Final Outcomes Report

FortisAlberta Waterton Energy Storage Project (R1060670)

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Date of the Project: 2019/03/01 - 2022/12/31

Technology Readiness Level (TRL) at Project initiation – Completion: 7-9

Total actual ERA funds received: $1,284,000.
Total actual Project costs: $6,052,342
Eligible Project Expense: $5,992,312
Ineligible Project Expense: $60,030

Submission date: 2023/06/13

Project Description

Waterton Lakes National Park is Alberta's southernmost park and encompasses the Waterton townsite, which hosts over 500,000 visitors annually. The Waterton area frequently experiences outages due to its long distance from the nearest substation and the mountainous terrain that presents restoration challenges. There is only one 70-kilometre-long distribution line feeding the area and connecting Waterton to the grid. If there is an interruption to the electricity on this line, such as if a tree falls, there is no other source of backup power.

FortisAlberta devised a new solution that is a first of its kind demonstration in the province to solve this problem. The solution includes utilizing a combination of a 324 kW DC/248 kW AC solar PV system, a 1.5MW/5.2MWh battery energy storage system (BESS) and an advanced control system to provide backup power at the Town of Waterton during system outages. The objectives of the FortisAlberta Waterton Energy Storage project are to:

1) improve grid reliability to residents, businesses, and visitors of Waterton Lakes National Park,
2) demonstrate the adoption and integration of Battery Energy Storage Systems (BESS) and Solar PV systems for insight into future applications,
3) prove an Alberta cost-benchmark for the use of microgrids in distribution system applications, and,
4) showcase the project successes and share project learnings with industry to promote the adoption of smart grid technologies throughout Alberta.

The design stage of the project started in March 2019 and was completed in March 2021. Construction, integration testing and commissioning of the project were completed between April 2021- August 2022. There was a brief outage at the Town of Waterton in October 2022, and the BESS successfully backed up the power to the services at the Town. Through this project, FortisAlberta gained valuable learnings to design, build and commission a power microgrid system. The learnings and impacts of the project are discussed in further detail within the report.

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The Waterton townsite experiences more electricity outages by frequency and duration compared to many other locations in Alberta. There is only one 70-kilometre-long distribution line feeding the area and connecting Waterton to the grid. If there is an interruption to the electricity on this line, such as if a tree falls, there is no other source of backup power. FortisAlberta devised a new solution that is a first of its kind demonstration in the province to solve this problem. The solution (FortisAlberta Waterton Energy Storage Project) includes utilizing a combination of a 324 kW DC/248 kW AC solar photovoltaic (PV) system, a 1.5MW/5.2MWh battery energy storage system (BESS) and an advanced control system to provide backup power at the Town of Waterton during system outages.

The design stage of the project started in March 2019 and was completed in March 2021. Construction, integration testing and commissioning of the project were completed between April 2021- August 2022. There was a brief outage at the Town of Waterton in October 2022, and the BESS successfully backed up the power to the services at the Town.

The BESS is expected to help increase power reliability of the Town by helping to avoid approximately 9 hours of outages on an annual basis. The project also helped support the Province of Alberta with its emission reduction target and effectively demonstrated the utilization of BESS as an alternative to Diesel generator to provide backup service. ~1,539 tCO2e could be offset by the Waterton microgrid system till 2030, including the emissions reduction from both the Solar PV system and the BESS. Through this project, FortisAlberta gained valuable learnings to design, build and commission a power microgrid system. The learnings include aspects from Request for Proposal (RFP) for equipment, environmental approval, stakeholder consultation, project management, project coordination and project commissioning, etc. FortisAlberta had periodically presented its learnings of the project through the Alberta Smart Grid Consortium and Alberta Power Industrial Consortium.

The project has also created social, economic and workforce benefits to Alberta as described in detail in the report. By Dec 31, 2022, all project objectives were achieved and the microgrid is expected to continue providing benefits to the Town of Waterton and to the Alberta power grid.

2 Project Description

The Waterton townsite experiences more electricity outages by frequency and duration compared to many other locations in Alberta. There is only one 70-kilometre-long distribution line feeding the area and connecting Waterton to the grid. If there is an interruption to the electricity on this line, such as if a tree falls, there is no other source of backup power. FortisAlberta devised a new solution that is a first of its kind demonstration in the province to solve this problem. The solution (FortisAlberta Waterton Energy Storage Project) includes utilizing a combination of a 324 kW DC/248 kW AC solar PV system, a 1.5MW/5.2MWh BESS and an advanced control system to provide backup power at the Town of Waterton during system outages.

