City of Summerside: Capacity Resource Plan

Submitted to: **CITY OF SUMMERSIDE**

Prepared by: **DUNSKY ENERGY CONSULTING**

March 2019

CITY OF SUMMERSIDE CAPACITY RESOURCE PLAN

SUBMITTED TO:

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ABOUT **DUNSKY**

Dunsky Energy, a leading clean energy advisory, provides strategic analysis and counsel in the areas of energy efficiency, distributed renewables and sustainable mobility. We support clients across North America through three services: we assess opportunities (technical, economic and market), design strategies (programs, plans and policies) and evaluate performance.

Dunsky's team of 20+ experts is wholly dedicated to helping our clients build a sustainable energy future.

EXECUTIVE SUMMARY

Summerside Electric, owned and operated by the City of Summerside, currently serves more than 7,000 commercial and residential customers, and, as part of its regular planning processes and service requirements, it is required to forecast future electricity needs of those customers. In its most recent analysis, Summerside is anticipating growth in both energy and capacity needs in order to serve its customers. The utility's contract to import capacity from New Brunswick will expire at the end of 2024, and Summerside is also expecting costs for continuing to import that capacity to rise.

For this reason, the City retained Dunsky Energy Consulting (Dunsky) to conduct a study and provide options and recommendations on ways it could address its capacity needs for the next 15 years. This report provides the results of our study, which, per the City's requirements, only examines capacity (not energy) needs and options.

CAPACITY PLANNING

Capacity planning is **forecasting what is needed to meet customers' demands for electricity at all times given foreseeable emergencies and contingencies**. In other words, it is a utility's responsibility to plan for, and be able to meet, the amount of electricity that customers will require at any one time. In reality, this means planning for the time each year when the most electricity is being used.

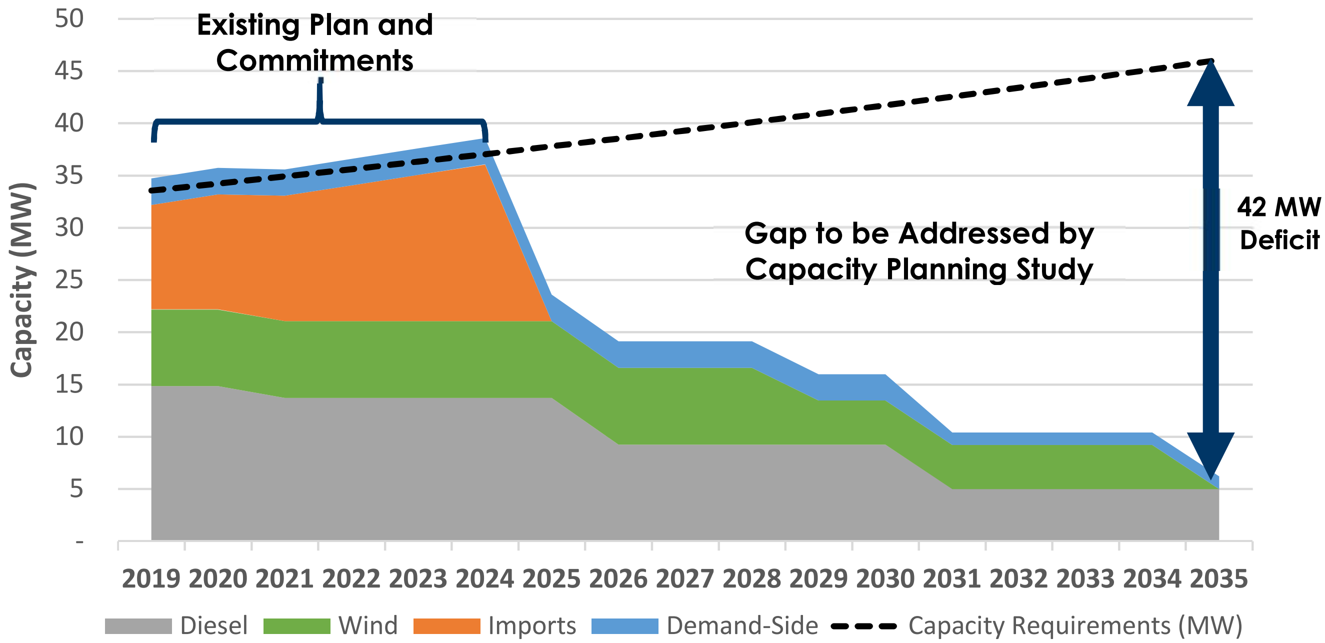
As an electric utility that is part of the New Brunswick System Operator (NBSO) balancing area, Summerside Electric is required to follow capacity planning criteria set out by the North American Electric Reliability Corporation (NERC) for the Northeastern region. In addition to its obligations under NERC, Summerside Electric also includes the following considerations in its capacity planning. In other words, an optimal solution would be:

- Revenue-neutral
- Resilient
- Able to have black-start capability
- Secure
- Diverse

SUMMERSIDE'S EXISTING CAPACITY SUPPLY

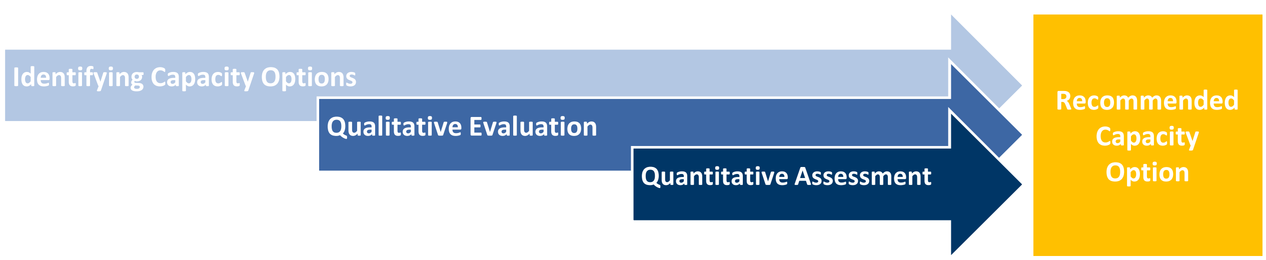
Using data on the capacity contribution of Summerside's generation asset' and lifetime as well as import contracts, we projected available capacity out to 2035. With the end of the current NB Power contract in 2024 and end-of-life of some existing assets, Summerside faces a capacity deficit of 15 MW in 2025 going up to 42 MW by 2035 (see Figure ES1).

Figure ES1. Summerside's existing capacity mix, 2019-2035



CAPACITY OPTIONS

After identifying capacity options and spending time understanding stakeholders' concerns and considerations, our team conducted a qualitative evaluation to determine the feasibility of options. From this evaluation, a short-list of options was developed; this list was used for our quantitative (financial) assessment:



Based on our initial qualitative analysis, the following options were selected for further analysis:

- Capacity imports (baseline option);
- Expansion of the Heat For Less Now (HFLN) program;
- Expansion of the Interruptible Load program (ILP);
- Grid-scale battery storage;
- Biodiesel generator; and
- Diesel generator.

ANALYSIS RESULTS

The conducted analysis highlighted the capacity adequacy and financial impacts under the baseline scenario (capacity imports) as well as under five distinct alternative capacity options in isolation. Table ES1 on the following page presents the summary of obtained results and indicates the following key takeaways:

- **No single capacity option except for capacity imports is capable of covering all of Summerside's future capacity deficit**, meaning that any option besides relying exclusively on imports to address the deficit will require the use of a "stacked approach" that features several options.
- **Based on projected cost assumptions for imports,[1] every assessed option has a positive economic case relative to imports either immediately or in the medium term (2025)**, as indicated by the net positive NPV for each modeled scenario. We note, however, that since energy and capacity prices can fluctuate, there is uncertainty regarding the cost assumptions, and it is therefore prudent to monitor changes to capacity market prices in the region, as changes to the forecast could impact the timing and feasibility of specific options.
- **All analyzed capacity options result in a reduction in revenue requirements**, which would correspond to rate decreases to the utility's customers or an increase in dividends paid to the city when compared to importing capacity. These include a diesel generator, the expansion of the HFLN and Interruptible Load programs, and battery storage (provided it is installed in 2025 or later and that current cost assumptions hold true).
- **Demand-side options have the most advantageous business case to Summerside**, with the Interruptible Load and Heat For Less Now program expansions having the lowest capacity cost and highest NPV.

