Final Outcomes Report

Project Title: **Demonstration of Near Zero Emission Well Control System**
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1. Executive Summary

The Calscan Energy Ltd (Calscan) project to demonstrate a near zero emissions well control system (NZE WCS) was launched in 2017 with the goal to develop, field test and commercialize a new technology solution to eliminate methane emissions from pneumatic equipment at off-grid oil and gas well sites. Calscan partnered with a leading group of consortium members consisting of Cenovus Energy, Repsol Oil and Gas Canada, Husky Energy (now owned by Cenovus), Modern Resources (now owned by Tourmaline Oil) and NAL Resources (now owned by Whitecap Resources) to carry out field demonstrations of the NZE WCS and partnered with technology provider SAFCell Inc on fuel cell technology development.

Pneumatic devices represent one of the largest sources of methane emissions in the oil and gas industry, yet pneumatic systems continue to be ubiquitous in the industry due to a lack of reliable and economic alternatives for remote sites. The focus of the project included the design and integration of a new electric linear actuator and related fail-safe components into Calscan's legacy solar-only "Bear" control system that had been deployed successfully at a modest number of well sites. Calscan's engineers designed new fail-safe controllers and an uninterruptable power supply that could be incorporated into the design of the NZE WCS to improve safety in the event of a loss of power, to improve customer uptake and to expand the market opportunity for the NZE WCS product. A key objective of the field trials was to accumulate meaningful operational runtime on the new electric linear actuator and to expose 5 potential oil and gas customers to the new technology in advance of methane regulations coming into force in Alberta and Western Canada in 2020-2023.

To further advance the market opportunity of the NZE WCS and to solve a particular pain-point associated with solar and battery systems in cold climates, Calscan incorporated a novel solid acid fuel cell from SAFCell Inc into the NZE WCS design in order to provide a more reliable solution for off-grid sites that lacked sufficient solar resources. A key feature of the SAFCell technology was its ability to use the same cheap industrial-grade methanol that is already widely available at most off-grid well sites. When combined with low capital costs, the ability to use cheap industrial methanol would significantly lower operating costs and improve product economics compared to competing technologies. The SAFCell technology was originally developed for military applications and required significant adaptions to the harsh climate conditions found in the Canadian oil and gas industry. A significant focus of the project was to conduct cold weather testing and design modifications and then rigorous field testing of several fuel cell units at well sites in Alberta.

Overall, the project consortium successfully deployed NZE WCS units at 11 field sites in Alberta and achieved measured greenhouse gas (GHG) reductions of 2,607 tCO_2e/year. The baseline emission vent rates were measured at 15 sites using Calscan's Hawk low flow meter to accurately quantify methane vent rates from pre-existing pneumatic controllers and pneumatic pumps. The GHG assertion was developed based on an average of 9 vent rates from 9 of the 11 field sites that were retrofitted (the other 2 sites were greenfield installations so it was not possible to measure vent rates). The other 6 data points were from candidate sites that were not ultimately deployed at. Had those 6 data points been included in the average, the GHG assertion would have increased to 4,645 tCO2e/year. For conservativeness, those higher emitting sites were excluded in the GHG assertion. The project emissions from operating the methanol fuel cell were also validated at approximately 0.4 tCO_2e/year, and are negligible relative to the baseline methane emissions.

The field trials confirmed the strong reliability of the Calscan electric linear actuator, which did not experience any significant downtime or failures over the four-year project duration and confirmed its ability to reliably eliminate methane emissions from pneumatic control systems. The electric linear actuator is ideally positioned as a solution for upstream oil and gas companies to meet methane emission regulations in Alberta, Western Canada and elsewhere. Calscan has now successfully deployed more than 200 units in the field to date and has orders for several hundred more already in 2022. We believe that ERA funding was a key enabler for commercializing the technology, which is already an emerging commercial success story in the pursuit of reducing methane emissions in Canada's oil and gas industry.

The project team also made significant strides in developing and refining the fuel cell product to improve its robustness and operational reliability in the harsh environmental conditions experienced in the Canadian oil and gas industry. The team made design modifications to overcome challenges related to tainted methanol and frost buildup on inlet ports, optimizing heating/cooling the fuel cell enclosure, modifying programming/firmware, and achieving cold starts after complete freeze-ups below -30°C. Although significant progress was made to re-design the fuel cell component to improve reliability and performance in cold weather, further field testing is planned for 2022 with the goal to commercialize the technology in winter 2022/2023. Calscan is planning to deploy an additional fuel cell unit at consortium partner Cenovus's well site to resume testing later in Q1 2022. In January 2022, Calscan signed a distribution agreement with Advent Technologies to be the exclusive distributor of the SAFCell-developed methanol fuel cell in Canada. Calscan and Advent are committed to commercializing the methanol fuel cell in Alberta and are optimistic that there is a strong market pull for the fuel cell technology and that the technology can be commercialized in the coming year.

Calscan would like to thank its consortium partners for their leadership and collaboration and would like to thank Emissions Reduction Alberta for its unwavering support and flexibility during a major industry downturn, during the COVID pandemic and during a period of adversity when Sustainable Development Technology Canada withdrew funding support for their share of the final project milestone costs.

2. Project Description

Introduction and background:

Calscan Energy Ltd (Calscan) is developing the Near Zero Emission Well Control System ("NZE WCS"), an ultra-low emissions well control system and power generation package that can be deployed at oil and gas well sites to eliminate methane emissions from pneumatic equipment and achieve a net greenhouse gas reduction of 99%+ compared to standard industry practices today. The NZE WCS components have been developed to provide a cost-effective "drop-in" solution to enable oil and gas operators to meet Canadian federal and provincial methane emission regulations and voluntary corporate emission reduction targets.

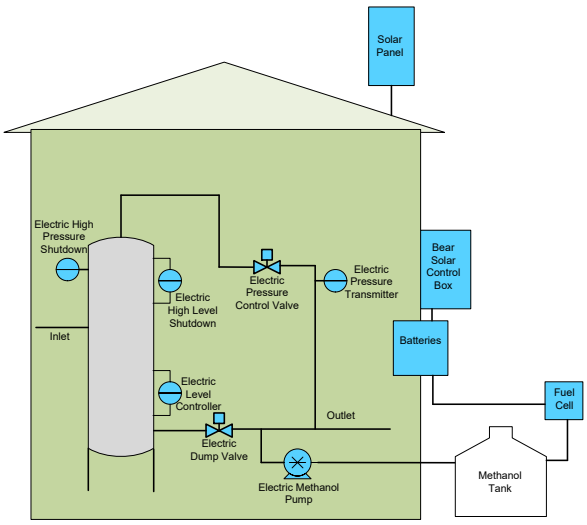
Methane is a potent greenhouse gas with a global warming potential that is 25 to 34 times greater than carbon dioxide on a 100-year basis and up to 86 times greater on a 20-year basis. In 2014, total methane emissions from upstream oil and gas operations were 31.4 million tonnes of carbon dioxide equivalent (tCO_2e) in Alberta, with ~ 49% or ~ 15 million tCO_2e of these emissions due to the use of pneumatic controllers and pumps. The use of electric pumps and controllers eliminates these methane emissions completely, but pneumatic equipment has remained the standard thus far because there are very few other solutions available on the market today that can be used to reliably and cost effectively electrify brownfield or greenfield off-grid oil and gas well sites.

Detailed technology description:

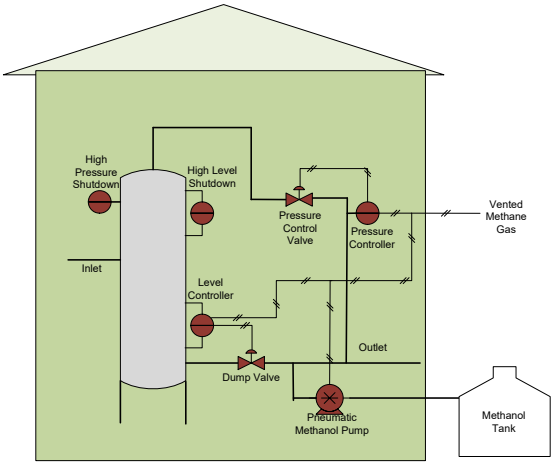
The NZE WCS is a custom engineered control system for oil and gas wells that combines a new ultra-low emissions hybrid solar photovoltaic-methanol fuel cell power module, a programmable logic control system, electric controllers, electric actuators, and electric pumps to completely eliminate all pneumatic equipment. The system is designed for reliable operations at remote off-grid well sites where poor solar resources and harsh Canadian winter conditions are part of normal operations. The methanol fuel cell technology is appropriate for challenging remote off-grid oil and gas applications since it was originally developed for military applications that require similarly rugged performance. The solar panels and batteries will be integrated with a low-cost solid acid fuel cell (SAFC) unit that will be fueled with the same cheap industrial-grade methanol that is available at the vast majority of well sites, which already use methanol for hydrate (freeze) protection. This innovation is expected to reduce fuel costs by 10-20X versus competing methanol fuel cells and propane-fueled thermoelectric generators.

The NZE WCS was designed to be more scalable and flexible than traditional solar-only systems as the additional power output from the fuel cell will enable the system to handle demanding start-up conditions at new high-pressure wells and support a wide variety of electrical loads (instrumentation, pumps or monitoring devices) at multi-well pads. The hybrid power configuration also maximizes the life of the fuel cell unit because the system relies primarily on the batteries and solar power. The solar panels charge the batteries during the day-time and the electrical loads draw current from the batteries to smooth out any peaks in demand. The fuel cell is used to charge the batteries (in winter), so it can be started-up slowly to gradually warm-up and avoid harsh duty cycles.

The image below provides an overview of the NZE WCS technology as compared to a pneumatic design.