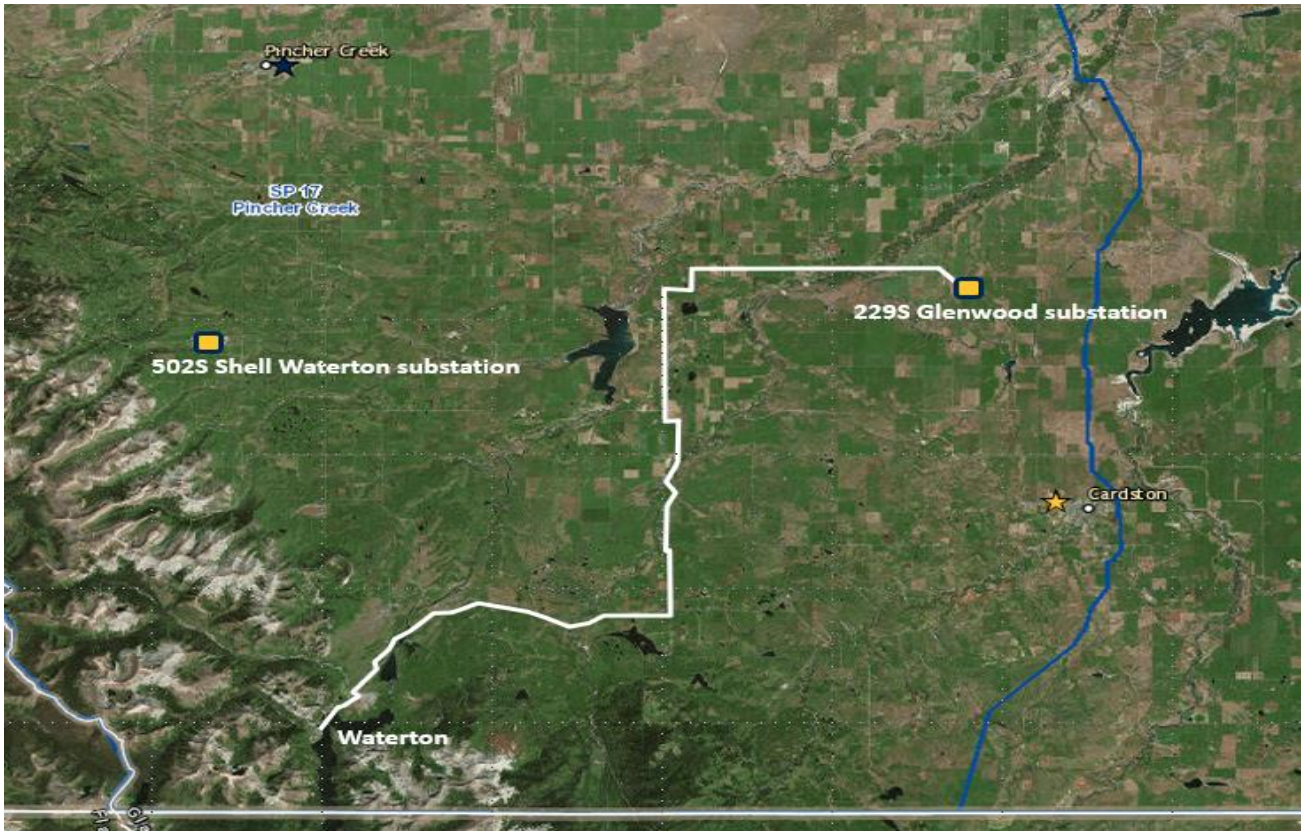

Figure 1: Glenwood Substation 70km radial distribution feeder to Town of Waterton

The key objectives of this project included the followings:

1) improve grid reliability to residents, businesses, and visitors of Waterton Lakes National Park,
2) demonstrate the adoption and integration of Battery Energy Storage Systems (BESS) and Solar PV systems for insight into future applications,
3) provide an Alberta cost-benchmark for the use of microgrids in distribution system applications, and,
4) showcase the project successes and share project learnings with industry to promote the adoption of smart grid technologies throughout Alberta.

Other than the key objectives, the project was also expected to provide environmental benefits, economic and social benefits, and to improve distribution system asset utilization.

