PTAC PETROLEUM TECHNOLOGY ALLIANCE CANADA

Distributed Energy Efficiency Projects Platform (DEEPP) Phase 2b

Final Report for NRCAN

May 23, 2017

1. Purpose

This document is the final report presented to Natural Resources Canada (NRCan) for participation in the Distributed Energy Efficiency Projects Platform (DEEPP) Project Phase 2b, which is currently managed by PTAC Petroleum Technology Alliance Canada. The purpose of this project was to finalize the *Quantification Protocol for Greenhouse Gas Reductions from Pneumatic Devices* and develop Phase 2b of the DEEPP. Phase 2b included the development of the methane vent reduction module and quantification methodologies for high-to-low pneumatic controller conversions and methane vent gas capture.

2. Project Description

The project was completed on time and on budget. The objective of building a production-ready methane venting capture/reduction module as a part of the DEEP Platform was met. In addition, the *Quantification Protocol for Greenhouse Gas Reductions from Pneumatic Devices* was submitted to Alberta Environment and Parks (AEP). The importance of this protocol has been noted by industry and government alike, and was in fact featured in the Alberta Climate Leadership Plan announcements of November, 2015 (see http://www.alberta.ca/climate-methane-emissions.cfm).

The protocol is a key component of the "Reducing Methane Emissions" pillar, one of four pillars announced including a phase-out of coal electricity, a carbon tax, and a cap on oil sands emissions. The public importance of reducing methane emissions, a large proportion of which can be met through the energy efficiency initiatives that are supported through this project, demonstrates the prescience of NRCan, PTAC, Cap-Op and other project partners who have been developing solutions for multiple years in advance of these public acknowledgements.

Similarly, the expansion of the DEEPP to include these methane emission reduction project types is very timely since it will unlock significant value for the industry. As part of the above announcement, it is anticipated that there will be a voluntary methane reduction period (5 years) wherein companies can pursue low-cost project aggregation through the DEEPP. Following this voluntary period, reductions may become mandated or be subject to additional regulation; in any case, the DEEPP will continue to provide significant value either through compliance or carbon monetization.

2.1. Objectives

The objective of the DEEPP Project was to build and deliver a streamlined technology solution to overcome the challenges associated with the development, aggregation, tracking and financing of distributed oil and gas energy efficiency projects. This included:

- Providing the oil and gas industry with an effective tool to manage energy efficiency assets and to quantify the value performance of each asset in terms of fuel gas savings and greenhouse gas (GHG) emissions avoided;
- Accelerating additional energy efficiency investments by industry that will further reduce GHG emissions;
- Providing reporting transparency to government for purposes of quantifying GHG offsets;
- Providing governments with an analytical tool to understand overall industry energy efficiency performance;
- Providing easy online access to existing best practices;
- Identifying trends and top performers to extract new best practices;
- Improving the overall energy efficiency performance of the Canadian oil and gas sector.

As part of the larger DEEPP Project, the objective of Phase 2b was to build and deliver a module to aggregate and quantify emission reductions from methane venting reduction projects. The quantification methodology within the new module was developed alongwide, and using methodologies from, the pending *Quantification Protocol for Greenhouse Gas Reductions from Pneumatic Devices.*

2.2. Project Narrative

The project built upon the achievements of Phase 1 and 2a, leveraging technological developments of the production version of the platform towards the incremental modules and thereby expanding the number and types of projects that the platform supports. Concurrently, the framework for carbon monetization was co-developed with Alberta Environment and Parks (AEP) such that companies could pursue carbon credits thereby enhancing the financial attractiveness of their energy efficiency projects.

The early work in July 2015 included re-engaging with AEP to determine the status of the revised protocol after work was halted due to the election. AEP had decided to revise the protocol to include methane vent gas capture/pneumatic devices. AEP was reviewing the technical seed document that Cap-Op had prepared and gave notice to proceed with the draft protocol. Concurrently, Cap-Op initiated software development modifications on the existing platform components to ensure compatibility with the new module, as well as work on the mobile app which is critical to the successful development and deployment of the quantification module itself. Specific activities included initiating the module requirement matrix, workflow diagrams and Calculation Code Identifiers (CCIDs), message centre reform tracking tool and inventory template.

