06	4.26	0.94	1.59	4.32	3.07
Total	4.28	6.15	1.32	2.23	5.63	4.25

Heat Trace	HLSD	HPSD	Level Control	Plunger Lift Control	Positioner	Pressure Control	Temp Control	Transducer
0.2%	14.4%	12.5%	41.4%	2.0%	1.8%	17.4%	0.9%	9.4%

## Drayton Valley Area

- Diverse production commodity types
- Mixture of sites with and without pneumatic controls
- Large diversity of producing operators in sample set
- Ranked #3 of 5 areas of highest average count (4.28) of pneumatic devices per well
- Ranked #4 of 6 areas of highest average emission sources (0.22) per land location
  - Approx. 2 non-pneumatic emission sources per 10 land location

Facility Type	Area Count	GPE Sample
Gas Well	7,869	98
Crude Oil Well	5,140	14
Crude Oil Multiwell Proration Battery	30	1
Crude Oil Single Well Battery	597	1
Gas Multiwell Group Battery	399	4
Gas Group NLR	2	0
Gas Proration Not SE AB	1	1
Gas Single Well Battery	885	15
n/a	0	2
<b>Total</b>	<b>14,923</b>	<b>136</b>

Facilities in Area and GreenPath Energy Sample

## Grande Prairie Area

- Sample sites largely gas production
- Oil production sites geographically focused in different part of administrative region
- Several multi-well facilities in area
- Ranked #1 of 5 areas of highest average count (6.15) of pneumatic devices per well
- Ranked #3 of 6 areas of highest average emission sources (0.58) per land location
  - Approx. 6 non-pneumatic emission sources per 10 land locations

Reporting Entity	Total Count	GPE Sample
Gas Well	8,082	40
Oil Well	4,098	1
Crude Oil Group	33	
Crude Oil Single	490	
Gas Group	314	2
Gas Group NLR	3	0
Gas Proration Not SE AB	36	31
Gas Proration SE AB	0	0
Gas Single	507	0
Compressor Station	n/a	2
Gas Gathering System	n/a	1
Enhanced Recovery Scheme	n/a	1
<b>Total</b>	<b>13,563</b>	<b>78</b>

Facilities in Area and GreenPath Energy Sample

## Medicine Hat/ Midnapore

- Two areas represent almost half of targeted facilities
- CBM wells in sample largely did not have pneumatic devices
- Uniformity among assets surveyed
- Ranked #4 (MR) #5(MH) of 5 areas of highest average count (2.23 & 1.32) of pneumatic devices per wellsite
- Ranked #5 (MH) # 6(MR) areas of highest average emission sources (0.11 & 0.02) per land location
  - Approx. 1.5 non-pneumatic emission sources per 10 land locations

Reporting Entity	MH	MR	Total	GPE
Gas Well	52,347	16,401	68,748	66
Coalbed Methane Well	In above	In above	In above	14
Oil Well	4,772	1,440	6,212	8
Crude Oil Group	27	19	46	0
Crude Oil Single Well Battery	407	486	893	6
Gas Group	246	217	463	0
Gas Group NLR	2	4	6	0
Gas Proration Not SE AB	99	185	284	0
Gas Proration SE AB	313	109	422	3
Gas Single Well Battery	209	257	466	0
Compressor Station	N/A	N/A	N/A	3
Water Injection well	N/A	N/A	N/A	1
<b>Total</b>	<b>58,422</b>	<b>19,118</b>	<b>77,540</b>	<b>101</b>

Facilities in Area and GreenPath Energy Sample

## Red Deer Area

- Most diverse sample population
- Mix of oil and gas production facilities
- Zero emissions well-sites operating found in this area
- Evidence zero emission systems had operated without incident for long periods of time.
- Ranked #2 of 5 areas of highest average count (5.63) of pneumatic devices per well
- Ranked #2 of 6 areas of highest average emission sources (0.70) per land location
  - Approx. 7 non-pneumatic emission sources per 10 land locations

