# Appendix A: Service Provider Questionnaire

**Questions will have a bracketed 3 number system highlighted in yellow for response rate of (X,Y,Z) where:**
**X = Response recorded**
**Y = No response due to NDA or other reason**
**Z = No response**
**Total respondents: 24**

**LDAR Feasibility Study: Invitation to Participate**

**Background:** The Petroleum Technology Alliance of Canada (PTAC) through DXD Consulting Inc. and its academic research partner at the University of Calgary, is conducting a feasibility study to address the knowledge gap between methane leak detection technology testing and commercial implementation in upstream and midstream oil and gas operations in Alberta. It is widely anticipated by industry and regulators that "alternative" methane leak detection and repair (LDAR) service providers will be prepared and available for work in the first quarter of 2020. However, it remains unknown whether these companies can (1) mitigate fugitive emissions as well as Method 21 or OGI cameras, (2) do so at a lower cost, (3) work legally and safely in Canada, and (4) scale operations to conduct up to tens of thousands of surveys per year that may be required across Alberta, beginning in January 2020.

The LDAR Feasibility Study is designed to compile and assess comprehensive data on methane leak detection technology performance, costing, and scaling from all market-ready and prospective service providers and technology developers. On behalf of PTAC and its members, we invite your organization to complete the following questionnaire. This questionnaire solicits key commercial and technical details from solution providers intending (now or at a future date) to enter the Canadian LDAR market. All participant information and related responses will be anonymized and aggregated for reporting.

**Participant Value Proposition:** The results from the Feasibility Study will be used to develop LDAR field programs for deployment as early as 2020. This information-gathering stage of the pilot program will create a comprehensive database of available solutions, helping us to develop effective LDAR programs for upstream oil and gas producers and midstream operators. After conclusion of the study, the most promising companies may be approached for additional modeling, analysis, and deployment.

In addition, at the written request of a participant, PTAC (via its website and related information services) will publish a respondent's company name, contact information and link to the participant's corporate/product/service website – no other details will be provided. Notably, this will provide methane leak detection technology developers and vendors with exposure to upstream and midstream operators across Canada – a market of in excess of 40,000 facilities requiring LDAR services.

**Commercial readiness:** We strongly encourage a wide range of companies to participate, ranging from those with low commercial readiness or limited scalability to those who have many years of experience providing LDAR services. We are looking to the future, and it will be important to be on this list as we continue to grow and explore new and innovative LDAR programs.

**Instructions:** We encourage participants to be as detailed and honest as possible. Embellishing the performance or playing down the cost of services may heighten initial interest, but will lead to problems during testing and deployment and may ultimately damage your organization's reputation. Before starting, we encourage participants to review the following open-source article in the journal Elementa [link]. This brief article covers important definitions and concepts for those seeking participation in an Alt-LDAR economy. In particular, pay close attention to the definitions of leak detection *technologies*, *methods*, and *programs*.

**Anonymity:** The findings from this study will be synthesized and shared with oil and gas producers and may form the basis of a peer-reviewed publication in which all identifying information, trademarks, and any specified proprietary information will be anonymized.

Please complete the questionnaire by **SET DEADLINE**. Feel free to include any available evidence to support your application (e.g. independent controlled releases, sample data products, etc.) Note that if your organization has multiple stand-alone deployment methods, an individual questionnaire should be filled out for each of them. However, if multiple pieces of equipment or sensors make up a single method, a single questionnaire should be submitted for the method.

Questions regarding the program are welcome and can be directed to fempfeasibilitystudy@ptac.org

*THE FOLLOWING WILL GO INTO AN ONLINE FORM (E.G. SURVEY MONKEY)*

**Application Information**

Applicant Organization:

Applicant:

Contact Information:

Role:

Date:

**Definitions**

For the purpose of this study, we use the following definitions:

- fugitive emissions (i.e., leaks): unintentional releases of hydrocarbons from sources that should not be emitting (e.g. broken valves, flanges, etc.)
- vented emissions: intentional releases of hydrocarbons, typically in a controlled manner, resulting from normal process conditions
- technology: a gas sensing instrument, optionally configured with a deployment platform and/or ancillary instruments (e.g. anemometers, positioning), that can be used to gather data on emissions.
- method: combines a technology, a work practice, and analytics for use in an LDAR program. A method must clearly state any mandatory actions to be performed as part of the work practice, along with suitable operating conditions for the technology. These can include environmental conditions, limitations on facility-types, technology configurations, and survey procedure.
- LDAR program: the systematic implementation of one or more methods across a collection of assets. The program describes the method, or combination of methods, to be used for each facility, along with survey frequency, repair response, and reporting standards. Ultimately, it is the LDAR program that results in emissions mitigation, not the technologies or methods in isolation.

**Survey and Data Management**

Please confirm that your understanding that all data collected as a part of this study is anonymous (tick Y)

Please select "yes" if you wish for your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (anonymity is preserved) (tick Y/N)

**General Information and Logistics**

1. Does your organization have commercial LDAR surveying experience (*tick Y/N/NA/unknown/decline to answer*)? If yes, please describe (*text box*). (23/1/0)
2. Is your organization able (legally/logistically/etc.) to work in Canada (*tick Y/N/NA/unknown/decline to answer*)? (24/0/0)
3. Is your organization able (legally/logistically/etc.) to work in the US (*tick Y/N/NA/unknown/decline to answer*)? (24/0/0)

4. Please describe any safety concerns, risks, interruptions or annoyances possibly introduced by your product/service when completing LDAR surveys (*text box*). (22/0/2)
5. Has the recent COVID-19 outbreak and/or market conditions affected/will affect your operations? (*Y/N/NA/unknown/decline to answer*) (24/0/0)
6. Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes. (24/0/0)
7. Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes. (23/0/1)
8. Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP? (21/0/3)

**Involvement in an LDAR program**

9. Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to) (*text box*):
    a. Does your organization offer a technology or a method (see definitions)? (21/1/2)
    b. Does your organization offer a product, a service, or a combination? (21/1/2)
    c. Is the method mobile or stationary? (21/1/2)
    d. Does your method require site access, or does it measure remotely? (21/1/2)
    e. What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together. (22/0/2)
    f. What is the specific work practice? Be as detailed as possible. Examples may include, but are not limited to: (20/2/2)
        i. At what distances from source are measurements taken?
        ii. What sensors are employed and how?
        iii. How many people comprise one field crew? What are their roles?
        iv. How much time do is spent surveying each potential source?
        v. How much training are field staff required to have??
        vi. What output data are generated and reported?

10. LDAR programs are required to mitigate fugitive emissions (i.e. unintentional emissions). However, most sites in Alberta and elsewhere have legal venting (i.e. intentional

emissions), which often accounts for 50-90% of total site emissions. In order to reduce fugitive emissions, individual leaks (at the component scale) must be tagged for repair.

a. What scale(s) does your method target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks (*tick component, equipment, facility*)? (22/0/2)
b. Is your method able to distinguish vented from fugitive emissions (*tick Y/N/unknown/decline to answer*)? If yes, how (*text box*)? If not, how does it account for potential false positives (*text box*)? (21/1/2)
c. Does the work practice lead to diagnosis and tagging of individual leaks (*tick Y/N/NA/unknown/decline to answer*)?)? (22/0/2)
    i. If yes, how? Please describe in detail the process of going from measurement to tagging of leaks (*text box, or tick NA/unknown/decline to answer*).
    ii. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks (*text box, or tick NA/unknown/decline to answer*)?
d. For methods that are unable to confirm and tag individual leaks (i.e. "screening" methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? If so (*text box, or tick NA/unknown/decline to answer*): (19/3/2)
    i. What criteria are used to determine which sites receive follow-up visits? Examples could include (*text box, or tick NA/unknown/decline to answer*):
        1. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)
        2. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)
    ii. What do follow-up crews do onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters? (*text box, or tick NA/unknown/decline to answer*):
        1. If following a non-standard work practice, what are the details?
        2. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.

11. Is your organization currently a part of an Alternative FEMP Proposal to the AER, as described in the AER's *Submission Checklist for Directive 060: Alternative FEMP Proposals*? *(text box, or tick NA/unknown/decline to answer)* (20/2/2)

a. If no, is your organization planning/intending to be involved in an Alternative FEMP Proposal in 2020? *(text box, or tick NA/unknown/decline to answer)*

**Technical specifications**

12. What is the methane sensor used? Where applicable, specify brand or type(*text box, or tick NA/unknown/decline to answer*): (18/4/2)
13. Does your surveying result in a quantified flow rate (*tick Y/N*)? If so:
    a. What are the minimum and maximum measurable flow rates of your method (SCFH)? (*text box, or tick NA/unknown/decline to answer*): (16/4/4)
    b. What is the median detection limit (i.e. the flow rate corresponding to a 50% detection probability)? (*text box, or tick NA/unknown/decline to answer*.): (12/3/9)
    c. What is uncertainty/quantification accuracy of flow rate estimates? (*text box*) (14/3/7)
    d. Are emissions quantified at the component, equipment or facility level? (*text box, or tick NA/unknown/decline to answer*): (18/0/6)
    e. Has your organization developed detection probability curves for your method? (*text box, or tick NA/unknown/decline to answer*) (15/4/5)
14. Does your method require environmental data? If so, what is it and how is it collected? (*text box, or tick NA/unknown/decline to answer*) (18/1/5)
15. Can your organization provide results from controlled release testing and/or field performance? If this information will be or has been published in academic papers, please indicate the paper/project. Please provide information on methods, e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions? (*text box, or tick NA/unknown/decline to answer*) (13/3/8)
16. Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? (*text box, or tick NA/unknown/decline to answer*) (13/3/8)

**Environmental and operational constraints**

17. Under what environmental and operational conditions does your organization not operate in the field (be specific)? (*text box*) (20/1/3)
18. What conditions affect your method's performance? For each condition, how is performance impacted? (*text box*) (20/0/4)
19. Please declare the following (qualifying responses if necessary): (20/2/2)

a. What is the range of temperatures where the technology is operational (max and min)? (enter range and units, or tick NA/Unknown/Decline to answer, comments box)
b. What is the range of wind speed where the technology is operational (max and min)? (enter range and units, or tick NA/Unknown/Decline to answer, comments box)
c. How much active rain is tolerated? (*tick none/light/medium/heavy*)
d. What is the maximum deployment humidity? (*enter number and units, or tick NA/unknown/decline to answer; comments box*)
e. How much falling snow is tolerated? (*tick category: none/light/medium/heavy; comments box*)
*f.* How much snow can be tolerated on the ground? (*tick category: none/patchy/thin cover/deep; comments box)*

20. How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method)? *(enter number, in minutes)* (22/0/2)
21. How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method)? (*enter number, in minutes)* (22/0/2)
22. Is deployment required at each site? If so, how long does set-up/take-down take? (*enter number, in minutes)* (22/0/2)
23. From the day of measurement, what is the *guaranteed* reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (*text box, or tick NA/unknown/decline to answer*) (20/1/3)
24. What is the factor most limiting to safe and efficient field performance leading to high-quality results? (*text box, or tick NA/unknown/decline to answer*) (20/1/3)

**Scalability**

25. What is your organization's approximate overall work capacity (number of facilities that can be surveyed per year)? (*text box, or tick NA/unknown/decline to answer*) (18/2/4)
26. How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (*text box, or tick NA/unknown/decline to answer*) (18/1/5)
27. How will the answers from questions 21-24 change over the next five years? (*text box, or tick NA/unknown/decline to answer*) (19/2/3)
28. What is your organization's capacity to scale operations to meet anticipated demands in Alberta (40 000+ facilities)? How long would it take and what are your biggest barriers to

scaling (e.g. investment, manufacturing of sensors, training of personnel) (*text box, or tick NA/unknown/decline to answer*) (17/4/3)

**Cost – THIS SECTION IS OPTIONAL**

29. What is your method's approximate all-inclusive cost per day (single value or range) in 2020 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5/km$^2$? (*text box, or tick NA/unknown/decline to answer*) (7/13/4)

30. How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (*text box, or tick NA/unknown/decline to answer*) (12/8/4)

31. Please complete the table below, to show costing (*optional*) and productivity for each type of site. Costs (*if supplied*) should be all-inclusive (i.e., include management, preparation, mobilization, field expenses, materials and reporting.) Please note the units requested in the headings of the columns. Use the following assumptions: (15/2/7)
    a. LDAR surveying of 2,000 sites, made up of these facility subtype codes. The percentage of each facility subtype code should not dramatically impact your estimates, given the request is for costs on a per facility subtype code basis. Number of sites is communicated largely for an understanding of the size of the program and the economies of scale that can be achieved.
    b. The sites are all located in central Alberta, in an area spanning approximately 1,000 KM N-S by approximately 600 KM E-W

***(fillable table with comments box)***

| Alberta Energy Regulator Facility subtype code | Description<br><br>(Full descriptions of AER facility subtype codes can be found the AER Manual 11) | *Cost (CAD)/site (single value or range)* ***Optional*** | Time to survey in minutes (not including time spent between sites) (single value or range) | Productivity (sites per day per crew, including time spent offsite) (single value or range) |
|---|---|---|---|---|
| 311/351 | Single-well battery | | | |

| | | | | |
|---|---|---|---|---|
| 321/361 | Multi-well group battery | | | |
| 401 | Gas plant – sweet | | | |
| 601 | Compressor station | | | |

**Final Comments**

32. Are you interested in being contacted for future research, including potential field campaigns (*tick Y/N*)?

As a reminder, the objectives of the application are to understand:

1. Capacity to mitigate emissions
2. Cost of services
3. Ability to work legally and safely in Canada
4. Work capacity and ability/intent to scale operations (in 2020, 2021 and beyond 2021)

If you have any further information that you would like to provide in fulfilment of one of these objectives, we welcome any further information you can provide, alongside the reminder that questionnaire data released publicly will be aggregated and anonymized.

(*text box*)

Files and supplementary information that exceed the space available here may be sent to: fempfeasibilitystudy@ptac.org

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# Appendix B: Duty Holder Questionnaire

**Questions will have a bracketed 3 number system highlighted in yellow for response rate of (X,Y,Z) where:**
**X = Response recorded**
**Y = No response due to NDA or other reason**
**Z = No response**
**Total respondents: 11**

**LDAR Feasibility Study: Invitation to Participate**

The School of Public Policy, University of Calgary, working in collaboration with DXD Consulting Inc. is studying the feasibility of regulatory-compliant and alternative Fugitive Emissions Management Programs (FEMPs and Alt-FEMPs) in Alberta. This project addresses the knowledge gap between technology testing and implementation. The LDAR Feasibility Study is designed to compile and assess comprehensive data on technology performance, costing, and scaling from all market-ready and prospective service providers.

The study will survey (1) alternative leak-detection suppliers; (2) optical gas imaging suppliers; (3) upstream producers; and (4) midstream facilities/pipelines.

As part of this study, we are soliciting information from oil and gas producers to evaluate the extent to which they intend to internalize regulatory and alternative Fugitive Emission Management Programs (FEMPs) (i.e., self-performed leak detection), rather than rely on hired third-party services. For the purposes of this study, self-performing LDAR means that your organization is planning to purchase all the necessary equipment and have employees conduct LDAR surveys.

The Petroleum Technology Alliance of Canada (PTAC) is funding this study, under grant XXXXX.

Results will be presented in a report and summary PowerPoint presentation and report to PTAC.

Questions should be directed to Mr. Wes Funk, Principal Investigator, at wes.funk@dxdconsulting.com or (403) 830-4715.

Thank-you for your time and contribution to this study. We look forward to disseminating the results.

**Participant Information**

Organization:
Name:
Contact Information:
Role:
Date:

**Survey Questions**

1. Does your organization intend to self-perform leak detection and repair (LDAR) in 2020?
   RESPONSES: [tick: *yes/no/unknown/haven't decided/decline to answer*]
   (11/0/0)

   ***BRANCH***

   a. If answer to Q1 is *yes/decline to answer*, "Please provide clarification on your organization's decision criteria to self-perform LDAR." Then proceed to….Q2
      RESPONSES: [text box*;* tick: *not applicable/decline to answer/unknown*]
   b. If Q1 was Yes, "What percentage of LDAR surveys does your organization intend to self-perform?" (11/0/0)

   RESPONSES: [tick category*: 1 – 25%, 25% - 50%, 50% - 75%, 75 – 99%, All, unknown, decline to answer*]

   c. If answer to Q1 is *no/haven't decided/unknown*, Proceed to Q2
2. Did your organization successfully apply for the Baseline and Reduction Opportunity Assessment Program (BROA) for 2020/21? (11/0/0)
3. What is the approximate number of assets licensed to your organization that will be subject to the Government of Canada's methane regulations for the upstream oil and gas sector (SOR/2018-16)? (5/2/4)
   RESPONSES: [text box to enter number*;* tick: *decline to answer/unknown*]

4. What is the approximate number of assets licensed to your organization that are subject to the Alberta Energy Regulator's methane regulations? (5/0/6)
   a. *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting*?
      RESPONSES: [text box to enter number*;* tick: *decline to answer/unknown*]
   b. *Directive 017: Measurement Requirements for Oil and Gas Operations*)?
      RESPONSES: [text box to enter number*;* tick: *decline to answer/unknown*]

5. Does your organization intend to use Method 21 (https://www.epa.gov/sites/production/files/2016-06/documents/m-21.pdf), Optical Gas Imaging (OGI) cameras, an alternative method/program, or some combination in 2020? Select all that apply. (11/0/0, also for responses for OGI, Method 21, and Alt-FEMP sections below)
   RESPONSES: [tick all that apply*: Method 21, OGI, Alternative Methods*)?
   a. If a combination, please describe. Include which alternative methods.
      RESPONSES: [text box or tick*: not applicable/unknown/decline to answer*].

***BRANCH***

a. If answer to Q5 includes selection of OGI, respondent completes OGI sub-section
b. If answer to Q5 includes selection of Method 21, respondent completes Method 21 sub-section
c. If answer to Q5 includes selection of Alternative methods, respondent completes alternative sub-section
d. If answer to Q5 is *not applicable/decline to answer/unknown*, proceed to …

**OGI sub-section**

1. Responses to previous questions suggest your organization will use OGI cameras in some capacity to comply with Canadian and Albertan methane regulations.
    a. How many cameras does your organization currently own? (6/1/4)
    RESPONSE: [text box to enter number or tick: *unknown/decline to answer*]
    b. Does your organization intend to purchase more OGI cameras? (5/0/6)
    RESPONSE: [tick: *Yes/No/Not applicable/unknown/decline to answer*]
    c. *If Q1b is Yes*: If so, how many and by when?
    RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

2. How many trained OGI inspectors does your organization employ?
RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

3. Does your organization intend to employ more or train more employees in OGI inspection?
RESPONSE: [tick: *Yes/No/Not applicable/unknown/decline to answer*]
    a. *If Q3 is Yes*: If so, how many and by when?
    RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

**Method 21 sub-section**

1. Responses to previous questions suggest your organization will use Method 21 (https://www.epa.gov/sites/production/files/2016-06/documents/m-21.pdf) in some capacity to comply with Canadian and Albertan methane regulations. How many trained Method 21 inspectors does your organization employ? (3/1/0)
RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

2. Does your organization intend to employ more or train more employees in Method 21 inspection?
RESPONSE: [tick: *Yes/No/Not applicable/unknown/decline to answer*]
    a. *If Q2 is Yes*: If so, how many and by when?

RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

**Alternative method sub-section**

1. Responses to previous questions suggest your organization will use alternative methods or technologies (e.g., other handheld technologies, alternative practices) in some capacity to comply with Canadian and Albertan methane regulations. If your organization intends to self-perform alternative LDAR, please provide a high-level overview of the program it intends to implement.
   RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]
   a. What deployment platform(s) will your organization use? (5/0/2)
      RESPONSE: [text box or tick: *Not applicable /unknown/decline to answer*]
   b. What labour or equipment limitations is your organization facing, and do you anticipate that they will be resolved?
      RESPONSE: [text box or tick: *Not applicable /unknown/decline to answer*]

2. How many trained alternative-method inspectors does your organization employ?
   RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

3. Does your organization intend to employ more or train more employees in alternative inspection methods?
   RESPONSE: [tick: *Yes/No/Not applicable/unknown/decline to answer*]
   a. *If Q3 is Yes*: If so, how many and by when?
      RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

4. Has your organization prepared an alternative fugitive emission management program (FEMP) proposal, as described in the AER's *Submission Checklist for Directive 060: Alternative FEMP Proposals*, or does your organization intend to prepare a proposal in the future (please state expected timeframe e.g., 6 months, 12 months etc.)? (10/0/1)
   RESPONSE: [text box or tick: *Not applicable/unknown/decline to answer*]

**End of survey**

1. Is your organization interested in being contacted to share the research outputs?
   RESPONSE: [tick *Y/N*]

As a reminder, the objectives of the research project are to understand:

- Demand for emissions-reducing technologies and methods
- Capacity to mitigate emissions
- Cost of services
- Ability to work legally and safely in Canada/Alberta
- Work capacity and ability/intent to scale operations (in 2020, 2021 and beyond 2021)

- Uncover lesser known service providers via a larger network of respondents

If you or your organization have any further information that you would like to provide in fulfilment of one of these objectives, we welcome any further information you can provide, alongside the reminder that questionnaire data released publicly will be aggregated and anonymized.