[1] The study used a forecasted increase in import costs between 2019 and 2035 based on a New England Avoided Energy Supply Components study and other factors (details are included in Appendix D: Capacity Imports).

Table ES1. Summary of analysis results for all options as compared to imports

Options		Levelized Unit Cost ($/kW/year)	Net Present Value (NPV)	Average Revenue Requirement Impacts (% over lifetime)	% of Capacity Resources On-Island (by 2035[2])	Relative GHG Emissions[3] (qualitative)
Imports		(Baseline against which alternatives are compared)				
Diesel	2020	$ 96	$ 0.2 M	-0.2%	49%	High
	2025	$ 96	$ 3.2 M	-0.6%	49%	High
Heat for Less Now		$ 72	$ 7.0 M	-2.2%	36%	Low
Interruptible Load		$ 12	$ 3.4 M	-0.5%	28%	Medium
Battery Storage	2020	$ 249	($ 4.2 M)	+ 1.4%	31%	Low
	2025	$ 166	$ 1.7 M	-0.7%	31%	Low
	2030	$ 120	$ 4.4 M	-1.8%	31%	Low
Biodiesel	2020	$ 97	($ 0.8 M)	-0.1%	49%	Medium
	2025	$ 97	$ 2.4 M	-0.4%	49%	Medium

Most desirable | Least desirable

[2] Percentages represent the portion of capacity provided by on-Island resources, assuming the analyzed option is the only one added to existing on-Island capacity that will still be operating in 2035.

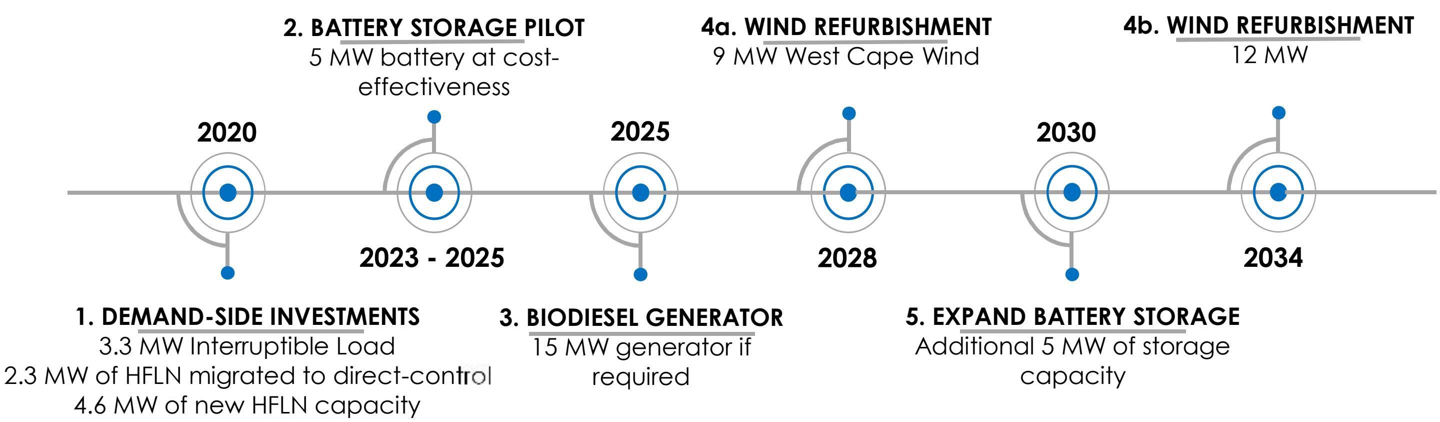
[3] GHG emissions are qualitatively assessed based on a per-unit basis, not in the context of overall use. For example, Summerside's existing diesel generation contributes only 1% of energy to its system, so while the GHG emissions are high according to the per-unit basis used in the analysis, they are not a large emissions source on an annual basis.