Reporting Entity	Area Count	GPE Sample
Gas Well	16,018	26
Oil Well	4,048	5
Crude Oil Group	50	6
Crude Oil Single Well Battery	791	19
Gas Group	780	9
Gas Group NLR	37	0
Gas Proration Not SE AB	303	1
Gas Proration SE AB	10	0
Gas Single	1,620	11
Compressor Station	N/A	1
Meter Station	N/A	1
N/A	0	1
<b>Total</b>	<b>23,657</b>	<b>81</b>

Total Subject Facilities and GreenPath Sample

## Bonnyville Area

- Different Survey Procedures
  - No Major Equipment count
  - No Pneumatic census
  - Observable leaks and tank vents via OGI
  - AER Staff conducted vas majority of inspections
- Overlap in area surveyed by Carleton and EDF Researchers
- Ranked #1 of 6 areas of highest average emission sources (2.21) per land location
  - Approx. 22 non-pneumatic emission sources per 10 land locations

## GreenPath Observations

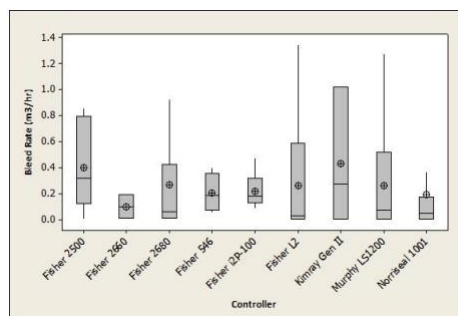
- Locations had tendencies to be either leak free or exhibit multiple leaks. Points to 20/80 rule of thumb
- Locations tended to have no pneumatics or inversely multiple pneumatic devices in operation
- Total count of censused pneumatics higher than expected compared previous industry knowledge
- Licensed facility type does not indicate what is actually on site in terms of production equipment
- Average 2 chemical injection pumps per well in GP area. Other areas had lower averages. Non-winter pumping observed including methanol injection
- Oil sites demonstrated high # of emission sources due to uncontrolled tank top venting
- Low emission i.e./ solar well site configurations overserved to be in operation for 10+ years
- Further study of level controller emission contributions warranted base on device being most common to all production area

## Recent/ Ongoing GreenPath Studies on Methane Emissions

- Cold Weather Pump Alternatives:
  - [http://auprf.ptac.org/wp-content/uploads/2016/08/Pneumatic-Pump-Alternatives-for-Cold-Weather-GreenPath-Energy-April-2016\\_Report\\_r2-1\\_WEB.pdf](http://auprf.ptac.org/wp-content/uploads/2016/08/Pneumatic-Pump-Alternatives-for-Cold-Weather-GreenPath-Energy-April-2016_Report_r2-1_WEB.pdf)
- Historical Fugitive Emissions Management Program Assessment
  - <http://auprf.ptac.org/wp-content/uploads/2017/02/Report-FUGITIVE-EMISSIONS-16-ARPC-02.pdf>
- Level Controller Emission Factor Update - 2018 release
  - GreenPath is currently completing field study on level controllers on behalf of the Alberta Upstream Petroleum Research Fund.
  - 150+ field measurements taken
  - Program of retrofit underway along with pre-post measurement

## Level Control – Area for Further Study

- Most variable venting pneumatic device in David Allen Study
- Manufacture steady state bleed rate a poor predictor of actual emissions
- Emissions from an active pneumatic device comprised of three elements;
  - Steady State (bleed)
  - Transient (about to dump)
  - Dynamic (dump vent)
- In an active device, dynamic may be the most significant contributor to emissions
- Large variance in reported values in Prasino Study (see right)
- Low emission controllers such as the L2sj and Norriseal EVS were not part of Prasino Study.
- GreenPath is currently completing field study on level controllers on behalf of the Alberta Upstream Petroleum Research Fund.
  - Over 150 Field measurements taken
  - Program of retrofit underway along with pre-post measurement
  - Study results expected early 2018



Source: 2013 Prasino Report