The design stage of the project started in March 2019 and was completed in March 2021. Construction, integration testing and commissioning of the project were completed between April 2021- August 2022. There was a brief outage at the Town of Waterton in October 2022, and the BESS successfully backed up the services at the Town with power supply.

At the time of project development, the use of microgrid in delivering real-time management and automated response to the modern grid was new to the distribution world in Alberta. This project is expected to demonstrate the use cases of non-wire alternatives with advanced control system to enhance reliabilities in remote communities, and to offer insight into how BESS can be used in future applications to support safe and reliable operation of the distribution system. The project will also help provide an Alberta cost-benchmark for the use of microgrids in distribution system applications.

While the project TRL advancement was estimated as 7-8 at the beginning of the project in March 2019, the TRL advancement level is estimated at around 9 by the end of this project in Dec 2022 (Technology proven through successful deployment in operational settings). All original objectives and the expected benefits of the project have been achieved and will be discussed in further details throughout this report.

3 Project Work Scope

The Waterton microgrid includes a 324kW DC/248kW AC solar PV system, a 1.5MW/5.2MWh BESS and an advanced microgrid control system.

Solar PV System:

Due to site geotechnical conditions and Parks Canada requirements, the solar PV system was installed on the sloping ground next to the Town of Waterton's operating house. The construction process of solar PV installation generally went well as expected. The construction started with forming the transformer pad, building conduit and cables back to the grid-interconnected power pole, followed by the installation of anchors and installation of service transformers. Solar modules and inverters were received on site in Sep 2021 and all the panels were installed by the end of Nov 2021. A picture of the layout and the Solar PV system is attached below.

Figure 2: Waterton Microgrid Solar PV System

BESS:

BESS was provided by Alberta local supplier ENEON ES. Throughout the RFP process, factors such as project schedule, product performance, modularity, installation, and operation easiness were considered. The BESS capacity is sized at 5.2MWh considering historical outage frequencies, outage durations and load level at the Town of Waterton during peak season.

The BESS is enclosed within two (2) customized containers, with a dimension of 20 ft(L) x 10.5 ft(W) x 9.5 ft(H). Each container has a weight of 59,200 lb with battery modules installed. To prevent silt sliding on the hill behind the transformer for the BESS area, gabion walls were constructed behind the BESS area to prevent erosion. In October 2021, the BESS container and Battery cells were separately delivered to the Waterton site and were installed. Installation of the service transformer and Molded Vacuum Interrupter (MVI) to the BESS were also completed.

In November 2021, connection of the BESS to the distribution system and energization of the BESS were successfully completed. As part of the energization process, the BESS needed to run two full charge and discharge cycles under grid-connected mode. FortisAlberta requested for the Alberta Utility Commission (AUC)'s temporary relief to allow the BESS to export back to the distribution system and received the approval on Nov 8th, 2021.

A picture of the BESS on site is shown below.

Figure 3: Waterton Microgrid BESS System

Control System and Integration Testing:

This project utilized a microgrid controller supplied by Opus One Solutions. Opus One Solutions is the only Canadian small-medium enterprise in Canada working in the micro-grid space. They were recognized as a Global Cleantech 100 company for two years. Opus One began as a utility focused company, geared to help utilities understand and adopt renewable technologies. Additionally, Opus One Solutions uniquely understands the Canadian Utility landscape as all its research and development is conducted in Canada.

The controller from Opus One Solutions was delivered and installed on Waterton site in November 2021. The upstream voltage regulator settings were adjusted to Co-Gen mode to allow for import and export testing of the BESS. With the inverter from ENEON being a grid-forming capable inverter, FortisAlberta was able to work with Opus One solutions to coordinate the settings between the reclosers, the microgrid controllers and the inverters to achieve transitions of power during outages and restoration of services.

After the BESS was energized and with the control system installed. Opus One Solutions, ENEON and FortisAlberta's engineering team worked together and delivered several communication and control system testing to ensure the integration and functionalities of the Microgrid. The primary testing included the following:

- ENEON & Dynapower's inverter integrations with Opus One Microgrid controller.
- Fortis Supervisory Control and Data Acquisition (SCADA) integration with Opus One Solutions' Microgrid controller.
- FortisAlberta relay settings integration with Opus One Solutions' Microgrid controller.
- BESS charging functionality testing and charging limit testing.
- Microgrid islanding capability testing.
- Islanding enable/disable through SCADA.