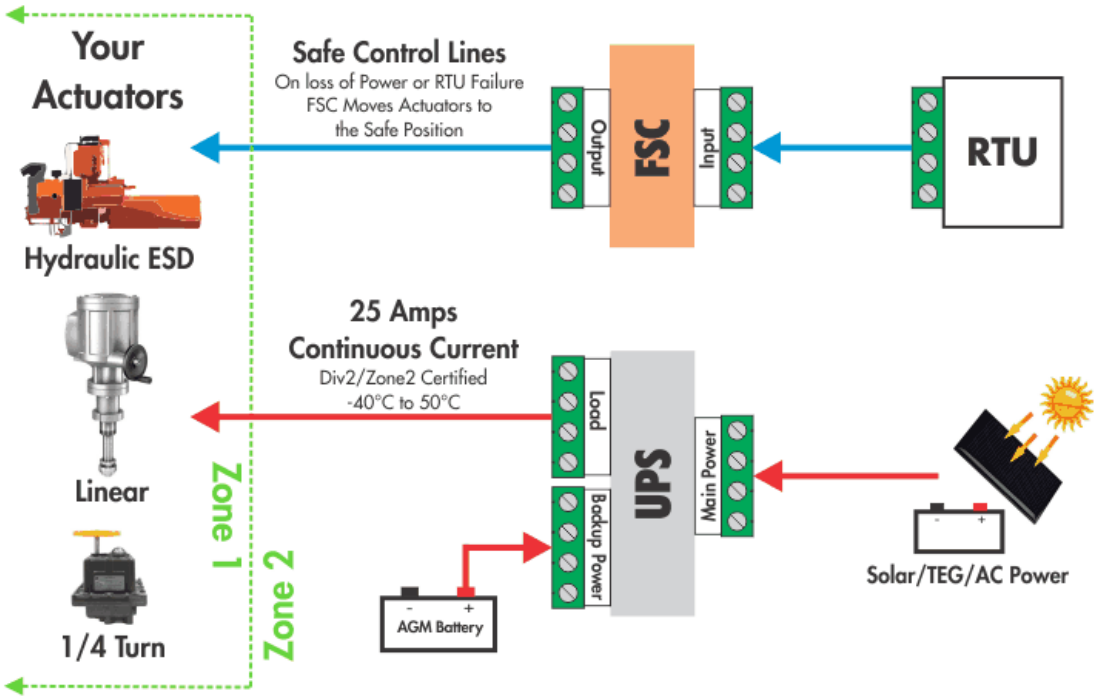
Near-Zero Emission Well Control System



Pneumatic Control Skid

A primary objective of the Project was for Calscan to modify its existing solar-electric "Bear" well control system technology to incorporate a new low power consumption electric linear actuator that had not been deployed in Canada before. Calscan's engineers also modified the whole system to make it "fail-safe" by adding a fail-safe controller and an uninterruptable power supply (UPS). The fail-safe components are important safety features that ensure valves will close (fail-closed) if there is a loss of power or if a power cable is cut. The electric actuator was integrated into the re-designed and modified version of the Bear Control System in order to meet customer specifications for the NZE WCS. The fail-safe controller and UPS add-ons expand the market opportunity for Calscan's core electric actuators and control products and significantly improve the efficiency of the hazard identification (HazOp) and safety review processes that customers require vendors to go through. The electric linear actuator and the different adaptors that Calscan has designed for different types of valves enable the customer to continue to use existing valves and remote terminal units, thereby reducing costs and increasing flexibility. The combination of these two improvements to the Bear control system is expected to greatly expand the market opportunity for the NZE WCS product and achieve further GHG reductions.

The figure below provides a more detailed technical illustration of the fail-safe controller and UPS components and how they integrate with actuators used at oil and gas well sites for gas/liquid separation.



Simplified Bear System Overview

Ultimately, if the fuel cell is unable to be commercialized, this ERA-funded demonstration project will still significantly grow the market opportunity for Calscan's electric control system products via the development of the fail-safe solar-only product and via the ability to swap in other alternative electrical power supply systems (other fuel cells, stirling engines, thermoelectric generators, batteries, reciprocating engines etc., if and when required by the customer) and will still achieve material GHG reductions by eliminating pneumatic equipment. Many sites will still be able to rely on Calscan's solar-only NZE WCS products, which are also significantly cheaper.

A second key innovation of the NZE WCS is the use of a novel solid acid fuel cell that can be fueled with industrial-grade methanol, a fuel that is already available at the vast majority of oil and gas well sites for hydrate protection. The fuel cell will use substantially less methanol than the chemical injection pumps on most sites (a 50W fuel cell running 24/7 would only use ~1 litre/day at full load versus 10 to 30 litres/day or higher for most methanol injection pumps), so incremental methanol deliveries are insignificant and no additional fueling infrastructure is needed (e.g. as compared to propane fueled thermoelectric generators which require regular propane deliveries). Other direct-methanol fuel cells suffer from higher capital and operating costs as they require ultra-high purity methanol, which is 10 to 20 times more expensive than field-grade methanol. The ability to run the NZE WCS on solar power and use industrial grade methanol as a back-up will provide a competitive advantage versus other systems that use high purity methanol (e.g. shipped in specialty cartridges), propane or diesel.

The Project was originally targeted at developing and scaling-up the NZE WCS product to meet two different applications: single/dual well sites (NZE WCS with a 50W fuel cell) and larger multi-well pads

(NZE WCS with a 250W fuel cell), but the field deployment of the larger 250W fuel cell did not substantially proceed due to the need for further re-design work and testing of the 50W unit.

Calscan's intellectual property related to the development of the control strategy for the Bear Control System, the electric linear actuator and related components are maintained through trade secrets and technical knowhow. SAFCell secured exclusive rights to SAFC systems through a license agreement with California Institute of Technology (Caltech). This agreement gave SAFCell access to Caltech's entire patent portfolio on solid acid electrochemical devices, applications, and methods of fabrication and operation. This portfolio contains eight and nine issued US and international patents, respectively, with some pending. As such, SAFCell had rights to all issued patents on SAFCs and other solid acid electrolyte applications. SAFCell had strong IP coverage in Canada on the core use of solid acid electrolytes in any type of electrochemical device. IP developed within the Project will be shared between Calscan and SAFCell based on a Memorandum of Understanding between the two companies. Patents related to SAFC stacks and systems will belong to SAFCell, whereas all other patents governing the function and design of the NZE control system will belong to Calscan. Knowhow and other IP generated within the Project on the integration of SAFC systems into the NZE well control system will be co-owned by SAFCell and Calscan. Knowhow and other IP generated on the NZE well control system that does not involve the SAFC system will belong exclusively to Calscan. Subsequent to the end of the Project, SAFCell transferred certain intellectual property to Advent Technologies, which has signed a distribution agreement with Calscan to continue developing the SAFCell fuel cell technology for the Canadian upstream oil and gas market.

3. Project Objectives

The overarching objective of the Project was to further develop the NZE WCS product to the point of commercialization by implementing a robust field-testing program in partnership with several leading oil and gas producers in Alberta. The goal was to prove that the NZE WCS technology could operate reliably enough in harsh winter conditions, meet customer requirements at off-grid well sites and be deployed within targeted cost parameters, all while achieving a 99%+ reduction in GHG emissions versus current practices.

For the Project, Calscan partnered with consortium partners SAFCell Inc., Cenovus Energy, Husky Energy, Repsol Oil and Gas Canada Inc., NAL Resources Ltd. And Modern Resources Inc. to deploy NZE WCS packages at 11 field sites in Alberta to replace methane-emitting pneumatic systems with non-emitting electric components.

As part of the Project, Calscan re-designed its Bear control system product by incorporating a new low power consumption electric linear actuator and by developing a fail-safe controller and uninterruptable power supply. These components were incorporated into the re-designed and modified version of the Bear Control System in order to meet NZE WCS customer specifications, to reduce the cost of well electrification (cost of replacing all pneumatic equipment) and to greatly expand the market opportunity for the NZE WCS product. These modifications to the NZE WCS will reduce barriers to deployment and will result in a scalable solution that can be deployed as a package or through individual component sales. The goal of the Project was to have the NZE WCS components ready for commercial rollout across

Alberta and Western Canada at around the same time as new provincial and federal methane emission regulations take effect.

The Project scope included an initial development of six (6) NZE WCS packages, each incorporating a 50-watt SAFC unit,[1] with deployment of these units at well sites for several months of field-testing. Finally, five (5) solar-only systems (without fuel cells) were deployed in order to increase customer exposure to the core Calscan electric actuator technology. After completing the rigorous field-testing program as part of this project and achieving multiple years of runtime at the 11 well sites, the electric linear actuator is now being sold commercially by Calscan and over 200 units are now in operation as of early 2022. The fuel cell remains at a pre-commercial stage of development, but significant technology advances were achieved during the project and plans are to continue development of the product in 2022.

Work Scope Overview:

The Project was structured with four milestones and took approximately 4 years to complete, as shown in the table below.

Milestone #	Description	Start Date	End Date
Milestone 1	NZE-50W WCS Prototype Development & Fabrication of Units for Field Demonstrations	April 2017	April 2018
Milestone 2	NZE-50W WCS Field Demonstrations (Install & Operate five (5) units) & NZE-250W WCS Scale Up, Design, Build & Testing	April 2018	May 2019
Milestone 3	NZE-50W Field Demonstrations (Build & Install six (6 more units): (one (1) with 50W fuel cells, and five (5) solar-only) & Initiation of Fuel Cell Teardown Analysis (one (1) units)	June 2019	June 2020
Milestone 4	Continuation of Field Demonstrations (Operation of six (6) units) & Completion of Fuel Cell Teardown Analysis (up to one (1) units)	July 2020	March 2021

The primary objectives for the project, as defined in the amended contribution agreement, included the following four goals:

(a) Complete eleven (11) field demonstrations of NZE WCS units at oil and gas production sites, including six (6) units with 50W fuel cells and five (5) solar-only systems.

(b) Demonstrate continuous rated power output, system reliability and 100% uptime in operating temperatures of -40°C to +40°C while using industrial grade methanol as a fuel supply.

(c) Re-design Bear control system for integration with NZE WCS, including an electric linear actuator and new fail-safe design elements.

[1] Note that a total of 7 fuel cells were deployed at the 6 different field sites as 2 fuels cells were deployed at the Cenovus 11-30-51-15W4M site. Multiple iterations of fuel cells were re-deployed at those 6 field sites as new upgrades and modifications were completed. Swapping out the existing units at the same sites was more operationally efficient and reduced risks and burdens on Calscan's demonstration partners versus rolling out more fuel cells to new sites.

(d) Verify target capital costs of $35,000 to $50,000/NZE WCS unit and target fuel costs of 50% less than competing methanol or propane-fueled technologies.

The original goal for the project was to install 15 NZE WCS units; however, the scope of work was scaled back to 11 total units in order to reduce deployment risks and further iterate on the technology in the lab and the field. The original scope of work also contemplated scaling up the fuel cell component from 50W to 250W; however, this was not feasible given the need for further design modifications and continued reliability testing of the 50W system. The learnings from the fuel cell field testing have been incorporated into the current design of the technology and future field testing will be used to validate its commercial readiness in 2022.

Performance/success metrics

The table below outlines the status of the technology at the start of the project, prior to receipt of any funding from ERA, as well as at the end of the Project.

