Pilot Measurements Study for Quantifying Methane Emissions at Upstream and Midstream Oil and Gas Facilities

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Methane is a potent greenhouse gas, and there is significant scientific, regulatory, and practical interest in understanding, quantifying, and reducing methane emissions from Alberta's upstream oil and gas (O&G) industry. Of particular interest are emissions from leaking or malfunctioning equipment and routine methane venting from pneumatic devices, glycol dehydrators, compressors, vessels, and tanks. The Government of Alberta's Climate Leadership Plan2 calls for a reduction of methane gas emissions from upstream O&G operations by 45% (relative to 2014 levels) by 2025, and active regulations and legislation are directed toward addressing the issue of methane emissions from O&G operations.3 This regulatory context provides an important impetus for the development, testing, and application of sensor-based systems that can help meet Alberta's upstream O&G industry goals.

The application of portable, next-generation methane sensors coupled with analysis techniques that may be utilized as an alternative method to identify, localize, and quantify emissions from small-scale sources at upstream or midstream O&G facilities is therefore an important topic for the Alberta Upstream Petroleum Research Fund (AUPRF). Sonoma Technology, Inc. (STI) has undertaken this study in the context of the AUPRF's research priorities related to methane—i.e., to develop more broadly applicable solutions for reducing methane emissions in ways that are both technically achievable and economically sustainable. The term "next-generation" refers to emergent sensor technology that has the potential to meet various O&G industry needs at substantially lower acquisition and operational costs compared to current "gold-standard" methane measurement systems. Recent advances in methane monitoring and analytical techniques have rendered these technologies more suitable to the AUPRF's research priorities than ever before. Methane sensors are becoming, and will continue to become, less costly, more sensitive, more portable, and easier to use.

Hence, a field study was undertaken to (1) address AUPRF's research priorities related to methane; (2) advance the understanding of the strengths and limitations of next-generation, portable methane sensors; and (3) advance the general understanding of how best to leverage sensor technologies for facility process improvements, how and when to suitably apply

the technologies, and how to defend against misuse or misinterpretation of results. The specific project objectives are to (1) demonstrate application of innovative, portable methane sensors that can eventually be coupled with inverse dispersion modeling analyses; and (2) develop recommendations and quantifiable data to illustrate how this data can support emissions quantification (or inverse modeling) analysis to address transient, low-level emissions sources. This will contribute to the body of knowledge concerning best and standard practices in upstream O&G facilities.

This report describes the three-week deployment during summer 2018 of two portable methane concentration sensors with co-located meteorological sensors at the Site 8-8 well pad, located near Drayton Valley in Alberta, Canada. This deployment was conducted to demonstrate the utility of the methane sensors and meteorological package to characterize potential methane emissions at an O&G site, and give information about the relative strength and location of methane emissions at the site. Although methane is the primary focus of this work, the sensors deployed in this project also measure ethane (C2H6), which can facilitate a more refined characterization and source identification of potential methane sources.
As part of this project, the sensor package was evaluated at STI before and after the deployment and challenged with gases of known concentration and composition. The sensor package was further challenged

in the field through a series of controlled release experiments that were conducted prior to the deployment. The controlled release experiments provide important data to evaluate the methane sensors in the field, and to evaluate emission quantification methods.

The end goal of these activities is to obtain a data set that can demonstrate the ability of these portable, next-generation sensors to provide information that can eventually be coupled with inverse dispersion modeling methods to estimate emission source strengths and locations at upstream O&G sites. These measurements will also provide a benchmark upon which data quality objectives can be established for similar new and emerging methane sensor technologies.

Final Report