

Project Summary, Milestones, Payment Schedule and Quarterly Update Reports

Report Date: (Q1, July 1st – September 30th, 2024)

Project Summary

Project Title:	Verified Methane Reductions: Leveraging Measurement-Based Methane Inventories to Quantify Reductions Trends and Prove Methane Intensities
Lead Investigator:	Matthew Johnson, Carleton University
AUPRF Managed Funds Award Amount:	\$150,000
PTAC Technical Champion:	
GL #:	23-ARPC-02
Project Total Cost (all years)	\$3,230,000
Leveraged Cash Funding (all years)	\$
Leveraged In-Kind Funding (all years)	\$3,080,000
Start Date:	July 1 st , 2023
Completion Date:	December 30 th , 2024
Final Report Due Date:	December 30 th , 2024

Provide a brief description of the challenges this project aims to address and how industry and others will benefit, including what the anticipated impact is. (i.e., cost reductions, improved environmental performance, impact on regulation, enhanced access to resources). (Maximum 150 words or less)

This project addresses critical gaps in current federal methane emission inventories, that rely on broad estimates rather than direct measurements leading to inaccurate methane emissions data that impede mitigation policy. Leveraging primary funding from NRCan, BC Government, and UNEP IMEO, this project provides unprecedented insight into the major methane emissions sources, inventories, and up-to-date methane emission intensities. Results will deliver the best possible information on methane emissions to drive cost-effective mitigation and evidence-based decisions. This work is expected to help define more efficient and informed regulatory strategies to reduce oil and gas sector methane emissions as required to meet 2030 targets. Most notably, the type of independent measurement, reporting, and verification (MRV) developed in this project is increasingly a requirement for accessing international markets and the approaches and technical capacity developed in this work are essential for maintaining the continued competitiveness of Canada's oil and natural gas sectors. The anticipated benefits of this project include economic benefits of potential cost savings and environmental benefits stemming from achieving emissions reductions and Canada's climate goals. Operationally, the project findings will offer clear mitigation opportunities, help industry pursue international standards like OGMP2.0, enhancing their competitiveness in global markets.

List scope key milestones with invoicing schedule. Include quarterly estimates.

Milestone	Planned Expenditures ¹	Actual Expenditures	Status
Q3 (Oct 1 – Dec 31) 2023			
1. Aerial GML Surveys in BC, AB, SK and Ground-based measurements in BC	Leveraged in-kind		Completed
Q4 (Jan 1 – Mar 31) 2024			
2. Aerial Source Attributions	Leveraged in-kind		Completed
Q1 (Apr 1 – Jun 30) 2024			
3. Synthesis of results to produce a comprehensive source-resolved, measurement-based methane inventory with robustly defined uncertainties	\$75,000	\$75,000	Preliminary inventory results are completed for BC, SK and part of Alberta
Q2 (Jul 1 – Sep 30) 2024			
4. Source-level Analysis and Comparison with Federal Inventories	\$25,000	\$10,000	In progress
5. Updated Methane Emissions Intensities and Trends in Western Canada	\$50,000	\$15,415	In progress
Q3 (Oct 1 – Dec 31) 2024			
6. Reporting and Dissemination	Leveraged in-kind		In progress
Total	\$150,000	\$100,415	

Please refer to the financial quarterly report submitted by Melanie Thompson for a complete Expenditure Summary

¹ All expenditures in Canadian dollars and must exclude GST and other applicable taxes.

Quarterly Update

Exception Highlight for the Quarter:

(any exceptions to the original project scope, timelines, payment schedule / amount(s) OR early significant findings) – this can be left blank if no changes are needed, and do not include exceptions already reported.

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| 1. The project is proceeding mostly as planned despite initial delays in the 2023 aerial campaign. |
| 2. NRCan has extended additional funding through 2024-2025 to support a follow-up survey in 2024 to enable year-over-year tracking of trends and mitigation progress. There is a potential opportunity to expand the scope and extend additional support for this project. |
| 3. Recent delays in receiving a final error model from Bridger Photonics have caused a delay in finalizing preliminary inventory results, which has caused a delay in Q2 milestones. Although changes to finalize uncertainty models are not expected to significantly affect the preliminary inventory results shared in previous reports, this step is nevertheless crucial before further disseminating results. Our current goal is to have these models available and inventory calculations finalized by late-November (Q3). |

Update on scope, key questions, gap analysis and work performed this quarter (include any requests for assistance to PTAC or the committees)

As of September 30th 2024, there has been a moderate progress in completing 2023 national methane census. Over the course of the last fiscal quarter, the project team has primarily focused on completing the remaining manual source attribution analysis for Alberta and launching a follow-up 2024 aerial campaign, separately funded by NRCan to track year-over-year trends in emission reductions and mitigation progress.