Success Metric	Commercialization target	Project Target	Status prior to start of Project (April 2017)	Achievements at end of Project (After March 2021)
Uptime	Operate throughout the winter without any manual operator intervention	Zero downtime over 4 months of field testing	The integrated NZE WCS system had not yet been tested. All of the individual components, including fuel cell, had been tested in a controlled temperature chamber down to -40°C for limited periods.	Successfully commercialized electric linear actuator and control system components with commercial field deployments of >200 units to date (and a further ~400 units ordered just in the beginning of 2022) and material sales to the largest natural gas producer in Canada (note that these installs do not include fuel cells as other power supply sources will be used). The fuel cell has not yet met uptime targets and continues to need further reliability testing before commercial sales can begin. Additional field trials are planned for late Q1 2022. Commercial sales of the fuel cell are targeted for 2023.
Fuel supply	Operate on industrial-grade methanol (same methanol as in tanks already at well sites)		Successful batch tests completed at SAFCell's lab prior to start of the project.	Successfully confirmed industrial methanol specifications and selected local suppliers from Edmonton after resolving issues related to tainted methanol during initial testing in 2018/2019. Confirmed importance of closely monitoring methanol quality and ensuring that

				corrosion inhibitor is not blended into methanol supply lines/tanks.
Maintenance	Only require annual maintenance service on system components		The integrated NZE WCS system had not been tested prior to the start of the project. Certain individual components have operated in the field for several years without maintenance. The new electric linear actuator had not been deployed in Canada previously.	The core Calscan electrical components successfully met this requirement and have had negligible failures in the field. The new electric linear actuators have demonstrated robust performance. The 50W fuel cell did not meet this target during field trials in 2018-2021, but significant re-design work provided confidence that with further testing and field trials in 2022, a path to commercialization exists for the fuel cell. It will ultimately take longer than expected and require deeper resources.
Power output	Demonstrate continuous rated power output from -40°C +40°C		Demonstrated in lab testing on original RP-50-M design; re-testing necessary on each new model.	Fuel cell met this target for short durations (weeks) during field trials, but long duration tests were not possible due to downtime and other failures.
Operating cost	50% lower fuel costs than competing options that use propane, high-purity methanol or diesel (TEGs, engines & other fuel cells)		50 mL/hour of methanol consumption for a 50W unit was tested in lab. Solar operating costs had been proven.	Field trials confirmed expected methanol consumption rates and validated low operating costs versus other technologies. For this operating cost advantage to be realized, further testing is needed to confirm that reliability improvements can be realized on a sustained basis.
Capital cost	~$35,000 to $50,000/NZE WCS unit and less expensive than competing electric technologies	Within +/-10% of Project budget	N/A, until prototype built.	The field demonstrations successfully validated the capital cost of all components. The Calscan electric linear actuators continue to meet capex expectations and the fuel cell fabrication was within cost expectations for materials. As fuel cells were only deployed at 6 different field sites, further development and demonstration will be required in order to validate

				commercial-scale equipment costs and sales pricing. The solar-only version of the NZE WCS product continues to be the most economic alternative and a robust market exists for that product following incorporation of the new electric linear actuator and other design improvements Calscan made over the course of this Project. Calscan has shifted to component sales instead of selling complete engineered packages.

Two primary risks were identified at the start of the Project and risk mitigation mechanisms were identified in order to overcome the identified barrier.

Risk/Barrier	Proposed approach to overcome each barrier (At project start in April 2017)	Results achieved by end of Project
Demonstrate reliability of system (in order to avoid downtime and production losses)	In the oil and gas sector, technologies must be reliable and robust as the risk of production downtime is exacerbated by remote sites, limited infrastructure and extreme cold weather. Acceptance of new technologies is often hindered by the risk or perceived risk of downtime and lost/deferred production revenues. A key to overcoming this barrier is rigorous field testing to avoid releasing a product too soon. For this reason, a total of 15 demonstration units have been planned over the project. Operating 15 systems through the winter, especially in extreme winter conditions, should help identify any design changes that are needed for the commercial product. Calscan has 20 years of experience in this area from developing new products in-house. Partnering with a customer (CPC) will be very valuable to get feedback to design the best product.	The consortium members successfully deployed NZE WCS components at 11 oil and gas field sites and gained very valuable operational information. The reliability of the Calscan electric linear actuators and related control system components has been very high with no significant downtime or failures reported by demonstration partners. Over 200 units have now been deployed with significant commercial sales that started at the end of the grant project with strong momentum into 2022. The Project also confirmed that the solar-only configuration of the NZE WCS remains the preferred and most economic alternative for customers. A total of 7 fuel cells were deployed at 6 field sites and accumulated meaningful runtime. Approximately 12-15 different 50W fuel cell systems were used in the project as units that failed or that required firmware upgrades were swapped out periodically. In order to avoid unnecessary operational risks, a decision was made not to proceed past the design phase for

		the scale-up of the fuel cell system from 50W to 250W so no 250W units were tested in the field. A 250W design was completed, but it was decided that further field testing of the re-designed 50W units would lead to a better chance of commercial success, especially given resource constraints during the 2020/2021 downturn.
Winterization of Fuel Cell	This barrier will be reduced through Calscan's 20 years of experience in developing and certifying electrical control systems and other oil and gas equipment for northern Canadian operations. Calscan's electrical engineers have extensive experience with Canadian Standards and electrical codes. Initial testing of SAFCell's methanol fuel cell down to -40°C was completed in Edmonton in late 2015 using Calscan's temperature-controlled chamber. This testing identified several opportunities to re-design the original military specification “RP-50” fuel cell to reduce complexity and cost and to better weather-proof the system. Similar lab testing will be conducted down to -40°C on subsequent designs to ensure the system is cold weather tolerant before it is field tested. Calscan's lab facilities in Edmonton will be utilized for this work.	Significant design work was completed ahead of field trials to winterize the fuel cell and its housing, but additional re-design work was required after encountering issues with frost clogging the air inlet ports and challenges maintaining the right internal temperatures (at both hot and cold ambient temperatures). To address these challenges several firmware/ control logic changes were made and a reversible fan was installed to address the frost issue. A number of cold starts were also tested to ensure the system could be re-started successfully after freezing. Overall, a significant number of fuel cell units were successfully fabricated and certified according to Canadian electrical standards and were deployed at field sites. The learnings from these trials are now being incorporated into a new design and additional field trials are planned for later in 2022 with the goal of advancing the product towards commercialization.

Overall, the project demonstrated that the core components (electric actuators and controls) of the NZE WCS can successfully replace pneumatic equipment and operate with a high degree of reliability. The electric linear actuators installed as part of the project in 2018, continue to operate reliably three to four years later with minimal maintenance. This low level of maintenance is favorable compared to instrument air compressors or other alternatives that require regular annual or semi-annual servicing (e.g. oil changes). Further work is required on the methanol fuel cell to build a reliable power supply that can outcompete other methanol fuel cells. The ability to use field-grade methanol was proven during this project and this feature substantially lowers operating costs. Calscan also believes that its capital costs and stack replacement costs will be lower than competing fuel cell technologies. If proven through

further testing, these features will make the SAFCell technology very competitive versus competing fuel cell technologies.

4. Project Outcomes and Learnings

Overall, the project achieved a number of significant steps towards commercializing a near-zero emission well control system in Alberta that can help upstream oil and gas producers meet methane emission regulations and meet voluntary corporate emission reduction objectives. The funding from ERA provided a critical bridge for Calscan and its consortium partners during an extended industry downturn. The most significant outcome from the Project has been Calscan's successful commercialization of its electric linear actuator and related components, which had not been deployed in Canada prior to the start of the Project. The technology is now commercially available and over 200 units have been deployed to date (and a further 400 units sold with deliveries occurring later in 2022), which speaks to the success of the core technology development by Calscan and its partners. To date, the electric linear actuator technology has shown robust reliability with minimal failures or downtime. The GHG emission reductions from the project exceeded the original expectations and detailed measurements were taken at each well site to validate the claimed methane emission reductions, as discussed in detail later in this report.

Although the Project did face several delays and the scope of work had to be modified, the overall results were still significant. A total of 11 well sites were retrofitted with NZE WCS systems versus the original target of 15. SAFCell was a key consortium partner throughout the Project and continues to be a valued partner of Calscan's with the CEO continuing to provide support to the Calscan team on matters related to the SAFCell technology and transfer of knowledge to new partners at Advent Technologies. The Project was originally conceived with a single demonstration partner before being expanded to three partners (Cenovus, Repsol and Husky) at the start of the project and expanded to 5 (addition of NAL Resources and Modern Resources in Milestone 3). The expansion of the Project consortium partners helped increase exposure for the technology to smaller and mid-size companies. All 5 producer partners provided valuable access to field demonstration sites and significant technical and operational input to make the project a success. It was noted that it was quite difficult at certain points earlier in the Project in 2018-2019 to get firm commitments and firm timelines for these field demonstration sites given competing priorities, particularly within larger companies. A key element for success was to have a corporate "champion" within each organization to get buy-in for the demonstration project internally and partner with field staff.

A total of 7 methanol fuel cells were deployed at 6 well sites and significant cold weather field testing was performed to validate the potential suitability of the technology in harsh off-grid Canadian oil and gas conditions. While the consortium was not able to deploy a 250W fuel cell in the field, significant design work was completed, which may be valuable in the future. The efforts to iterate on designs and field testing of the 50W fuel cell ultimately led to a number of important design changes to both enable the product to be certified for use in Canada and to improve reliability in cold weather. These design changes have all been incorporated into the current design and that knowledge has been transferred to the current owner of the technology, Advent Technologies. Calscan has partnered with Advent Technologies to continue development and field testing of the 50W fuel cell and plans to deploy additional fuel cells at field sites in 2022.

Calscan continues to see increasing customer demand for small scale power generation systems for off-grid well sites and continues to view the SAFCell fuel cell technology as an attractive solution for its customers given the widespread availability of low-cost industrial-grade methanol at oil and gas field sites. Overall, the time and resources required to commercialize the fuel cell technology exceeded expectations, but Calscan is optimistic about the technology and its future under new partner Advent Technologies. Calscan will continue to be the exclusive Canadian distributor of the SAFCell technology.

As discussed below, a number of technical and operational challenges were faced during the Project. These issues required the re-design of the fuel cell balance of plant and housing, the heating and cooling systems and re-designed firmware, programming and system alarms. The Project also led to important discoveries related to poor quality methanol (and the previously unknown practice of blending of methanol and corrosion inhibitor), which were remedied during the Project. Significant delays were encountered due to the oil and gas industry downturn, budget cuts, mergers/acquisitions (halting spending in certain fields) and due to the widespread impacts from the Covid pandemic. Other logistical issues were encountered when certain oil and gas producer partners changed their plans related to field demonstration sites which led to delays in finding replacement sites. These issues were exacerbated by the selection of older well sites that required more extensive retrofits as compared to greenfield sites. The older well sites were ultimately better testing grounds for the more experimental fuel cell component though as production downtime was lower of a concern.