RESPONSE: [text box]

# Appendix C: Service Provider Contact List

| Organization | Name | Phone | E-mail |
|---|---|---|---|
| Advisian | | | ERIC.JOHNSON@advisian.com |
| Aerodyne Research | | (978) 663-9500 | info@aerodyne.com |
| AGAT | | | |
| Altomaxx Technologies | Sent to contact us form on website | 1 833 258-6629 | jared@altomaxx.com |
| Bravo Target Safety | | (403) 264-1160 | info@bravotarget.ca |
| Bridger Photonics | Ben Losby | (406) 585-2744 | Ben.Losby@bridgerphotonics.com |
| Bureau Veritas | Shawn Miner | | shawn.miner@bvlabs.com |
| Calvin Consulting Group Limited | | (403) 547-7557 | info@calvinconsulting.ca |
| Canadian Infrared Ltd. | Gord Gonie | (587) 988-1498 | gord@canadian-infrared.ca |
| Clearstone Engineering | Yori Jamin | | yori.jamin@clearstone.ca |
| Dapenco Inc. | | (403) 869-7368 | info@dapenco.ca |
| Davis Safety Consulting | Josh Clarke | | jclarke@davissafety.ca |
| Digital IR Technologies | Rodger Legault | (250) 257-0092 | rodger.legault@digitalir.ca |
| Edmonton Valve & Fitting | Andrew Beliveau | | Andrew.beliveau@edmontonvalve.com |
| Emission Monitoring Service Inc. | | (281) 628-7800 | |
| Enviro Trace Ltd | | (780) 418-0882 | info@envirotrace.ca |
| Eosense | Colleen Gosse | | colleen@eosense.com |
| Flux Lab | Dave Risk (St. Francis Xavier University)<br>Chelsea Hall, PMP | (902) 867-4854<br>(902) 867-5282 | drisk@stfx.ca<br>chall@stfx.ca |
| Frostbyte Consulting | | (403) 370-9675 | info@frotbyteconsulting.com |
| GAS Recon Inc | Vic Kelly | 1 (403) 693-2691 | vic.kelly@gasrecon.ca |
| Gas Track Engineering | Jason Paziuk | (780) 228-1080 | jp@gastrack.ca |
| GHG Sat | David Wares | | david.wares@ghgsat.com |
| Greenpath | Mike D'Antoni | | mdantoni@greenpath.ca<br>janhalt@greenpathenergy.com |
| Grey Owl Engineering | | (403) 266-5810 | hello@greyowleng.com |
| Grid Environment Ltd. | | (587) 226-0268 | info@gridenvironmental.com |

| | | | |
|---|---|---|---|
| | | (306) 910-3378 | |
| Heat Seeking Thermal Imaging Ltd. | | (403) 329-1539 | info@heatseeking.ca |
| Heath Consultants | Kevin Bendele | | k.bendele@heathus.com |
| Hetek Solutions | Ashwin Mohan | | ashwin.mohan@hetek.com |
| Highwood Emissions Management | Thomas Fox | | thomas@highwoodemissions.com |
| Infratech Corporation | | (780) 778-4226 | sales@infratech.cc |
| Integra Technologies | Shalayne Martens | (780) 670-3994 | smartens@integratechnologies.com |
| Intelliview Technologies | | (403) 338-0001 | |
| Ion Engineering | | (587) 689-2039 | info@ionengineering.ca |
| IRT Consult Inc. | Darren Whyte | 353 (0) 89-457-7198 | info@irt.ie |
| Kuva Systems | | (617) 925-0480 | info@kuvasystems.com |
| LiDAR Services International Inc. | | 403-517-3130 | info@lidarservices.ca |
| LineRiders Inc. | Phil McNeil | (780) 518-5356 | phil@lineriders.ca |
| Matrix Solutions Inc. | | (403) 237-0606 | info@matrixsolutions.com |
| Montrose Environmental Group | Montrose acquired Target in 2019 | | |
| Noralta | Nathan Bender, Technical Operations<br>Corey Hegseth, COO Field Operations | (403) 462-5093<br>(306) 461-6637 | |
| North Shore Environmental Consultants | Cody Halleran | (403) 228-3095 | |
| Optimum Results | | 1-403-633-0589 | doug@optimumresults.ca |
| Pace Technologies | | (403) 580-0770 | https://www.pacetechnologies.com/contact |
| Qube | Carol Elliot<br>Eric Wen | | Carol.elliott@qubeiot.com<br>Eric.wen@qubeiot.com |
| Resolve Energy Solutions | James Garten | (250) 263-9434 | jgarten@resolvesolutions.ca |
| RJA Contracting Ltd | | 403 391-3493 | Only facebook page, no emails found |
| SeekOps | Paul Khuri | | pkhuri@seekops.com |
| SensorUp Inc. | | | info@sensorup.com |
| SolutionCorp Inc. | | (403) 742-0123 | |

| | | | |
|---|---|---|---|
| Step Engineering | | (403) 476-9560 | info@step-eng.com |
| Target | Imran Nurani | | nurani@targetemission.com |
| The Sniffers (Keneco Environmental in Canada?) | Kevin Kropf<br>Troy Wawrinchuk | | kevin.kropf@the-sniffers.com<br>twawrinchuk@kenecoenviro.com |
| Thermal Scan Ventures | Ryan Wetherill<br>Murray Handfield | (250) 782-0976<br>(250) 784-5447 | thermal@pris.ca |
| Vertex Resource Group Ltd. | Dani Urton (female) | | |
| WSP | | | |
| AROlytics | | | liz.oconnell@arolytics.com |
| UofC POMELO | | | tbarchyn@ucalgary.ca |
| GeoVerra | Jennifer Baillie | | adrienne.maskalyk@geoverra.com<br>jennifer.baillie@geoverra.com |
| ESRI | | | leads@esri.ca |
| Deloitte | | | |
| Tetratech | | 4037236879 | kim.baker@tetratech.com |
| Clarifi? | Sent to contact us form on website | | |
| Envirosoft? | Sent to contact us form on website | | |
| ABB Los Gatos | Sent to contact us form on website | | doug.s.baer@us.abb.com |
| Avitas | Sent to contact us form on website | | |
| Bruker Scientific | Sent to contact us form on website | | |
| FLIR/Providence Photonics | Sent to contact us form on website | | |
| Fluke | Sent to contact us form on website | | canadaservice@fluke.com |
| IC-More | Can't find website, (Defence/Security company??) | | |
| Kairos | Sent to contact us form on website | | info@kairosaerospace.com |
| Nexus Space | | | INFO@NEXUSSPACE.NET |
| Project Canary | Found no contact info other than phone # on site | | |
| Prosaris | Contact Form & Info e-mail | | csewell@prosaris.ca |
| QLM technology Ltd. | Only e-mail on website ( | | doug@qlmtec.com |
| Rebellion Photonics | Links to Honeywell, link is dead? | | info@rebellionphotonics.com |
| Scentroid | E-mail provided (Craig Louks) | | craig.l@scentroid.com |

| | | |
|---|---|---|
| Scientific Aviatino | All Contacts - Michael Conleyt is General Counsel, Stephen Conley is President & CEO | mconley@scientificaviation.com<br>sconley@scientificaviation.com |
| Sensit | jscottk is CEO | jscottk@gasleaksensors.com |
| SM Instruments | Can't find website or company | |
| Wyvern Space | Can't find website or company | |
| Picarro | info@picarro.com | info@picarro.com |
| Aeris Technologies | Sent to contact us form on website | |
| Bluefield | Sent to contact us form on website | i@bluefield.co |
| MethaneSAT | Sent to contact us form on website | |

# Appendix D: Duty Holder and Midstreamer Contact List

| Company Name | Main Contact Name | Role | E-mail |
|---|---|---|---|
| Advantage Oil & Gas Ltd. | Reg Beck | Director HSE and Regulatory Compliance | rbeck@advantageog.com |
| Alliance Pipeline Ltd. | Daryl Bailey | Facility Project Engineer | daryl.bailey@alliancepipeline.com<br>dbailey@alliancepipeline.com |
| ATCO | Kym Fawcett | HSE & Quality Director | kym.fawcett@atco.com<br>kymfawcett@atco.com |
| Baytex Energy Corp. | Anthony Traverse | Sr. Environmental Coordinator | Anthony.Traverse@baytex.ab.ca |
| Black Crane Energy Corp. | Too small | | |
| Canlin Energy Corporation | Julie Oxtoby | Senior Regulatory and Environmental Advisor | julie.oxtoby@canlinenergy.com |
| Cardinal Energy Ltd. | LinkedIn Request | | |
| Chevron | Paul Dziuba | Environmental Specialist | pdziuba@chevron.com |
| CNOOC Petroleum North America ULC | Adam Judd referred Chris Kellerman | | Chris.Kellerman@intl.cnoocltd.com |
| CNRL | Richelle Foster | Project Engineer | richelle.foster@cnrl.com |
| ConocoPhillips | Julie Dalzell | Senior GHG Coordinator | julie.a.dalzell@conocophillips.com |
| Crescent Point | Morgan Reid | | |
| Ember Resources Inc. | Bryce Watson | Environmental/Regulatory Coordinator | bwatson@emberresources.com |
| Encana | Moruf Aminu | | moruf.aminu@encana.com |
| Enerplus | Lisa Studzinski | Environmental Compliance Advisor | LStudzinski@enerplus.com |
| Harvest Operations Corp. | Pat Harrison | Senior Regulatory and Environmental Coordinator | pat.harrison@harvestenergy.ca |
| Inter Pipeline Ltd. | Audra Papp<br>Salima Loh | EHS & Sustainability Manager | audra.papp@interpipeline.com<br>salima.loh@interpipeline.com |
| Keyera | Kerri Gilders | Environment and Regulatory Director | kerri_gilders@keyera.com |
| NAL/Whitecap | Patrick Kitchen | | |
| Obsidian Energy Ltd. | Steve Sterling | President and Chief Executive Officer | steve.sterling@obsidianenergy.com |
| Ovintiv (previously Encana) | Filiz Onder | Air Compliance Manager | filiz.onder@encana.com |

| | | | |
|---|---|---|---|
| Pacific Canbriam | Dave Webster? | Operations/HSE/Integrity Manager | |
| Paramount Resources Ltd. | Leili Chepelkevitch | Sr. environmental representative | leili.chepelkevitch@paramountres.com |
| Pembina Pipeline Corporation | Jeff Hamilton | Senior Environmental Advisor | JHamilton@pembina.com <JHamilton@pembina.com> |
| Perpetual Energy Inc. | Darren Gramlich | Surface Land Manager | Darren.Gramlich@perpetualenergyinc.com |
| Petrochina Canada | Devin Newman | Regulator, Land & Stakeholder Affairs Director | Devin.Newman@PetroChinaCanada.com |
| PETRUS RESOURCES CORP. | Neil Korchinski | President and Chief Executive Officer | nkorchinski@petrusresources.com |
| Plains Midstream Canada ULC | Chris Horne | HSE Director | chris.horne@plainsmidstream.com |
| Plains Midstream Canada ULC | Tom Knapik | | tom.knapik@plainsmidstream.com |
| Repsol | Greg Unrau | Senior Environmental Coordinator | gunrau@repsol.com |
| Rife Resources Ltd. | Bob Lamond? | | reception@rife.com |
| Seven Generations Energy Ltd. | Carolyn Pfau | Emissions Engineer | cpfau@7genergy.com |
| Shell | Bill Kovach rep Allison Fisher | Senior Air Specialist | Allison.Fisher@shell.com <Allison.Fisher@shell.com> |
| Strathcona Resources Ltd. | Megan Bowen | Environment and Sustainability Coordinator | |
| Suncor | James Beck | | jbeck@suncor.com |
| Suncor | Rekha Nambiar | | rnambiar@suncor.com |
| Syncrude | Michelle Velez | Bitumen Production Advisor | |
| TAQA North Ltd. | Tracy Yarrow<br>Aileen Raphael<br>Mark Stanley | President and Chief Executive Officer<br>Engineer and Technical Sales | tracy.yarrow@taqa.ca<br>aileen.raphael@taqaglobal.com<br>mark.stanley@taqaglobal.com |
| TC Energy | Rob Cooney | Senior Environmental Advisor, Air Emissions at TC Energy | rob_cooney@tcenergy.com |
| TC Energy | Koray Onder | | koray_onder@tcenergy.com |
| TC Energy | Neuczki Mathurin | | neuczki_mathurin@tcenergy.com |
| TORC Oil and Gas Ltd. | Shelly Gerber | Operations Accounting Manager | sgerber@torcoil.com<br>shelley.gerber@torcoil.com |
| Torxen Energy Ltd. | Holly MacDonald | Regulatory, Compliance and Environment Manager | holly.macdonald@tolko.com |
| Tourmaline | Dean Soucy? | HSER Manager | soucy@tourmalineoil.com |

| | | | |
|---|---|---|---|
| Trans Mountain Corporation | Margaret Mears<br>Cyril Jenkins | Environment Manager<br>Senior Director, EHS | cyril_jenkins@transmountain.com |
| TransGas Limited | Lori Parks | Manager, Environmental Protection at SaskEnergy | lori.parks@gs.gov.sk.ca |
| Trans-Northern Pipelines Inc. | Gail Sharko | Regulator & External Affairs Manager | gsharko@tnpi.ca |
| Vermilion | Robin Cole | Senior Environmental Coordinator | rcole@vermilionenergy.com |
| Vesta Energy Ltd | Mark Lansing | VP HSE & Sustainability | mark.lansing@vestaenergy.com<br>mlansing@vestaenergy.com |
| Whitecap Resources Inc. | Patrick Kitchin | Director, Regulatory and Environmental Sustainability | pkitchin@wcap.ca |
| Wolf Midstream | Rebecca McAllister | HSE & Regulatory Coordinator | rmcallister@wolfmidstream.com |
| Yangarra Resources Ltd. | Jim Evaskevich<br>Michael D'Entremont | President and Chief Executive Officer<br>COO | trina@yangarra.ca<br>michael.dentremont@yangarra.ca<br>michael@yangarra.ca<br>j.evaskevich@yangarra.ca |

# Vendor #1 Response

**Collector:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 1 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
We offer LDAR in the Oil and Gas industry across Western Canada. We currently use the FLIR IR camera technology with both a standard lens and telescopic lens for higher risk locations. [redacted] Vendor 1 [redacted] been in the leak detection industry since [redacted].

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes**

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

There are no safety concerns with our current technology as it is a hand held device that is intrinsically safe. The only safety hazards are the one encountered while on the clients site eg: requirements for tight spaces, working at heights.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
The requirements for individual travel has increased our general cost to conduct our operations. Reduced budgets from clients has had the largest impact due to low oil prices and world wide demand.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

The larger demand has led to an increase in interest. We are still finding the larger corporations are purchasing their own equipment and incorporating it into their preventative maintenance plan.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

We have increased our targeted business directed to LDAR as government programs have increased the requirement for testing.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Technology and method** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **service** |
| c. Is the method mobile or stationary? | **mobile** |
| d. Does your method require site access or does it measure remotely? | **site access** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

We use a hand held platform that allows us to get as close as possible to the leak location. For harder to reach area we are able to use our high magnification lens to identify leak locations. We offer the ability to spot and record any leak locations in video form for our clients to ensure they are aware of the size and exact location of the leaks. We offer the ability to provide a post repair scan as well of the previously identified leaks.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **N/A** |
| b. What sensors are employed and how? | **N/A** |
| c. How many people comprise one field crew? What are their roles? | **1 to 2** |
| d. How much time is spent surveying each potential source? | **2-5 mins** |
| e. How much training are field staff required to have? | **FLIR gasfind certification, 3-6 months hands on training (depending on number of scans)** |
| f. What output data are generated and reported? | **Location of leak, video and pictures of leak location, Leak identificatino tag** |
| Additional work practice details | **If requested a site walk through with operations indicating leak locations** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Decline to Answer**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

Due to proximity of scanning, false positives are negligible.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Each individual leak is tagged at the source with a bright yellow tag, with the Company Logo, technicians name, date, time and location of leak. We also provide the client with pictures and a video of the leak source to verify size of leak for the client.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Follow up visits are at the request of the client based on on-site communications, reports and follow up calls with clients.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Follow a standard work practice of scanning the reported leaks first, then will conduct a shorter general scan to ensure no new leaks were formed during the repair.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

N/A

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**No**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

**Respondent skipped this question**

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**N/A**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

**Respondent skipped this question**

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

Under high wind conditions, extreme cold

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Extreme cold - affects the quality of the scan
Wind- Due to open atmosphere of most locations it affects the ability for a proper scan as leaks can be missed due high wind sweeping across leak location, could indicate a smaller leak than the actual size.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-15 - +40** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **N/A** |
| How much active rain is tolerated (None, light, medium, heavy)? | **medium** |
| What is the maximum deployment humidity (%)? | **20-80%** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **medium** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **thin cover** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

15 mins

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

15 mins

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

yes, Set up 15 mins - take down 15 mins (excluding permitting)

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Guaranteed report is delivered in 5 days upon completion of the entire project

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Field Location hazards eg: working at heights, H2S release, confined space, slips/trips/falls

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

2-3 single well batteries per day depending on size of battery

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

unknown

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

currently capable of meeting current demands

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

unknown with the goal to increase work capacity [redacted]

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Entry into market share and competition.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

[redacted]

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

unknown

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
2-10 hours per site depending on variables in testing, number of leaks recorded, site locations, permitting requirements, difficult testing areas

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
2-10 hours per site.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**No**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

N/A

**Q57**

What LDAR-based data management services does your organization offer?

N/A

# Vendor #2 Response

[redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 2 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

[redacted] developed and commercialized a vehicle-based solution for Advanced Leak Survey for natural gas pipelines which is currently used for compliance leak survey at a number of LDCs around the world as well as for leak detection and leak emissions rate quantification in downstream/midstream/upstream gas operations.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

[redacted]

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

The system is vehicle-based and data is collected generally at night on roads or easements near gas assets. This generally does not cause significant safety issues or annoyances, however.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**

If Yes, please explain.:

On-site installation and training and support of our customers has been hindered by covid and remote or online solutions have had to be implemented.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Both** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **All of the above** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **Remote but must be within 150m minimum to measure.** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Both vehicle-based and handheld systems can be used. The vehicle-based systems drive in areas where there are gas assets, collecting methane, ethane, wind and GPS data. In a typical distribution system, a total of six passes on each street, over at least two nights, are undertaken. After the drives are complete, Vendor 2 combine the data, removing non-natural gas indications, combining coincident leak indications, and calculating the resulting Field of View (FOV) coverage area. In an area where methane is detected, a leak indication is shown, and a search area is computed from the wind direction and variability – the software highlights the pipeline GIS assets requiring follow-up on foot to locate and grade the leak(s) using traditional ppm-level equipment or Picarro's handheld sensor. The measured ethane content of the gas is also used to determine the confidence level of the gas being from a natural gas leak or not. [redacted]

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **From <1m to >150m** |
| b. What sensors are employed and how? | **Vendor 2's patented [redacted] measure methane in the ambient air as the vehicle passes through plumes from leaks.** |
| c. How many people comprise one field crew? What are their roles? | **One driver per vehicle and later, one or more foot-based leak investigators.** |
| d. How much time is spent surveying each potential source? | **The car produces 2mi (plus associated services/assets up to 150m on either side of the vehicle path) of measured distribution mains per hour of driving. Each leak indication takes an average of 25 minutes to find and grade any leak(s).** |
| e. How much training are field staff required to have? | **Minimal training for driver, typical industry standard training duration for foot-based leak investigaiton personnel.** |
| f. What output data are generated and reported? | **GIS-based, digital outputs in various formats for FOV and leak indication search areas.** |
| Additional work practice details | **After the data is collected, personnel must run a report in the cloud-based software to generate the actionable output data for field crew follow-up.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

We currently have one gas distribution customer in Canada. It is unknown what regulatory approval, i[redacted] Vendor 2 [redacted]

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**
If yes, how? If not, how does it account for potential false positives?:
Potentially yes, assuming that fugitive emissions are constant in time and vented emissions are discontinuous. It would be possible to differentiate between these two temporal signatures provided data were taken during the time of the vented emission and compared to a time when no venting is occurring. False positives are virtually ruled out using the system's ethane measurement capability to distinguish natural gas from biogenic sources of methane.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Leak indication search areas are produced by the software. These are investigated by foot-based crews with handheld equipment. They identify grade/tag leaks found at that time and repairs are conducted on the schedule determined by the severity of the leak.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A. The process confirms and tags leaks.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

This is determined by the operator. Vendor 2 provides three key metrics for each leak indication: potential risk of the leak, emissions rate of the leak, and probability of the leak being below-ground vs. above ground. These metrics are used differently by different operators to determine followup and/or mitigation actions.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Crews fully investigate leak indication search areas with handheld tools following typical industry standards. Each operator has a different time period for followup which can range from days to weeks.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Vendor 2 proprietary Technology Name sensor.

**Q25** **Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

0.1 to >10,000 SCFH depending on distance to the source

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

0.5 SCFH at <150m with 90% detection probability in winds <2m/s

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

3x factor uncertainty within a 90% confidence that improves with multiple plume measurements

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

at all levels as desired

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

If yes, which variables contribute to your detection probabilities?:
Leak rate, distance to leak, number of plume detections, wind speed and atmospheric stability class.

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

The system collects its own environmental data on wind speed and variability via the system's sonic anemometer. The technician manually determines the atmospheric stability class by logging general weather condition information at the time of data collection.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Yes, upon request, Vendor 2 can provide aggregate data [redacted]

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Unknown

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

In winds >20mph and during heavy precipitation.

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Wind and heavy precipitation.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-10 to 45 °C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **0-32 kmph** |
| How much active rain is tolerated (None, light, medium, heavy)? | **medium** |
| What is the maximum deployment humidity (%)? | **99% RH non-condensing** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **medium** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **deep** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

5min

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

1min

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

no, system is installed in a vehicle and ready to use

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Data is available <30min from final data collection run.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Site access to within 150m.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

10 facilities/day

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

Depends on type and location of deployment.