Moving forward, August and September work focused on revisions to the protocol, including modifying project type descriptions and updating procedures for new project types. Improving the quantification methodologies was required to ensure that all calculations in the software module would follow the AEP protocol. Software development activities included further work on workflow calculations, CCIDs, and coding for calculations. Integration of data pulled from the

mobile app into the DEEPP was verified, and a new inventory template was created for meta data captured regarding different project types.

October to December was a very active period in the project, with the protocol being completed and submitted to AEP and, therefore, the quantification methodologies were aligned. Development of the upload and data integration procedures was completed, and development and integration of the quantification procedures was initiated now that the procedures were finalized. Cap-Op completed methane vent gas capture module design.

Lastly, December and January included testing of the module and finalization of the quantification module for pneumatic controller conversions. The module was fully integrated into the production version of the DEEP Platform. With the announcements from the Alberta government, it is understood that the protocol is in final stages of AEP approval; Cap-Op's involvement was completed as of December 17th, 2015. Cap-Op submitted an Offset Project Plan to the registry with the intention that, pending final approval of the protocol, carbon credits from 2015 can be quantified, verified and monetized. ConocoPhillips completed a number of conversions throughout the year which were used for testing data; it is anticipated that these conversions will generate the first carbon credits from this protocol using the new module in the DEEP Platform.

2.3. Outcomes

As part of Phase 2b, a methane vent reduction module was developed in the DEEPP. This module was designed to facilitate the data collection, tracking, quantification, and reporting of emission reductions from industrial processes that are retrofitted to reduce or eliminate the venting of methane directly to the atmosphere. It included the following tasks:

- Developing and testing the production phase of the high-to-low pneumatic controller quantification on the methane vent reduction module; and,
- Finalizing development and testing of the production phase of the well site vent gas capture quantification for the methane vent reduction module.

In developing a quantification module for methane vent reduction projects, Cap-Op has developed an effective tool to manage energy efficiency assets at the upstream oil and gas facilities and report on fuel savings and GHG savings associated with specific assets. Phase 2b allows industry to better understand the economics of these projects because industry can now effectively quantify the fuel savings and GHG credits generated. Additionally, the platform is accessible through an online portal and existing best practices and learnings are available for DEEPP users. The DEEPP is transparent and all calculations within the module are verifiable and viewable to 3rd party or government auditors. In short, we have developed the premier platform for developing offsets from methane vent reduction projects and will contribute to improving the overall energy efficiency performance in the oil and gas sector.

3. Benefits

3.1. Overview

This project couples the power of cloud computing with years of industry experience in tracking and aggregating GHG credits in Alberta and across North America. Benefits include:

- Increased transparency and standardization of industry reporting, enabling provinces to more confidently report their GHG reductions from energy efficiency projects;
- Reduced CO_2 credits transaction cost and risk, thereby making more projects economic and increasing the deployment of energy efficiency projects. Expectations are for an additional 1 to 5 million tonnes per year of GHG reductions after all modules have been developed;
- Increased natural gas conservation resulting in higher returns for producers and greater royalty revenues for governments; and,
- Access to a wealth of information on what is working and what is not when it comes to actual distributed energy efficiency project performance in the field. The data and insights gained from this project should help guide future investment and policy.

3.2. Knowledge

Upstream oil and gas sector activities result in significant emissions of both carbon dioxide (CO_2) from combustion and flaring, as well as methane from venting, but little research into the potential impact of applying existing energy efficiency upgrades to the sector has been done. Upstream oil and gas facilities include batteries, compressor stations, gas gathering stations, and gas plants; these facilities contain assets including pneumatic controllers, pneumatic pumps, and engines that vent methane gas or produce combustion emissions as part of their normal operations. Emissions from these aspects of the oil and gas industry are significant. At a national level, energy-related activities are the largest source of GHG emissions reported in the Canadian National Inventory Report. In 2011, 163 Mt carbon dioxide equivalents (CO_{2e}) were attributable to the upstream oil and gas sector. This accounts for 23% of emissions in the Canadian National Inventory Report. An opportunity exists to reduce these emissions with new market-ready technologies, which reduce or eliminate the amount of CO_2 emitted and methane vented as part of normal operations.