At the start of the Project the technology readiness level (TRL) for the NZE WCS package was estimated to be at a TRL of 5; although some of the individual components that make up the package were more proven. Based on ERA guidance, at the start of the Project the NZE WCS product would likely have been described as in the “Technology Development” phase where the concept had been proven and the technology was ready for prototype development. All of the individual components were at the prototype stage or more advanced, but the components still needed to be integrated and developed into a complete NZE WCS prototype package. At the end of the Project, the majority of the NZE WCS components had achieved a TRL of 9 as commercial sales have been achieved. The fuel cell component remains at a TRL of 7 - Commercial Demonstration. At this stage of development, a prototype system is ready to demonstrate commercial viability and Calscan and Advent Technologies are committed to continuing to pursue commercial demonstration of subsequent system prototypes in an operational environment.

Commercialization Plans:

Calscan has now achieved more than one year of commercial sales of its electric linear actuator and related products. Previously, Calscan had targeted to have 50 NZE WCS units in operation by the end of 2022. Calscan has significantly exceeded this goal and over 200 electric linear actuators have now been deployed to date and the company has orders in hand for another 400 units to be delivered later in 2022. These advances in commercializing the NZE WCS product is very exciting for Calscan and has validated the market demand for its products. In part due to the ERA funding, Calscan was able to increase its exposure with key oil and gas producers in Alberta and prove out excellent runtime with its electric actuator and control products, which provided additional producers with the confidence to deploy them. Of note, Calscan has now sold its electric actuators to the largest natural gas producer in Canada and several other major producers in Canada. The largest natural gas producer in Canada has now standardized on Calscan’s equipment for its new wells, which is a major milestone for the company.

For the fuel cell, Calscan has set a goal of deploying up to 20 units by the end of winter 2022/2023, subject to successful technology testing in H1 2022. Additional field testing is planned for late Q1 2022 and the results from that testing will inform the company's sales and marketing strategies. Calscan's engineers take a very conservative approach to deploying new technology and are not willing to roll out the fuel cell until it has demonstrated improved reliability. Calscan's new fuel cell partner Advent Technologies is a strong partner and has made the off-grid oil and gas market segment a key focus for the company.

At present, there continues to appear to only be one methanol fuel cell supplier to the Canadian oil and gas industry and that technology reportedly has reliability issues in cold weather and requires expensive high-purity methanol to run. Despite those issues, the technology has reportedly achieved significant sales (>1000 units) in Canada, which further validates the opportunity for the fuel cell.

Technical Learnings:

The table below provides a summary of a few of the technical issues that were encountered during both the design phases of the project and during the field trials.

Operational Issues Encountered	Corrective Actions
***Tainted methanol*:** The initial installs in Milestone 1 in Q4 2018 used Methanol from a supplier in Fort Saskatchewan, Alberta and was discovered to contain dirt/rust soot, likely from barrels that were not properly sterilized prior to filling/distributing. This would not be an issue for normal applications of Methanol in the oil and gas industry, but the fuel cells saw drastic degradation of system power output due to these impurities.	Two methanol distributors in Edmonton were vetted for clean methanol and were able to produce methanol at the required specifications for use in the fuel cell. The industrial methanol was subjected to a burn test to measure undissolved residues present and subsequently tested in a fuel cell with successful results
***Frost clogging airflow ports*:** With certain climate conditions, frost was observed forming and building up on the inlet and outlet airflow ports. These conditions occurred when the dew point and ambient temperature were the same, and the ambient temperatures were well below freezing (these airflow issues were only observed at -20°C or colder). The build-up of frost decreased airflow through the system leading to system errors/alarms that would further lead to fuel cell shutdowns/ loss of power generation abilities.	The RP-50M firmware was adjusted so the board could alternate fan flow direction in and out of the air flow ports when low air flow through the system is detected. This firmware adjustment allowed for air to flow from inside of the fuel cell enclosure outwards for a short duration of time to defrost the port screens. The internal temperature of the system was typically around 30°C depending on the power state of the system and ambient temperatures. This is enough heat to warm the frosted screens and clear them of any blockage that may have formed.
***High internal temperatures*:** One of the first attempts at dealing with the frost problems was to reconfigure the fans to keep the system warmer at super cold temperatures (-40°C operation). A major setback of reconfiguring the fans this way is that the system started to overheat when ambient temperatures were above -10°C. This observation required SAFCell to design an entirely new heating/cooling solution inside the fuel cell that could work over a much wider temperature range (-40°C to +40°C). The fans were originally configured to spin in one direction, which made the system unable to reverse fan direction when	To correct this issue a two-way reversible van was installed at the airflow port outlet. After the condenser fan was swapped for a reversible fan, the system was able to carry heat from the condenser into the system when ambient temperatures became colder than minus 10°C; and when temperatures were above the limit of -10°C the fan would blow out of the system pulling fresh air into system and removing excess heat. This subcomponent swap made the fuel cell able to control internal temperatures through a wider range of ambient temperatures and conditions (-40°C to +40°C).

temperatures would swing drastically during spring months.	
Design of Bear Control System: Based on customer feedback and learnings from the initial field trials several improvements were made to the Bear control system to redesign it to incorporate inlet/outlet pressure control utilizing the Bear linear actuator.	Additional design changes were made to the Bear Control System based on feedback and observations from milestone 2 & 3 of the Project. These design changes primarily related to the solid state relay design and functionality, the design of additional modules for fail-safe backup power to properly shut down in case of fault, a fail-safe controller with watch dog timer, a temperature compensated universal power supply, a stabilizing voltage converter for the linear actuator to run 24 volt actuators on 12 volt sites and the ability to integrate all modules together to maximize safety nets in case of power loss due to theft, vandalism, or fault.

Economic Learnings:

Economic Objectives	Results
Goal: Verify target capital costs of $35,000.00 to $50,000.00/NZE WCS unit	Actual costs incurred for equipment during the Project verified target capital costs per NZE WCS unit at between $35,000 and $50,000. The first three Calscan well control systems that were installed as retrofits to replace pneumatic devices (Two at Repsol Oil & Gas, and one at Cenovus) verified that non-fuel cell related direct equipment costs for each NZE WCS were between $20,000 and $30,000 per site, depending on the well site control and process requirements. The 50W fuel cell was verified by SAFCell to be approximately $13,000 USD for the configuration in use in milestone 2. During the Project, the total direct materials cost per NZE WCS was typically between $33,000 and $43,000 on average. Overall, the materials and equipment costs were within the target range of $35,000 to $50,000 and the NZE WCS is expected to be able to compete with existing technologies. It should be noted that Calscan is now primarily pursuing component sales, rather that complete package sales, so the above numbers are presented primarily for comparison to the original project objectives. **Importantly, Calscan has now been able to deploy its electric control devices in commercial sales to a number of oil and gas producers in Western Canada. Over 200 electric linear actuators have now been deployed to date and the largest natural gas producer in Canada has standardized its new field design to use Calscan's electric linear actuator. The fuel cell component has advanced significantly as a result of**

	this Project, but further field testing is planned in 2022 before commercial sales can begin.
Goal: Target fuel costs of 50% less than competing methanol or propane-fueled technologies.	The observed fuel costs from field deployments of the fuel cell demonstrated that in ideal situations at full power production capacity, the 50W fuel cell consumed just over one liter of methanol per day, while producing 50W of continuous power. The current supplier cost for methanol is approximately $180.00 for 205 litres (L). This is less than a dollar per litre, and is much cheaper than propane, diesel, gasoline or other fuels without the pollutant emissions that hydrocarbon combustion creates. Even at the worst methanol consumption observed during the trial (between 3-4 litres of methanol per day on a troublesome stack) the fuel costs of running the system would still be less than $3.50/day. Comparable DC battery charging generators will use between 1-2 liters of fuel per hour and depending on the energy source, these costs would be much more than just 50% greater than the SAFCell methanol fuel cell. **Overall, the field trials demonstrated that the methanol fuel cell is capable of significantly lowering operating costs versus other non-solar power generation technologies. Further reliability testing is needed to fully estimate the full lifecycle costs and the lifespan of the fuel cell under field conditions. Due to the limited runtime of the fuel cell during this Project, further testing is planned in 2022. The results from this Project confirmed that where solar is viable on a standalone basis, it remains the cheapest solution and the preferred technology. This result reaffirmed the market-leading position that Calscan enjoys for its solar powered electric control packages. In particular, the electric linear actuator has demonstrated extremely high reliability.**

Overall, from a technology commercialization perspective, the ERA-funded Project enabled Calscan to improve the designs for its products and to expand the overall market opportunity. For example, the addition of a fail-safe controller and a UPS expanded the market opportunity and addressed a particular customer pain-point (process safety of operations upon loss of power or a cable being cut) and helped to streamline the HazOp process. Calscan also now offers 3 different models of electric linear actuators with different torque ratings, which enables the company to offer different price points for its valves and improve competitiveness. Calscan has also streamlined its sales and marketing efforts to prioritize working with fabrication shops and system integrators instead of pursuing direct sales to oil and gas producers.

The current regulatory environment is extremely supportive for methane emission reduction technology solutions and the business environment has improved markedly in the past year as oil and gas producers are actively seeking out solutions like the NZE WCS to meet corporate ESG objectives and mandatory

government regulations. Effective Jan 1, 2022, under Alberta Directive 60 new oil and gas well sites in Alberta cannot use methane-emitting pneumatic equipment and therefore must consider electrification, instrument air or methane capture systems.[2] The market for brownfield retrofits has also improved as well as companies look to reduce methane venting.

5. Greenhouse Gas Benefits

The completed Project and the NZE WCS technology will achieve direct GHG emission reductions across Alberta through the elimination of methane emissions at off-grid oil and gas well sites. The deployment of NZE WCS packages as either retrofits or in greenfield applications avoids the use of methane venting pneumatic equipment. Methane-emitting pneumatic equipment have been the standard across the industry for decades and there are limited options available on the market today for reliable non-emitting solutions. The 11 sites where the NZE WCS units were deployed for this Project were primarily brownfield retrofits and direct measurements of the vent rates from the 9 sites that had pre-existing equipment confirmed GHG reductions of approximately 2,607 tCO_2e per year. Vent rates were measured at a further 6 candidate sites, and the inclusion of that data into the average vent rate calculations would have increased the net GHG reductions to 4,645 tCO2e/year since those sites had higher emitting equipment in place. The operation of the NZE WCS equipment eliminates all methane emissions from pneumatic equipment and results in negligible CO_2 emissions from the usage of a very small amount of methanol (generally less than 1 litre per day, equal to <1 tCO_2e/year per site).