There were three islanding tests completed as part of the integration process. In March 2022, FortisAlberta completed an islanding test of the Town of Waterton. The BESS was able to support the town for approximately 25 minutes before the inverter detected faults. It was suspected throughout this test that a bypass switch for the Neutral Grounding Resistor (NGR) is required for commissioning the project.

In April 2022, FortisAlberta performed another islanding test for the Town of Waterton and manually by-passed the NGR during the test. The Town was successfully backed up for an hour.

In July 2022, FortisAlberta performed the third islanding test of the Town of Waterton with the bypass switch of the NGR installed. The Town was successfully backed up with black starting of the BESS.

In October 2022, there was a brief outage at the Town of Waterton and the BESS successfully kicked in and backed up the power at the Town of Waterton.

Benefits to the Town Reliability:

The Town of Waterton typically experiences 2-5 outages per year, with the outages primarily driven by extreme weather and foreign interferences such as motor vehicle collisions. Each outage duration is different

based on the source of the fault and the time takes to restore the services. The peak load at the Town of Waterton is approximately 1.1 MW. With the 5.2 MWh BESS, it could back up Waterton townsite for more than 4 hours during peak load conditions, while the solar system could offer additional support during outages depending on load conditions of the town and time of the day.

The BESS is expected to help increase power reliability of the Town by helping to avoid approximately 9 hours of outages on an annual basis.

4 Commercialization

In FortisAlberta's service area, there are several sites just like the Town of Waterton where the power supply is through a radial feeder with reliability concerns. The learnings from this project could be applied to address the reliability concerns of these communities as well.

For the Waterton BESS project, below FortisAlberta provided its updates to the success metrics that the Company submitted under its original Contribution Agreement with the ERA:

Avoided Outage Hours:

The Town of Waterton typically experiences 2-5 outages per year, with the outages primarily driven by extreme weather and foreign interferences such as motor vehicle collisions. Each outage duration is different based on the source of the fault and the time takes to restore the services. The peak load at the Town of Waterton is approximately 1.1 MW. With the 5.2 MWh BESS, it could back up Waterton townsite for more than 4 hours during peak load conditions, while the solar system could offer additional support during outages depending on load conditions of the town and time of the day.

The BESS is expected to help increase power reliability of the Town by helping to avoid approximately 9 hours of outages on an annual basis.

% BESS Round Trip energy efficiency:

FortisAlberta receives the following information from ENEON, the equipment provider for Waterton BESS.

- Nominal round trip DC efficiency is 95% when the battery is operating at rated power, and is affected by temperature, state of charge (SOC), stage of health (SOH), rates of charge/discharge.
- Self-discharge of the battery system while online and operating (all controls online, connected to PCS) is 4% per week, including both cell and monitoring board losses. While offline, battery self-discharge is approximately 2% per month.

TRL Advancement:

While the project TRL advancement was estimated as 7-8 at the beginning of the project in March 2019, the TRL advancement level is at 9 by the end of this project in Dec 2022 (Technology proven through successful deployment in operational settings). The Waterton microgrid demonstrated that it could provide back-up power to the Town of Waterton during outages, as originally expected out of this project. There also have been documentation and maintenance manuals developed from the project.

Bill 22 (Electricity Statues Amendment Act, 2022) in Alberta passed in May 2022, which aims to help Alberta's electricity system meet its customers evolving needs. The act allowed distribution and transmission utilities to own and/or operate energy storage assets under specific conditions. Both the technical and legislative advancements will help accelerate the commercial adoption of Microgrid solution to remote communities, such as Waterton.

In FortisAlberta's service area, there are several sites just like the Town of Waterton where the power supply is through a radial feeder with reliability concerns. The learnings from this project could be applied to address the reliability concerns of these communities as well.

5 Lessons Learned

Milestone 1: Design Phase Learnings

<u>BESS RFP Process</u>

Learnings: During the RFP process, several applicants asked for detailed survey and geotechnical site information to reduce the number of assumptions/considerations filed in their submissions. There is a significant cost and schedule impact to this early level of due diligence. FortisAlberta considers this is a nice-to-have scenario if resourcing allows. If completed, however, this would reduce risk of change orders to account for design changes after the RFP process was awarded.