RECOMMENDATION

Based on the results of our analysis, **Dunsky proposes that Summerside takes a staged approach to capacity resource planning by implementing multiple options**. If the utility "stacks" multiple capacity sources rather than relying on one option only, Summerside has the potential to meet its goal of supplying a greater share of its capacity needs with on-Island resources.

Figure ES2 below provides an overview of this stacked option; additional details follow.

Figure ES2. Timeline of stacked recommendation option



This recommendation can be implemented in multiple ways; in this report, we outline two: eliminating all capacity imports to meet the City's needs for greater security and independence of its electricity system, and maintaining some level of imports.

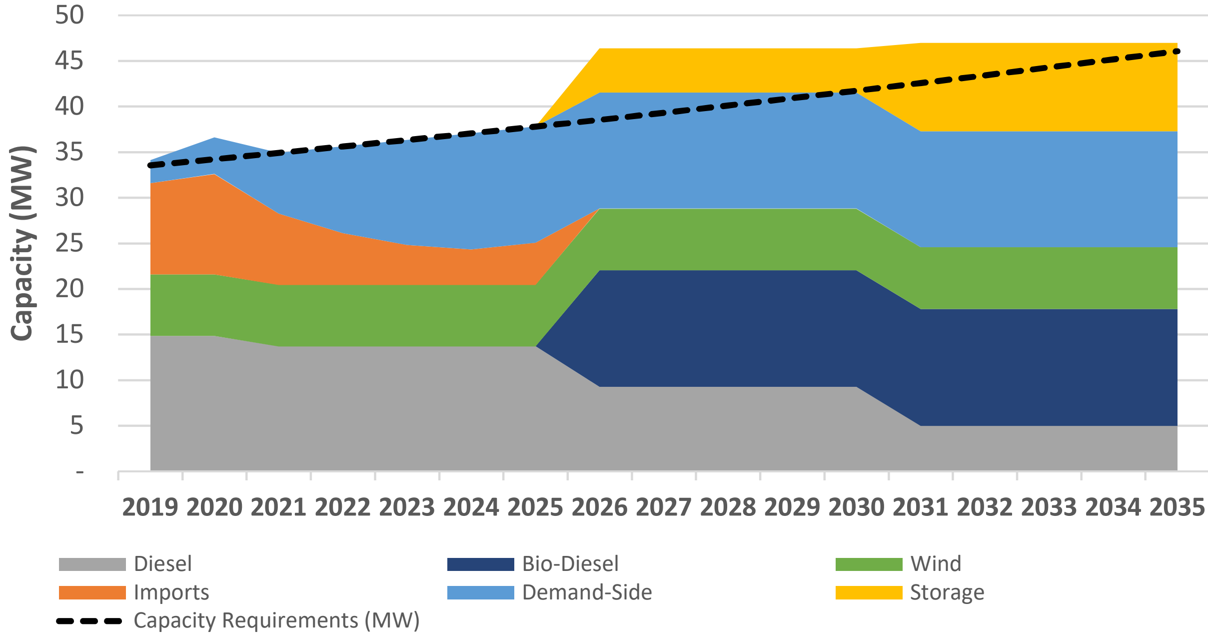
OPTION ONE: NO IMPORTS

PROJECTED IMPACTS

Resource Adequacy

The recommended strategy enables Summerside to fully meet capacity requirement with on-Island resources, gradually reducing the utility's reliance on imports from the current 30% down to 10% in 2023 and 0% by 2025 (see Figure ES3). Another notable change is the increased diversity in Summerside's capacity mix, with the introduction of biodiesel generation and battery storage.

Figure ES3. Recommended capacity resource mix in MW



The proposed staged approach provides Summerside with the flexibility to adapt its system and react accordingly under changing market and technology conditions, while still securing the city's long-term capacity needs.