The DEEPP Project fills a crucial knowledge gap by capturing and aggregating information about the operating fleet of GHG emitting equipment in Canadian oil and gas facilities. This information will not only inform governments about emissions and energy efficiency performance in the sector but also identify opportunities for industry to increase investment in energy and emissions reduction equipment.

3.3. Innovation

While oil and gas producers increasingly rely on electronic control systems and computer databases, many of these systems fall short of the capabilities needed to achieve significant improvements in performance and deployment of energy efficiency projects. Existing systems are

fragmented between operating companies and even within companies, resulting in prohibitive costs for aggregating data and learning from it.

The DEEPP Project is an innovative solution that applies the power of cloud computing to energy efficiency challenges. DEEPP provides a computing platform that is agnostic of the specific systems and formats used by individual companies and that is universally accessible in the cloud. DEEPP provides the opportunity, which was unachievable until now, to cost-effectively aggregate energy efficiency operating data across the industry in order to assess and understand overall performance, and identify trends, learnings and best practices.

3.4.Greenhouse Gas Emissions Reductions

The DEEPP project is primarily aimed at reducing GHG emissions through effective operation of GHG efficient and emissions reduction equipment. The cost reductions in management and aggregation of offset credits can be directly translated into improved economics for future energy efficiency projects, thereby stimulating broad deployment in industry.

For example, for the calendar year 2012, 44,000 tonnes of avoided CO_2 emissions were aggregated and registered through DEEPP from only two operating companies and for only one type of equipment. This achievement demonstrates the potential of DEEPP. For calendar years 2013 and 2014, over 105,000 tonnes of avoided CO_2 emissions were generated.

3.5.Economic Competitiveness

The equipment for improving energy efficiency and reducing emissions in distributed oil and gas operations is principally composed of small equipment manufactured locally and/or imported and installed and services by small and medium enterprises (SMEs). The DEEP platform is expected to stimulate investment in energy efficiency equipment thereby increasing economic opportunities for specialized Canadian SMEs.

The present focus of DEEPP is on Alberta and British Columbia due to the existence of relevant regulation, protocols, and projects. It is expected that, over time, Saskatchewan will follow an equivalent approach. Once the DEEPP platform is fully commercialized, it would be easily extendable to oil and gas operations in Atlantic Canada and/or internationally, should these jurisdictions adopt offset regulations and the relevant protocols.

3.6.Value to Stakeholders

The DEEPP platform provides immediate value to stakeholders through the efficient management of energy efficiency assets and the aggregation of carbon offsets. However, the medium to long-term value of DEEPP resides in the identification of trends and future best practices through the generation of a unique dataset over multiple years and across the industry and the application of sophisticated analytics tools of this dataset.

4. Key Performance Indicators

As part of Phase 2b, the methane vent reduction module has success indicators and metrics built in to illustrate the value generated for clients. As part of the reports, when viewing installation on their own or in aggregate, users of the DEEPP will know fuel gas savings and GHG credits generate. For specific project types, users will know how much methane venting was reduced or how much fuel gas was displaced. As more projects come online, the cost of managing and reporting on GHG credit generation will decrease. Additionally, best management practices will continue to evolve and continue to decrease the cost of project implementation.

The DEEP Platform has successfully quantified and monetized over 160,000 t CO_2e to date. Each year this number has grown and now with the addition of a new module, and approval of a new protocol, it is anticipated that this metric will increase many times over. To date the module has not quantified any real emission reductions other than the test scenarios, since equipment installations are ongoing and further data collection will be required. However, the framework is now in place to scale the platform significantly as these external activities are completed. Cap-Op estimates that 2016 data may generate upwards of 60,000 tCO_2e incremental emission reductions from this module, in addition to approximately 54,000 t CO_2e from the Engine Fuel Management module (Phase 1 and 2a).

Cap-Op has been able to maintain a low-cost structure for users of the DEEPP, targeting a low-risk performance fee based structure. Cap-Op has designed two different fee structures for clients of the DEEPP. Both fee structures target approximately $4.00 per tonne CO_2e reduced.