<u>Parks Canada Environmental Approval</u>

The Environmental Approval process for the project was unprecedently detailed and complex. FortisAlberta has a strong history and positive working relationship with Parks Canada to build and operate the electric Distribution system in all National Parks in the service territory including Waterton Lakes and Banff. This project, however, being a new technology and application and being sited in the Waterton Parks Canada Operations yard took a significant amount of investigation, discussion, expert analysis, and the promise of future monitoring to get all parties comfortable.

The main considerations for review included:

- Discussions around solar siting for:
    - Visual impact from popular points-of-interest to not disrupt the visitor experience.
    - Effect of light reflection from the solar panels on waterbodies and helicopter flight paths
    - Minimizing disturbance to undisturbed areas

- Temporary and permanent fencing around the project for wildlife protection
- Plan for post construction vegetation regrowth and invasive species management
- Aligning with Parks Canada's proposed operations yard development plan

The Environmental Protection Plan required a higher than anticipated level of pre-qualification and site orientation for FortisAlberta and all contractors prior to starting construction. The significant process to acquire environmental approval contributed to the delay of competing Milestone 1 stage of the project from April 2020 to March 2021.

Learnings: This significant process to acquire environmental approval relates to the novel nature of battery storage systems. When FortisAlberta builds traditional powerline upgrade projects including a significant line rebuild after the Kenow wildfire, this environmental assessment process is familiar, consistent, and much less involved. It is expected that as BESS technology becomes more mainstream, the comfort and familiarity with the technology will result in an expedited approval process.

Stakeholder Consultation

Learnings: FortisAlberta notified the Alberta Utilities Commission (AUC), Alberta Electric System Operator (AESO), and AltaLink of the project specifics including location, size and intended operation. The AUC requested FortisAlberta to submit a Letter of Enquiry, which led to a formal project application. The AUC determined there was no material effect to other industry stakeholders and approved the project on January 15, 2021.

The AUC notice of project approval is a positive sign of the regulatory support for technology demonstration projects such as this. FortisAlberta will continue to participate in industry discussions as the regulatory environment for energy storage evolves.

Milestone 2: Construction & Commission Learnings

FortisAlberta encountered and overcame multiple challenges in Milestone 2 stage of the project, with some challenges that the Company didn't have control of, such as supply chain issues due to COVID restrictions and COVID outbreak in BESS container suppliers' warehouse. The contents below represent some of the challenges FortisAlberta encountered throughout Milestone and the learnings that could be applicable to future projects.

Project Management

Learnings: Besides supply chain challenges, the project schedule was impacted by coordination and communication issues. Field staff and a few other relevant teams (Metering, FortisAlberta Control Center (FCC), etc.) weren't fully engaged before the construction phase. The Real Time Automation Controller (RTAC) software from Opus One Solutions didn't simulate well during the final integration testing process. Field staff could have been engaged sooner prior to commissioning the project. Both the Metering and FCC teams could have been engaged at an earlier stage (design stage) as well since there were close collaborations required between those two teams. There could have been a few additional tests with the simulation of RTAC prior to final commissioning of the project. Some pre-testing with RTAC would help identify simulation issues earlier and to get these issues addressed sooner.

The learnings related to project management and coordination for this project will allow FortisAlberta to have better engagement, communications, and testing plans for identical projects in the future.

Technical Challenge:

Learnings: Through an island testing at the Town of Waterton in March 2022, FortisAlberta noticed that the Neutral Grounding Resistor (NGR) has more current running through it than expected during islanding mode due to unbalanced load at the microgrid. To address the issue, FortisAlberta decided that a bypass switch to the NGR would be required during islanding mode to avoid equipment failure in the future. There were challenges sourcing the bypass switch within the project schedule and it took some time to design the structures for the bypass switch as it was considered non-typical.

The bypass switch to the NGR wasn't identified as a requirement till the first islanding test at the Town of Waterton. If a full Electromagnetic Transients (EMT) analysis was completed ahead of time, the requirement of the NGR switch could have been identified. Sourcing of the switch and structural design could then happen at an earlier stage, which may help shorten the project schedule. A full EMT analysis could be performed at an earlier stage for future projects.

BESS Commissioning:

Learnings: There was harmonics identified during an integration testing in March 2022. Through investigations with ENEON and Dynapower, it was identified that the harmonic filter switch of the inverters was left as OFF during the BESS Commissioning process. In addition, all inverters were left at Factory Settings and were not adjusted for Commissioning.