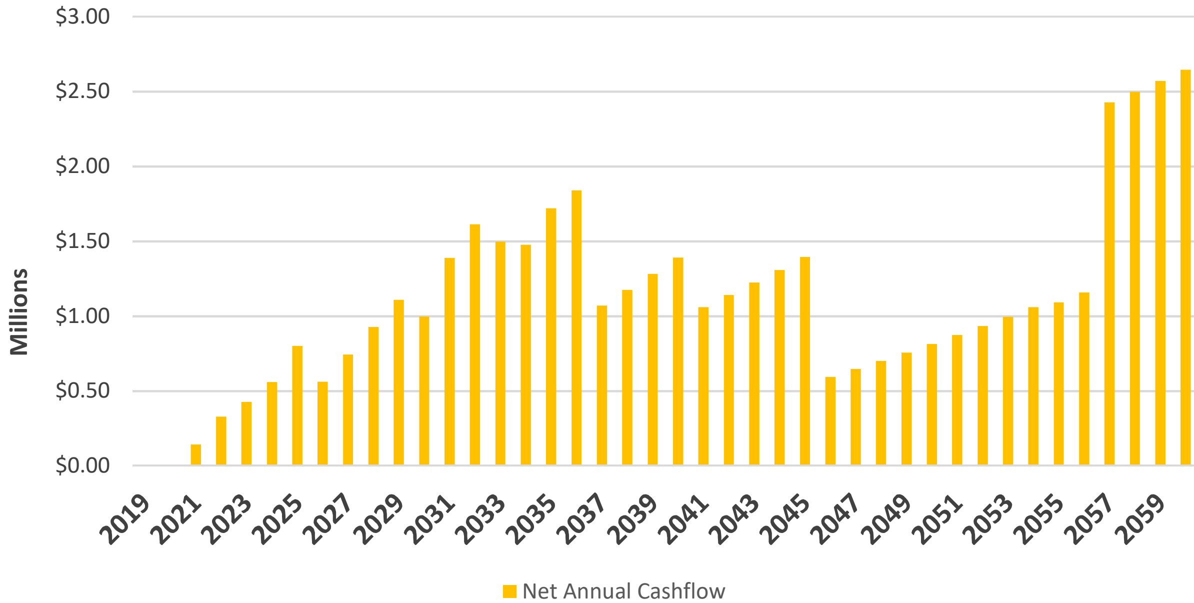
During the period of 2025 to 2035, additional planned capacity serves as a buffer that allows Summerside to closely monitor its requirements and resources and react to unforeseen shifts such as increased peak demand due to electrification of heating and transportation or lower than projected demand-side savings. Additionally, it reduces Summerside's reliance on the proposed battery during early years of the piloting phase.

Financial Impacts

The proposed option has a positive NPV and net-positive cash-flow beginning in 2020. This results in a decline in Summerside's revenue requirement as a result of the avoided energy and capacity import costs. Compared to other capacity options, the recommendation has the highest NPV, second-lowest aggregate levelized cost of capacity and the lowest decline in revenue requirements.

Figure ES4 shows that the revenues (avoided costs and miscellaneous benefits) and costs (capital and operational) associated with the recommended option provide Summerside with a net positive cash flow by 2020, meaning that when compared to the baseline imports option, the recommendation improves the City's financial position.

Figure ES4. Annual cash flow of recommendation compared to baseline



In the figure above, the net annual cashflow consists of revenues after expenses have been paid (2019 and 2020 are neutral). It is important to note, however, that these are not actual project revenues; rather, they are revenues *in comparison to the baseline option* (capacity imports), meaning that Summerside would save money by implementing the recommended option if import prices materialize as assumed.

OPTION TWO: MAINTAIN IMPORTS AS PART OF AN OVERALL DIVERSE SUPPLY MIX

While the recommended strategy maximizes energy security by ensuring 100% of capacity requirements are met through on-Island resources, there are several trade-offs to consider before choosing this path, such as changing technology, the uncertainty of cost changes to battery systems, effort required for demand-side resource options, and the role of imports as well as a changing role of renewables and sustainability in PEI and across Canada.

In addition, Summerside's history and existing relationship with NB Power is not something to discard lightly. The contract between the two utilities provides security and stability for the City, particularly given the changing landscape of technology and general utility planning highlighted above.

For these reasons, we recommend that Summerside consider retaining some level of imports in Summerside's portfolio of capacity resources. Imports could be reduced to allow for a greater diversity of capacity supply, but nevertheless, some level of imports would be beneficial. It would also allow Summerside to continuously evaluate its needs and determine the appropriate time to implement other stacked options, all of which are still valid in a scenario with continued imports.

