EXECUTIVE SUMMARY

In September 2021 the University of Waterloo, Arolytics, Inc., and Carbon Management Canada commenced a 3-year study focused on assessing the potential of existing and emerging technologies for measuring methane emissions from upstream oil and gas sources, and developing uncertainties for these estimates. This second interim report summarizes progress up to January 2023, with a focus on the second field campaign, held at Carbon Management Canada's Field Research Station between September 25-October 1 2022.

The second field trial examined the performance of four technologies operated by five providers: two quantitative optical gas imaging (QOGI) systems; a truck-based tunable diode laser-absorption spectroscopy (TDLAS) system; and airborne near infrared (NIR) and long-wavelength infrared (LWIR) hyperspectral (HS) imaging systems. These technologies were used to quantify controlled emissions from: a 1.7 m stack, a 3.4 m stack, a 4.8 m stack, a 13 m unlit flare, from the top of a 2.7 m storage tank, and from the side of a shed. Emission rates ranged from 0.25 kg/hr to 80 kg/hr.

On average, the FLIR QOGI system provided the most accurate estimates under all conditions. The QOGI technologies (FLIR GFx320/QL320 and OPGAL EyeCGas/EyeCSite) had similar performance and with airborne NIR measurements, and were generally more accurate compared to the truck-based TDLAS system. The accuracy of these systems was highest for the stack and unlit flare releases, and considerably lower for releases from the storage tank and shed. This was attributed to the complex aerodynamics surrounding the structure, and, in the case of the QOGI systems, distance, obstructed lines-of-sight, and reflectance from the metallic surfaces.

The performance of the QOGI technologies depended strongly on the distance between the release and the cameras, the ambient wind, the release rate, and the temperature difference between the gas and the background. The FLIR QOGI system outperformed the OPGAL system for releases from the stack and unlit flare, while the OPGAL system was more accurate for the tank and shed releases. It is unclear whether this is due to the different algorithms used by the systems, or the different level of experience of the operators.

The airborne NIR system performed similarly to the QOGI systems, while the LWIR HS systems had a much lower accuracy compared to the other technologies due to operational problems and issues with the emissions quantification algorithm. The NIR HS system performed considerably better in the second field campaign compared to the first field campaign, likely due to the clearer sky condition. Both the LWIR and NIR HS systems require wind speed as an input, and are therefore susceptible to errors in the local wind conditions.

The remainder of the project, which ends in December 2023, will focus on: developing an improved quantification technique for the LWIR HS imaging system; understanding the impact of wind variability on the truck-based TDLAS system; evaluating the potential of incorporating the quantification systems into an emissions management plan through Monte Carlo simulations; and development of a Bayesian framework for estimating the uncertainty of emissions estimates.