Steps were missed by ENEON during the BESS Commissioning process, which created extra effort and time for investigation and trouble shooting. In the future, a checklist should be developed to make sure all Commissioning steps were followed and completed by vendors.

Project Coordination

Learnings: Throughout the integration testing stage of the project, the coordination between FortisAlberta, project vendors (ENEON and KCP solar) and project partner (Opus One Solutions) to complete the integration testing of the Microgrid system have impacted the project schedule. Opus One Solutions provided the Microgrid Controller for the project, ENEON provided the BESS and KCP Energy provided the Solar PV system. For each integration testing, all relevant participants need to agree on the schedule for discussion, and participants from each entity need to learn the capabilities of the equipment of the other to move forward.

For future projects, the easiness of coordination and communication between FortisAlberta and the vendors should be considered during the RFP process.

Project Learning & Knowledge Transfer:

Learnings: Through this project, FortisAlberta gained experience and knowledge on commissioning, integration testing and maintenance of the Battery Energy storage system. The Company built its operation manuals and delivered training to its field crews and FCC for future BESS operations. This will provide a solid

foundation for enhancements for identical projects in the future and allow faster deployment of the BESS once it's commissioned.

Broader impacts of the learnings to the industry and beyond

FortisAlberta presented its learnings from this project and some of its technical challenges (such as seamless transition of the system and protection requirements) through the Alberta Smart Grid Consortium and Alberta Power Industrial Consortium. The attendees include members from other utilities and project partners.

From the technology advancement perspective, the learnings from Waterton microgrid are greatly valuable to similar technology deployment in the future and provides a great foundation for further enhancements.

On the legislation side, Bill 22 (Electricity Statues Amendment Act, 2022) in Alberta passed in May 2022, which aims to help Alberta's electricity system meet its customers evolving needs. The act allowed distribution and transmission utilities to own and/or operate energy storage assets under specific conditions.

On the regulatory side, Waterton microgrid is a great example that demonstrates the economic and social benefits of utilizing a non-wire alternative to help a remote community with their reliability concerns. The project required less construction work and is expected to create economic benefits to rate payers.

Both the technical and legislative advancements, along with the social and economic benefits, are expected to help accelerate the commercialization of microgrid solutions to remote communities and to other applications.

6 Environmental Benefits

The direct GHG offsets of this demonstration project are from:

1. The local production of renewable energy, offsetting consumption from the Alberta Interconnected Electric System (AIES).
2. Restoring electricity supply to customers in the Town of Waterton by battery-stored energy from the AIES compared with diesel backup generation.

FortisAlberta estimated ~1,540 tCO2e could be offset by the Waterton microgrid system till 2030, including the emissions reduction from both the Solar PV system and the BESS. ~192 tCO2e could be reduced on an annual basis as compared to if Diesel generators are utilized to provide the backup power. Since the Solar PV system was commissioned in January 2022, the Solar PV system has generated a total energy of 341 MWh by the end of 2022, offset the Town of Waterton's energy consumption by 8% with renewable energy.

Environmental benefits of similar projects in the future could be impacted by system factors and changes of calculation parameters.

System Factors:

For the solar PV generation system: type of the solar PV materials, solar radiation received, temperature, weather, inverter efficiency, solar panels orientation, life span of the assets all could impact the performance of the solar generation and therefore impact its greenhouse gas reductions/benefits.

For the Battery Energy Storage System: parameters such as customers' load level at the time of the outage, outage duration, frequency, time to restore the services as compared to historical restoration could all impact its estimated benefits towards greenhouse gas reduction. In addition, battery efficiency and the length of its life span could impact GHG benefits as well.

Changes of Calculation Parameters

Other factors that may impact the GHG emission reductions calculation could include: the change of emission displacement factors to diesel generation and Alberta Grid Energy Generation, calculation methods to decide the GHG emissions, etc.

7 Economic and Social Impacts

Economic benefits:

The Waterton microgrid is a more economical alternative to address the Town's reliability concern as compared to constructing long distribution feeders. The Waterton microgrid is a more economical non-wire alternative and is expected to provide benefits to rate payers.