NEXT STEPS AND CONCLUSION

If the City implements these recommendations, there are some short-term and intermediate steps that are required for implementation. These include:

- Developing a marketing and outreach strategy for demand-side programs;
- Assessing staffing needs and resources;
- Prepare for each stage of implementation in advance; and
- Revisit and adjust the capacity plan on a recurring basis.

Dunsky's analysis led to a recommendation that Summerside consider a stacked approach to address current and future capacity needs. Under this approach, multiple capacity options and sources are planned for and built over the coming years to **ensure a stable and diverse resource mix** that will meet peak demand and serve the City's needs.

In addition to meeting the City's objectives of having a **secure, reliable and diverse resource mix**, the proposed approach allows the city to **maintain flexibility moving forward,** which is critical when forecasting capacity needs in a time of fast-paced technological and policy changes. In other words, it:

- **Avoids technology lock-in** (e.g. investing in an option that may become too outdated in comparison to other emerging opportunities) and hedges against technology innovation (e.g., emerging technologies or significant cost reductions in newer ones). Newer technologies that are not yet commercialized may change the landscape even further in the future.

- **Allows Summerside to adapt its system to changing conditions,** which may include uncertainty around future load growth in the context of electrification of heating and transportation.

- **Provides an ability to adapt to changing policy directions** such as potential future constraints placed on specific technologies by federal or provincial governments, as well as an increasing demand for renewable energy.

- **Allows additional considerations**, important for policymakers but out of scope of this analysis, to be included prior to any particular option being implemented (for example, the ability to decommission existing diesel generators earlier or adding imports for diversity purposes as included in our Plan B).

These drivers for a diverse and flexible capacity supply also mean that actual implementation decisions and preferred timing of each stage are flexible and can be made closer to specific milestones. This means the utility can consider operational needs that will shift over time. In other words, the recommendation helps to ensure that Summerside does not make a short-term decision that have long-term unintended consequences. It enables continued monitoring of the changing context of grid operations and opportunities, costs and policy considerations before specific, all-or-nothing decisions are made.

LIST OF ABBREVIATIONS AND DEFINITIONS

Abbreviation or Term	Definition
8760	The number of hours in a year, used in analyzing peak demand forecasts
AESC	Avoided energy supply components
Ancillary Services	Electrical system services necessary to support the reliability of the power grid and its operations at acceptable voltage and frequency level
Arbitrage	Making a profit by benefiting from price differentials between different timeframes by purchasing energy at a lower cost during off-peak and selling energy at a higher cost during peak hours
Black Start	The practice of restoring electric power service after an outage without relying on an external transmission network
BNEF	Bloomberg New Energy Finance
Capacity	The greatest amount of electricity that a utility can supply at any one time
Demand-Side Resources	Electricity generation sources that supply electricity to individual customers rather than to the electrical grid as a whole, or sources that reduce individual customers' need for electricity (note that some customers may choose to then supply excess electricity to the grid via contracts with the utility (as in net metering for solar panels), but the electricity is still generated for those customers specifically)
Derated Value	The capacity of a generator that can be claimed towards the utility's capacity requirements
Dispatch	An algorithm or strategy that defines the rules of operations for a generator or a storage asset
Direct Load Control Management (DCLM)	Shifting or reduction of energy use that is under direct control of a utility (i.e., the utility is able to change when a piece of technology uses electricity or turn it off as required)
Discount Rate	The interest rate used in net-present value (NPV) cash-flow analysis
EIA	United States Energy Information Administration
Energy	The total amount of electricity that Summerside Electric supplies to customers throughout the year
Engineering, Procurement and Construction (EPC) contract	A contracting arrangement in which the contractor is responsible for all activities including design, procurement, construction, commissioning, and handover to the client
EV	electric vehicle