**Q44**

What is your organization's capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

Unknown

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

Unknown

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes, we project significant growth [redacted]

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Personnel

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

Unknown -- would need more information about the infrastructure, etc. to formulate an answer.

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Generally longer engagements would have higher efficiency and lower costs.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
Highly dependent upon site density and road accessibility.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
Highly dependent upon site density and road accessibility.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
Highly dependent upon site density and road accessibility.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
Highly dependent upon site density and road accessibility.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**No,**
If yes/no/varied, are there any key reasons?:
Most of our clients are on the distribution side and so are more concerned with compliance leak survey rather than LDAR as it is commonly referenced for upstream infrastructure.

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes, each customer generally has unique requirements on each of these elements to which we adapt our solution/data delivery.

**Q57**

What LDAR-based data management services does your organization offer?

We provide geo-spatial (often customized) analysis and management of data collected by/for customers.

# Vendor #3 Response

**Collector:** [redacted]
**Started:** [redacted]
**Last Modified:** [redacted]
**Time Spent:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 3 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**No**

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes**

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

None.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Unique approach to ultrasonic leak detection, direction and quantification.** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Yes, combination of [redacted] and record and data management offline to support resolution management.** |
| c. Is the method mobile or stationary? | **Mobile, hand-held.** |
| d. Does your method require site access or does it measure remotely? | **Site access required.** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Hand-held unit which attaches to an [redacted] tablet [redacted] (cell phone).

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Typically from 0.4m to 2m…. but detection at greater distance.** |
| b. What sensors are employed and how? | **Highly sensitive microphones in a designed arrangement.** |
| c. How many people comprise one field crew? What are their roles? | **Our approach can be used by existing facility personnel. No special crew required.** |
| d. How much time is spent surveying each potential source? | **Between 2-4 minutes.** |
| e. How much training are field staff required to have? | **Very little. One 5 minute YouTube clip would cover all instruction.** |
| f. What output data are generated and reported? | **All data is available on a cloud based backend. Every piece of info on the tablet is replicated and can be extracted in csv or pdf. Back end allows data sorting, charting and establishment of key metrics for user or company.** |
| Additional work practice details | **Only additional requirements would be linking to our solutions to the facility or company plan.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
Yes, we plan to submit an Alternative FEMP Proposal in 2021.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**No**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Each leak is quantified, tagged, photo record taken and all details specific to the leak source recorded by user for off-line access. Location is also tagged to support remediation and periodic monitoring and the application included a process for managing corrective actions.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Decline to answer

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Our device provides GPS, photo, tag, date of leak, priority of repair and actions required. Once complete the repair can be directly logged in our device and the device used to scan and confirm zero leakage.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

NA

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

decline to answer

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Decline to answer

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

decline to answer

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Component

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Decline to Answer**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Ambient temperature which can be user defined for weather app linked.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

decline to answer

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

decline to answer

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

N/A, all conditions are acceptable.

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Only temperature, below -20C battery life is reduced.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **decline to answer** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **decline to answer** |
| How much active rain is tolerated (None, light, medium, heavy)? | **N/A** |
| What is the maximum deployment humidity (%)? | **N/A** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **N/A** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **N/A** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

1 minute.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

1 minute.

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

No, hand-held, pick up and go.

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Every piece of data entered or provided by the user or generated by the tablet at the leak event source is location and time stamped and saved.  Data can be sored for as long as the client requires.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

N/A

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

N/A, clients personnel can carry our device and can complete inspection at any time they are normally at the location.

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

N/A, clients personnel can carry our device and can complete inspection at any time they are normally at the location.

**Q44**

What is your organization's capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

Our limitation is only how many of our products we can manufacture and distribute. As such we have no barrier to scale for Alberta.

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

We will scale to meet the demand of the market.

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

N/A

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

[redacted]

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

NA

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

N/A

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

We sell our hardware, application and data management access to our clients and they perform the site activities. With our solution their personnel are able to locate and repair leaks directly, monitor annual surveyed sources to reduce recurrence time and find, report and manage new leaks in the 364 days between annual surveys. This may allow then eventually to eliminate some of their expensive external consultant costs.

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes,**
If yes/no/varied, are there any key reasons?:
Our product is a hand-held leak detection device but the value is in effective resolution. Event data management is key.

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

No

**Q57**

What LDAR-based data management services does your organization offer?

All leak event data which is record at he source is available in our backend. We transfer this data in the format that our clients want for their analysis.

# Vendor #4 Response

**Collector:** [redacted]
**Started:** [redacted]
**Last Modified:** [redacted]
**Time Spent:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 4 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

LDAR services provided: [redacted] provides a vehicle-based emissions monitoring service to the upstream and midstream energy industry in Western Canada. We specialize in providing alternative solutions to fugitive emission management programs (FEMP), leak detection and repair (LDAR) programs using our [redacted] emissions detection vehicle. The [redacted] truck is a higher-order emissions screening tool used to quantify methane emissions at the facililty level. [redacted]

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

[redacted]

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Unknown**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

- Driving hazards
- Road/site congestion

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

Yes, due to the perceived decreased regulatory risk of conducting an alt-FEMP

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

Yes, some ongoing and future work is funded via Canadian provincial  programs

## Page 4: Leak Detection Service Description

| **Q13** | **AltFEMP** |
|---|---|
| Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP? | |

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Both** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Service** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **On-site and public/lease road monitoring both applicable** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Truck-mounted sensors

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **10-500m** |
| b. What sensors are employed and how? | **--** |
| c. How many people comprise one field crew? What are their roles? | **2 (shared role)** |
| d. How much time is spent surveying each potential source? | **Less than 5 minutes** |
| e. How much training are field staff required to have? | **--** |
| f. What output data are generated and reported? | **Dependent on client needs but generally: date, time, facility name, location, coordinates of detections, emission rate in m3CH4/day, confidence intervals, distance to source, measured methane concentration** |
| Additional work practice details | **--** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
Yes, we are planning to be involved in an Alternative FEMP Proposal in 2021. Details are unable to be shared currently.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**No**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Facility level screening technology generally requires follow up with OGI or another component-level monitoring technology to tag and diagnose leaks. The follow-up procedure/frequency is developed via an alt-FEMP model.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

Client and alt-FEMP model dependent but follow up with OGI may occur

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Client and alt-FEMP model dependent but follow up criteria may include:
- Top X% of emitters
- Emitters above a specific emission rate threshold

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Client and alt-FEMP model dependent

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Picarro G2201i

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Minimum detection limit: 0.2 gCH4/hr

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Unknown

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

+/- 60%

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Facility level

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Decline to Answer**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Wind speed (measured)
Wind direction (measured)
Atmospheric stability class (inferred)

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

- Yes
- St FX University
- Outdoors
- See O'Connell et al. 2019
- Publication: O'Connell, E, et al. 2019. Methane emissions from contrasting production regions within Alberta, Canada: Implications under incoming federal methane regulations. Elem Sci Anth, 7: 3. DOI: https://doi.org/10.1525/elementa.341

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

-Yes
-Unknown

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

NA

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

- Low wind impacts plume dispersion
- Temperature impacts plume dispersion

## Q36

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-40°C to +40°C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **Benefits from wind speeds greater than 0.8 m/s and must be able to get downwind of an emission source** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Minimal limitations, can survey in light to moderate rainfall** |
| What is the maximum deployment humidity (%)? | **No limitations** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Minimal limitations, can survey in light to moderate snowfall** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Minimal limitations, any road conditions that affect a 4x4 truck would have an impact on the ability to survey** |

## Q37

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

30

## Q38

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

15

## Q39

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

No

## Q40

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

14 days

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Site access

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

Day: 50-75

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

2

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

unknown

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

decline to answer

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

decline to answer

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

decline to answer

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

decline to answer

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

decline to answer

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
Less than 5 minutes per site, assumption is that the region has moderate to high density of sites.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
Less than 5 minutes per site, assumption is that the region has moderate to high density of sites.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
10-15 minutes per site, gas plants are not the ideal target for our monitoring technology, assumption is that the region has moderate to high density of sites.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
Less than 5 minutes, assumption is that the region has moderate to high density of sites.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Varied,**
If yes/no/varied, are there any key reasons?:
Some clients are developing or have their own data management tools

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes, many clients require standardization at some level to integrate with their data processing/handling/management tools.

**Q57**

What LDAR-based data management services does your organization offer?

ESRI-based data management and reporting tools

# Vendor #5 Response

**Collector:** [redacted]
**Started:** [redacted]
**Last Modified:** [redacted]
**Time Spent:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 5 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**No**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**No**

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes**

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

Road access is required.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

a. Does your organization offer a technology or a method?

[redacted]

b. Does your organization offer a product (for sale?), a service, or a combination?

[redacted]

c. Is the method mobile or stationary?

[redacted] **is a truck based system**

d. Does your method require site access or does it measure remotely?

[redacted] **requires site access to produce accurate data, but can measure without site access less accurately.**

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

[redacted] is a vehicle based system system for rapid triaging of emissions sources on upstream pads.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Measurements are taken from the vehicle at 7-25 m from sources.** |
| b. What sensors are employed and how? | [redacted] **are fused to measure the location of sources and emissions rates.** |
| c. How many people comprise one field crew? What are their roles? | **One crew member is used to drive the vehicle and operate the system.** |
| d. How much time is spent surveying each potential source? | **Each source requires less than 30 seconds of data.** |
| e. How much training are field staff required to have? | **Field staff require approximately 2 days of training.** |
| f. What output data are generated and reported? | **Emissions locations, approximate emissions quantifications for follow up triage purposes.** |
| Additional work practice details | **We recommend using a 'one visit model' with** [redacted] Technology **Operator arrives, circles the site several times, and then performs follow-up OGI surveys only on the equipments that are emitting.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Yes**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Equipment**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**No**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
The Technology maps emitting equipment on sites. Equipment that is not emitting can be skipped from follow-up. Equipment that is emitting can be surveyed with conventional, widely understood, and easy to apply D060 compliant OGI surveys. From these OGI survey tags can be issued.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

Technology is part of a one visit model, OGI is deployed to follow up immediately and as part of the survey.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

We recommend all anomalies be followed up immediately, onsite. Operators can use different work practices if they choose to, such as different triage schemes, but this is a decision of the operator.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Crews operate the system and follow up on identified anomalies with a chosen work practice. Follow-up is suggested to be conducted with D060 close range survey or some user defined follow up method. There is no suggested delay between measurement and follow-up. We suggest identifying emitting equipment, triaging, and follow-up to be completed in one visit.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

**Q25**

**Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

We have detected and measured emissions rates of [redacted] methane.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

We have performed detection limit testing at METEC. We could not identify a median detection limit as the median detection limit of [redacted] Technology is below what METEC can meter. We measured a minimum emissions rate of [redacted] methane - we expect the median detection limit to be below this value. We cannot provide a detection limit surface as a function of distance or wind speed as we cannot provide a median detection limit.

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

We do not provide uncertainty estimates on flow rate quantifications at present.

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Emissions can be quantified at the equipment scale.

**Q30**

**No**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

All data required for the system are automatically collected. We use temperature, pressure, methane concentrations, location, measured wind speed and directions.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

The most relevant and accurate data on Technology performance was collected in a single-blind study conducted at [redacted]

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Performance data has been used in computer simulations and AltFEMP applications.

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

The Technology system cannot operate below -25 degrees C, above 40 degrees C, in strong rain or snowfall, or in conditions where lightning is possible.

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

The Technology system functions poorly in conditions of no wind.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-25 - 40 degrees C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **0 - 100 kmph (upper limit untested)** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Light rain is tolerable.** |
| What is the maximum deployment humidity (%)? | **100%** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Light falling snow is tolerable.** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Deep snow can be tolerated.** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Initial setup on the vehicle takes between 0 minutes (no setup required), to 5 minutes (full setup required).

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Take-down time takes from 0 minutes (no takedown required), to 5 minutes (full take-down required).

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

No deployment actions are required when arriving at site - system functions at all times on the roof of the vehicle.

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Reports are provided immediately after surveying from the system on the truck. No post-processing or office work is required.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

N/A

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

This depends on the work practice and is not explicitly related to the technology. How you use [redacted], how you follow up, how far away sites are from each other, etc. - these are the things that control survey time.

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

Currently there are [redacted] simultaneous deployment, involved in various deployments.

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

N/A

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

N/A

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

N/A

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Investment.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

Cost is proportional to time, time is proportional to deployed work practice. Deployed work practice depends on how the user intends to use the system.

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Cost would reduce as a function of deployment time due to efficiencies associated with reduced training and shipping overhead.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
N/A - survey cost depends on work practice.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
N/A - survey cost depends on work practice.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
N/A - survey cost depends on work practice.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
N/A - survey cost depends on work practice.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

The costs per site are dependent on the work practice that is utilized. Our recommended work practice involves immediate follow-up of detected anomalies. The per site time relates to how the operator chooses to follow up on these anomalies, and the number of anomalies.

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Decline to answer,**
If yes/no/varied, are there any key reasons?:
N/A

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

N/A

**Q57**

What LDAR-based data management services does your organization offer?

N/A

# Vendor #6 Response

**Collector:** [redacted]
**Started:** [redacted]
**Last Modified:** [redacted]
**Time Spent:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 6 |
| E-mail: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**No**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**No**

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes**

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

no concerns at all.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**N/A**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

N/A

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

n/a

## Page 4: Leak Detection Service Description

| **Q13** | **AltFEMP** |
|---|---|
| Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP? | |

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Yes** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Yes** |
| c. Is the method mobile or stationary? | **It is a satellite constellation.** |
| d. Does your method require site access or does it measure remotely? | **see c. above** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Satellite constellation with [redacted].

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **we measure from a low Earth orbit (500-500km)** |
| b. What sensors are employed and how? | **hyperspectral and super-spectral sensors, by satellite.** |
| c. How many people comprise one field crew? What are their roles? | **We do not have a field crew** |
| d. How much time is spent surveying each potential source? | **We will cover the complete global infrastructure in 5 days.** |
| e. How much training are field staff required to have? | **n/a** |
| f. What output data are generated and reported? | **That is a NDA question.** |
| Additional work practice details | **PTAC [redacted] We are happy to set up a meeting to provide more detail on measurements.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

Satellites are listed in the latest manuals by AER. However, they all do not represent accurately what space companies and satellite companies are capable of and are working on.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

That is again a NDA questions. It is a very complex process to monitor emissions from space. We have implemented a feasibility study with world-class experts and our technology partners.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Again, a NDA question.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

We will offer a holistic system. Satellites can scan all infrastructure of our customers in 5 days. Incident detection can be early. That depends on when emissions or leaks occur and when satellites pass over the facility or pipeline. We will offer a holistic and systematic approach. AI will after a while learn to trigger the next step. There is a lot of infrastructure to cover, 100,000s or wells for example. We are not merely focusing on super-emitters like our competitors. Our detection will be superior.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

See above. If we will cover in 5 days all of the Canadian infrastructure, there will be a holistic and intelligent follow-up plan in place. When we will measure something, that means that a follow-up crew needs to be deployed.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

That depends on the incident. Let's say, we will see emissions of 500kg/hr or 100kg/hr or 50kg/hr, I do argue that someone will go out there to deal with the incident.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

NDA Question. It is a super-spectral sensor.

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Respondent skipped this question**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

That is a NDA question. Scientific method of measurement is kg/h.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

**Respondent skipped this question**

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Quantification by satellites are part of our approach.

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

If yes, which variables contribute to your detection probabilities?:
NDA

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

We are creating environmental data with our satellites ourselves but apply data fusion with available third-party data.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

We have done tests and are planning more tests via breadboarding.

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Yes, we have conducted a significant and complex feasibility study. [redacted] Another comment about regulations: Companies need to follow regulations, investors care more about ESG and the overall reputation of companies and their emissions as an industry. This is frankly too much ignored by regulators.

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

n/a

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

we work with an optical instrument. The weather has an effect on our satellite measurement.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **n/a** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **NDA** |
| How much active rain is tolerated (None, light, medium, heavy)? | **NDA** |
| What is the maximum deployment humidity (%)? | **NDA** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **NDA** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **NDA** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

n/a.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

n/a

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

n/a

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

We will cover with our capacities all infrastructure in 5 days.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

n/a

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

**Respondent skipped this question**

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

we will launch the first two satellites end of next year. The full constellation in 2024. More via NDA.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

NDA

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

NDA

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
see above about the topic of site coverage.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
see above

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
see above

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

I think that most questions do not relate to remote sensing via airborne or satellite systems.

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**N/A**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

We will offer a client an online data platform to inform about incidences that we were able to detect.

# Vendor #7 Response

**Collector:** [redacted]
**Started:** [redacted]
**Last Modified:** [redacted]
**Time Spent:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 7 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
[redacted] provides methane monitoring hardware and data tools. We work with service providers and operators to support methane management with passive monitoring tools. Our instrument is installed on any vehicle and measures methane along with regular site work. [redacted]

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
US and EU

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

We don't anticipate any major safety concerns, risks or interruptions with the instrument. A safety concern would be related to the height of the mast and the risk of hitting any low hanging obstructions on a site. Duty holders might be annoyed if site data is requested or a facility inventory. Another challenge might be related to using the vehicle power output which might be occupied by a phone charger or other instrumentation on a fleet vehicle. Finally, the installation takes 20 minutes and space inside of the vehicle or outside might need to re-arranged to make space for the hardware (it's about the size of two briefcases).

Otherwise, it's intended to run with minimal input.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
Vendor 7 is based in [redacted] so it's been challenging [redacted] to develop our business.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

We are happy to see that the equivalent regulations include opportunities for alternative LDAR programs.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

The imposition of federal methane regulations in the first place has been a positive for our business. We can plan to develop our business knowing that methane will need to be monitored for the foreseeable future.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**Respondent skipped this question**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

**Respondent skipped this question**

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

**Respondent skipped this question**

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

**Respondent skipped this question**

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Respondent skipped this question**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Respondent skipped this question**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Respondent skipped this question**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Respondent skipped this question**

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. "screening" methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q23**

Respondent skipped this question

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

## Page 7: Technical Specifications

**Q24**

Respondent skipped this question

What is the methane sensor that is used? Where applicable, specify brand or type.

**Q25**

Respondent skipped this question

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

Respondent skipped this question

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

**Q27**

Respondent skipped this question

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Q28**

Respondent skipped this question

What is the uncertainty/quantification accuracy of flow rate estimates?

**Q29**

Respondent skipped this question

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

**Respondent skipped this question**

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

**Respondent skipped this question**

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

**Respondent skipped this question**

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

**Respondent skipped this question**

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

**Respondent skipped this question**

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

**Respondent skipped this question**

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

**Respondent skipped this question**

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

**Respondent skipped this question**

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

**Respondent skipped this question**

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

**Respondent skipped this question**

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Respondent skipped this question**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

**Respondent skipped this question**

# Vendor #8 Response

**Collector:** [redacted]
**Started:** [redacted]
**Last Modified:** [redacted]
**Time Spent:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 8 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
[redacted] dedicated leak detection company covering everything from pipelines to facilities. We conduct facility inspections for troubleshooting, regulatory and specialize in start-up/commissioning with our proprietary tracer gas system. We utilize both FLIR and OpGal OGI cameras as well as a suite of laser, ultrasonic and thermal conductivity detection devices. We typically quantify with the High flow sampler, various vent gas data logging systems and plume calculation software informally called photonics.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
[redacted]

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

Unnecessary flaring overwhelms sensors, too many people (black body baseline) and vehicles in the area can obscure small emission sources and fatigue the operator. As little background movement as possible is best.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
Additional safety measures and the costs born from them. Some companies were permitted to skip inspections.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

Mandated frequency has obviously increased.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

Yes. While there is more work, every laid off engineer in Calgary bought a camera and is taking a stab at it. With that goes profit. More work to bid on but at very thin margins.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Yes** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Combo** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **N/A** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Hand held, truck/ATV mounted, UAV, pipeline GPS inspection software

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Most are captured as they come to atmosphere. Others, like photonics, can be several meters away.** |
| b. What sensors are employed and how? | **Varies** |
| c. How many people comprise one field crew? What are their roles? | **1-3 depending on a la carte** |
| d. How much time is spent surveying each potential source? | **Depends on size. Small ones are as quick as 5 minutes. Some (compressor seals)** |
| e. How much training are field staff required to have? | **1-3 years depending on aptitude** |
| f. What output data are generated and reported? | **We are customer #2 [redacted] the very best data collection and analysis product out there.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Decline to Answer**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Decline to answer**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Source identified, measured, data (pic, video, description, flow rate) inputted into intrinsically safe tablet, Bluetooth printed on a thermal tag and affixed to the leak source with flagging.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

Decline

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Budget. Typically there balking at any duplicative visit to a site.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Decline

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Decline

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Decline

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

D

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

D

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Comp

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Decline to Answer**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

D

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Done several. Cannot share.

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

D

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

Super snow conditions overwhelm the IT sensors. Very windy conditions can blow dirt on equipment.