2023 campaign:

Over the last quarter, the EERL team has been immersed in completing the manual attribution for the province of Alberta (the largest region in the 2023 survey with 8,910 surveyed sites, comprising 11,395 active facilities and 16,438 active wells) and the additional analysis to refine the 2023 measurement-based oil and gas sector methane inventories for the provinces of British Columbia and Saskatchewan.

However, the key remaining challenge is to finalize a quantification uncertainty model for Bridger Photonics second generation gas mapping LIDAR (GML 2.0) used during the 2023 surveys. As highlighted below, we have successfully collaborated with Bridger to publish a peer-reviewed paper detailing a robust probability of detection model (POD) for GML2.0, however parallel work to develop and uncertainty model is ongoing. This model, which includes a bias correction as well as a model to quantify precision uncertainty, is essential for being able to finalize a 2023 inventory. We have been working closely with Bridger to share controlled release data as well as other reference data from direct compressor measurements taken by ourselves and in collaboration with industry partners. As of this writing we are hoping to have a workable uncertainty model available by early November. Once this is finalized, it will be possible to put together final 2023 inventories for Alberta, Saskatchewan, and BC.

2024 campaign

Although not currently included as part of the PTAC AUPRF funding which at the moment only extends through the current calendar year, based on the lessons learned in 2023 campaign our team is continuing collaborations with NRCan and BC Government into 2025 and has completed extensive planning to design a follow-up 2024 aerial survey in the western provinces of British Columbia, Alberta, and Saskatchewan (Figure 1). The initial sample set of approximately 12,933 representative sites aims to achieve a similar representation of relevant upstream oil and gas facility types covered in the initial 2023 survey, while balancing the constraints of available NRCan budget. This follow-up aerial survey was designed to include 1,300 active sites in British Columbia, 8,628 sites in Alberta, and 3,005 sites in Saskatchewan.

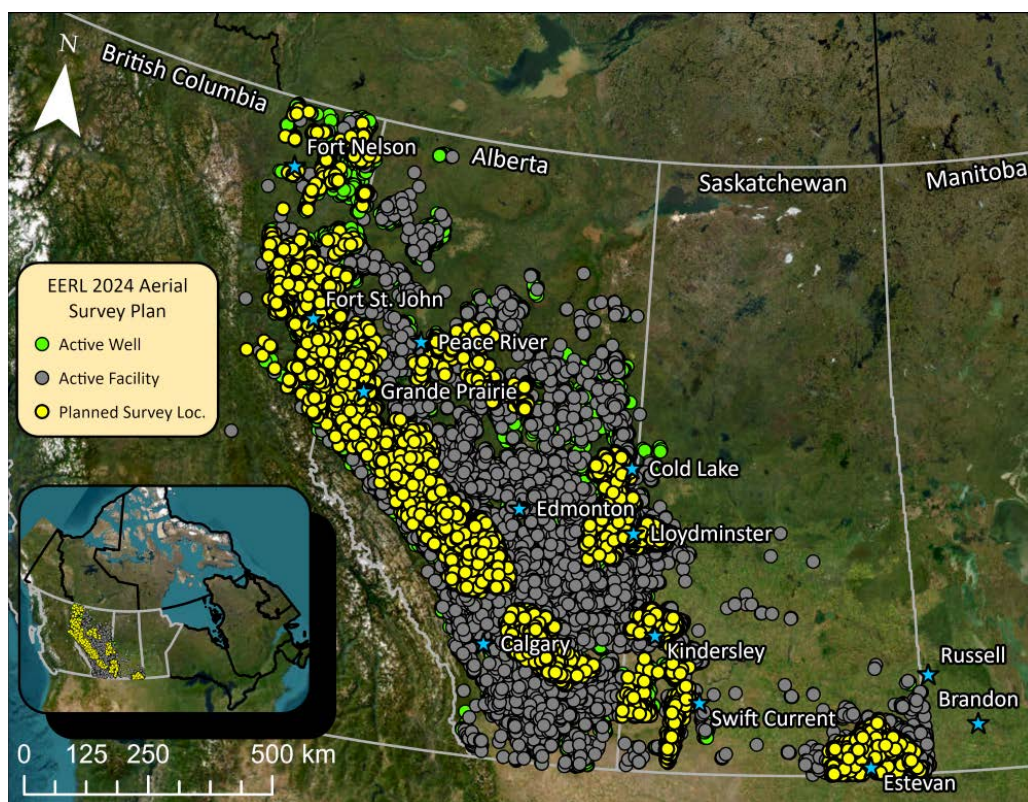


Figure 1: Western Canada 2024 aerial survey sites (yellow) overlaid on active facilities (grey) and wells (green). Sample of approximately 12,933 sites was designed to achieve representative coverage in production regions of British Columbia, Alberta and Saskatchewan.