In addition, through the process of the project from January 2019 to December 2022, there have been ~40 employees from FortisAlberta that actively and inactively participated in the project due to technical requirements and ~10 participants from Opus One Solutions. In addition, there were workforces actively working on this project from both the solar system and BESS vendors. Employees frequently form different working groups to address specific project challenges. There were site visits arranged to ENEON's warehouse to educate project participants about BESS and visitations to Waterton Sites for integration testing and commissioning of the system. Although the actual number of new employments driven by this specific project isn't fully quantifiable, it is expected that new employment opportunities would emerge if there are high volume of similar projects in the future.

Building Innovation Capacity:

The professionals that worked on developing the projects had different technical backgrounds and effectively combined their expertise to make this project a success. Several engineering PhD professionals were involved in developing the project as well. A great number of teams in FortisAlberta participated in this project including Distribution Planning, Protection & Control, SCADA, Project Management, Metering, Power Quality, Field Services, Emerging Customer Solutions, etc. FortisAlberta believes that Distributed Energy Resources (DER) technologies have the potential to create significant disruptions on the power grid and has gained more knowledge of utilizing DERs to create grid benefits through this project. The Company now has a larger individual engineering team that performs DER Planning and is looking into other locations where BESS could be utilized as a better alternative to address the concerns of the distribution system and its customers.

In addition, it is highly possible that future identical projects would require similar or more advanced skillsets and knowledge as compared to the Waterton microgrid project and create employment opportunities.

Social: Through the project, FortisAlberta was able to enhance the existing positive relationship with Parks Canada. The Environmental Approval process for the project was unprecedently detailed and complex. FortisAlberta has a strong history and positive working relationship with Parks Canada to build and operate the electric Distribution system in all National Parks in the service territory including Waterton Lakes and Banff. This project, however, being a new technology and application and being sited in the Waterton Parks Canada Operations yard took a significant amount of investigation, discussion, expert analysis, and the promise of future monitoring to get all parties comfortable. FortisAlberta appreciates the level of attention and care that Parks Canada has contributed to the project and is confident that the Plan as agreed upon in the Basic Impact Assessment will result in successful construction and operation.

The way FortisAlberta and Parks Canada worked together to address the community concern at the Town of Waterton delivered a strong message that FortisAlberta is looking ahead and being innovative of its solutions to the distribution system and is engaging in innovative partnerships with the communities to address their service concerns.

In FortisAlberta's service area, there are several local and indigenous sites just like the Town of Waterton where the power supply is through a radial feeder with reliability concerns. The learnings from this project could be applied to address the reliability concerns of these communities as well.

8 Scientific Achievements

With this project, FortisAlberta contributed three papers to IEEE with two papers already published(APPENDIX B & APPENDIX C), one paper accepted and is expected to be presented, include the followings:

1. K.A. Wheeler, H. Buyukkocabas, M. Simone, J. Guo, E. Lee and B. Winger, "A Protection and Operating Scheme Integrated into a Grid-Edge Microgrid," in *IEEE Global Power, Energy and Communication Conference*, pp. 1-5, Cappadocia 2022.
2. K.A. Wheeler, H. Buyukkocabas, M. Simone, T. Ding, B. Smith and N. Cumming, "A Microgrid Case Study: Steps and Considerations for Implementation," in *IEEE Global Power, Energy and Communication Conference*, pp. 1-5, Cappadocia 2022.
3. K.A. Wheeler, J. Guo, K. Paterson, G. Edwards, E. Lee, M. Simone and P. Zhou, "Practical Lessons Learned from an Installed Grid-Edge Microgrid," in *IEEE Power and Energy Society General Meeting*, pp. 1-5, Orlando 2023. (ACCEPTED MANUSCRIPT)

It is expected that the presentations and the media publications could help other utilities and the industry look into the applications of the same or similar technology in their service areas to create social and economic benefits for their customers. The learnings that are shared by FortisAlberta under this project could help other utilities and the power industry understand the challenges that the Company encountered during project development and create plans to optimize the deployment process. It is also expected that the provincial utility regulators could see the positive impacts that the Waterton microgrid creates to the local community and to the rate payers, which may help accelerate the development of regulatory framework for more deployment of non-wire alternatives in the future.

9 Overall Conclusions

The Waterton Energy Storage Project was designed as a non-wire alternative solution to address reliability concerns in a remote community. The objectives of this project, including environmental, economic, power reliability and learnings sharing, as described in the Executive Summary of this report were all successfully achieved. Project design stage started in March 2019 and the project was commissioned in August 2022. The project successfully demonstrated its ability to provide backup power to the Town of Waterton through a brief outage in October 2022.