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Nothing works in the cold. Rain isn't good on equipment. Wind is too dusty and makes small emission sources difficult to see.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-30 to +40** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **Max 30/hr average.** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Light** |
| What is the maximum deployment humidity (%)? | **Any** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Light** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Depends. If it covers connections it's too deep.** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

After FLHA and permitting, we're ready to do spect in 10min.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

10min

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

10min

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

D

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

D.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

D

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

6

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

D

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

D

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Profitability. As mentioned, everyone has gotten into the business and lowered the prices at a time when the prices should be holding sting as demand surges.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

D

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

D

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

# Vendor #9 Response

**Collector:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 9 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
Pipeline and facility leak survey and data management. Wide area mapping and leak detection. Alberta, BC, Saskatchewan.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
BC/Saskatchewan

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

Occasional staff walking on customer property.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
Several clients postponing/cancelling leak detection projects.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

Not yet.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**Respondent skipped this question**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

**Respondent skipped this question**

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

**Respondent skipped this question**

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

**Respondent skipped this question**

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Respondent skipped this question**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that ‘component’ means inspectors can confirm, diagnose and tag individual leaks.

**Respondent skipped this question**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Respondent skipped this question**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Respondent skipped this question**

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

**Respondent skipped this question**

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Respondent skipped this question**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

**Respondent skipped this question**

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

**Respondent skipped this question**

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

**Respondent skipped this question**

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

**Respondent skipped this question**

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

**Respondent skipped this question**

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

**Respondent skipped this question**

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

**Respondent skipped this question**

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

**Respondent skipped this question**

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

**Respondent skipped this question**

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

**Respondent skipped this question**

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

**Respondent skipped this question**

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Respondent skipped this question**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

**Respondent skipped this question**

# Vendor #10 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 10 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

[redacted] provides continuous monitoring using low-cost IoT devices that are installed around the fence line of a LDAR compliant site. Our continuous monitoring solution enables real-time detection of leaks that lead to faster repair and a greater reduction in GHG emitted to the atmosphere. Our sensors are capable of detecting methane, H2S, SO2, NO and CO as well as measuring meteorological data such as wind speed and direction that is necessary for quantifying and locating leak sources. To date we have [redacted] deployments across Alberta.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

US

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

No. Our devices are designed to be low power and low maintenance with very little chance of triggering any sparks. We are in the process of getting class 1 div 2 safety certification.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

We have submitted [redacted] (Alt-FEMP) Pilot as of [redacted] and aim to launch our pilot in [redacted]. We plan to use our experience with the AER to apply for additional Alt-FEMPs with other operators in Alberta as well as in other provinces with equivalency frameworks

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

We have been the recipients of federal and provincial funding programs [redacted] to help develop and deploy our technology with industry partners

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Technology: IoT device deployed at site, cloud platform for storing and analyzing data and web-based dashboard for viewing data and insights** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Combination of products (e.g., IoT device, dashboard) and service (e.g., install, calibration and maintenance of devices deployed in the field)** |
| c. Is the method mobile or stationary? | **Stationary as its meant to continuously monitor when deployed but can be moved to other sites relatively easy** |
| d. Does your method require site access or does it measure remotely? | **Can measure remotely but should be deployed between 10-100m from physical asset. We typically deploy around the fence line of a site** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

[redacted] provides continuous monitoring using low-cost IoT devices that are installed around the fence line of a LDAR compliant site. Our continuous monitoring solution enables real-time detection of leaks that lead to faster repair and a greater reduction in GHG emitted to the atmosphere. Our sensors are capable of detecting methane, H2S, SO2, NO and CO as well as measuring meteorological data such as wind speed and direction that is necessary for quantifying and locating leak sources

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Ideally between 10-100m** |
| b. What sensors are employed and how? | **A mix of electrochemical and metal oxide gas sensors are continuously measuring concentrations while compensating for temperature and humidity** |
| c. How many people comprise one field crew? What are their roles? | **Two. Installation, calibration and field testing** |
| d. How much time is spent surveying each potential source? | **Continuously 24hrs per day sampling up to every second if required** |
| e. How much training are field staff required to have? | **Minimal. They need to know how to install a device on the fence line** |
| f. What output data are generated and reported? | **Time series gas concentration data across 5+ gases along with local meteorological conditions (temperature, wind speed/direction, humidity, pressure)** |
| Additional work practice details | [redacted] **employs a proprietary alerting system which has various levels that get triggered depending on IoT measurements (e.g., level 1 indicates a peak of 2x the standard deviation above a rolling 5-day average, level 3 indicates repeatability of level 1 alert given similar meteorological conditions)** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Yes,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
We have submitted Alberta's [redacted] Alt-FEMP pilot. The pilot is scheduled to kick off in [redacted]

Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

We are developing [redacted] to quantify, locate and classify leaks. The leak classification model aims to distinguish vented from fugitive emissions by incorporating operational data and observing changes in the temporal nature of leak detection events.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**

If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:

Currently, our system issues a series of alerts that dictate when and where an OGI follow-up is required. This enables us to provide a service that not only reduces unnecessary OGI visits but also leads to faster response to leak events. In the future, we would like to identify the location of the leak without requiring an OGI follow using our AI/ML models.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. "screening" methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

Our current work practices dictate follow-up OGI crews will be sent to sites with confirmed leaks. In the future we aim to use AI/ML to confirm and tag individual leaks

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

We are still determining if a generalized threshold is applicable given the variety in facility types and sizes. We do have the flexibility of measuring many different factors (e.g., numerous gases and meteorological conditions) which enable us to test different site-level emissions thresholds to see what works and what doesn't. We also have our own controlled release testing facility to confirm such thresholds. Same thing applies with follow-up ratios.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Follow-up crews on site will visit any sites that where 10 devices indicate that a follow-up is required (e.g., alert level 4). We aim to follow up within 15 days of alert and repair with 30 days of a confirmed leak.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Proprietary

**Q25** **Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Proprietary

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Proprietary

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

Same as OGI

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Component level during OGI follow-up

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

If yes, which variables contribute to your detection probabilities?:
We have theoretical detection probability curves and are developing them based on tests at our proprietary controlled release testing facility. We aim to refine these results through the Alt-FEMP pilot.

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Yes, wind speed/direction, temperature, humidity and pressure

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Yes, our controlled release testing facility is capable of both indoor and outdoor testing but results are kept confidential for now as we continue to refine our technology

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Yes, results from dispersion models and simulations were included in our Alt-FEMP pilot application

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

We currently have devices operating continuously in the field for the past 4 months when temperatures have dipped below <-40C. We have an upper designed temperature limit of +50C

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Our sensors are sensitivity to relative humidity and temperature. We compensate for this using proprietary calibration processes and compensation curves

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-40C to +50C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **0 - 230km/h** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Heavy** |
| What is the maximum deployment humidity (%)? | **100%** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Heavy, though some snow may new to brushed off our solar panel arrays which we can detect remotely** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Deep, our devices typically sit on top of the fence line between 2-3 meters above ground** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

One time installation of 30-60min per device depending on the site

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

N/A, our sensors are stationary and meant to deployed continously

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

Yes, each site requires roughly 3-5 devices and each device requires 30-60min to install

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Data is continuously available on our dashboard and updated every minute. Custom reports can also be created from this data at will

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Our technology requires some wind to fully perform as designed. Most of Alberta has a prevailing wind from the West that averages 8-11 km/h for most of the year

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

N/A, [redacted] requires 3-5 devices per site. For smaller sites 1-2 devices could even suffice if placed downwind from prevailing wind direction

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

We currently have 2 crews available. A single crew can install and setup a facility in 2-4 hours. Depending on the relative distances between sites, each crew can service 1-3 sites per day

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

We have funding and capacity to deploy [redacted] (100-400 facilities

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

2 years

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes, we expect to scale our field workforce and device inventory in line with expected deployments

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Manufacturing of sensors

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

We typically charge a one-time mobilization fee of [redacted] and a on-going monitoring fee of [redacted]

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

We plan to offer discounts on the mobilization fee depending on order volumes and contract duration

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
1-2 devices depending on size and and surrounding topography

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
2-4 devices depending on size and and surrounding topography

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
3-5 devices depending on size and and surrounding topography

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
2-4 devices depending on size and and surrounding topography

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

**Respondent skipped this question**

# Vendor #11 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 11 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
As your global service provider in the oil & gas and (petro)chemical industry, [redacted] is committed to helping you realize your environmental, sustainability, and integrity ambitions. We develop and execute best-in-class emission management and pipeline integrity programs with a meaningful impact on safety, compliance, environmental footprint, and business profitability. Our team of more than [redacted] emission reduction surveys and pipeline integrity projects in more than 35 countries across the globe. Our customers value [redacted] in-depth knowledge, dedicated people, innovative approach, and reliable, accredited processes.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
Globally

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

[redacted] are a field based approach to fugitive emission management. We travel to site by vehicle and preform our duties onsite in operating conditions.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
Federal recommended travel restrictions has limited international travel has impacted scheduling of LDAR programs.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

The roll out of the Federal and Provincial programs have delayed decisions and start times.

## Page 4: Leak Detection Service Description

**Q13**

**AltFEMP**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Service** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **Site Assess** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

11 ALT FEMP proposes an optimized LDAR program, which consists of one high quality onsite survey per year, combining several measurement technologies. A smart combination of OGI and FID technology for leak detection forms the basis of the optimized program. A detailed source-based inventory and SFEMP software are also essential components of the program.

Our best practices in LDAR programs demonstrate that when certain quality features are present in an LDAR program, average results of 60% - 90% of emission reduction are achieved with one survey per year, combined with attention for leak follow up.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Point source** |
| b. What sensors are employed and how? | **FID Devices** |
| c. How many people comprise one field crew? What are their roles? | **(1-2) Field Technicians for OGI & FID surveys. (1) technician inventory management.** |
| d. How much time is spent surveying each potential source? | **This depends on the manufactures recommendation of the device being used.** |
| e. How much training are field staff required to have? | **min. 2 years training.** |
| f. What output data are generated and reported? | **Complete inventory management at all sites is obtain for the clients. This includes identification of all potential leaks sources. Repair reports, as defined by the client repair threshold are generated for field and corporate office. Corporate office will receive an full overview of all leaks and recommendation for repair and emission reduction program. The data is owned by the client.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Yes**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
After project preparation, all detailed information for each potential leaking source is registered by the FEM technicians in a digital inventory for the identification of sources. This identification is preferably performed onsite for the highest accuracy. All potentially leaking equipment will be given a unique Leak Equipment Code (LEC). A LEC is followed by a source identification number. This number is used to make the distinction between all different sources on a single equipment.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

OGI Camera -Optical Gas Imaging by Infrared Camera is a great addition to other (LDAR) measurements, and suitable for fast discovery of larger leaks in both accessible and non-accessible areas.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Regulator reporting requirements, Clients protocols.
The ALT FEMP program designates requirements of 75%.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

All immediate repairs completed activate second recordings which are posted to software.  All remissions above the threshold and repaired at a latter data will be tested through OGI, FID, or HFS. HFS.  All later repair dates are posted within the software, once retest are completed these results are post dated.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

[redacted] are agnostic to the methane device for the client. We select the best device for the situation.

**Q25** **Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

minimum - 200l/min.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

N/A

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

N/A

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Component

**Q30** **Decline to Answer**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Source product

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Yes.

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Yes to both.

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

< -25C and > 50C

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Temperature.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **dependent to the equipment being used. < -25C and > 50C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **dependent to the equipment being used.** |
| How much active rain is tolerated (None, light, medium, heavy)? | **dependent to the equipment being used.** |
| What is the maximum deployment humidity (%)? | **dependent to the equipment being used.** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **dependent to the equipment being used.** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **dependent to the equipment being used.** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

30 mins.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

30 mins.

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

5 mins

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Field Repair Reports provide to operations same day or next day if required. Repair reports include but not limited too -a picture, P&ID drawing, location of leak source component and leak rate.
Corporate aggregated reports are 4 weeks total emission summary from all locations and leak sources.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Most limiting factor is assess to components.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

9 per day

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

[redacted]4 person crews.

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

Decline

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

We are confident with our finances to scale to market conditions.

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

We expect increase in personnel and capital equipment in 2021 and beyond.

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Regulatory changes and enforcement.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

decline

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Multi year contracts reduce costs 40% from year 1 to year 2.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Varied**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Some clients request their data management software tie into other environmental reports issued to AER.

**Q57**

What LDAR-based data management services does your organization offer?

[redacted]'s data management service

# Vendor #12 Response

**Collector:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 12 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

[redacted] offers traditional LDAR services globally including Canada. [redacted] uses OGI and Method 21 instruments to complete LDAR surveys. In Canada, core markets include AB, BC, SK, MB and are looking to expand monitoring services to Eastern Canada. [redacted] has over

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

[redacted] currently offers LDAR in Manitoba and Saskatchewan. [redacted] is highly interested to expand the service across entire Canada and also offers services in other countries in Europe, Asia, and other parts of the world.

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**No**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

[redacted] uses a traditional method to survey therefore does not face major risks o concerns other than human risks/errors.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**

If Yes, please explain.:

We saw decreased number of duty holders show interest.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | [redacted] **offers a method to complete LDAR survey.** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **A Service** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **Require site access** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

[redacted] uses a hand-held device to complete a full survey at a site.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **2-15m** |
| c. How many people comprise one field crew? What are their roles? | **1. A technician completes a survey as per Directive60 and records necessary data/videos.** |
| d. How much time is spent surveying each potential source? | **2 seconds - 30 seconds** |
| e. How much training are field staff required to have? | **At least 2 weeks or 500hrs with the OGI camera.** |
| f. What output data are generated and reported? | [redacted] **CNTRAL platform to generate a report which can be shared to the client. Reports are also available in excel, PDF, and all the data is also available online.** |
| Additional work practice details | [redacted] **quantification services using Providence Photonics QL320, Method 21 verifications, and gas analysis where needed.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

No, [redacted] offers traditional "Boots on the ground" method servey

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

Experts are in the field investigating and diagnosing the source, therefore, better understand the process and situation of the leak or potential false positives.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
When leak/fugitive emission is suspected, a trained technician then investigates the leak further pinpointing the source. After investigation, the leak is recorded and a leak tag is put on the source with leak details.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

N/A

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

N/A

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

FLIR OGI GFx320

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Minimum: ~0.3m3/day. Maximum: ~430m3/day

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

~20m3/day at 2-3m distance with minimal wind.

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

+/- 20%

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

component

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Yes**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Temperature and wind condition.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

[redacted] does not have results we are able to share at the moment however, the product studies can be found/obtained from the manufacturer.

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

N?A

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

[redacted]offers services in all conditions except in extreme cold (below -20'C) or when wind speed is >25MPH

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Our method is best at -20'C-50'C, low precipitation and windspeed calmer than 25MPH.
At temperature outside of -20'C-50'C, gas may not be detected or is more difficult to "visualize" the gas on the camera.
With rain or snow, this may result in biased results when quantifying. Should have no problem with qualifying.
At windspeed above 25MPH, quantified rate may result in biased number.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **50'C maximum and -20'C minimum.** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **~40km/h** |
| How much active rain is tolerated (None, light, medium, heavy)? | **heavy** |
| What is the maximum deployment humidity (%)? | **Unknown** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Heavy** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Deep** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

5-10 minutes.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

1-2 minutes.

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

No, once the camera is "cooled" it is ready at next site.

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Next business day or within 1-2 hours if rushed.
Reports include site information, inspection details such as survey time, GPS, leak/emission details with a photo, video of the leaking source and etc.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Normal human risks as technicians are out in the field exposed to gases.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

7-8 sites a day, ~50sites a week

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

[redacted]

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

The desired number is ~500-1000 sites in a year to complete a full comprehensive site-level LDAR Servey.

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

unknown

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes, [redacted] is looking to increase assets and the number of crews. However, increasing capacity is business dependant.

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

The biggest barriers [redacted] facing is non-compliance from the companies and uncertainties. [redacted] to increase the scale of business and investments will be available once there is a business model.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

$2000-$2400

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

[redacted] % discounts on large volume contracts and will look at a cost reduction to be competitive in the market.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
1.25hrs per site @ ~$275 per site.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
1.75-2.25hrs per site @ $450 per site

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
~3-8hrs per site @ $1000-$1800 per site

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
~4-10hrs per site @ $1000-$2200 per site

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

N/A

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes,**
If yes/no/varied, are there any key reasons?:
Survey details/data is required by the regulation.

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Progress reports and leak reports are required by the clients.

**Q57**

What LDAR-based data management services does your organization offer?

[redacted] uses CNTRAL as the main LDAR-based data management services. [redacted] to the use of other data management services.

# Vendor #13 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 13 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
[redacted]YEARS DIRECT EXPERIENCE WITH DATA COLLECTION, PROGRAM IMPLEMENTATION STRATEGY PLANNING, INVENTORY DEVELOPMENT AND MANAGEMENT EMPLOYING A VARIETY OF EMISSION MANAGEMENT SOFTWARE SOLUTIONS - PROFICIENCIES WITH INSPECTION METHODS SUCH AS OPTICAL GAS IMAGING, EPA METHOD 21, ACOUSTIC AND AOV. WE HAVE WORKED IN UPSTREAM, DOWNSTREAM AND CHEMICAL FACILITIES. WE ALSO MAINTAIN PROFICIENCIES WITH REPORTING AND AIR EMISSION CALCULATION

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
ONTARIO AND NWT

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

NONE

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, but resolved by year-end 2020,**
If Yes, please explain.:
SMALLER WORK TEAMS - SPREAD OVER LONGER PERIODS OF TIME TO MAINTAIN SOCIAL DISTANCING AS PER PROVINCIAL STANDARDS. REGIONAL LODGING FOR REMOTE LOCATIONS

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

NO

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

NO

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **EPA METHOD 21 AND AWP IN ACCORDANCE WITH CFRO PART 40** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **SERVICE** |
| c. Is the method mobile or stationary? | **MOBILE** |
| d. Does your method require site access or does it measure remotely? | **SITE ACCESS AND REMOTE SERVICES OFFERED** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

PDA, PORTABLE INSTRUMENTS - ELECTRONIC DATA GATHERING AND TRANSFER /

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **CONTACT AND UP TO 6 METERS** |
| b. What sensors are employed and how? | **FID / IR** |
| c. How many people comprise one field crew? What are their roles? | **UP TO 5 - FORMAN WITH CROSS SHIFT PLUS SUPPORT RESOURCES** |
| d. How much time is spent surveying each potential source? | **MINIMUM 15 FOR EPA METHOD 21 AND DEPENDS ON EXTERNAL INFLUENCES FOR OTHER METHODOLOGIES** |
| e. How much training are field staff required to have? | **MINIMUM 40 HOURS FIELD + CLASS ROOM BASE TRAINING W/COMPETENCY CONFIRMED THROUGH WRITTEN KNOWLEDGE EXAM (PASS MARK 80 REQUIRED)** |
| f. What output data are generated and reported? | **SUMMARY DETAILS OF EMISISONS, AND INSPECTIONS W/FINDINGS AND MTC AND REPAIR** |
| Additional work practice details | **WORK STANDARDIZATION DOCUMENTS** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Yes**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:
VISUAL AND/OR THROUGH FLOW METER QA/QC REVIEW FIELD LABOR COMPETENCY WITH PROCESS EQUIPMENT OPERATION

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
WE WORK TO INTEGRATE SYSTEM WITH SITE ASSET MANAGEMENT PLATFORMS LEAK IDENTIFIED - IMMEDIATE REPAIR - FAILED REPAIR - TAG LEAK - BUILD LEAK PACKAGE W/DETAILS ENTER WORK ORDER FOR REPAIR

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

ALL LEAKS ARE ABLE TO BE INVENTORIED AND IDENTIFIED FOR FOLLOW UP REPAIR

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

WE QA ALL SITES

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

ALL SOURCES ARE INPSECTED AS PER THE SITE DESIGNATED REGULATORY REQUIRMENTS

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

FID / THERMO SCIENTIFIC

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**No**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

DEPENDS ON TESTING TYPE ( M3/DAY)

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

2%

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

COMPONENT OR FACILITY

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Yes**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

SCREENING DATA

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

ANY EXTERNAL INFLUENCES THAT WILL INFLUENCE SAMPLES (OPERATIONS, PROCESS PRESSURE, WEATHER)

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

WORK IS RE-SCHEDULED TO MORE SUITABLE TIMEFRAME

## Q36

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-10** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **25kmph** |
| How much active rain is tolerated (None, light, medium, heavy)? | **light** |
| What is the maximum deployment humidity (%)? | **n/a** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **none** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **n/a snow on ground not an influence / instrument manufacture operating spec determine instrument performance / process speciation determines HC volatility** |

## Q37

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

1.5 hrs

## Q38

**Respondent skipped this question**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

## Q39

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

1.5 -2 hours

## Q40

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

daily reporting - semi annual or annual

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

people and accountability!!

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

depends on the program set up and results - more leaks take more time

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

crews

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

n/a

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

we are ready now

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

decline to answer

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

regulations and interpretation -

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

Lump sum pricing

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

piece work

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
depends on the findings more leaks mean more time logging results our teams find leaks!

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
depends on the findings more leaks mean more time logging results our teams find leaks!

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
depends on the findings more leaks mean more time logging results our teams find leaks!

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
depends on the findings more leaks mean more time logging results our teams find leaks!

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

we have daily work performance variables that are tracked through daily KPI reporting - we are always on time and on budget

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes we work with our customers to develop implementation strategy plans that assign key roles and responsibilites

**Q57**

What LDAR-based data management services does your organization offer?