During the Project, Calscan completed detailed methane emission measurements at a total of fifteen well sites for Cenovus, Husky, NAL Resources, Modern Resources and Repsol in order to quantify the GHG emission reduction opportunity from the deployment of additional NZE WCS packages. These 15 data points provided valuable data on methane vent rates from typical site configurations. Vent rates varied significantly depending on the specific pneumatic equipment at each site as well as operating parameters. Certain newer well sites actually had higher vent rates than older well sites. The figure below shows the vent rate measurements from the 15 sites as compared to the average of the 9 data points that were included in the GHG assertion and the original grant proposal estimate.

Overall, the average baseline emissions across all 15 measured sites was 424 tCO_2e/year. It is worth noting that this average vent rate is exactly 2X larger than what was assumed in the original grant application (estimated baseline emissions of 212 tCO_2e/y). For conservativeness, only 9 data points where actual retrofits were completed were included, which brought the average down to 237 tCO2e/year per site.

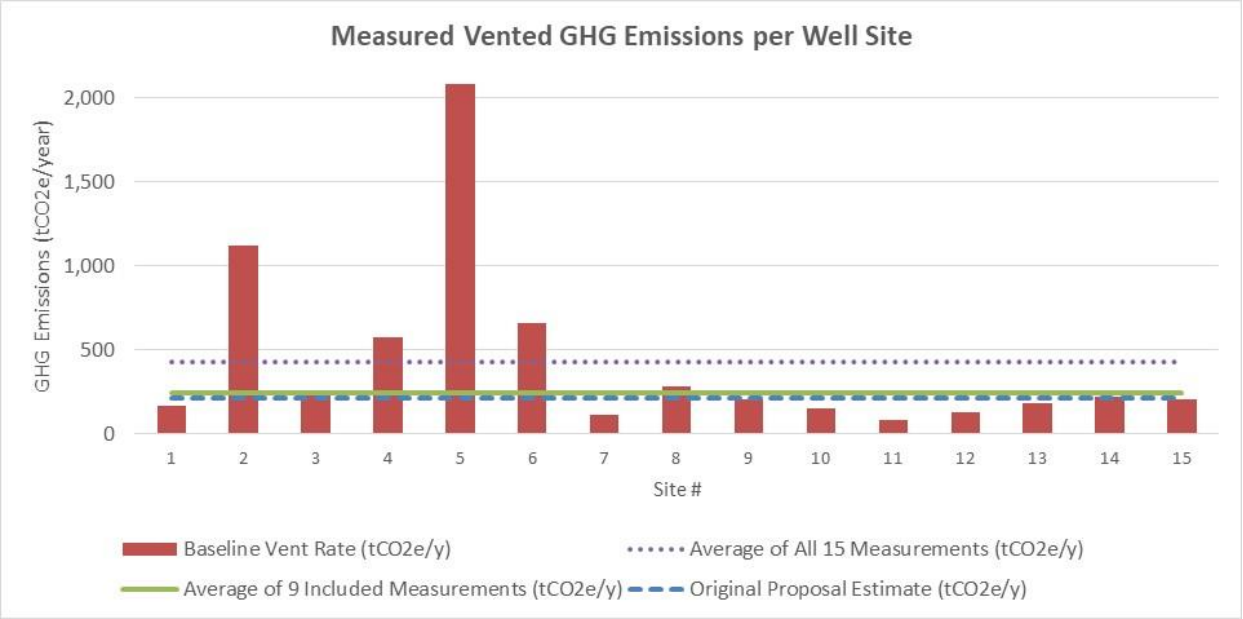
The original grant application baseline emission estimate of 212 tCO_2e/year assumed that a typical standard conventional pneumatic well site would have 1 diaphragm pump (most common type of pneumatic pump) and 2 pneumatic controllers (selected most common controllers - a Fisher DVC 6000 positioner for flow control & a Fisher L2 level controller). The use of these factors resulted in an overall vent rate of 1.579 m^3 of natural gas/hour/well, which was assumed to be 90% methane. The baseline emission factors were based on measured data from 765 pneumatic devices/pumps obtained from the December 2013 Prasino Group Study "Determining Bleed Rates for Pneumatic Devices in British Columbia". At that time, this study was the most comprehensive study on methane vent rates from

[2] https://www.aer.ca/regulating-development/rules-and-directives/directives/directive-060

pneumatic devices in Canada and provided an excellent baseline for common types of devices encountered at BC & AB well sites and specified methane vent rates in m^3/hr.

Based on the field data collected during the Project, a limited sample size (15) of measurements was obtained to validate the original emissions estimate based on actual process conditions and equipment configurations. This data represents a snapshot in time as it was not feasible nor cost effective to use continuous monitoring. Based on the higher measured emissions in the field, we believe the original GHG reduction estimates per well site were appropriate for use in the market roll out estimates and are likely conservative, but there is clearly significant variation from site to site. It is worth noting that the newer well sites generally had the highest emissions. Many sites use more than one chemical injection pump, which results in higher emissions.

The project emissions from operating the fuel cell are estimated to be <1 tCO_2e/year/site as the fuel cell only uses a very small amount of methanol. The chemical conversion of methanol in the fuel cell into CO_2 is estimated to release 1.08 kg CO_2/Litre of methanol based on US EPA emission factors, so the use of 1L/day of methanol would result in about 0.4 tCO_2e/year of GHG emissions, which are de minimis relative to the baseline emissions from venting of methane from pneumatic devices which are at least 500 to 1,000 times larger.



The Project scope was reduced to 11 NZE WCS deployments in total, versus the original proposal of 15. Despite the reduction in number of sites, the actual measured emissions per site were higher than expected, especially when including all data points.

	Forecast Net GHG Reductions Per Site (tCO2e/year/site)	**# of Sites**	**Total Estimated Project GHG Emission Reductions (tCO2e/year)**
Original Project Proposal	210	15	3,145

Measured Results from 9 Included Sites	237	11	2,607
Measured Results from All 15 Sites	422	11	4,645

Although, the measured results from the project were somewhat higher than the original projections, we observed significant site to site variations based on the equipment at each site and process conditions. For the market roll out calculations, a more conservative estimate of GHG reductions was used as it is expected that some of the highest emitting equipment will be retrofitted due to the new requirements under the Alberta Energy Regulator methane regulations in the coming years. As discussed in the GHG assertion report, the Alberta regulations require retrofits of pneumatic controllers by Jan 1, 2023, but generally do not directly require retrofits of pneumatic pumps. Although the retrofit of high bleed pneumatic controllers with low bleed devices can achieve significant GHG emission reductions (estimated at around an 80% reduction on average), low bleed devices still vent significant amounts of methane and the largest emission source at most well sites (the chemical injection pumps) are generally not subject to mandatory replacements/retrofits under the AER Directive 60. It is reasonable to expect that under the AER methane regulations, as currently written, typical well sites will see a reduction of less than 50%, if only the high bleed pneumatic controllers are replaced. Using the typical assumed pneumatic equipment for a single well configuration from the original grant proposal, as shown in the table below, we can see that swapping out high bleed devices to low bleed (assuming an 80% reduction in venting from those devices), would only yield a 27% overall reduction for the well site.

Device Type	**Original High Bleed Well Configuration - Vent Rate (m3/hour)[3]**	**Assumed AER Regulatory Scenario in 2023 - Use of Low Bleed Controllers, no change to pump (m3/h)**	**% Reduction**
Chemical Injection Pump	1.05	1.05	0%
Positioner	0.2649	0.05	80%
Level Controller	0.2641	0.05	80%
Totals	**1.58**	**1.16**	**27%**

As discussed in the GHG assertion report, we believe that the impact of AER methane regulations in 2023 on the assumed baseline for this project would be modest as the replacement of high bleed pneumatic controllers with low bleed controllers would have likely achieved less than a 50% reduction in methane emissions at the 11 project sites. A component-by-component analysis was not conducted for all sites, but based on a sample site, the forecast reduction from the implementation high-to-low bleed controller conversions was a reduction of about 14% to the baseline, which was lower than the theoretical example above. If that ratio were applied across the 11 sites, the forecast Project reductions would be approximately 2,242 tCO_2e/year. Overall, the deployment of the NZE WCS technology successfully eliminated all methane emissions from pneumatic equipment at the 11 well sites and significantly exceeded the GHG reductions that could reasonably be expected to be achieved based on AER Directive 60 regulatory requirements.

[3] December 2013 Prasino Group Study "Determining Bleed Rates for Pneumatic Devices in British Columbia".

GHG Reductions from Market Rollout

Since the actual measured vent rates from the field measurements were up to 2X larger than the original vent rate estimates, the impact of the AER regulatory requirements in 2023 will likely reduce the baseline by less than the conservative assumptions used in this report. For the market rollout of the technology, we believe that it is still conservative to assume similar GHG reductions per site on average, as assumed in the original proposal (210 tCO_2e/ well site/year). It is likely that the highest emitting sites will be retrofitted first, but over the longer term most well sites will need to adopt non-emitting technologies. For consistency, the original assumption of 210 tCO_2e reduction/unit has been kept for the rollout. The forecast market rollout and environmental benefits of that rollout have been compiled in the tables below. The market rollout continues to reflect the potential for a slower rollout due to severity of the major downturn in the oil and gas sector in 2020, but this might prove to be overly conservative given Calscan's current order backlog for NZE WCS components.

The GHG reductions from the rollout of the NZE WCS technology, either as a package, or as individual components, are forecast to be very material at approximately 500,000 tCO_2e in Alberta by 2030. The cumulative GHG reductions in Alberta are estimated to be approximately 1.85 million tCO2e by 2030. Sales of the NZE WCS product will likely continue beyond 2030 (and have been forecast in to continue to at least 2035 in Alberta, in the tables below). The units are assumed to operate for 20-years, so the equipment will continue to generate incremental GHG reductions out to 2050, as shown in the table below. It should be noted that it is inherently difficult to forecast future sales out so far into the future, and actual results may differ materially from what is projected in these tables.