FortisAlberta estimated ~1,539 tCO2e could be offset by the Waterton microgrid system till 2030, including the emissions reduction from both the Solar PV system and the BESS. ~192 tCO2e could be reduced on an annual basis as compared to if Diesel generators are utilized to provide the backup power. Since the Solar PV system was commissioned in January 2022, the Solar PV system has generated a total energy of 341 MWh by the end of 2022, offset the Town of Waterton's energy consumption by 8% with renewable energy.

Throughout the project, FortisAlberta was able to gain expertise and knowledge on the RFP process of microgrid equipment (solar PV, BESS, etc.), environmental approvals, stakeholder consultation, project management, project coordination and project commissioning. FortisAlberta also developed its operation & maintenance manuals, procedures documents and conducted training to field staff and control centers. The learnings from this project have helped lay a solid foundation for future enhancement and microgrid deployment.

The project has created environmental, social, economic and workforce benefits as described in the report, increased clean energy usage and enhanced the reliability of power services at the Town of Waterton. The project also helped support the Province of Alberta with its emission reduction target and effectively demonstrated the utilization of BESS as an alternative to Diesel generator to provide backup service. FortisAlberta worked well along with the project vendors including ENEON ES and Opus One Solutions, and together delivered multiple presentations to Alberta Smart Grid Consortium and Alberta Power Industrial Consortium to share its learnings and to support grid innovation with new DER technologies. The project was also made aware to the Alberta Utility Commission to introduce the potential application of BESS technology and to help develop the regulatory framework for future BESS deployment in Alberta power grid. With Bill 22 passed in Alberta, the Waterton microgrid project sets up a great demonstration of how distribution facility owners could effectively adopt new DER technologies to create benefits to rate payers, businesses, and industries.

10 Next Steps

FortisAlberta identified multiple areas to enhance the project process and practices, some examples of areas for improvements could include:

- Better detailed survey and geotechnical site information for BESS project during future RFP process.
- Education to increase customers' familiarity on BESS to accelerate stakeholder consultation process.

- Early engagement of operations and field staff.
- Take project coordination effort into consideration through RFP process.
- Create checklists to make sure all commissioning steps are followed by the project vendors.
- Early detail project analysis to identify potential technical challenges.

FortisAlberta will compile its learnings from this project and utilize it to refine its practices and process for future projects deployment. FortisAlberta will also investigate other locations in its service area where BESS could be utilized to address distribution system deficiencies following the Bill 22 legislation.

The project learnings are expected to be continuously shared in discussions and conferences to help advance the technology usage and development of regulatory framework in Alberta. In FortisAlberta's service area, there are several sites just like the Town of Waterton where the power supply is through a radial feeder with reliability concerns. The learnings from this project could be applied to address the reliability concerns of these communities as well.

11 Communications plan

Through each stage of development for this project, FortisAlberta presented its learnings through the Alberta Smart Grid Consortium and Alberta Power Industrial Consortium. The attendees include members from other utilities and project partners. FortisAlberta also educated its customers about the utilization of Waterton microgrid at various customer meeting conferences and tradeshows. The audience groups, presenters and the date of the presentations have been included in the table below. The presentation contents(APPENDIX A) have also been attached as part of this report.

Audience Groups	Presenter	Date
Alberta Smart Grid Consortium Project Committee	FortisAlberta	5-Oct-20
Alberta Smart Grid Consortium Project Committee	FortisAlberta & Opus One Solutions	8-Dec-20
Alberta Smart Grid Consortium Project Committee	FortisAlberta	31-May-21
Alberta Power Industry Consortium	FortisAlberta	28-Jun-21
Alberta Smart Grid Consortium Project Committee	FortisAlberta &ENEON	23-Feb-22
Alberta Smart Grid Consortium Project Committee	FortisAlberta	TBD

Since the project was Commissioned in August 2022, there haven't been additional project communications to the public as the Company is hoping to review the performance of the system through multiple real outages events. FortisAlberta is planning to host the Ribbon Cutting for Waterton microgrid in April 2023 and is planning to invite public media (such as CTV Lethbridge, Globe and Mail, Lethbridge Herald, etc.), project participants, officers and employees from all federal, provincial and local levels.

The Company will arrange a presentation session with the Alberta Smart Grid Consortium to discuss its observations and overall learnings from the Waterton microgrid project in 2023.