Formal reporting or support as required

# Vendor #14 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 14 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
We have sold [redacted] detection instruments to the natural gas utility market for 10 years. In addition, our leak survey team has performed surveys across Alberta, Northern BC, Manitoba, and Ontario.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
National

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

None

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **technology** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **product** |
| c. Is the method mobile or stationary? | **mobile** |
| d. Does your method require site access or does it measure remotely? | **requires site access** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

We have handheld units as well as other instruments that are capable of being mounted on an ATV or truck. We employ a variety of technologies to measure and quantify leaks from mechanical sensors to infra red absorption spectroscopy.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **depending on detection threshold - we can be meters away, or in the plume.** |
| b. What sensors are employed and how? | **typically our survey tools use infra-red absorption spectroscopy** |
| c. How many people comprise one field crew? What are their roles? | **2 people - one on the instrument, one recording data and field observations** |
| d. How much time is spent surveying each potential source? | **this is dependent on the reporting required and site conditions** |
| e. How much training are field staff required to have? | **1 week leak survey, 1 day bear awareness, 1 day general field practices** |
| f. What output data are generated and reported? | **multiple datasets are possible - depending on customer needs** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

Not at this time.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

Utilizing an Ethane detection instrument, we can distinguish between 'line gas' which contains ethane, and 'natural' methane, which does not contain ethane.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
A wide area survey can indicate a gas plume. The site undergoes a visual inspection to try and identify any possible leak sources, which are then investigated at close range to determine if any are contributing to the overall plume on site. Anything discovered can then be tagged with the survey date and on-site measurements of the gas detected at that time.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

unknown

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

unknown

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

unknown

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

infra red tunable laser, or Pellistor sensor

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**No**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

**Respondent skipped this question**

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

**Respondent skipped this question**

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

driving rain, wind in excess of 30 km/hr, temps below minus 15c

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

wind is the largest factor. High winds will spread the plume to a non-detectable threshold, making survey work inconclusive. Rain or snow can interfere with laser based measurements.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-15 - +40** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **0-20** |
| How much active rain is tolerated (None, light, medium, heavy)? | **light** |
| What is the maximum deployment humidity (%)? | **no restriction** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **light** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **thin cover** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

15

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

2-3 minutes

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

15

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

2 days for general site reports and notes. 2 weeks for detailed maps/drawings with notes.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

weather and site access

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

unknown

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

zero

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

Size of potential contract would determine staffing needs.

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

Scope of project would determine staffing needs

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Scope of project would determine staffing needs

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

availability of personnel

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

decline to answer

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

decline to answer

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
This is impossible to determine without complete knowledge of the site layout and reporting requirements.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
This is impossible to determine without complete knowledge of the site layout and reporting requirements.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
This is impossible to determine without complete knowledge of the site layout and reporting requirements.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
This is impossible to determine without complete knowledge of the site layout and reporting requirements.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

This is impossible to determine without complete knowledge of the site layout and reporting requirements.

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**N/A**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Varies client to client

**Q57**

What LDAR-based data management services does your organization offer?

Decline to answer

# Vendor #15 Response

**Collector:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 15 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

Vendor 15's specific offerings [redacted] Satellites have worked globally in Oil +Gas, Waste Management, Power Generation, Mining and Agriculture The Aircraft Variant has worked in Canada and the USA primarily in Oil and Gas

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

Global

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

None based on the altitude we fly the aircraft

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

Not aside from interest in Alt-FEMP programs

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Technology and Method** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Service** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **Remotely** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Satellite - takes observations from 500km above the earth's surface.  Revisits each location every two weeks through a sun synchronous polar orbit.
Aircraft Variant- uses the same instrument as the satellites, but 2-3kms above ground on demand
Analytics - Utilizes publicly available methane data, customer proprietary data and our own methane data to catalogue historical methane concentration/emission data and inform machine learning algorithms to predict where future emission risk is highest and this is used to point/cue future observations with our satellite and aircraft variant

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Satellite - 500k, Aircraft Variant - 2-3km** |
| b. What sensors are employed and how? | **Wide Angle Fabry-Perot** |
| c. How many people comprise one field crew? What are their roles? | **0** |
| d. How much time is spent surveying each potential source? | **<1 minute** |
| e. How much training are field staff required to have? | **N/A** |
| f. What output data are generated and reported? | **Abundance Data Sets, Concentration Maps, Emission Rates by pixel** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
Yes, working with various partners in pilots with this being the goal.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**No,**
If yes, how? If not, how does it account for potential false positives?:
Working with the operator.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**No,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
The operator would take action on our reported leak to mitigate it.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

Work with operator

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Work with operator

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Dependent on operator.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Wide Angle Fabry-Perot

**Q25** **Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

300 m3/day +

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

N/A

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

Varies

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

equipment to facility

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Decline to Answer**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Wind data from various sources

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Yes we can upon request

**Q33**

Has controlled release testing data or performance data on your organization’s method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Modelling, but not an AltFEMP proposal to date.

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

We require reflectance from the sun.  We are unable to take observations at night or with significant cloud cover

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Wind impacts our results, but this is mitigated with accurate wind data in our processing

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **All** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **Most, accurate wind data from weather stations improves accuracy** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Clouds from rain would make us unable to capture data** |
| What is the maximum deployment humidity (%)? | **All** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **All** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **All** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

0

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

0

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

No

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

In the first 1/2 days we have a Y/N for a plume of methane.  We will then have emission rates within a week.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Lack of sunlight

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

Plenty.  3 satellites orbiting the earth 15 times a day and revisiting each point every two weeks.  It depends much more on the location of each individual battery.

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

3 Satellites, 1 Aircraft Variant

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

We have significant capacity to increase our market share

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

N/A

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

We will be adding an additional [redacted] satellites. [redacted]

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Operator buy-in

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

Decline to answer

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Subscriptions to service significantly decrease costs on a "per observation basis"

## Page 11: Productivity and Cost (Optional):

**Q50** **21+**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q51** **21+**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

Satellite - We capture 12km x 12km images
Aircraft Variant - We fly a linear area with a 750m swath

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes,**
If yes/no/varied, are there any key reasons?:
Looking at concentrations over time Predicting risk probability for future leaks Identifying changes to flares (Lit/Unlit) Identifying methane hot spots one week to the next

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes, see above

**Q57**

What LDAR-based data management services does your organization offer?

See above which is contained in our Analytics Portal and the data is also available for clients to use in their own software

# Vendor #16 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 16 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

[redacted] of direct LDAR surveying experience across Alberta in [redacted] oil and gas facillities.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

Facilities in Saskatchewan and BC

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

none

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**

If Yes, please explain.:

Permitting etc.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

yes, increase survey frequencies

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Method 21, optical gas imaging, organic vapor analyzer** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **both** |
| c. Is the method mobile or stationary? | **mobile** |
| d. Does your method require site access or does it measure remotely? | **both** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

hand held for all three

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **varies fron inches to in excess of 100 meters** |
| b. What sensors are employed and how? | **Flir imaging, Ultrasonic detection, organic vapor 1ppm-100% by volume** |
| c. How many people comprise one field crew? What are their roles? | **1-2 depending on additional tasks required.** |
| d. How much time is spent surveying each potential source? | **varies** |
| e. How much training are field staff required to have? | **training is ongoing, to be deemed experienced approx 2 years plus a written exam.** |
| f. What output data are generated and reported? | **leak location, pictures or leak, estimate on volume. stored in a database** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

Possibly

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

vented vs fugitive emissions are the technicians evaluation. Technicians have required training to determine which is which

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**

If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:

Tagged, flagged and photographed. Entry into dBase. Also provide leak tracking and oversite for clients

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

all leaks are identified to absolute specific component, where possible leak is identified in photograph through soaping or detailed text discription.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

N/A

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

N/A

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

GMI GT 44/43

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

varies by increase in volume

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

component

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**No**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

no

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

no

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

None to date

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Rain can affect OIC and Ultrasonic detection

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-45 to +40** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **na** |
| How much active rain is tolerated (None, light, medium, heavy)? | **medium** |
| What is the maximum deployment humidity (%)? | **n/a** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **n/a** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **deep** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

5 min

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

3

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

no

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

1 day

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

n/a

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

15-20/day

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

rely on scheduling

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

unknown.....approx 3000

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

3 years

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

yes, an increase

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

training of personell

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

[redacted]

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

possible slight reduction 5-10%

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+,**
Survey time per site, cost per site (optional), and additional comments::
20-30 minutes travel included

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**11-20,**
Survey time per site, cost per site (optional), and additional comments::
20-40 minutes including travel

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
1-10 hours depending on site. Nominal around 4

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
1-3 hours depending on number of compressors

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Most utilize Cntral

**Q57**

What LDAR-based data management services does your organization offer?

Cntral is used the most

# Vendor #17 Response

**Collector:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 17 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

Our organization uses a drone with an integrated Methane sensor to fly over a site to pinpoint any Methane leak locations. The sensor can detect Methane as low as 5 ppm.m. We then go to the detected leak locations with an OGI Camera for quantification of leaks. This is much faster than using just the OGI, as the setup time is quite long with the camera.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**

If yes, which markets? (Optional):

[redacted]

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

Since our drones are battery powered, they do not create a lot of noise. The drones also do not fly very high (30m - 50m max), so airspace is generally not a concern. We do work with the local airspace authority to get proper authorization and maintain contact where necessary. We just have a 1 vehicle crew that handles both the drone flights and OGI camera, so there is minimal interruptions.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

Yes, since Directive 60 has been implemented in Alberta, there has been more desire for Methane detection companies to come forth and offer services. This has allowed Vendor 17 to expand our operations very quickly.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

Yes, our office in [redacted] has been working very closely with local companies to help comply with federal regulations.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Both. We offer the technology as a method of detecting leaks** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Combination. We offer the services, but are capable of selling the equipment as well.** |
| c. Is the method mobile or stationary? | **Mobile** |
| d. Does your method require site access or does it measure remotely? | **Site Access** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

We use a UAV to detect the leak, and then a ground-based OGI Camera to quantify the leak once it is detected.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Around 25m for the UAV sensor, and about 10-15ft with the OGI Camera** |
| b. What sensors are employed and how? | **U10 Methane sensor with a Matrice 300 RTK Drone** |
| c. How many people comprise one field crew? What are their roles? | **Our crew is 2 people. One is the Pilot in Command, and the other is the Visual Observer. Both assist with the OGI Camera as well.** |
| d. How much time is spent surveying each potential source? | **It depends on many factors, but normally around 20 minutes.** |
| e. How much training are field staff required to have? | **Our crew requires a Drone Pilot Certificate for Advanced Operations, plus training on the drones and sensors. The OGI camera also requires training. About 1 week for full training of all equipment.** |
| f. What output data are generated and reported? | **We have a Fugitive Emissions Dashboard that shows all leaks from all surveys at all locations on a single screen. Workflows are able to be generated for repairing equipment, and all leaks can be exported in a .xls file with the same Excel Template as the AER.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

The drone itself is not able to, but the trained staff can distinguish the emissions when they quantify the leak.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Each leak is uploaded into our Fugitive Emissions Dashboard, which then creates the workflow for each leak. We have the capability of using a QR code/tagging system which allows an operator to scan the QR code with their phone and track any leaks or repairs that way.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

The leak points from the drone are still uploaded to the Fugitive Emissions Dashboard. If the OGI crew is unable to get to the leak location, then it would be noted on the dashboard. If OGI crew is capable of getting to the area, then they will quantify the leak and upload the data to the dashboard.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

Our clients will generate a list of sites that require follow-up. Some sites will require 1 survey, while others may require 3 surveys per year.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Our OGI crew will target any detected leak points from the drone-based Methane sensor. Since the drone does an overhead, top-down flight, all GPS points are tagged on the map so the OGI crew can take the camera to those locations. This is done in tandem with the drone flights, so there is no delay. If repairs are required, the workflows are created in our Fugitive Emissions Dashboard, which allows operators to check off if a repair has been complete, and if/how they plan on validating the repair when it is done.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

[redacted] sensor that integrates with a drone.

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Unknown. FLIR does not post a minimum or maximum flow rate, but it seems to be very low to almost unlimited.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Detection median is temperature difference between the measured gas and the ambient gas.

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

±1°C (±1.8°F) for temperature range (0°C to 100°C, 32°F to 212°F) or ±2% of reading for temperature range (>100°C, >212°F).

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

All of the above. We will breakdown each individual component or equipment on our Fugitive Emissions Dashboard, but it does also provide data for each well pad, site, or facility.

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

If yes, which variables contribute to your detection probabilities?:
We are working on an AI Platform that will help detect future Methane leaks based on equipment type, damages, etc. This platform is still in development and is not ready for use yet.

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Windspeed, distance, and temperature need to be very accurate so we use an Anemometer to gather this information, as well as a laser rangefinder for distance.

---

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

We have done a test with a client that opened a valve while our drone-based Methane sensor flew overhead to show that the technology works. This did not show a leak rate, but showed that the drone is capable of detecting methane leaks. Since we use the FLIR GFX320 OGI Camera, there is plenty of proven data on that so we did not quantify the leak.

---

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

N/A

---

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

We do not operate in temperatures colder than -20°C, warmer than 50°C, or in flying heavy snow. We can operate in light snow and rain.

---

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Falling/Flying rain or snow can affect the OGI Camera, since it is an object with a temperature differential moving across the detection area. Heavy snowfall can give us false readings with the drone-based sensor, but we check every leak point with an OGI camera, so there will not be false leaks showing up on the dashboard.

---

### Q36

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-20°C to 50°C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **54km/hr maximum wind resistance on the drone** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Heavy** |
| What is the maximum deployment humidity (%)? | **There is no limit** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Medium** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Deep (just need to clear a take-off/landing area for the drone)** |

### Q37

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

5 minutes

### Q38

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

5 minutes

### Q39

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

No. We can setup the drone at the first site, and leave it unfolded/calibrated for the remainder of the day.

### Q40

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

7 days. This includes all the data submitted on the Fugitive Emissions Dashboard. If our crew is staying at a plant camp and has stable internet, they can upload the data each night.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Heavy snow is the main factor that will limit our ability to fly the drone, and effectively use the OGI Camera.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

Approximately 4-6 single well batteries per day. Depends on the amount of leaks detected and how far apart they are.

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

3, but have active job postings and candidates being interviewed to expand operations.

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

Our organization is able to expand and scale as needed. There is no specialized schooling required as we just train each employee as they are hired. This gives them the tools they need to perform the job quickly, safely and efficiently. Our projections for single well batteries are as follows:
2021: 250
2022: 500
2023: 1000

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

We are expanding this quarter, and will be continuing to expand throughout the following years.

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes, we will be growing both our crews and equipment.

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

Manufacturing of Sensors and cost of equipment. The OGI Cameras and U10 Methane Sensors are very expensive.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

[redacted]

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

We would need to examine all aspects of the job including site density, # of sites, size of sites, etc. If we were contracted for a large job, we can charge less.

## Page 11: Productivity and Cost (Optional):

**Q50** **6-10**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q51** **1-5**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q52** **1-5**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes,**
If yes/no/varied, are there any key reasons?:
Leak data can be very large and hard to process. That is why we have developed our Fugitive Emissions Dashboard.

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes, some clients want just an excel spreadsheet, but some want audit trails, carbon credits, and workflows integrated into the dashboard.

**Q57**

What LDAR-based data management services does your organization offer?

The Fugitive Emissions Dashboard. This puts all the leak data from the drones and OGI Cameras into a single page where the client can see each leak from a survey and see what equipment is leaking, flow rates, repair status, etc. The dashboard also allows for the data to be exported to a .xls Template for reporting to the AER.

# Vendor #18 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 18 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
OIl & Gas since [redacted]

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
OIl & Gas, Landfill, Composting

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

**Respondent skipped this question**

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
Travel restrictions to sites. Lab testing.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

NO

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**Respondent skipped this question**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Technology - Portable, Fixed Continuous and Drone Based Air Quality Monitors** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Product** |
| c. Is the method mobile or stationary? | **Mobile and Stationary** |
| d. Does your method require site access or does it measure remotely? | **Both site access and remote measuring** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

hand-held, aerial, truck mounted, UAV, fixed sensor, portable, temporary.
Multiple system varieties for virtually all applications.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **0-? horizontal and vertical distances are applicable** |
| b. What sensors are employed and how? | **TLDAS and LEL, in hand-held, fixed, UAV** |
| c. How many people comprise one field crew? What are their roles? | **1 for hand held, 0 for fixed (remote monitoring, 1 for UAV based models** |
| d. How much time is spent surveying each potential source? | **Short duration for hand held. Indefinite for fixed, up to 8 hours for UAV based.** |
| e. How much training are field staff required to have? | **15-30 minutes** |
| f. What output data are generated and reported? | **graphical analysis with included software. CSV format for data only.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
No active projects at this time

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**
If yes, how? If not, how does it account for potential false positives?:
the hand held and UAV systems can be moved to multiple locations to pinpoint vented and/or fugitive emissions.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Our software will create hotspots that can be measured repeatedly and/or for longer periods to determine if it is a leak or fugitive. WE can then develop a model to determine where the source is originating from

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

N/A

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

N/A

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

TLDAS- Tunable Laser Diode and/or Electrochemical sensors

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**No**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

**Respondent skipped this question**

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

**Respondent skipped this question**

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

We are manufacturers and generally do not operate in the filed

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

**Respondent skipped this question**

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-40 to +40 C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **N/A** |
| How much active rain is tolerated (None, light, medium, heavy)? | **hand-held and UAV none-light, Fixed heavy** |
| What is the maximum deployment humidity (%)? | **90%** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **hand-held and UAV none-light, Fixed heavy** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **N/A** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Hand-held/UAV less than 15 minutes. Fixed  always on

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Hand-held/UAV less than 15 minutes. Fixed  always on

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

Hand-held/UAV less than 15 minutes. Fixed  always on

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Live data reporting

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

N/A

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

N/A

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

n?A

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

N/A

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

N/A

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

N/A

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

N/A

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

N/A

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

N/A

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
N/A

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
N/A

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
N/A

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
N/A

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

WE are a manufacturer not a service organization

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**N/A**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

**Respondent skipped this question**

# Vendor #19 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 19 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
(Yes, with heavy caveats). [redacted] is a startup offering a new type of emissions visualisation and quantification solution, based around quantum dingle photon detection technology. The first commercial units are shipping within the month, and we are actively seeking field trials for the equipment in the second half of 2021 and onwards. [redacted] has had solid support from Innovate UK and has been working closely with the UK National Physical Laboratory to prove we can do what we claim. We have demonstrated our cameras in multiple industrial trials and shown they work in bright sunlight, snow, rain, fog and the dark. We have also carried out industrial trials at the [redacted]
We are working with industrial partners [redacted]

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
Global

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

None - the technology has a small form factor (similar to a security camera) and uses an entirely eye safe tunable diode Lidar to gather gas concentration data. The greatest safety concern is the preference to be installed at height. The equipment is small and light enough to be attached to existing infrastructure, a MEWP or a tripod/mast.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
The Covid-19 pandemic has limited access to the development laboratory to only a porportion of staff, at only a proportion of the time. This has slowed down the delivery of the first camera units for sale, and will continue to slow delivery of new units for field trial over the course of 2021. [redacted] is expecting to be carrying out field trials by Q4 2021.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No. [redacted] has had no exposure to the Canadian market so far.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No. [redacted] has had no exposure to the Canadian market so far.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | 19 **offers a gas measurement camera utilising unique quantum single photon technology based on Tunable Diode Lidar (TDLidar).** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | 19 **offers both the quantum gas camera, operational software, and interprative and consultative expertise.** |
| c. Is the method mobile or stationary? | **The cameras are currently fixed emplacments, sat on a pan-tilt mechanism. Future versions of the camera (Q3 2022) will be mountable on UAVs.** |
| d. Does your method require site access or does it measure remotely? | **The camera can monitor methane emissions at a range of up to 200m. While site access is beneficial (as the equipment can be set up to view more infrastructure), surveys can take place from outside the fenceline if necessary.** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

The cameras are currently fixed emplacments, sat on a pan-tilt mechanism. Future versions of the camera (Q3 2022) will be mountable on UAVs.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Up to 200 metres.** |
| b. What sensors are employed and how? | **Quantum single photon detection using single photon avalance detector (SPAD) technology coupled with a tunable diode Lidar (TDLidar) at the absorption wavelength of the target gas.** |
| c. How many people comprise one field crew? What are their roles? | **The quantum gas camera can be operated by a lone worker.** |
| d. How much time is spent surveying each potential source? | **A single area can be surveyed for anywhere between 60 and 180 seconds, and individual methane sources identified from that. In practice, when searching for sources, the camera will 'tile' the area with scans, building up a picture of the surrounding area over time (dependent on scan duration for each 'tile).** |
| e. How much training are field staff required to have? | **At present, cameras are operated solely by 19 staff. Future operators would receive at least one day of training in the operation of the camera.** |
| f. What output data are generated and reported? | **Output data include calculated leak rate as a function of time for each individual leak that is located, and a concentration isobar map overlaid on a visual image of the area being surveyed. All data is metadata tagged so datapoints and images can easily be associated with each other.** |
| Additional work practice details | **N/A** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

19 is eager to participate in an Alternative FEMP Proposal in 2021 or 2022. At this stage, we are making explorative enquiries and searching for parter operations in Canada.

Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that ‘component’ means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

The initial offering of the software (Q2 2021) will not distinguish between vents and fugitive emissions. Future versions of the software (Q4 2021 onwards) are expected to be able to monitor regular emissions over time (for regularity, intermittency and intensity) and designate these as 'vents' (visualising and quantifying for emissions budgets but not necessarily reporting an alarm). Any further emissions detected over the top of expected vents (distinguishable by their persistence and lower intensity than vents) will be designated as 'leaks' (visualising, quantifying, and reporting an alarm).

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**

If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:

As methane is detected, the camera can be made to zoom in on the individual source, recording datapoints tagged with metadata including date, time and relative location of the focus (and therefore, the individual leak).

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A. 19 quantum gas camera can confirm and tag individual leaks.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

N/A

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

N/A

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Uncooled single photon avalanche detector, employing time-correlated single photon counting technology. White paper available on request.