Updated Environmental Benefits Tables - GHG Reduction Forecast

Alberta Rollout (Project Only)					
Year	Baseline Emissions (kilotonnes CO_2e/y/unit)	Project Emissions (kilotonnes CO_2e/y/unit)	Production (functional unit) Cumulative Units	Emission Reduction (kilotonnes CO_2e/y)	Emission Intensity (kilotonnes CO_2e/functional unit)
2013			0	0	
2014			0	0	
2015			0	0	
2016			0	0	
2017			0	0	
2018	0.212	0.002	3	0.63	0.21
2019	0.212	0.002	5	1.05	0.21
2020	0.212	0.002	11	2.31	0.21
2021	0.212	0.002	11	2.31	0.21
2022	0.212	0.002	11	2.31	0.21
2023	0.212	0.002	11	2.31	0.21
2024	0.212	0.002	11	2.31	0.21
2025	0.212	0.002	11	2.31	0.21
2026	0.212	0.002	11	2.31	0.21
2027	0.212	0.002	11	2.31	0.21
2028	0.212	0.002	11	2.31	0.21
2029	0.212	0.002	11	2.31	0.21
2030	0.212	0.002	11	2.31	0.21
2031	0.212	0.002	11	2.31	0.21
2032	0.212	0.002	11	2.31	0.21
2033	0.212	0.002	11	2.31	0.21
2034	0.212	0.002	11	2.31	0.21
2035	0.212	0.002	11	2.31	0.21
2036	0.212	0.002	11	2.31	0.21
2037	0.212	0.002	11	2.31	0.21
2038	0.212	0.002	8	1.68	0.21
2039	0.212	0.002	6	1.26	0.21
2040	0.212	0.002	0	0	0.00
2041	0.212	0.002	0	0	0.00
2042	0.212	0.002	0	0	0.00
2043	0.212	0.002	0	0	0.00
2044	0.212	0.002	0	0	0.00
2045	0.212	0.002	0	0	0.00
2046	0.212	0.002	0	0	0.00
2047	0.212	0.002	0	0	0.00
2048	0.212	0.002	0	0	0.00
2049	0.212	0.002	0	0	0.00
2050	0.212	0.002	0	0	0.00

Alberta Rollout (Commercial)				
Year	Units Sold	Active Units in Operation	Total # of Wells by all active units in operation	GHG Reductions in ref. year (kilotonnes / y)
2013	0	0	0	0.00
2014	0	0	0	0.00
2015	0	0	0	0.00
2016	0	0	0	0.00
2017	0	0	0	0.00
2018	5	5	5	1.05
2019	5	10	10	2.10
2020	5	15	15	3.15
2021	10	25	25	5.25
2022	25	50	50	10.50
2023	50	100	100	21.00
2024	100	200	200	42.00
2025	200	400	400	84.00
2026	400	800	800	168.00
2027	400	1,200	1,200	252.00
2028	400	1,600	1,600	336.00
2029	400	2,000	2,000	420.00
2030	400	2,400	2,400	504.00
2031	400	2,800	2,800	588.00
2032	400	3,200	3,200	672.00
2033	400	3,600	3,600	756.00
2034	400	4,000	4,000	840.00
2035	400	4,400	4,400	924.00
2036	0	4,800	4,800	1008.00
2037	0	4,800	4,800	1008.00
2038	0	4,795	4,795	1006.95
2039	0	4,790	4,790	1005.90
2040	0	4,785	4,785	1004.85
2041	0	4,775	4,775	1002.75
2042	0	4,750	4,750	997.50
2043	0	4,700	4,700	987.00
2044	0	4,600	4,600	966.00
2045	0	4,400	4,400	924.00
2046	0	4,000	4,000	840.00
2047	0	3,600	3,600	756.00
2048	0	3,200	3,200	672.00
2049	0	2,800	2,800	588.00
2050	0	2,400	2,400	504.00

As shown in the table above, the annual GHG reduction from the installation of a forecast commercial rollout of 2400 units is expected to be approximately 500,000 tCO2e/year in 2030. The cumulative GHG reductions from those same units is expected to be approximately 1.85 million tCO2e by 2030. Commercial sales of the core NZE WCS components began in 2021 and several hundred units have

already been deployed. The fuel cell component has not been fully commercialized yet, but further testing in late 2022-2023 is anticipated to lead to commercial sales in 2023. Commercial sales of all NZE WCS components is expected in 2023, but it should be noted that material GHG reductions can be achieved with or without the fuel cell as many sites can run a solar-only configuration or can be powered by other power generation technologies. However, the successful commercialization of the fuel cell will serve to expand the market potential of the NZE WCS and will increase GHG reductions by increasing the total addressable market for the NZE WCS. Deployments beyond 2030 have not been forecast in this report due to the inherent uncertainty of predicting a market rollout and a dynamic GHG baseline beyond this decade; however, these reductions could be material.

The tables below show the projected rollout for the rest of Canada and the rest of the world; however, it should be noted that there is significant uncertainty in accurately predicting the rollout of the technology outside of Calscan's core Western Canada market so these forecasts only go to 2030 and are for illustrative purposes only.

Rest of Canada Rollout									
	Unit Definition	Estimated delay before units are put into operation	Estimated useful lifetime of the unit	Functional Unit Equivalence	Emission Factor - GHG	Emission Factor - PM	Emission Factor - NO_x	Emission Factor - SO_x	Emission Factor - VOC
Unit:	Sales Unit	Years	Years	# of Wells per Active Unit in operation	[ktonnes CO2e / # of Wells]	[tonnes PM / # of Wells]	[tonnes NOx / # of Wells]	[tonnes SOx / # of Wells]	[tonnes VOCs / # of Wells]
	NZE WCS	0	20	2,400	0.21000000	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Rest of Canada Rollout								
Year	Units Sold	Active Units in Operation	Total # of Wells by all active units in operation	GHG Reductions in ref. year (kilotonnes / y)	PM Reductions in ref. year (tonnes / y)	NOX Reductions in ref. year (tonnes / y)	SOX Reductions in ref. year (tonnes / y)	VOCs Reductions in ref. year (tonnes / y)
2013	0	0	0	0.00	0.00	0.00	0.00	0.00
2014	0	0	0	0.00	0.00	0.00	0.00	0.00
2015	0	0	0	0.00	0.00	0.00	0.00	0.00
2016	0	0	0	0.00	0.00	0.00	0.00	0.00
2017	0	0	0	0.00	0.00	0.00	0.00	0.00
2018	0	0	0	0.00	0.00	0.00	0.00	0.00
2019	0	0	0	0.00	0.00	0.00	0.00	0.00
2020	0	0	0	0.00	0.00	0.00	0.00	0.00
2021	5	5	5	1.05	0.00	0.00	0.00	0.00
2022	10	15	15	3.15	0.00	0.00	0.00	0.00
2023	25	40	40	8.40	0.00	0.00	0.00	0.00
2024	50	90	90	18.90	0.00	0.00	0.00	0.00
2025	50	140	140	29.40	0.00	0.00	0.00	0.00
2026	50	190	190	39.90	0.00	0.00	0.00	0.00
2027	50	240	240	50.40	0.00	0.00	0.00	0.00
2028	50	290	290	60.90	0.00	0.00	0.00	0.00
2029	50	340	340	71.40	0.00	0.00	0.00	0.00
2030	50	390	390	81.90	0.00	0.00	0.00	0.00

Rest of World Rollout									
	Unit Definition	Estimated delay before units are put into operation	Estimated useful lifetime of the unit	Functional Unit Equivalence	Emission Factor - GHG	Emission Factor - PM	Emission Factor - NO_x	Emission Factor - SO_x	Emission Factor - VOC
Unit:	Sales Unit	Years	Years	# of Wells per Active Unit in operation	[ktonnes CO2e / # of Wells]	[tonnes PM / # of Wells]	[tonnes NOx / # of Wells]	[tonnes SOx / # of Wells]	[tonnes VOCs / # of Wells]
	NZE WCS	0	20	1	0.21000000	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Rest of World Rollout								
Year	Units Sold	Active Units in Operation	Total # of Wells by all active units in operation	GHG Reductions in ref. year (kilotonnes / y)	PM Reductions in ref. year (tonnes / y)	NOX Reductions in ref. year (tonnes / y)	SOX Reductions in ref. year (tonnes / y)	VOCs Reductions in ref. year (tonnes / y)
2013	0	0	0	0.00	0.00	0.00	0.00	0.00
2014	0	0	0	0.00	0.00	0.00	0.00	0.00
2015	0	0	0	0.00	0.00	0.00	0.00	0.00
2016	0	0	0	0.00	0.00	0.00	0.00	0.00
2017	0	0	0	0.00	0.00	0.00	0.00	0.00
2018	0	0	0	0.00	0.00	0.00	0.00	0.00
2019	0	0	0	0.00	0.00	0.00	0.00	0.00
2020	0	0	0	0.00	0.00	0.00	0.00	0.00
2021	0	0	0	0.00	0.00	0.00	0.00	0.00
2022	5	5	5	1.05	0.00	0.00	0.00	0.00
2023	10	15	15	3.15	0.00	0.00	0.00	0.00
2024	25	40	40	8.40	0.00	0.00	0.00	0.00
2025	50	90	90	18.90	0.00	0.00	0.00	0.00
2026	100	190	190	39.90	0.00	0.00	0.00	0.00
2027	100	290	290	60.90	0.00	0.00	0.00	0.00
2028	100	390	390	81.90	0.00	0.00	0.00	0.00
2029	100	490	490	102.90	0.00	0.00	0.00	0.00
2030	100	590	590	123.90	0.00	0.00	0.00	0.00

Market Adoption, Speed and Rollout:

As noted above, the full commercialization of the NZE WCS product is expected in 2023. All of the core components other than the fuel cell have been sold commercially since 2021 and sales of the electric linear actuator are now in the hundreds of units already. An updated market rollout forecast was created to show the changes from the original proposal, which reflects the delays observed in milestone 1, 2 and 3 as well as the severe industry downturn. The rollout is conservative and yields a 10-20% market adoption of the NZE WCS technology. It also considers the phase-in of methane regulations in the 2021-2023 time frame (BC, then AB, then Canada) for new sites; however the downturn was a much more significant factor as the number of new drills and completion of new well sites was significantly reduced. It should be noted that due to the volatility of the oil and gas industry, it is inherently difficult to predict activity levels.

Despite the revised forecasts, Calscan believes there is still a large market opportunity for the NZE WCS product and that its forecast rollout is achievable. As shown in the tables above, the peak sales are targeted at 400 units per year by 2026 in Alberta alone. Market adoption of non-emitting alternatives to pneumatic devices at greenfield sites has already begun to a meaningful degree based on the Alberta Energy Regulator methane regulations. Calscan has already achieved sales of several hundred electric linear actuators. The speed of adoption at greenfield sites is expected to increase from 2022-2026 as a larger number of operators gain experience with the technology and incorporate it into their new well designs.

In terms of the market opportunity, according to the Canadian Association of Petroleum Producers, as of 2018, there were 129,845 active natural gas wells in operation in Western Canada. Of those wells,

83,282 were in Alberta, 8,843 were in BC and 16,041 were in Saskatchewan.[4] A large proportion of those wells have pneumatic equipment that could conceivably be replaced with electric actuators to eliminate methane emissions. It should be noted that greenfield (newly drilled and completed) wells are more economic to deploy at for Calscan's products and for the producer. Each year, several thousand new wells are drilled, completed and equipped for production. In 2022, the Petroleum Services Association of Canada is forecasting 5,400 new wells to be drilled and completed in Western Canada, which is an increase from the estimated 4,650 wells drilled in 2021.[5] A majority of these new wells are candidates for NZE WCS components. Calscan's technology is most applicable to conventional or shale wells that have separator packages with pressure control, flow control and liquid level control. The oil sands sector is not a focus for the NZE WCS. In terms of PSAC's forecast for 2022, they project 3,125 wells in Alberta, 1,495 in Saskatchewan, 605 in BC and 160 in Manitoba. Similar to 2021, the majority of activity is expected to occur in the Montney and Viking formations, both of which are amenable to Calscan's technology.