Abbreviation or Term	Definition
Heat For Less Now (HFLN)	A program run by Summerside Electric by which customers receive a reduced electricity rate in return for installing an electric thermal storage (ETS) system that stores energy from off-peak times for use during on-peak times
ISP	Internet Service Provider
Interruptible Load (IL) or Interruptible Load Program (ILP)	Electricity use that customers agree (via contract) will be reduced when required by the utility
Megawatt (MW)	A unit of electric power (equal to 1 million watts) produced by a generation source
Net Present Value (NPV)	The total value of cash flows over a period of time, where future cash flows are converted to the equivalent amount in present-day dollars
New Brunswick System Operator (NBSO)	The entity responsible for the reliability and adequacy of the integrated electricity system within New Brunswick, PEI, Nova Scotia, and part of Northern Maine. The entity is currently New Brunswick Power
North American Electric Reliability Corporation (NERC)	The regulatory authority responsible for ensuring the "effective and efficient reduction of risks to the reliability and security of the grid"[4] throughout North America
Peak demand	The greatest amount of electricity that a utility's customers use (demand) at any one time through the year.
Power Purchase Agreement (PPA)	An electricity power agreement or contract between a buyer and seller of electricity
Request for Information (RFI)	A stage used in some procurement processes in which suppliers provide written information about their capabilities. This information is used to assess next steps and potential to move forward with a full request for proposals
SOC	State of charge
Supply-Side Resources	Electricity generation sources that supply electricity to an overall electrical grid or system, generally commissioned and operated by a utility
T&D	Transmission and distribution (infrastructure that enables the flow of electricity from its source to customers)
TOU	Time-of-use rates in which customers pay a higher electricity rate during periods of higher demand and lower rates during periods of less demand

[4] https://www.nerc.com/AboutNERC/Pages/default.aspx

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Summerside Electric, owned and operated by the City of Summerside, currently serves more than 7,000 commercial and residential customers, and, as part of its regular planning processes and service requirements, the utility is required to forecast future electricity needs of those customers. In its most recent analysis, Summerside is anticipating growth in both energy and capacity needs in order to serve its customers (see text box below for definitions or the Overview of Capacity Planning section of this report). The utility's contract to import capacity from New Brunswick will expire at the end of 2024, and Summerside is also expecting costs for continuing to import that capacity to rise.

Energy: The total amount of electricity that Summerside Electric supplies to customers throughout the year. On customers' bills, this is measured in the number of kilowatt-hours (kWh) used.

Capacity: The greatest amount of electricity that Summerside Electric can supply *at any one time.*

Peak demand is the greatest amount of electricity that the utility's customers use (demand) at any one time through the year. Summerside's peak demand is approximately 28 MW, and Summerside Electric must have at least as much capacity (plus additional reserves in case peak is higher than expected) to meet this demand when it occurs, even if very little of that amount is required for the vast majority of the year.

For this reason, the City retained Dunsky Energy Consulting (Dunsky) to conduct a study and provide options and recommendations on ways it could address its capacity needs for the next 15 years. This report provides the results of our study, which, per the City's requirements, only examines capacity (not energy) needs and options.

The study involved the following key steps as outlined in Figure 1.

Figure 1. Summerside capacity planning study key steps

STRUCTURE OF THE REPORT

This report is structured as follows:

Overview of Capacity Planning

This section provides an explanation of capacity planning, including requirements, considerations, and common misconceptions.

Methodology

This section explains our process for completing the study, the analytical framework we used, and key assumptions and considerations used in the study.

Capacity Options

In this section, we outline the initial "long list" of capacity options and explain how they were narrowed down to the list of analyzed ones.

Assessment of Final Options

This section provides the results of our analysis, with each capacity option summarized individually.

Recommendation

This section presents Dunsky's recommendation based on our analysis and key findings.

Conclusion

The conclusion addresses final points and considerations that may be of importance to Summerside Electric.

OVERVIEW OF CAPACITY PLANNING

Capacity planning is **forecasting what is needed to meet customers' demands for electricity at all times given foreseeable emergencies and contingencies**. In other words, it is a utility's responsibility to plan for, and be able to meet, the amount of electricity that customers will require at any one time.

In reality, this means planning for the time each year when the most electricity is being used (see Figure 2 below for an analogy).

Figure 2. Analogy for capacity planning

Analogy for Capacity Planning

A small car has much less storage space than a minivan. Due to its small size (among other reasons), it uses much less energy (gasoline) than the van.