**Q25** **Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Minimum detection ~ 1.6 cubic metres of methane per day. Upper limit less well-known - very roughly 1000 times greater than minimum.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Unknown.

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

Accuracy and uncertainty are two different measures. Field trials have esitmated leak flow rates with ~30% inaccuracy. Intrinsic uncertainty is still pending traceable measurement.

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

The quantum gas camera quantifies emissions at the component level, allowing for quantification at the equipment or facility level by combining leak measurements.

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Unknown**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

To calculate leak flow rate, the system needs to receive wind speed and direction data from an anemometer.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Data from controlled release studies in the UK and France can be provided on request. A white paper containing results is currently in pre-print with the Applied Energy Journal (and is also available on request).

**Q33**

Has controlled release testing data or performance data on your organization’s method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

N/A

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

The camera is compliant with IP64 requirements (certification pending), and can operate between 0 and 40 deg C. Performance is not guaranteed outside of these temperatures, nor in the presence of zero wind, which affects the leak flow rate calculation.

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

The camera is compliant with IP64 requirements (certification pending), and can operate between 0 and 40 deg C. While the equipment is not known to stop working outside of these temperaturtes, performance is not guaranteed. In the presence of zero wind, the leak flow rate calculation will be negatively impacted (to the point where measurement uncertainty will become unreasonably high).
The system has been observed to perform with no appreciaable loss of performance in persistent rain.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **40 and 0.** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **100(?) and 7.2** |
| How much active rain is tolerated (None, light, medium, heavy)? | **At least medium.** |
| What is the maximum deployment humidity (%)? | **Unknown** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Unknown, expected to tolerate at least medium** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Deep** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Setup time expected to be less than one day, depending on the facility, and perhaps considerably less.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Similar in time to setup, and highly dependent on the installation (fixed emplacement, tripod mount, installation position etc).

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

The fixed emplacement camera is deployed on a pan-tilt, allowing it to survey up to 200m in any direction within line of sight. It does not need to be set up at each individual leak point.

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Unknown. On the order of days for a full report on top of real-time alerts.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Unknown, likely wind.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

This is entirely dependent on how close the wells are to each other and whether they can surveyed more than one well at a time. It is impossible to answer this question quantitatively. 19 cameras are designed to continuously monitor a facility on a 24/7/265 basis, normally powered from mains power. Current operation off 24V batteries enables the camera to run for approximately 8 hours.

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

One or two cameras will be available for field trial in Q4 2021, quickly expanding to approximately ten times this in 2022.

**Q44**

What is your organization's capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

N/A. 19 produces a continuous monitoring solution rather than an intermittent survey monitoring solution.

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

Methane is the gas we are focusing on first because it causes about one quarter of manmade global warming and leaks are valued at >$30B a year (Rhodium Group 2015). Methane is such a potent GHG it only takes a 3% leak rate to make natural gas as bad for climate change as burning coal. The global natural gas leak detection market is US$1.5B+ with a CAGR of >7% (Research and Markets 2018) driven by gas becoming the dominant fossil fuel, slowly increasing government regulations, and expanding investor pressure to improve industry standards.
Current detection technologies are complex, expensive and need trained experts to operate so regulations only enforce occasional inspections. The gas industry is searching for ways to catch these leaks and reinstate natural gas as a transition fossil fuel and gas suppliers as environmentally responsible and worthy investment.
Methane production and supply are not the only markets we are pursuing. Our next largest target is the petrochemical industry which consumes natural gas to manufacture a wide range of industrial materials. The gas leak detection market for the 2,000 chemical plants worldwide is US$0.5B and is expanding rapidly with product diversification in major industries such as construction and transport and increasing safety regulation. This market also has a strong use for methane detection but demand detection of other gases as well, notably carbon dioxide and ethylene. Another market we are addressing is environmental monitoring for landfill and Landfill-Gas-To-Energy plants that need improved GHG leak detection.
We believe the customers we can reach already service at least 60% or >US$1B of the total global revenue, and as major equipment suppliers to them we can obtain 20% of this and more than $200M revenue per year ourselves.

---

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes. [redacted] expects to expand rapidly over the next five years from its current state as an 8-employee SME.

[redacted] was founded [redacted] years ago and has to date received around [redacted] industry contracts. We have [redacted] more in contracts and another [redacted] of grants awarded and still to be claimed.

In FY2022 our strong Innovate [redacted] in grants, commercial contract activity will grow to more than [redacted] total. In FY2023 we will continue to grow and close a Series A investment round for around £4m.
[redacted] uses an extensive network of expert contractors and advisors for technology and business development and has a hiring plan to expand the internal teams for these functions as well as business operations and administration as our revenue expands.
FY2023 sales will be more than 50 units and then in FY2024 more than 200 units for [redacted] In FY2025 we will sell more than 1000 units and start to generate cash.
In 5 years [redacted] will have a world leading high-value gas measurement platform deployed globally and growing rapidly. Our expanded engineering, business development, operations and administration staff will be close to 100 people, mostly in the UK. Sales of around 2,000 cameras per year will generate more than [redacted] in revenue and service and development contracts will add another [redacted] We will have a gross margin around 50% and an EBITDA of more than 20%. Several of our major customers will be discussing with us how they might acquire us.
We expect to be a strategic acquisition by one of our large customers for [redacted] in <7 years, in line with the following table of comparable acquisitions and the recent acquisition of Rebellion Photonics by Honeywell.

---

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

The oil and gas industry is at a strategic crossroads, where a path needs to be defined into a lower-carbon future dictated by the need to achieve Net Zero by the middle of the century. However, the industry is also driven by regulation, safety and compliance, as well as the needs of investors. More and more, investors are asking ethical and environmental questions of their beneficiaries where previously only financial output was a concern. What the industry is currently struggling with is the lack of standards and regulatory policy time lag with respect to current innovation. The industry is reluctant to fully commit to a solution that may become anathema under new regulations, or that will hit a target that is seen as less valuable than what a different solution will enable.
Regulatory policy is, therefore, the major rate determining step of widespread uptake of continuous monitoring technology. Various approaches (of which 19 offering stands pre-eminent) are ready and waiting to deliver on the the requirement, and the current march of climate change policy is tipping the balance increasingly towards needing to make a commitment and define how it will be achieved.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

Unknown.

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Unknown.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
Unknown. 19 technology is new, and designed for 24/7 continuous monitoring rather than intermittent site surveys.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
Unknown. 19 technology is new, and designed for 24/7 continuous monitoring rather than intermittent site surveys.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
Unknown. 19 technology is new, and designed for 24/7 continuous monitoring rather than intermittent site surveys.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

Survey time per site, cost per site (optional), and additional comments::
Unknown. 19 technology is new, and designed for 24/7 continuous monitoring rather than intermittent site surveys.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

19 technology offers multiple benefits over the current state of the art. The ability to simultaneously visualise and quantify releases of methane is a step forward, as is the ability to provide this on a 24/7/365 basis, offering faster responses than intermittent studies. The user emits less methane, for a lower overall investment.

The industry is looking for disruptive sensors that combine selectivity, sensitivity, high rejection of spurious results, long lifetime and low cost of operation so they can be widely deployed and operated in continuous automatic monitoring systems from which data can be integrated into comprehensive and automated safety, environmental and maintenance response systems. Other technologies can offer a portion of this benefit, but only 19 combination of accuracy, sensitivity, long range, robustness, and low-cost scalability addresses all the requirements for tackling the market.

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Varied**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

These arrangements are subject to corporate confidentiality.

**Q57**

What LDAR-based data management services does your organization offer?

19 is still producing its first units. At present, data management is on a case by case basis.

# Vendor #20 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | [redacted] |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization’s name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
We provide technological solutions for finding and quantifying natural gas leak emissions.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
worldwide

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

none

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

yes, current regulations may specify other technologies that are less effective but legacy and thus make it more difficult to introduce to the market despite offering superior performance.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

no

## Page 4: Leak Detection Service Description

**Q13**

**Respondent skipped this question**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **technology** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **we offer both products as well as services, whichever the customer prefers.** |
| c. Is the method mobile or stationary? | **we offer products that are mobile and products that are stationary.** |
| d. Does your method require site access or does it measure remotely? | **Generally, we require site access but we can detect and quantify emissions from 100meters from the source while driving, flying or walking.** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

1. hand-held
2. UAV
3. vehicle mounted
4. fixed location

all solutions (which are independent) utilize a common, patented laser absorption-based technology that extractively samples local air and measures local wind velocity. These methods detect leaks and provide measurements of leak location and size (emissions rate) and send comprehensive digital reports to the Cloud that summarize measurements and results.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **distances range from less than 1 meter to 100 meters (or farther) from sources** |
| b. What sensors are employed and how? | **laser absorption analyzers are employed to measure methane and ethane, and combined with sensors recording wind velocity and GPS, as appropriate.** |
| c. How many people comprise one field crew? What are their roles? | **1 person can operate any one of our solutions.** |
| d. How much time is spent surveying each potential source? | **depends on the size/extent of the source but typically a source can be surveyed in a few minutes.** |
| e. How much training are field staff required to have? | **2-4 hours of training is sufficient** |
| f. What output data are generated and reported? | **output data that describes the leak location, source attribute and size of each recorded leak are available in digital reports digitally and on displayed on Google Earth maps** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**Decline to Answer**

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**No**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
our hand-held solution can pinpoint leak locations. our driving and UAV based solutions can estimate leak locations and thus save considerable time finding the precise locations of leaks.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

for leaks estimated while using our flying or driving solutions, followup practices may include crews using our handheld solutions, not necessarily OGI, to pinpoint leaks.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

users of our solutions can determine whether to follow up or not based on the reported quantitative leak rates and geospatial locations provided.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

see above

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

ABB LGR-ICOS laser-absorption based analyzer

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

minimum measurable flow rate: 0.3 m3/day

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

40meters from the source, we can detect 0.6 m3/day with 50% probability.

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

**Respondent skipped this question**

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Yes**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

our methods record all environmental data necessary to yield results.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

heavy rain poses difficulties (>0.1"/hour)

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

**Respondent skipped this question**

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **<50C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **<40kmph** |
| How much active rain is tolerated (None, light, medium, heavy)? | **<0.1"/hour** |
| What is the maximum deployment humidity (%)? | **N/A** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

<2 minutes to start recording data after power on

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

negligible

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

negligible

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

reports may be obtained after survey completion automatically and in a few minutes.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

**Respondent skipped this question**

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

**Respondent skipped this question**

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

**Respondent skipped this question**

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Respondent skipped this question**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

**Respondent skipped this question**

**Q57**

What LDAR-based data management services does your organization offer?

**Respondent skipped this question**

# Vendor #21 Response

**Collector:** [redacted]

## Page 2: Introduction

**Q1**

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 21 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

**Q2**

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

**Q3**

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

**Q4**

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**

If yes, please describe::

Yes, we provide monitoring services at over 200 upstream well sites, primarily in the United States.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes**

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Yes**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

We offer stationary monitoring services. While installing the monitors does not interrupt operations, we do request that operators install t-posts ahead of time to mount our monitors.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No, though we are saying this as a primarily [redacted]

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

**Respondent skipped this question**

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AltFEMP**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **We offer a continuous monitoring and certification service** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Service** |
| c. Is the method mobile or stationary? | **Stationary** |
| d. Does your method require site access or does it measure remotely? | **We require site access initially to install** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Stationary sensor that is installed on site.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Variable- 10-100 meters** |
| b. What sensors are employed and how? | **Methane (TLDAS), TVOC (PID), in a stationary package** |
| c. How many people comprise one field crew? What are their roles? | **We send out one trained field technician** |
| d. How much time is spent surveying each potential source? | **Sensors sample every second** |
| e. How much training are field staff required to have? | **None; we provide a training session on our dashboard as part of the service** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
We are beginning to engage [redacted] we may

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Unknown**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes**

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. "screening" methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

Typically, customers pair our stationary monitoring with a follow-up OGI crew when leaks are detected. However, for many leaks we detect that are operational in nature- for example, a leaking thief hatch, or contractors who don't use vapor recovery lines-no OGI camera is needed to resolve the emission.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

We develop and set criteria with producers. For example, one of our operators in Colorado is concerned with VOC emissions due to community air pollution concerns, and so we set a 5 minute alarm when tVOC levels exceed a certain threshold.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Again, this varies by the emissions source. While traditional LDAR only addresses certain components, much our follow-up addresses operational emission sources and the time interval between identifying and remediating varies heavily- we've had remediation action taken as soon as 10 minutes after an alarm being isssued.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

Our [redacted] methane sensor uses a tunable laser diode absorption spectroscopy technique.

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

A minimum of .1 g/s in most wind conditions. We've never calculated the maximum flow rate; our maximum detection of 10,000 ppm.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

**Respondent skipped this question**

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

+/- 30%

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Equipment group level

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Yes**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Yes, we collect wind speed and direction.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Yes, we've conducted testing at Colorado State University's METEC facility.

**Q33**

Has controlled release testing data or performance data on your organization’s method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Yes, our performance data has been using in FEAST model simulations.

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

**Respondent skipped this question**

**Q35**

What environmental conditions affect your method’s performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

We have approximately one week of battery backup, so there are certain field conditions where performance could be impacted by low temperatures and cloudy conditions. For such locations, we recommend an extra set of batteries and solar panels.

### Q36

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-40 to 40 C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **0 - 120** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Heavy** |
| What is the maximum deployment humidity (%)? | **100%** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Heavy** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Heavy** |

### Q37

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

20-30 minutes per sensor, including the initial post installation (typically happens before our technician)

### Q38

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

0

### Q39

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

Yes, 20-30 minutes/sensor

### Q40

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Sensors sample every second and report to the cloud every minute in regions with cellular connection. For satellite or other connectivity, reporting frequency may be lower

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

N/A

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

N/A

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

N/A

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

Our capacity is high- while we haven't entered this market yet, as a venture backed company we have the operational capacity to scale both production and deployment staff to meet these needs

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

N/A

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes

**Q47**

**Respondent skipped this question**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

Variable

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Costs reduce with scale

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Respondent skipped this question**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

Our customers are interested in overall leak reductions rather than efficiencies. We communicate the advantages of our approach as lowering emissions and being able to independently verify those reductions.

## Page 12: Data Management

**Q55** **Yes**

Have LDAR-based data management services been a core requirement of your client/s?

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

[redacted] our data management, QA/QC and reporting procedures have been developed to meet Regulation 7 (new continuous monitoring requirement for 6 months before and after drilling)

**Q57**

What LDAR-based data management services does your organization offer?

We offer our clients a dashboard where they can explore and visualize data, as well as automated reporting to state/provincial agencies.

# Vendor #22 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 22 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Decline to answer**

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
British Columbia

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**No**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

We created our service to have a low impact to our clients resulting in little to no impact on day to day operations

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, but resolved by year-end 2020,**
If Yes, please explain.:
Delays due to new methods of permitting, was quickly resolved in partnership with [redacted] and our clients.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

We're primarily a BC based company, the regulations have had a significant impact on reducing emissions

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

**Respondent skipped this question**

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Method** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **a service** |
| c. Is the method mobile or stationary? | **mobile** |
| d. Does your method require site access or does it measure remotely? | **site access** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

We use the GF320 camera

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **between 1.5m and 16m** |
| c. How many people comprise one field crew? What are their roles? | **1-2 technician and an assistant** |
| d. How much time is spent surveying each potential source? | **varies depending on component** |
| e. How much training are field staff required to have? | **3+ months before they can work independantly** |
| f. What output data are generated and reported? | **rates, location, description, history, physical tags, and digital records** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

We have looked at options, however in the BC regulations giving detailed surveys isn't really possible with the top alt femp methods.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**

If yes, how? If not, how does it account for potential false positives?:

Technician training to distinguish what is fugitive and what is normal operational venting

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**

If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:

We tag and document every leak and vent directly.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. "screening" methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

N/A

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

We do facility wide OGI

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

GF320 Flir camera

**Q25** **Yes**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

M3, and L/min

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

unknown

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

GF320 has a 20% error margin

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Component, and facilitiy.

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**Unknown**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

We build CO2e totals per client, total number of leaks/vents, their repair rate and initial emission rate and end of year repair rate.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

N/A

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

N/A

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

During shut downs, and temperatures below -30C

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

All of the examples can have an impact. The extent of which is determined at the field level on if a reschedule is needed.

## Q36

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **30C to -20C** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **Below 20km/h** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Medium** |
| What is the maximum deployment humidity (%)? | **N/A** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Medium** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **moderate coverage, depends on the site** |

## Q37

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

10 minutes

## Q38

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

10 minutes

## Q39

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

5 minutes cool down time

## Q40

**Respondent skipped this question**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

Very cold or very hot temps, but it's more personnel comfort than equipment.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

depending on distance between 20 single well sites on average

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

2 complete crews, with a 3rd if additional equipment can be acquired.

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

We are capable of performing [redacted], but can increase that easily.

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

1 quarter, depending on equipment availability and if current market demand justifies purchase

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

We do expect growth in the future

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

growth trend justifying purchase of new equipment

## Page 10: Productivity and Cost (Optional):

**Q48**

Respondent skipped this question

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

**Q49**

Respondent skipped this question

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

## Page 11: Productivity and Cost (Optional):

**Q50**

Respondent skipped this question

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q51**

Respondent skipped this question

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q52**

Respondent skipped this question

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q53**

Respondent skipped this question

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Yes,**

If yes/no/varied, are there any key reasons?:

Providing comprehensive access to our clients

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes they've all got individual needs that we try to accommodate

**Q57**

What LDAR-based data management services does your organization offer?

An online database with statistics and leaking components list by site

# Vendor #23 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 23 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
[redacted] Services include: Fugitive Emission Inspections, Nitrogen and Air Leak Detection, Infrared Flare Stack Inspections, Electrical Inspections, Process Inspections, and Motion Amplification. [redacted] core markets currently include: Oil and Gas and Wood Product sectors. [redacted] has been providing Infrared and Gas Detection Services for over [redacted]

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
British Columbia, Saskatchewan

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**Unknown**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

None.

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**Yes, ongoing,**
If Yes, please explain.:
The COVID-19 outbreak had reduced typical work loads in 2020 and has affected usual work procedures, but has been manageable.

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

No

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

No

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | [redacted] **provides Inspection and Reporting Services.** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | [redacted] **provides Inspection and Reporting Services.** |
| c. Is the method mobile or stationary? | [redacted] **services are mobile.** |
| d. Does your method require site access or does it measure remotely? | [redacted] **provides on-site inspection services** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Fugitive Emission Inspections are performed with Infrared Cameras (hand-held) and a High Flow Sampler (Backpack).
Nitrogen and Air Leak Detection is performed with Ultrasonic Detectors and Infrared Cameras (both hand-held).
Infrared Flare Stack Inspections are performed via UAV Drone equipped with Infrared Camera (portable).
Electrical Inspections are performed with non-contact Ultrasonic Detectors.
Process Inspections are customized and can use all of the above equipment.
Motion Amplification utilizes video camera technology in conjunction with software and processing algorithms. Motion Amplification is typically used on rotating equipment but can be used to detect any subtle movement.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **Typically measurements are taken from 1 to 3 meters away. Depending on required safe distance** |
| b. What sensors are employed and how? | **Infrared Sensors are employed in the Infrared Camera and Combustible Sensors are used in the Hi-Flow Sampler.** |
| c. How many people comprise one field crew? What are their roles? | **One person can be deployed for an inspection but in some cases two inspectors are sent to cut down the inspection time.** |
| d. How much time is spent surveying each potential source? | **Depend on the leak anywhere from 15-20 minutes** |
| e. How much training are field staff required to have? | **Employees are trained for all required Safety Training and go through in-house training via equipment manuals and testing. Vendor Certification is also available after probationary periods** |
| f. What output data are generated and reported? | [redacted] **Reports include video data of gas leaks and lost emission data is provided with Hi-Flow Sampler software.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**

If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:

[redacted] may consider being involved in an Alternative FEMP Program, but to date have not seen a cost effective / viable AltFEMP that we'd like to be involved with. Digital IR always considers the best solutions for our customers.

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes,**
If yes, how? If not, how does it account for potential false positives?:
[redacted] equipment may not be able to distinguish vented from fugitive emissions, but we only hire well experienced Red Seal Journeyman Instrumentation Technicians that have extensive knowledge of normal venting.

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
[redacted] well experienced Red Seal Journeyman Instrumentation Technicians have extensive knowledge of equipment and typical venting. Repair solutions are provided in our reports and any serious leaks are reported to site operations as soon as possible.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

[redacted] always performs a building pre-scan for safe entry. If the leak is serious and poses a safety hazard, [redacted] notifies site operations immediately.

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

[redacted] leaves the site follow-ups in the hands of our clients, but we do pass on the regulation requirements.

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

Unknown

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

FLIR Infrared Sensors in the Camera and Bacharach Combustible Sensors in the Hi-Flow Sampler.

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Cubic feet per minute and litres per minute.

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Median detection limit is 1.5 - 3 meters for the OGI.

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

Uncertainty of the Hi-Flow sampler is +/- 4%.

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Component

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**No**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Atmospheric conditions are recorded for all of our inspections.

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

Decline to answer.

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

Unknown

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

[redacted] OGI cameras accuracy are effected at -20 Deg.C so we don't use this equipment below this temperature. We also do not work if conditions are deemed unsafe.

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

[redacted] OGI cameras accuracy are effected at -20 Deg.C so we don't use this equipment below this temperature. Extreme rain, snow, and wind are also avoided for our outdoor inspections, but correction factor calculations can be provided for mild conditions.