The scope of the 2024 surveys have been updated to include complete re-flights of all surveyed sites, i.e., two complete, whole-site measurements on different days over each site. This extended approach differs from previous campaigns (2021, 2023), in which only sites with detected sources were flown a second time and, for larger sites, only portions of the site with previously detected sources were re-flown. This enhanced survey design is expected to give a much richer statistical data set that will help us quantify overall uncertainties while specifically considering the influence of source persistence and occurrence/reoccurrence rates. The 2024 aerial surveys are currently underway and, although there have been significant forest fires in some of the study regions, surveys are expected to be largely completed by late October (Q3).

We invite the PTAC AUPRF committee to consider joining the provincial and federal funding partners to support extension of this project to facilitate inventory development and quantification of achieved reductions through 2024.

Reporting and Dissemination:

To maximize impacts of ongoing work, research findings are being directly and continually disseminated in real-time wherever possible to relevant stakeholders. This includes formal and informal data sharing, workshops, conference presentations, and peer-review publications, all of which are essential to supporting timely action to reduce methane. Relevant formal presentations during this reporting period included:

- M.R. Johnson (2024) Methane Emissions Research Collaborative (MERC) Annual Meeting, Invited Presentation to British Columbia Energy Regulator (BCER), Virtual, September 18.

Otherwise, as a team we have been trying to devote as much time as possible to ongoing data analysis and work toward article submissions for peer-review. We recently published a journal article reporting first-ever measurements of methane emissions from catalytic heaters, a potential source found at almost all upstream oil and gas sites in Canada. Although not currently addressed in any existing regulations, surprisingly, results from the 2023 survey show that these heaters could represent 4.8-6.2% of the total oil and gas methane inventory in British Columbia and as an aggregate methane source ***are likely 3.8 to 5× more significant than abandoned wells***. This is a very important and timely insight in the context of regulatory review.

- S.A. Festa-Bianchet, M. Mohammadikharkeshi, D.R. Tyner, M.R. Johnson* (2024) Catalytic Heaters at Oil and Gas Sites May be a Significant yet Overlooked Seasonal Source of Methane Emissions, *Environmental Science & Technology Letters*, 11(9):948–953 (doi: [10.1021/acs.estlett.4c00453](https://doi.org/10.1021/acs.estlett.4c00453))

Additionally, as noted above in collaboration with Bridger Photonics we have published the updated probability of detection (POD) model for their second generation (GML2.0) aerial methane detection technology:

- M.J. Thorpe, A. Kreitingner, D.T. Altamura, C. Dudiak, B.M. Conrad, D.R. Tyner, M.R. Johnson, J.K. Brasseur, P.A. Roos, W.M. Kunkel, A. Carre-Burritt, J. Abate, T. Price, D. Yaralian, B. Kennedy, E. Newton, E. Rodriguez, O.I. Elfar, D.J. Zimmerle (2024) Deployment-invariant probability of detection characterization for aerial LiDAR methane detection, *Remote Sensing of Environment*, 315:114435 (doi: [10.1016/j.rse.2024.114435](https://doi.org/10.1016/j.rse.2024.114435))

Finally, PTAC and EERL have collaborated to submit an application to present as part of the expert panel moderated by PTAC at the Canadian Pavilion at COP29 in Baku, Azerbaijan in November 2024. If approved, the goal would be to share data-driven insights into the progress and challenges in reaching Canada's 2030 methane goals and how these can help other countries reduce emissions on the same timescale.

Planned next steps:

While working within the expanded scope of the National Methane Census project (2023-2024), the key next steps over the Q3 include:

- Finalizing the 2023 methane inventory for all western provinces. The 2023 insights will be instrumental in reflecting the actual distribution of oil and gas sector emission sources and accurately tracking achieved reductions to date.
- Sharing of relevant results to multiple stakeholders, especially including ECCC inventory development team who are keen to continue incorporating measurement data generated through this project into their official national inventory;
- Continued reporting and further real-time dissemination of preliminary 2024 findings as available.