The total addressable market for the NZE WCS product is likely to be 20,000 to 50,000 units in Canada. In terms of market adoption, the forecast rollout is expected to result in the ballpark of 10%-20% market share, which is a reasonable target given Calscan's early mover advantage. Candidate sites identified during the project and through Calscan's commercial sales include primarily liquids-rich natural gas wells or light oil wells that have associated gas production and require separator packages to separate gas, hydrocarbon liquids and water. Calscan's equipment replaces the conventional pneumatic devices used to operate the gas-liquids separation equipment (e.g. Calscan's electric actuators and electric controllers replace pneumatic actuators and pneumatic controllers). These types of sites are very common across the upstream industry and a well defined market opportunity exists.

The fuel cell product, if commercialized, may have other applications for remote power at monitoring sites or even in the telecommunications sector. At this time, the primary focus for the fuel cell technology is at off-grid well sites that need power to run communication systems (remote terminal units), electric controls, actuators and chemical injection pumps. The main competitor in that market segment (Simark/EFOY) has reportedly deployed 3,000 units, which illustrates the initial market size for the product (largely prior to the release of methane regulations that will further expand this opportunity).

The near-term focus will be on actuator component sales and sales of the solar-only version of the NZE WCS product. The field testing further validated that well site equipment can be reliably run off of solar power alone, provided that the equipment is properly engineered with sufficient battery reserves. Once further testing of the fuel cell has demonstrated improved reliability, Calscan will offer the fuel cell for sale either individually, or in conjunction with the other NZE WCS components. Fuel cell sales are targeted for winter 2022/2023.

The tables below show the original forecast for GHG reductions at the start of the project and a revised table that shows the current forecast for GHG reductions based on the various challenges encountered in the execution of this Project and market conditions. These forecasts are only illustrative of the potential of the NZE WCS technology and actual results may differ materially.

[4] https://www.capp.ca/wp-content/uploads/2020/02/Statistical-Handbook-2019-Data_357106.pdf
[5] https://www.psac.ca/media/psac-forecasts-16-per-cent-increase-in-drilling-activity-for-2022/

Original Forecast GHG Reductions (kt CO2e/year)					
Year	Project	Alberta	Rest of Canada	Rest of World	Total (All Regions)
2018	1	3	-	-	4
2019	3	14	11	-	27
2020	3	35	21	21	80
2021	3	98	32	63	195
2022	3	161	42	105	311
2023	3	224	53	147	426
2024	3	308	63	189	563
2025	3	392	74	231	699
2026	3	476	84	273	836
2027	3	560	95	315	972
2028	3	644	105	357	1,109
2029	3	728	116	399	1,245
2030	3	812	126	441	1,382
Totals	**39**	**4,451**	**819**	**2,541**	**7,850**

New Forecast GHG Reductions (kt CO2e/year)					
Year	Project	Alberta	Rest of Canada	Rest of World	Total (All Regions)
2018	1	1	-	-	2
2019	1	2	-	-	3
2020	2	3	-	-	5
2021	2	5	1	-	9
2022	2	11	3	1	17
2023	2	21	8	3	35
2024	2	42	19	8	72
2025	2	84	29	19	135
2026	2	168	40	40	250
2027	2	252	50	61	366
2028	2	336	61	82	481
2029	2	420	71	103	597
2030	2	504	82	124	712
Totals	**27**	**1,849**	**365**	**441**	**2,683**

As noted above, the life of the NZE WCS equipment is expected to be at least 20 years, so additional GHG reductions are forecast to occur from 2030-2050 and these forecasts have been provided for Alberta only, earlier in this section.

6. Economic and Environmental Impacts

The Project is expected to lead to significant long-term economic benefits for the province of Alberta through investment and deployment of clean technology in Alberta and via exports to other jurisdictions, high-skilled engineering work (in the Edmonton area), technical and field work for the oil

and gas service industry, and royalty savings from natural gas conservation (gas sold instead of vented to the atmosphere). The forecast contribution to Alberta's GDP from the market rollout of the NZE WCS could be as large as $20-30 million if the technology continues to be commercialized at expected rates. Future provincial corporate tax payments from the business profits of selling NZE WCS units over the life of the technology rollout are anticipated to be of similar magnitude to the level of grant funding awarded by ERA. Based on the forecast rollout of the technology in Alberta and the assumed life of each unit, the royalty benefits from gas savings are estimated to be as much as $5-10 million in Alberta alone assuming a 10% royalty rate and $3/GJ value for natural gas. Overall, the NZE WCS technology is an important solution for oil and gas producers to use to meet compliance with Alberta's methane emission regulations and to remain competitive with increasingly stringent government and investor expectations around environmental, social and governance (ESG) practices.

The Project is not expected to have a material impact on criteria air contaminants (CACs), land use or water consumption, as the core environmental benefit of the NZE WCS technology is the reduction of methane emissions. The elimination of fuel gas venting does have a minor positive impact on volatile organic compound (VOC) emissions as some non-methane hydrocarbons are also eliminated. The use of solar photovoltaic panels, batteries and methanol fuel cells to provide off-grid power does not require any fuel combustion, so CAC emissions are negligible compared to natural gas or propane-based combustion technologies. The NZE WCS technology is also compact and fits within the existing oil and gas surface lease, so no land impacts are expected. The technology has a much lower risk of spills compared to diesel or gasoline fueled systems.

The ERA funding was significant for Calscan as it provided an important bridge during an industry downturn and allowed key highly-skilled personnel to continue to devote a portion of their time to research, development and testing. Calscan was also able to hire a dedicated project manager for the Project, who has now advanced within the organization to be Calscan's General Manager. Due to the severe industry downturn, Calscan was forced to reduce certain staff in 2020. Since that time, in 2021, Calscan hired a new technical sales lead in Calgary, who will be actively involved with marketing the fuel cell product to potential customers later this year if technical performance milestones are met. Calscan may also consider hiring an additional shop technician in 2022 or 2023 now that industry activity levels have bounced back and Calscan's order book is robust. Overall, the ERA funding helped to create 2 full time jobs in Alberta and helped Calscan to retain many of its key staff during a major downturn. Calscan's business model is more robust and fewer staff are required to manage the business. The marketing strategy has evolved to rely more on fabrication partners that integrate Calscan's equipment into complete separator packages/skids, rather than custom engineering and field visits to each customer site.

7. Overall Conclusions

Overall, the Project significantly advanced the commercialization of an engineered-in-Alberta technology solution to eliminate methane emissions at off-grid oil and gas well sites. Calscan and its consortium partners were able to deploy the NZE WCS technology at 11 field sites in Alberta and achieved impressive GHG reductions of 2,607 tCO_2e/year. The GHG reductions per well site were approximately 13% higher than the estimate used in the original grant proposal. The methane vent rate was measured at each well site using Calscan's "Hawk" low flow meter to validate all claimed GHG emission reductions.

Demand is currently very strong for zero emissions technologies that can eliminate the use of methane-emitting pneumatic equipment, especially as oil and gas industry activity levels have accelerated into 2022. Tourmaline, the largest natural gas producer in Canada has now standardized its well site designs to use Calscan's NZE WCS components and is also currently implementing a large scale retrofit program in BC. ERA funding was critical in supporting Calscan and its consortium partners through a challenging period of time for the upstream oil and gas industry. This support was especially critical after Sustainable Development Technology Canada withdrew its support for the Project during the Covid pandemic and decided not to fund the final milestone.

The SAFCell fuel cell component continues to show promise as a solution for the Canadian upstream oil and gas sector, given its modest capital costs and ability to use widely available low-cost industrial-grade methanol. A number of important design improvements were made to the technology, but an additional round of field testing will be necessary to ensure the technology is sufficiently reliable for remote off-grid applications. Calscan is excited to have signed a new distribution agreement with Advent Technologies, which acquired the rights to the SAFCell solid acid fuel cell technology for upstream oil and gas applications. Advent brings additional resources and fuel cell technology development capabilities, which will be very valuable in combination with Calscan's market leading electric actuators and controls. A recent innovation in late 2021 by has been to add proprietary filter technology to remove impurities from the methanol, which increases the robustness of the technology. The combination of these attractive features is expected to make the M-ZERØ™ technology competitive with incumbent technologies in Canada.

8. Scientific Achievements

Since this Project was primarily focused on field demonstration efforts, no patents were filed. The modifications to the fuel cell and to the electric control system components fell under trade secrets rather than patentable concepts. No books or student theses were published.

Subsequent to the end of the Project, a journal article[6] was published in 2021 in Elsevier's journal called Joule 5, 1–18, July 21, 2021 under Gittleman et al., Proton conductors for heavy-duty vehicle fuel cells, Joule (2021)[7]. The article focused on methanol testing and other long term testing of the fuel cell. The summary of the article is provided below.

> "Fuel cells utilize the chemical energy of liquid or gaseous fuels to generate electricity. As fuel cells extend their territory to include heavy-duty vehicles, new demands for proton conductors, a critical component of fuel cells, have emerged. A near-term need is ensuring the chemical and mechanical stability of proton exchange membranes to enable long lifetime vehicles. In the mid-term, achieving stable conductivity of proton conductors under hot (>100°C) and dynamic fuel cell operating conditions is desirable. In the long term, targeting high thermal stability and tolerance to water enables the utilization of high energy density liquid fuels that will increase

[6] Gittleman et al., Proton conductors for heavy-duty vehicle fuel cells, Joule (2021). https://doi.org/10.1016/j.joule.2021.05.016

[7] https://doi.org/10.1016/j.joule.2021.05.016

pay-load space for heavy-duty vehicles. This article presents our perspective on these near-, mid-, and long-term targets for proton conductors of heavy-duty fuel cells."

A number of conference presentations were completed during the course of the project as well, including presentations at the Petroleum Technology Alliance Canada[8] in May 12, 2017, at the 2019 Fuel Cell & Hydrogen Seminar in Long Beach, California, USA on Nov 6, 2019 and at the 2020 US Department of Energy High Temperature Proton Exchange Membrane Fuel Cell Workshop (Virtual, September 9, 2020). A number of marketing and technical presentations were given throughout the duration of the Project to educate potential customers, regulators and other stakeholders on the benefits of the NZE WCS product.