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **–40°C to +350°C (Note: Digital IR works in –20°C to +35°C)** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **OGI Cameras are operational with wind of 0 - 28 km/hr.** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Light rain or snow is tolerated.** |
| What is the maximum deployment humidity (%)? | **95% relative humidity +25°C to +40°C** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Light snow is tolerated** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Deep snow is tolerated** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Deployment times vary widely. [redacted] works with client requirements.

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

Take-down times vary widely. [redacted] works with client requirements.

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

Deployment time after site check-in and safety is completed is approximately 10 - 15 minutes.

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Initial reports are provided immediately after inspection (same day). Final reports are provided after data has been fully processed.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

The most limiting factors to field inspections are weather and inspector experience.

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

[redacted] crews can inspect a maximum of 10 single-well batteries per day if they're in close proximity.

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

[redacted] has one fully equipped deployment platform for fugitive emissions surveys. We have more equipment to perform other types of inspections, but only one Hi-Flow Sampler.

**Q44**

What is your organization's capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)? (if a null response please enter N/A, unknown, decline to answer)

Unknown

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

Unknown

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Unknown

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

23 has found that price undercutting competing businesses have made Fugitive Emission Surveys more fiscally unviable as
23 only hires well experienced Journeymen Inspectors that can confidently identify issues, this requires a higher wage.
23 has taken notice that competitors have been hiring inspectors with low experience levels at low wages.

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method's approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

[redacted] for a 12 hour day.

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

[redacted] gives discounts for bundled contracts.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**11-20,**
Survey time per site, cost per site (optional), and additional comments::
[redacted] one-man-crew can survey 11 - 20 inspections per 12 hour day.

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**6-10,**
Survey time per site, cost per site (optional), and additional comments::
[redacted] one-man-crew can survey 6 - 10 inspections per 12 hour day.

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
[redacted] one-man-crew can survey 1 - 5 inspections per 12 hour day.

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5,**
Survey time per site, cost per site (optional), and additional comments::
[redacted] one-man-crew can survey 1 - 5 inspections per 12 hour day.

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

N/A

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**Varied,**
If yes/no/varied, are there any key reasons?:
[redacted] provides many inspection services including predictive maintenance. Fugitive Emission Surveys are one one part of our company.

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes, [redacted] multiple systems depending on client requirements.

**Q57**

What LDAR-based data management services does your organization offer?

[redacted] only provides Gas Leak Detection / Data.
Clients handle their own OGC and AER submissions.

# Vendor #24 Response

**Collector:** [redacted]

## Page 2: Introduction

### Q1

Contact Information (For Administrative Purposes Only - All Responses Are Anonymized)

| | |
|---|---|
| Respondent Organization: | [redacted] |
| Respondent Name: | Vendor 24 |
| Respondent Role: | [redacted] |
| E-mail: | [redacted] |
| Phone: | [redacted] |
| Website: | [redacted] |
| Response Date (yy/mm/dd): | [redacted] |

### Q2

Please confirm your understanding that all data collected as a part of this study are anonymous - check "Yes" to confirm.

**Yes**

### Q3

Are you interested in being contacted for future PTAC methane emissions management research including, potential field campaigns?

**Yes**

### Q4

Please indicate if you would like your organization to be publicly listed as a participant in this study. In this scenario, your organization would be identified as a participant that contributed data, but your organization's name is not associated with data you have submitted (data anonymity is preserved).

**Yes**

## Page 3: General Information and Logistics

**Q5**

Does your organization have commercial LDAR surveying experience? If yes, please describe e.g., types of LDAR services provided, core markets (industry and/or locations), years of corporate experience with LDAR services.

**Yes,**
If yes, please describe::
Pipeline leak inspection, compressor station surveys, building surveys, distribution / fabrication of OGI cameras, hi flow sampler, mobile leak detection solutions, and portable gas detection instrumentation.

**Q6**

Does your organization participate in methane measurement markets outside of Alberta? If you intend to enter new methane measurement markets in 2021 or later please answer - Yes.

**Yes,**
If yes, which markets? (Optional):
Across Canada

**Q7**

Is your organization able (legally/logistically/etc.) to work in Canada?

**Yes**

**Q8**

Is your organization able (legally/logistically/etc.) to work in the United States?

**No**

**Q9**

Please describe any safety concerns, risks, interruptions or annoyances (for duty holders/operators and/or local residents/communities) possibly introduced by your product/service when completing LDAR surveys (e.g., noise, airspace, road/site congestion).

N/A

**Q10**

Has the COVID-19 outbreak and/or recent market conditions affected your operations re. LDAR services or is it expected to affect your operations? Please provide a comment if answering yes.

**No**

**Q11**

Has the establishment of equivalency with federal methane regulations in Alberta and Saskatchewan affected your operations? e.g., scale, frequency, jurisdictions? Please comment if yes.

Yes - greater demand for products / services.

**Q12**

Have methane-related Canadian provincial and federal programs affected your operations or planned operations? Please comment if yes.

Yes - greater demand for products / services.

## Page 4: Leak Detection Service Description

**Q13**

Is your method or technology compliant with AER Directive 60 leak detection methods (e.g., Method 21) or is it intended to be applied in an AltFEMP?

**AER Directive 60 Compliant / Method 21**

**Q14**

Define your method in detail, including what equipment is used and how it is deployed. Points to address include (but are not limited to):

| | |
|---|---|
| a. Does your organization offer a technology or a method? | **Yes** |
| b. Does your organization offer a product (for sale?), a service, or a combination? | **Both products and services** |
| c. Is the method mobile or stationary? | **Both mobile and stationary options are available** |
| d. Does your method require site access or does it measure remotely? | **Both options are available** |

**Q15**

What deployment platform(s) is/are used? (for example: hand-held, aerial, truck-mounted, UAV, fixed sensor, portable and temporary on-site mount). If multiple deployment platforms are used, explain them all and how they work together.

Manual survey deploying combination of OGI, Hi flow sampler, CGI, and laser instruments.
UAV surveys are available using a laser based sensor mounted to a drone.
Mobile leak detection primarily geared toward pipeline leak inspection in urban areas using a
leak survey vehicle.
24/7 monitoring of facilities using either laser based or OGI instrumentation that is permanently mounted and tied into the BMS.
H2S / Odour monitoring using temporary or permanently installed H2S loggers.

**Q16**

What is the specific work practice associated with your methane leak detection method/technology? Several key elements of the work practice are listed below. Please add and comment on any others you feel are pertinent to your offering.

| | |
|---|---|
| a. At what distances from source are measurements taken? | **From directly on top of the asset to up to 50 metres** |
| b. What sensors are employed and how? | **Infrared, Laser, Electrochemical, OGI** |
| c. How many people comprise one field crew? What are their roles? | **Typically crews of two are deployed.** |
| d. How much time is spent surveying each potential source? | **For manual surveys using OGI, typically 10 to 30 seconds at each source followed by quantification and pinpointing as required.** |
| e. How much training are field staff required to have? | **1.5 days of classroom training, 3.5 days of field training, 1 written exam, 1 instrument operator exam, and 1 field exam.** |
| f. What output data are generated and reported? | **All surveys are geotagged and information collected can be customized based on customer needs. Depending on the type of survey information package might include some or all of the following: walking / driving trails, instrument readings, leak details, temperature, leak flow rate, abnormal operating conditions, date / time of survey, instrument serial #, instrument calibration records, photos, videos.** |

**Q17**

Has your method or technology been included in a successful AltFEMP proposal or application with a provincial regulator e.g., AER accepted Alternative FEMP Proposal, as described in the AER's Submission Checklist for Directive 060: Alternative FEMP Proposals? If yes, please state the jurisdiction, regulator and scale of adoption by clients/duty-holder.

**No,**
If no, is your organization planning to be involved in an Alternative FEMP Proposal in 2021 or later? Please provide specifics of your participation but do not reference duty holder(s).:
No

## Page 5: Involvement in an LDAR Program

**Q18**

What scale(s) i.e., component, equipment, facility does your method/technology target? Note that 'component' means inspectors can confirm, diagnose and tag individual leaks.

**Component,**

**Equipment,**

**Facility**

**Q19**

Is your leak detection method/technology able to distinguish vented from fugitive emissions?

**Yes**

**Q20**

Does the work practice lead to diagnosis and tagging of individual leaks?

**Yes,**
If yes, how? Please describe in detail the process of going from measurement to tagging of leaks. If no, how does the information generated lead to the mitigation of fugitive emissions/leaks?:
Typically leaks are initially identified from a distance using OGI or laser based instruments in order to identify areas of interest. Areas of interest are then further investigated using hi flow sampler, infrared instrument, or CGI to pinpoint source of the leak which is then photographed, videoed with verbal annotation, and tagged.

## Page 6: Leak Detection Service Description

**Q21**

For methods that are unable to confirm and tag individual leaks (i.e. “screening” methods), please define any relevant follow-up work practices used. For example, are follow-up OGI crews sent to high-emitting sites to tag leaks? (N/A, unknown, decline to answer)

N/A

**Q22**

What criteria are used to determine which sites receive follow-up visits? Examples could include:a. Site-level emissions thresholds to trigger follow-ups (in which case, what thresholds are used?)b. Follow-up ratios, such that the top 50% of emitting sites surveyed in a day receive follow-up surveys (if so, what ratios are used?)(N/A, unknown, decline to answer)

N/A

**Q23**

What are the roles/tasks of follow-up crews when onsite? For example, do they conduct classic facility-wide OGI surveys, looking for all leaks, or do they target large emitters?a. If following a non-standard work practice, what are the details?b. If not immediate, what is the time interval between screening measurement and follow-up tagging of leaks (in days). Please explain how this delay is estimated.(N/A, unknown, decline to answer)

We typically are involved up to the point the leak is pinpointed at which time we report same to our customer for follow up.

## Page 7: Technical Specifications

**Q24**

What is the methane sensor that is used? Where applicable, specify brand or type.

[redacted]

**Q25**

Does your surveying result in a quantified flow rate? If no, please skip to next page.

**Yes**

**Q26**

What are the minimum and maximum measurable flow rates of your method (m3/day to align with AER regulations - please note if using another unit of measurement e.g., SCFH)? (N/A, unknown, decline to answer)

Instrument calculates SCFH and we convert

**Q27**

Please state its median detection limit (i.e. the flow rate corresponding to a 50% detection probability - please specify a corresponding distance and windspeed)? (N/A, unknown, decline to answer)

Unknown

**Q28**

What is the uncertainty/quantification accuracy of flow rate estimates?

+/- 10%

**Q29**

Are emissions quantified at the component, equipment or facility level? (N/A, unknown, decline to answer)

Component

**Q30**

Has your organization developed detection probability curves for your method? (N/A, unknown, decline to answer)

**No**

**Q31**

Does your method require environmental data? If so, what types of data required and how are they collected?

Temperature, barometric pressure

**Q32**

Can your organization provide results from controlled release testing (CRT) and/or field performance? Please provide information on methods (e.g. Who conducted the testing? Was it performed indoors or outdoors? Under what range of environmental conditions?)If this information will be or has been published in academic papers, please indicate the paper/project. (N/A, unknown, decline to answer)

No

**Q33**

Has controlled release testing data or performance data on your organization's method been used in modelling or computer simulations? Were the model results used for AltFEMP proposals (N/A, unknown, decline to answer)

No

## Page 8: Environmental and Operational Constraints

**Q34**

Under what environmental and operational conditions does your organization not operate in the field (please provide specifics)?

N/A

**Q35**

What environmental conditions affect your method's performance (e.g., temperature, precipitation, wind)? For each condition, how is performance impacted?

Wind

**Q36**

Please declare the following (qualifying responses if necessary) (N/A, unknown, decline to answer where necessary):

| | |
|---|---|
| What is the range of temperatures where the technology is operational (°C, max and min)? | **-20 to +40 degrees Celsius** |
| What is the range of wind speed where the technology is operational (kmph, max and min)? | **20 kmph** |
| How much active rain is tolerated (None, light, medium, heavy)? | **Light** |
| What is the maximum deployment humidity (%)? | **N/A** |
| How much falling snow is tolerated (none, light, medium, heavy)? | **Light** |
| How much snow can be tolerated on the ground (none, patchy, thin cover, deep)? | **Thin Cover** |

**Q37**

How long does it take to deploy at the start of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

<15 minutes

**Q38**

How long is take-down at the end of the day (exclude time spent driving to individual sites, if that is a part of the method) in minutes?

< 15 minutes

**Q39**

Is deployment required at each individual site? If so, how long does set-up/take-down take (in minutes)?

Yes - < 15 minutes

**Q40**

From the day of measurement, what is the guaranteed reporting timeline (in days)? If multiple reports are generated/provided, please explain what information they contain, and the number of days required for delivery of each report. (if a null response please enter N/A, unknown, decline to answer)

Most information is available within 24 hours with final reports within 7 days.

**Q41**

What is the factor most limiting to safe and efficient field performance leading to high-quality results? (if a null response please enter N/A, unknown, decline to answer)

N/A

## Page 9: Supply and Scalability of Service Offering

**Q42**

Using single-well batteries as a baseline, approximately how many facilities can each crew inspect in a typical day, week, month, and/or year? (if a null response please enter N/A, unknown, decline to answer)

Unknown

**Q43**

How many independent crews fully equipped with deployment platform, sensor, and trained personnel are currently available for simultaneous deployment? (if a null response please enter N/A, unknown, decline to answer)

3

**Q44**

What is your organization’s capacity to scale operations to meet your planned/desired market share of leak detection demand in Alberta? Using single well batteries to normalize site counts, how many do you project your operation to service in 2021, 2022, 2023 at 1 event per year (if this measurement of frequency doesn't apply to your method please explain)?  (if a null response please enter N/A, unknown, decline to answer)

Operation is easily scalable to meet customer requirements

**Q45**

How many quarters in 2021 or years (if beyond) 2021 do you believe it will take to scale your operation to planned capacity based on projected market conditions?

1

**Q46**

Does your organization expect any changes in its overall work capacity (e.g., number of crews, equipment stock, etc.) in the next 5 years? (N/A, unknown, decline to answer)

Yes - expanded operations

**Q47**

What are your biggest barriers to scaling (e.g. investment, manufacturing of sensors, training of personnel)?

N/A

## Page 10: Productivity and Cost (Optional):

**Q48**

What is your method’s approximate all-inclusive cost per day (single value or range) in 2021 Canadian dollars (please state assumed currency exchange if Canada is not your host country) under typical operating conditions in areas with facility densities up to 0.5 per square km? (if a null response please enter N/A, unknown, decline to answer)

[redacted] for labour and equipment

**Q49**

How would this cost per day change if your organization is contracted for multiple days, weeks, months, or years? (N/A, unknown, decline to answer

Depending on the geographic location and density of the work may result in economies of scale which could lower price.

## Page 11: Productivity and Cost (Optional):

**Q50**

Approximately how many sites/day/crew can your technology/method survey for AER Facility Subtype 311/351 (Single well)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**11-20**

**Q51**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 321/361 (Multi-well group battery)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**21+**

**Q52**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 401 (Gas Plant - Sweet)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q53**

Approximately how many sites/day/crew can your technology/method survey for AER Facility subtype 601 (Compressor Station)? Please specify survey time and cost (optional) in comments, as well as clarification on sites/day/crew if needed.

**1-5**

**Q54**

If your technology or method is not readily quantified using the 4 questions above, please describe your approach to capturing and conveying leak detection efficiencies to your clients (duty holders) and the indicative performance.

**Respondent skipped this question**

## Page 12: Data Management

**Q55**

Have LDAR-based data management services been a core requirement of your client/s?

**N/A**

**Q56**

Have your clients set specific requirements regarding data management, quality assessment/control, other requirements? Please explain if possible.

Yes.  Operator certification, quality assurance audit (desktop and field)

**Q57**

**Respondent skipped this question**

What LDAR-based data management services does your organization offer?

## Appendix F: Service Provider Data Analysis

| Anonymization Key | Commercial LDAR Experience | Areas | | | | | | | Type | | | | | | | | Type - Least 'accurate' method considered only for data analysis (Accuracy: OGI>Continuous>Truck>UAV>Satellite), see columns K-P to determine actual offerings per service provider. | | | | | | | People per crew (if applicable) | Time per leak (h | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Respondent ID | | AB | BC | SK | US | Other | Alt-FEMP or D60/M21 | Mobile/Stationary | Handheld | Truck | UAV | Aircraft | Sattelite | Fixed | Total | If Multiple, Together or Separate | Handheld | Truck | UAV | Aircraft | Sattelite | Fixed | If Multiple, Together or Separate | | <5min | 5-30min | 30 min+ |
| 2 | Yes | Yes | | | Yes | | AltFEMP | Mobile | 1 | | 1 | | | | 2 | Together | | | 1 | | | | Together | 2+ | | | 1 |
| 3 | No | Yes | | | | | AltFEMP | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | N/A? | 1 | | |
| 4 | Yes | Yes | Yes | Yes | | MB | AltFEMP | Mobile | | | 1 | | | | 1 | | | | 1 | | | | | 2 | 1 | | |
| 5 | No | Yes | | | | | AltFEMP | Mobile | | | 1 | | | | 1 | | | | 1 | | | | | 1 | 1 | | |
| 6 | No | Yes | | | | | AltFEMP | Mobile | | | | | | 1 | 1 | | | | | | | 1 | | N/A | 1 | | |
| 7 | Yes | Yes | | | Yes | EU | | | | | | | | | 0 | | | | | | | | | | | | |
| 8 | Yes | Yes | | | Yes | | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | 1 | 1 | | | 3 | Together | | | 1 | | | | Together | 1-3 | 1 | 1 | |
| 9 | Yes | Yes | Yes | Yes | | | | | | | | | | | 0 | | | | | | | | | | | | |
| 10 | Yes | Yes | | | Yes | | AltFEMP | Stationary | | | | | | 1 | 1 | | | | | | | 1 | | 2 | 1 | | |
| 11 | Yes | Yes | Yes | Yes | Yes | Global | AltFEMP | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | 1-2 | | | |
| 13 | Yes | Yes | | | | ON, NWT | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | 2-5 | | 1 | |
| 14 | Yes | Yes | Yes | Yes | | Canada | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | 1 | | | | 2 | Together | | | 1 | | | | Together | 2 | | | |
| 15 | Yes | Yes | Yes | Yes | Yes | Global | AltFEMP | Mobile | | | | | 1 | 1 | 2 | | | | | | | 1 | | | 1 | | |
| 16 | Yes | Yes | Yes | Yes | | | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | 1-2 | | | |
| 17 | Yes | Yes | | | | NFL&Lab Offshore | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | 1 | | | 2 | Together | | | | 1 | | | Together | 2 | | 1 | |
| 18 | Yes | Yes | | | | | | Both | 1 | | 1 | 1 | | 1 | 5 | Together | | | | | 1 | | Together | 1 | 1 | | 1 |
| 19 | Yes | Yes | Yes | Yes | Yes | Global | AltFEMP | Stationary (soon Both) | | | | | | 1 | 1 | | | | | | | 1 | | 1 | 1 | | |
| 20 | Yes | Yes | Yes | Yes | Yes | Global | | Both | 1 | | 1 | 1 | | 1 | 4 | Separate | | | 1 | | | | Separate | 1 | 1 | | |
| 22 | Decline to ans | Yes | Yes | | | | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | 1-2 | | | |
| 23 | Yes | Yes | Yes | Yes | | | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | 1 | | | 2 | Together | | | | 1 | | | Together | 1-2 | | | 1 |
| 24 | Yes | Yes | Yes | Yes | | Canada | AER Directive 60 Compliant / Method 21 | Both | 1 | | 1 | 1 | | 1 | 4 | Together | | | 1 | | | | Together | 2 | 1 | | |
| 1 | Yes | Yes | | | | | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | 1-2 | 1 | | |
| 12 | Yes | Yes | | Yes | | MB | AER Directive 60 Compliant / Method 21 | Mobile | 1 | | | | | | 1 | | 1 | | | | | | | 1 | 1 | | |
| 21 | Yes | Yes | | | Yes | Canada, US | AltFEMP | Stationary | | | | | | 1 | 1 | | | | | | | 1 | | 1 | | | |