Lastly, additional Best Practices have been developed around the data collection procedures for the DEEPP. Cap-Op worked with Spartan Controls to develop a short tutorial video to demonstrate the steps required for data collection, emphasizing the ease of data collection which has lead to an reduction in time required for this step for this year's Engine Fuel Management verification process. Learnings can now be shared with regard to the new module, once the first credit verification process is initiated (expected for 2016).

5. Deliverables

The specific deliverables include:

- The delivery of the *Quantification Protocol for Greenhouse Gas Reductions from Pneumatic Devices* to Alberta Environment and Parks, and the development of methane vent reduction project quantification methodologies;
- Production phase methane vent reduction module for aggregation, quantification and verification of emission reduction benefits from the conversion of high bleed to low bleed pneumatic devices in Alberta; and,
- Development of methane vent reduction module for aggregation, quantification and verification of emission reduction benefits from well site vent gas capture in Alberta;

6. Project Partners

6.1.PTAC Petroleum Technology Alliance Canada (Project Lead)

The mission of PTAC Petroleum Technology Alliance Canada is to facilitate innovation, collaborative research, and technology development, demonstration and deployment for a responsible Canadian hydrocarbon energy industry.

PTAC is a unique not-for-profit organization with members ranging from large oil and gas producers, governments, regulators, service and supply companies, researchers and individuals concerned about energy, environmental and social issues. PTAC is led by Dr. Soheil Asgarpour, President, who has successfully led PTAC over the past six years in a range of collaborative initiatives focused on clean energy production, environmental technology demonstrations, and assessment of alternative energy systems, such as small scale nuclear power, waste heat utilization, geothermal power, and renewable energy for remote operations. Over the years PTAC has demonstrated an ability to generate significant financial leverage on projects conducted through its operations and continues to play a key role in providing support for multi-stakeholder networking and organizing events.

PTAC is facilitating the DEEPP Project, as well as providing administrative support for the overall Project, including contract administration and is the liaison between the steering committee and Cap-Op Energy.

6.2.Cap-Op Energy

Cap-Op Energy is a pioneer in the clean energy technology sector and is focused on making offsets easy. Co-founded by Keith Driver and Adam Winter, they have over 25 years of experience in the clean technology and Canadian GHG offset project development, regulation and implementation fields.

Adam Winter

Adam Winter is President of Cap-Op Energy and has built technology based companies for the last 12 years in San Francisco, California. His previous business was called Recurve, and they produced the leading residential energy efficiency sales and modeling software in the US that was recently acquired by Tendril, a smart-grid infrastructure company.

Keith Driver, M.Sc., P.Eng., MBA

Keith is one of Canada's foremost experts on quantifying and reporting carbon emission reductions, and green project development. He has been active at the interface of GHG offsets and energy efficiency for the past 5 years – with particular focus on the oil and gas industry. Working with industry partners, Keith has developed the DEEPP platform under Cap-Op Energy as a means of tracking energy efficiency projects and aggregating the resulting GHG offset credits.

6.3.Cenovus Energy

Cenovus Energy is a major Canadian oil and gas producer and is a participant that has provided financial and intellectual capital resources to the Project.

6.4.ConocoPhillips Canada

ConocoPhillips Canada is a major Canadian oil and gas producer and is a participant that has provided financial and intellectual capital resources to the Project.

6.5.Devon Canada

Devon Canada is a major Canadian oil and gas producer and is a participant that has provided financial and intellectual capital resources to the Project.

6.6.Husky Energy

Husky Energy is a major Canadian oil and gas producer and is a participant that has provided financial and intellectual capital resources to the Project.

6.7.Taqa North

Husky Energy is a Canadian oil and gas producer and is a participant that has provided financial and intellectual capital resources to the Project.

6.8.Spartan Controls

Spartan Controls is a major Canadian supplier of energy efficiency and emissions reduction equipment and is a participant that has provided financial and intellectual capital resources to the Project.

6.9.Alberta Energy Efficiency Alliance

The Alberta Energy Efficiency Alliance is a diverse group of stakeholders actively working to maximize energy efficiency. Since 2008, the Alliance has brought people together to collaboratively solve problems, coordinate action and be a common voice through discussion papers, multi-stakeholder speaking engagements and events.

The Alberta Energy Efficiency Alliance contributes insights and networking opportunities to the DEEPP Project.