9. Next Steps

The Project was very successful on a number of fronts. Calscan was able to leverage the grant funding to conduct important design work and field testing during an industry downturn to position its products for commercial sales as the oil and gas industry has rebounded in 2022 and as methane regulations have begun to take effect. The electric linear actuator and controls are now offered commercially with significant sales growth over the past year as Calscan has now deployed over 200 units to date and a total of approximately 400 units have already been sold this year with deliveries to be executed over the rest of 2022. Some of these orders for the electric linear actuator have come from consortium partners that participated in this ERA-funded project as they gained confidence with several years of runtime and are now ramping up drilling in Alberta. In fact, the largest natural gas producer in Canada has standardized its new well designs to use Calscan's NZE WCS components. That same producer was also recently awarded funding to execute a major retrofit program to replace 222 pneumatic devices with electric equivalent device across their BC operations starting in 2022, which is expected to reduce GHG emissions by 44,500 tCO_2e through 2031.[9]

Next steps for Calscan will be to continue marketing the NZE WCS components (without the fuel cell for now) to existing and new oil and gas customers in Canada. Calscan has hired one additional senior sales / business development specialist to assist in this effort. Calscan now offers three different sizes of electric linear actuators with different kilo-Newton design capacities that fit different market applications. This has enabled the company to offer a lower priced (smaller) actuator that occupies a significant market niche at an attractive price versus competing alternative actuators. Additional design modifications have led to customized adapters for different valve manufacturers and a new "smart relay" to reduce mechanical stops that wear down mechanical parts. A significant focus for Calscan is to optimize and actively manage its global supply chain to address the current challenging environment for sourcing components and different machine shops and parts suppliers in Europe, Mexico, the USA, Canada and elsewhere.

Calscan's focus has shifted to supplying components such as the electric linear actuator to fabricators instead of designing and engineering complete packages for end users. This approach optimizes Calscan's resources to carry out design, engineering and QA/QC of its products, while leveraging the

[8] https://www.ptac.org/events/methane-emission-calscan-tis/

[9] https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/cleanbc-industry-fund/funded-projects

sales channels and integration capabilities of the fabrication shops. Calscan's recent commercial successes have been achieved in part through strong collaboration with local fabrication shops in the Edmonton area and with select valve manufacturers and engineering, procurement and construction (EPC) companies. Although, Calscan continues to directly market the NZE WCS components to oil and gas producers, it is now less reliant on custom engineering of each package and less reliant on direct sales to oil and gas customers. Key successes have been achieved in building adapters and plug-and-play solutions that make Calscan's products accessible to a far larger market opportunity.

To gain additional exposure to new oil and gas customers, Calscan also collaborated with the Petroleum Technology Alliance Canada (PTAC), Advantage Energy and Yangarra Resources Ltd to execute a demonstration project with NZE WCS components in 2020/2021. Additional fuel cell-only field tests were completed separately from this grant Project at sites in west central Alberta operated by Shell Canada and Bellatrix Exploration (now Spartan Delta). These field demonstration projects provided further operational learnings and technology exposure for two high profile oil and gas customers. The Shell demonstration project was particularly innovative as the SAFCell fuel cell was deployed as a trial to help power methane detection technology that was also at the field demonstration stage and being trialed as part of the Methane Detectors Challenge partnership between Environmental Defense Fund[10], Shell, Statoil and PG&E. Articles were published on the Shell methane detector trial on SAFCell's website[11] as well as in the BOE Report[12], JWN Energy[13], and on Shell's website[14].

The development of the fuel cell technology encountered more challenges than expected and the technology has not yet been commercialized as further field testing is required. Significant progress was made during the initial field trials in 2018-2021 as major components were re-designed to improve reliability in extreme winter conditions and to resolve firmware and programming issues. In fact, some fuel cell units that had frozen solid during exceptionally cold weather, were able to function perfectly after they had thawed out. These important lessons learned have been incorporated into the technology and that knowledge continues to be shared between Calscan and its partners. Importantly, Calscan's core engineering team members continue to work on the fuel cell technology and Calscan remains committed to advancing the fuel cell technology as it continues to be the exclusive distributor of the technology for the Canadian oil and gas market.

In 2021, SAFCell entered into an agreement with publicly traded fuel cell technology company Advent Technologies. In 2021, Advent purchased Ultracell,[15] the company that had been a fabrication partner for SAFCell. This was a positive development as Advent Technologies is better capitalized and will bring significant resources to support the continued development of the SAFCell technology for oil and gas market applications in Canada. Since the end of the grant Project, Advent's engineers and technicians have been working closely with Calscan's team to refine the fuel cell design. In particular, 3 re-designed fuel cell units were shipped to Calscan's lab in late 2021 for further testing. An Advent technician has

[10] https://www.edf.org/methane-detectors-challenge
[11] https://static1.squarespace.com/static/551b6d27e4b071275ffcea7b/t/5c1755446d2a733821a3012d/1545033028694/20181030-Shell+trial+at+RMH-v6.pdf
[12] https://boereport.com/2017/08/09/shell-launches-methane-detection-pilot-2/
[13] https://www.jwnenergy.com/article/2017/8/9/shell-launches-alberta-methane-detection-pilot-par/
[14] https://www.shell.us/media/2017-media-releases/shell-launches-methane-detection-pilot.html
[15] https://www.advent.energy/2021/02/22/advent-technologies-announces-acquisition-of-ultracell-a-leader-in-lightweight-fuel-cell-technology/

been working in Edmonton with the Calscan team for the past 3 months to continue testing and development work. On January 10, 2022, Calscan and Advent announced that a Distribution and Service Agreement had been signed between the two parties. Calscan will continue to be the exclusive distributor of the fuel cell in the Canadian oil and gas market. Calscan continues to believe that the Advent M-ZERØ™ 50W fuel cell can achieve comparable or lower capital costs and lower stack replacement costs than competing systems and can achieve significantly lower operating costs through the use of industrial-grade methanol.

Next steps for the fuel cell include Calscan's target to deploy at least one additional test unit in the field in late Q1 2022 to try and obtain additional runtime before the end of winter. Current plans are to work with consortium partner Cenovus again to re-deploy at their well site near Edson, AB, where two SAFCell fuel cells were previously tested in 2020/2021 as this site is already configured for a fuel cell unit to be dropped into service. Cenovus has been an excellent partner and continues to need a power generation solution for that well site since it has poor solar resources. Additional technical resources will be allocated to go through the Canadian Standards Association (CSA) electrical certification process, initially for a general-purpose area classification, and then later for a hazardous area classification. The next generation design of the fuel cell package is underway and features an approximate 50% reduction in size to make it easier for a single person to move the fuel cell and its enclosure. Additional refinements are being made to the heating system and water handling equipment to further winter-proof the M-ZERØ™. If the fuel cell testing progresses as expected and meets reliability requirements, then Calscan is targeting first sales of the re-designed and rebranded M-ZERØ™ 50W fuel cell starting in the winter of 2022/2023. Initial efforts remain focused on a 50W unit, but additional larger units are being considered at the 150W and 400W scales[16] and potentially larger (Advent already offers a 5kW unit to the telecom industry).

10. Communications plan

During the Project, Calscan was able to showcase its technology at a number of different conferences and through several news articles. This included a Technical Information Session (TIS) hosted by the Petroleum Technology Alliance Canada[17] on May 12, 2017. The session provided oil and gas producers with the opportunity to learn more about SAFCell Inc and Calscan Solutions' joint development of a near-zero emission well control system to eliminate methane emissions from pneumatic equipment.

Calscan also collaborated with consortium partner Cenovus to issue a news article on Cenovus' demonstration of the fuel cell and NZE WCS technology to reduce methane emissions.[18] The article titled "No sunlight? No problem: How methanol fuel cells can help us reduce our emissions" described how most of Cenovus's conventional oil and gas well sites require electricity to operate on-site equipment, but the assets are too remote to be feasibly connected to the electricity grid. As such, they have relied on solar panels to provide electricity for many devices including on-site instrumentation, control panels and data communications. Given that solar panels aren't a reliable power source in times of low sunlight and bad weather, they needed a reliable backup power supply - and thanks to recent advancements in

[16] https://www.advent.energy/oil-gas/
[17] https://www.ptac.org/events/methane-emission-calscan-tis/
[18] https://www.cenovus.com/news/our-stories/no-sunlight-no-problem-how-methanol-fuel-cells-can-help-us-reduce-our-emissions.html

fuel cell technology, they were able to trial the methanol fuel cells as a consortium member with Calscan. These trials will enable future applications of fuel cells and allow solar power to be more reliably used instead of combustion power generation alternatives. A second key objective from the pilot was for Cenovus to electrify its off-grid well sites to replace pneumatic equipment and eliminate methane venting from instrumentation using Calscan Energy's new electric linear actuator and control system and prepare for the Alberta Energy Regulator Directive 060 which will mandate the use of non-emitting technologies at new sites to eliminate venting effective Jan 1, 2022.

Consortium partner Modern Resources also highlighted their deployment of Calscan's NZE WCS components and their subsequent standardization to use the technology at all of their well sites. Modern Resources featured the technology (dubbed Modern Ultra Low Emissions or "MULE") in their corporate presentation and through a featured article in the Canadian Association of Petroleum Producers (CAPP) website[19]. Modern reported that "For three well pads on a natural gas site, MULE has enabled a reduction of 1,743 metric tonnes of CO2 equivalent per year" and "For oil sites, that figure is 1,036 metric tonnes for three wells." Modern Resources was the 2017 winner of the EPAC Award as Top Private Emerging Producer and captured the 2018 Environmental Excellence Award at the Global Petroleum Show, in part for their leadership in deploying Calscan's NZE WCS components and other low emission technologies. Modern Resources is now owned by Tourmaline Oil, the largest natural gas producer in Canada.

In 2022, Calscan and Advent Technologies issued a press release on their continued collaboration to further develop and commercialize the methanol fuel cell technology.[20] The press release highlighted the signing of a Distribution and Service Agreement between the two parties. "The agreement details Calscan's plans to market, resell, install, and service the Advent M-ZERØ™ and SereneU fuel cell products to address the demand for electric systems in the oil and gas sector. Current regulatory pressure is focused on targets which will aggressively reduce oil & gas industry methane emissions throughout Canada."

Henri Tessier, President of Calscan, was quoted in the article: "We are excited to have Advent Technologies as an industry partner. Calscan is committed to reducing well site GHG emissions through innovative and progressive design, and Advent's products make this mission a reality. We look forward to bringing this solution to our customers."

[19] https://context.capp.ca/articles/2019/profile_mule/

[20] https://www.advent.energy/2022/01/10/advent-technologies-announces-signing-of-distribution-and-service-agreement-with-calscan-solutions/