**Appendix F:**

| Anonymization Key | Est.) | | Successful AltFemp? | Plan to be altFEMP? | | Detection Scale | | | Fugitive vs. Vent distinction | | Individual Leak Tagging | Methane Sensor | Flow Rate Calculated? | Detection Limits | | Max Distance (m) | Detection probability | | Ter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Respondent ID | Continuous | Variable | Y/N | Y/N | | Component | Equipment | Facility | | | | | Y/N | Min | Max | | | | min °C |
| 2 | | 1 | N | | | 1 | 1 | 1 | Yes | | Yes | Picarro's proprietary closed-path, infrared Cavity Ring Down Spectroscopy sensor. | Yes | 0.5 scfh | | 150 | 90 | 5 | 4 | -10 |
| 3 | | | N | Y | | 1 | | | No | | Yes | NA | Yes | | | | | | | |
| 4 | | | N | Y | | | | 1 | No | | Yes | Picarro G2201i | Yes | 0.2 gCH4/hr | | | | 2 | 3 | -40 |
| 5 | | | Y | | | | 1 | | No | | Yes | Li-Cor LI7700 (with custom configuration) | Yes | | | | | 4 | 3 | -25 |
| 6 | | 1 | N | Y | | 1 | 1 | 1 | Yes | | Yes | NDA Question. It is a super-spectral sensor. | | | | | | | | |
| 7 | | | Decline to Answer | | | | | | Decline to answer | | | | | | | | | | | |
| 8 | | 1 | | | | | | 1 | | | Yes | Decline | Yes | | | | | 3 | 3 | -30 |
| 9 | | | | Y | | | | | | | | | | | | | | | | |
| 10 | 1 | | Y | | | 1 | 1 | 1 | Yes | | Yes | Proprietary | Yes | | | | | 2 | 4 | -40 |
| 11 | | 1 | Y | | | 1 | | | Yes | | Yes | Multiple | Yes | | | | | 4 | 4 | -25 |
| 13 | | 1 | Y | | | 1 | 1 | 1 | Yes | | Yes | FID / THERMO SCIENTIFIC | No | | | | | 5 | | -10 |
| 14 | | 1 | N | N | | 1 | 1 | 1 | Yes | | Yes | infra red tunable laser, or Pellistor sensor | No | | | | | 5 | 3 | -15 |
| 15 | | | N | | | | 1 | 1 | No | | No | Wide Angle Fabry-Perot | Yes | | | | | 1 | 5 | -99 |
| 16 | | 1 | N | | | 1 | | | Yes | | Yes | GMI GT 44/43 | Yes | | | | | 2 | 3 | -45 |
| 17 | | 1 | N | | | 1 | 1 | 1 | Yes | | Yes | AlphaOne U10. It is a TDLAS (Tunable Diode Laser Absorption Spectroscopy) sensor that integrates with a drone. | Yes | | | | | 4 | 4 | -20 |
| 18 | 1 | 1 | N | N | | 1 | 1 | 1 | Yes | | Yes | TLDAS- Tunable Laser Diode and/or Electrochemical sensors | No | | | | | 2 | 3 | -40 |
| 19 | | 1 | N | Y | | 1 | 1 | 1 | Yes | | Yes | Uncooled single photon avalanche detector, employing time-correlated single photon counting technology. White paper available on request. | Yes | | | | | 2 | 1 | -40 |
| 20 | | 1 | Decline to Answer | | | 1 | 1 | 1 | No | | Yes | ABB LGR-ICOS laser-absorption based analyzer | Yes | | | | | 1 | 4 | -99 |
| 22 | | 1 | N | N | | 1 | 1 | 1 | Yes | | Yes | GF320 Flir camera | Yes | | | | | 4 | 2 | -20 |
| 23 | | 1 | N | Y | | 1 | | | Yes | | Yes | FLIR Infrared Sensors in the Camera and Bacharach Combustible Sensors in the Hi-Flow Sampler. | Yes | | | | | 2 | 3 | -40 |
| 24 | | 1 | N | N | | 1 | 1 | 1 | Yes | | Yes | Heath DP-IR, Heath RMLD-CS, ABB MobileGuard, GMI Gasurveyor, Opgal Eye-C-Gas OGI | Yes | | | | | 4 | 1 | -20 |
| 1 | | | Decline to Answer | | | 1 | 1 | 1 | Yes | | Yes | N/A | No | | | | | 5 | 3 | -15 |
| 12 | | | N | N | | 1 | | | Yes | | Yes | FLIR OGI GFx320 | Yes | | | | | 4 | 4 | -20 |
| 21 | 1 | | N | Y | | | 1 | 1 | | | Yes | Proprietary methane sensor | Yes | | | | | 2 | 3 | -40 |

**Appendix F:**

| Anonymization Key | mp | | Wind | | Max Relative Humidity (%) | Rain Level | | | | Snowfall | | | | | Snow on ground | | | | | Setup Time | Take Down Time | | Inspections/ day (SWB) | | | Current Crews | Potential Future Sites/Year | | Approximate Cost Per Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Respondent ID | max °C | | min kmph | max kmph | | None (no cloud) | Light | Medium | Heavy | None | Light | Medium | Heavy | N/A | None | Thin | Moderate | Deep | N/A | Min. | Max (min.) | Alt-FEMP or D60/M21 | Facilities/d | | | | Facilities/d | | $/d |
| 2 | 45 | | 0 | 32 | 99 | | | 1 | | | | 1 | | | | | | | 1 | 5 | 1 | AltFEMP | 10 | 10 | 0 | | Unknown | | Unknown - More info needed |
| 3 | | | | | N/A | | | | | | | | | 1 | | | | | 1 | 1 | 1 | AltFEMP | N/A | 0 | 0 | | Manufacture Limitation | | N/A |
| 4 | 40 | | | | No Limit | | | 1 | | | | 1 | | | | | | | 1 | 30 | 15 | AltFEMP | 65 | 65 | 2 | 2 | Unknown | | Decline to Answer |
| 5 | 40 | | 0 | 100 | 100 | | 1 | | | | 1 | | | | | | | | 1 | 5 | 5 | AltFEMP | | 0 | 5 | 5 | N/A | | Unknown - More info needed |
| 6 | | | | | | | | | | | | | | | | | | | | N/A | 0 | AltFEMP | | 0 | 0 | | | | Decline to Answer |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | | | | |
| 8 | 40 | | 0 | 30 | No Limit | | 1 | | | | 1 | | | | | 1 | | | 1 | 10 | 10 | AER Directive 60 Compliant / Method 21 | | 0 | 6 | 6 | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | | | | |
| 10 | 50 | | 0 | 230 | 100 | | | | 1 | | | | 1 | | | | | | 1 | 45 | 0 | AltFEMP | N/A | 0 | 2 | 2 | | 400 | $2000/device, $50/mo/device |
| 11 | 50 | - | - | | - | | | | | | | | | | | | | | | 30 | 30 | AltFEMP | 9 | 9 | 10 | 10 | Decline to answer | | Decline to answer |
| 13 | | | 0 | 25 | N/A | | 1 | | | 1 | | | | | | | | | 1 | 90 | | AER Directive 60 Compliant / Method 21 | Unknown | 0 | 8 | 8 | N/A | | Unknown - More info needed |
| 14 | 40 | | 0 | 20 | No Limit | | 1 | | | | 1 | | | | | 1 | | | | 15 | 3 | AER Directive 60 Compliant / Method 21 | Unknown | 0 | 0 | 0 | Staff Limitation | | Decline to answer |
| 15 | 99 | | 0 | | No Limit | 1 | | | | | | | 1 | | | | | | 1 | 0 | 0 | AltFEMP | 1000 | 1000 | 0 | N/A | N/A | | Decline to answer |
| 16 | 40 | | | | N/A | | | 1 | | | | | | 1 | | | | | 1 | 5 | 3 | AER Directive 60 Compliant / Method 21 | 20 | 20 | 0 | | | 3000 | $3,000 |
| 17 | 50 | | 0 | 54 | No Limit | | | | 1 | | | 1 | | | | | | | 1 | 5 | 5 | AER Directive 60 Compliant / Method 21 | 6 | 6 | 3 | 3 | | 1000 | $3,500 |
| 18 | 40 | | | | 90 | | 1 | | 1 | 1 | | | 1 | | | | | | | 15 | 15 | | N/A | 0 | 0 | N/A | N/A | | N/A |
| 19 | 0 | | | | Unknkown | | | 1 | | | | 1 | | | | | | | 1 | | | AltFEMP | N/A | 0 | 2 | 2 | N/A | | Unknown - More info needed |
| 20 | 50 | | 0 | 40 | N/A | | 1 | | | | | | | | | | | | | 2 | 0 | | | 0 | 0 | | | | |
| 22 | 30 | | 0 | 20 | N/A | | | 1 | | | | 1 | | | | | 1 | | | 10 | 10 | AER Directive 60 Compliant / Method 21 | 20 | 20 | 2 | 2 | 1500+ | | |
| 23 | 35 | | 0 | 28 | 95 | | 1 | | | | 1 | | | | | | | 1 | | - | | AER Directive 60 Compliant / Method 21 | 10 | 10 | 1 | 1 | Unknown | | $3,200 |
| 24 | 4 | | 0 | 20 | N/A | | 1 | | | | 1 | | | | | 1 | | | | 15 | 15 | AER Directive 60 Compliant / Method 21 | Unknown | 0 | 3 | 3 | Scalable | | $750 |
| 1 | 40 | | | | 80 | | | 1 | | | | 1 | | | | 1 | | | | 15 | 15 | AER Directive 60 Compliant / Method 21 | 3 | 3 | 2 | 2 | Unknown | | $3,500 |
| 12 | 50 | | 0 | 40 | Unknown | | | | 1 | | | | 1 | | | | | | 1 | 10 | 2 | AER Directive 60 Compliant / Method 21 | 8 | 8 | 3 | 3 | | 1000 | $2,250 |
| 21 | 40 | | 0 | 120 | 100 | | | | 1 | | | | 1 | | | | | | 1 | 25 | 0 | AltFEMP | N/A | 0 | 0 | N/A | Scalable | | Unknown - More info needed |

**Appendix F:**

| Anonymization Key | Pricing for Larger Projects/Contracts | | Current Crews | Facility type 311/351 (Single well) | Facility type 321 361 Multi Group | Facility type 401 - Sweet Gas Plant | Facility type 601 - Compressor station | | Data Mangement a base requirement of Clients? |
|---|---|---|---|---|---|---|---|---|---|
| Respondent ID | | Alt-FEMP or D60/M21 | | Facilities/d | | | | Other | |
| 2 | Efficiency up costs down | AltFEMP | | 6-10 | 6-10 | 6-10 | 6-10 | | No |
| 3 | N/A | AltFEMP | N/A | | | | | We sell our hardware, application and data management access to our clients and they perform the site activities. With our solution their personnel are able to locate and repair leaks directly, monitor annual surveyed sources to reduce recurrence time and find, report and manage new leaks in the 364 days between annual surveys. This may allow then eventually to eliminate some of their expensive external consultant costs. | Yes |
| 4 | Decline to answer | AltFEMP | 2 | 21+ | 21+ | 21+ | 21+ | | Varied |
| 5 | Costs down as time increased | AltFEMP | 5 | 21+ | 21+ | 21+ | 21+ | The costs per site are dependent on the work practice that is utilized. Our recommended work practice involves immediate follow-up of detected anomalies. The per site time relates to how the operator chooses to follow up on these anomalies, and the number of anomalies. | Decline to answer |
| 6 | Decline to answer | AltFEMP | | | | | | I think that most questions do not relate to remote sensing via airborne or satellite systems. | N/A |
| 7 | | | | | | | | | |
| 8 | | AER Directive 60 Compliant / Method 21 | 6 | 6-10 | 1-5 | 1-5 | 1-5 | | Yes |
| 9 | | | | | | | | | |
| 10 | Discounts on Mobilization fee | AltFEMP | 2 | | | | | | Yes |
| 11 | multi year 40% reduction in cost | AltFEMP | 10 | | | | | | Varied |
| 13 | piece work | AER Directive 60 Compliant / Method 21 | 8 | 1-5 | 6-10 | 6-10 | 6-10 | We have daily work performance variables that are tracked through daily KPI reporting - we are always on time and on budget | Yes |
| 14 | Decline to answer | AER Directive 60 Compliant / Method 21 | 0 | | | | | This is impossible to determine without complete knowledge of the site layout and reporting requirements. | N/A |
| 15 | Subscriptions lower cost | AltFEMP | N/A | 21+ | 21+ | 21+ | 21+ | Satellite - We capture 12km x 12km images Aircraft Variant - We fly a linear area with a 750m swath | Yes |
| 16 | 5-10% reduction | AER Directive 60 Compliant / Method 21 | | 21+ | 11-20 | 1-5 | 6-10 | | Yes |
| 17 | large job - less charge | AER Directive 60 Compliant / Method 21 | 3 | 6-10 | 1-5 | 1-5 | 1-5 | | Yes |
| 18 | N/A | | N/A | | | | | We are a manufacturer not a service organization | N/A |
| 19 | Unknown. | AltFEMP | 2 | | | | | Our technology offers multiple benefits over the current state of the art. The ability to simultaneously visualise and quantify releases of methane is a step forward, as is the ability to provide this on a 24/7/365 basis, offering faster responses than intermittent studies. The user emits less methane, for a lower overall investment. The industry is looking for disruptive sensors that combine selectivity, sensitivity, high rejection of spurious results, long lifetime and low cost of operation so they can be widely deployed and operated in continuous automatic monitoring systems from which data can be integrated into comprehensive and automated safety, environmental and maintenance response systems. Other technologies can offer a portion of this benefit, but only QLM's combination of accuracy, sensitivity, long range, robustness, and low-cost scalability addresses all the requirements for tackling the market. | Varied |
| 20 | | | | | | | | | |
| 22 | | AER Directive 60 Compliant / Method 21 | 2 | | | | | | Yes |
| 23 | Bundled contract discount | AER Directive 60 Compliant / Method 21 | 1 | 11-20 | 6-10 | 1-5 | 1-5 | N/A | Varied |
| 24 | Lower price for economies of scale | AER Directive 60 Compliant / Method 21 | 3 | 11-20 | 21+ | 1-5 | 1-5 | | N/A |
| 1 | unknown | AER Directive 60 Compliant / Method 21 | 2 | 1-5 | 1-5 | 1-5 | 1-5 | | No |
| 12 | Discounts on large bundle contracts | AER Directive 60 Compliant / Method 21 | 3 | 6-10 | 1-5 | 1-5 | 1-5 | N/A | Yes |
| 21 | Costs reduce with scale | AltFEMP | N/A | | | | | Our customers are interested in overall leak reductions rather than efficiencies. We communicate the advantages of our approach as lowering emissions and being able to independently verify those reductions. | Yes |

## Appendix G Duty Holder and Midstreamer Data Analysis

| Anonymization Key | FEMP Budgets | | | Self Perform LDAR 2020? | | | | | | | Self Perform | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Producer # | 2021 FEMP? | 2021 Budget? | Influenced by 2020? | SP LD | LD 3rd Party | SP Repair | Repair 3rd Party | Data SP | Data 3rd Party | Comments | Self-perfor | 3rd party LI | Repair |
| 9 | Yes | Yes | | | 1 | 1 | 1 | | 1 | | 1 | | 1 |
| 13 | Yes | No, incorporated into OPEX budget. | | | 1 | 1 | | | 1 | | 1 | | 1 |
| 1 | Yes | No, this is still under general operation budget. Though there will likely be a distinct budget in the future. | | | 1 | 1 | | 1 | 1 | | 1 | | 1 |
| 11 | Yes | Yes | Yes | | 1 | 1 | | 1 | | | 1 | | 1 |
| 7 | Yes | Yes | | | 1 | 1 | | | 1 | | 1 | | 1 |
| 12 | | | | | | | | | | | | | |
| 5 | Yes | Yes | | 1 | | 1 | | 1 | | | | | |
| 8 | Yes | Yes | Yes | | 1 | 1 | | | 1 | | | 1 | 1 |
| 3 | Yes | Yes | | 1 | 1 | 1 | 1 | 1 | 1 | Annual Wellsite Screenings - Internal, FEMP/LDAR - 3rd party | 1 | 1 | 1 |
| 6 | Yes | Yes. | | | 1 | 1 | | 1 | | | | 1 | 1 |
| 2 | Yes | Yes | | | 1 | 1 | | 1 | 1 | | | 1 | 1 |

## Appendix C

| Anonymization Key | LDAR 2021? | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Producer # | Repair 3rd | Data SP | Data 3rd Pa | Comments | Self Perform % 2021 | BROA 2020/21 | BROA Comments |
| 9 | 1 | | 1 | Operational guideline and Union rules | 0 | | not sure |
| 13 | | | 1 | Our operations team can perform the majority of leak repairs. | 0 | Yes | Applied for a subset of our facilities, targeting only MWBs and GSs. Facilities known to have extensive instrument-air systems, like GPs, were omitted due to the cost associated with gathering the inventory of equipment on the I/A systems with no value to us. |
| 1 | | 1 | | For cost control, data consistency, reporting consistency and ESG strategy, we prefer to have as much data in house as possible. We may use in house resources for the surveys in the future, but so far there has not been the drivers to develop this in house. | 0 | Yes | We completed company-wide fugitive emissions surveys, as well as a complete new inventory, gathering emitting device data to a very granular level. The results are intended to inform the refinement of our MRRCP, FEMP and our D60 reporting. |
| 11 | | 1 | | | 0 | No | |
| 7 | | | 1 | | 0 | No | |
| 12 | | | | | | | |
| 5 | | | | Third party aerial screening technology, Self perform truck screening, OGI and repair | 76+% | No | |
| 8 | | | 1 | | 0 | No | |
| 3 | 1 | 1 | 1 | Annual Wellsite Screenings - Internal, FEMP/LDAR - 3rd party | 0 | No | |
| 6 | | 1 | | | 76+% | No | |
| 2 | | 1 | 1 | | 0 | No | |

## Appendix C

| Anonymization Key | Federal Assets | | AER Assets | | | | Method Used | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Producer # | # of Assets | Comments | D60 | D117 | Unknown | Decline to Answer | OGI | Method 21 (other than OGI) | Alternative Methods (alt-FEMP) | # of OGI cameras |
| 9 | | | | | | | 1 | 1 | | |
| 13 | 0 | | 708 | | Unknown | | 1 | | 1 | 0 |
| 1 | >100 | | >100 | >100 | | | 1 | | | N/A |
| 11 | Decline to answer | | | | | X | 1 | 1 | 1 | Decline to answer |
| 7 | >500 | | | | x | | 1 | | 1 | N/A |
| 12 | | | | | | | | | | |
| 5 | | | | | | | 1 | | 1 | >1 |
| 8 | Unknown | With the merger with xxx this is unknown | | | Not sure | | 1 | | 1 | None |
| 3 | Decline to Answer | Please study the publicly available datasets | | | | X (Please study the publicly available datasets) | 1 | 1 | 1 | Unknown |
| 6 | Unknown | | | | x | | 1 | | | 0 |
| 2 | | | | | | - | 1 | 1 | | 0 |

## Appendix C

| Anonymization Key | | | | | | Self Perform Alt-Femp LDAR? | |
|---|---|---|---|---|---|---|---|
| Producer # | Make/Model | Number of trained operators: | Train more? | # in 2021 and beyond | Alt-FEMP proposal with AER? | Leak Detection - Yes | Leak Detection - No (Use 3rd party) |
| 9 | | | | | | | |
| 13 | N/A | 0 | No | | Yes | | 1 |
| 1 | N/A | 0 | Unknown | | No | | |
| 11 | | Decline to answer | Decline to answer | 100+ | No | | 1 |
| 7 | | N/A | No | N/A | Yes | | 1 |
| 12 | | | | | | | |
| 5 | FLIR GF x320 | >1 | Yes | | Yes | | |
| 8 | | | | | Yes | | 1 |
| 3 | FLIR GH 320/x 320 | Unknown | Decline to answer | Unknown | Yes | 1 | 1 |
| 6 | N/A | 0 | No | 0 | No | | |
| 2 | Unknown | 0 | No | 0 | Yes | | 1 |

## Appendix C

| Anonymization Key | | | | | | If your organization intends to self-perform its AltFEMP efforts in 2021, please provide a high-level overview of the program it intends to implement (e.g., times per year and when, execution method, number of sites, etc.). (N/A, unknown, decline to answer) |
|---|---|---|---|---|---|---|
| Producer # | Data management - Yes | Data management - No (Use 3rd party) | Unknown | Decline to answer | Other/Comments (e.g., combination of self perform and 3rd party): | Open-Ended Response |
| 9 | | | | | | |
| 13 | | | 1 | | | N/A |
| 1 | | | | | | NA |
| 11 | | | | | | N/A |
| 7 | | | 1 | | | N/A |
| 12 | | | | | | |
| 5 | | | | | Combination | Combination |
| 8 | | | 1 | | | |
| 3 | 1 | | 1 | | | Not self-performing Alt-FEMP. |
| 6 | | | | | | |
| 2 | 1 | | 1 | | | n/a |

## Appendix C

| Anonymization Key | What deployment platform(s) will your organization use in 2021? (N/A, Unknown, Decline to Answer) | Are there any FEMP-related labor or equipment limitations your organization is facing, and do you anticipate that they will be resolved? (N/A, Unknown, Decline to Answer) | How many trained alternative-method inspectors does your organization employ? (N/A, Unknown, Decline to Answer) | Does your organization intend to employ more or train more employees in alternative inspection methods in 2021? | | Is your organization interested in being contacted to share the research outputs? |
|---|---|---|---|---|---|---|
| **Producer #** | Open-Ended Response | Open-Ended Response | Open-Ended Response | Response | If yes, how many and by when? | Response |
| 9 | | | | | | |
| 13 | Aircraft-mounted, truck-mounted and fixed continuous. | No. | N/A | | No | |
| 1 | NA | Yes, we don't have the staff to implement any in-house OGI training, leak detection training or detailed data management training. | NA | | No | |
| 11 | N/A | No | N/A | No | | Yes |
| 7 | N/A | N/A | N/A | No | | No |
| 12 | | | | | | |
| 5 | | No concerns with OGI or Aerial at this time | | 8 Yes | | Yes |
| 8 | OGI and Aerial | None | None | No | | Yes |
| 3 | Aerial & Ground-based OGI (by exception) | No, the FEMP providers have been able to expand with demand. | Unknown | Unknown | | Yes |
| 6 | | | | No | | No |
| 2 | n/a | Decline to answer | | 0 No | | Yes |

## Appendix C

| Anonymization Key | If you or your organization have any further information that you would like to provide in fulfilment of one of these objectives, we welcome any further information you can provide, alongside the reminder that questionnaire data released publicly will be aggregated and anonymized. |
|---|---|
| **Producer #** | Open-Ended Response |
| 9 | |
| 13 | |
| 1 | |
| 11 | |
| 7 | |
| 12 | |
| 5 | |
| 8 | |
| 3 | |
| 6 | |
| 2 | |