As an analogy for capacity planning, think about a family of 5 or 6 people. If the family were planning which type of vehicle to purchase, they would need to consider the different situations the vehicle was needed for:

- For general, everyday purposes such as driving to work (overall use over the course of a year) a small car would be more appropriate because the extra space is not needed on a regular basis and the car is less expensive to operate.
- For family outings and events, however, the family needs to fit everyone in the vehicle. In these cases, a minivan van is more appropriate for the family's needs.

The family may decide it is more efficient to buy the car and borrow or rent a van for those times when it is needed. In reality, many families end up purchasing both, using the car for commuting and the minivan for family requirements, which also works for the analogy but may cost more.

In this analogy, the rationale for buying a car for regular, everyday use represents **energy planning: How much energy do we need over the course of the year, and how do we provide it in a cost-effective and sustainable way?**

However, the rationale for buying a van (or ensuring that one is available) for those times when we need more space represents **capacity planning: How much energy do we need at those few times when demand for energy (or space, in the case of our analogy) is highest?**

With capacity planning, we need to plan for those days when we need the extra space.

As an electric utility that is part of the New Brunswick System Operator (NBSO) balancing area, Summerside Electric is required to follow capacity planning criteria set out by the North American Electric Reliability Corporation (NERC) for the Northeastern region, as outlined in the following section.

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION REQUIREMENTS

NERC sets the capacity requirements for North American electric utilities. In the Northeastern region, which applies to Summerside, these requirements include the following:

- **Reserve Margin:**
  - Available capacity must include a 15% reserve margin above the utility's forecasted demand.
  - This provides confidence that the utility can meet its customers' needs if they require more energy than expected, or to cover electricity needs if a generator or transmission line experiences a planned (e.g. maintenance) or unplanned (e.g. storm or accident) outage.
  - The reserve margin must keep pace with projected load growth. In other words, Summerside must plan ahead for its reserve margin to be 15% above its future anticipated needs when they occur; it cannot simply assume that growth will not occur or reduce the reserve margin accordingly.
- **Eligible Capacity Resource Options:**
  - **Supply-Side (placed on the overall electricity system):** There are two primary sources of eligible capacity on the supply side: generation and imports.
    - Any generation resource located on the bulk power system *that can supply peak loads* (which is dependent on the timing of each jurisdiction's peak and when the resource can supply energy) is an option including thermal, hydroelectric, wind, and solar generation as well as energy storage.
    - In addition, capacity can be imported using a contract that has firm transmission rights to the utility.
  - **Demand-Side (placed behind-the-meter at customer sites):** Two key options are eligible for Summerside to address peak demands by reducing that demand when required.[5] *To be eligible, they require either a contract with the customer and/or direct control by the utility*:
    - **Direct Load Control Management (DCLM)**: Shifting or reduction of energy use that is under direct control of the utility. DCLM may control the electric supply to equipment or individual appliances on customer premises. It can be linked with price increases during peak periods (critical peak price) or provide other benefits to customers such as lower rates.
    - **Interruptible Load (IL):** Customers agree via contract to reduce portions of their energy use when required by the utility.

[5] These definitions and categories have been revised from formal NERC requirements to highlight their relevancy to Summerside Electric, but the meaning and intent have not been altered. Actual NERC requirements can be found at https://www.nerc.com/files/glossary_of_terms.pdf.

SUMMERSIDE ELECTRIC'S CONSIDERATIONS

In addition to its mandatory, technical obligations under NERC, which are designed to ensure an electric gird is secure, resilient, and diverse, Summerside Electric also includes the following considerations within those categories as well as considering some additional ones in its capacity planning. In other words, an optimal solution would be:

- **Revenue-neutral:** Would not significantly increase electric rates or reduce dividends to the City;
- **Resilient:** Would have the ability to serve Summerside customers' vital needs (e.g. heat) during an extended outage;
- **Able to have black-start capability:** Would provide the ability to restore Summerside's operations without relying on an external transmission network to recover from a shutdown;
- **Secure:** Would be located on-Island to allow for Summerside's greater control over its system;
- **Diverse:** Would contribute to greater fuel and/or technology diversity on the system, which helps to reduce cost and operational risks.

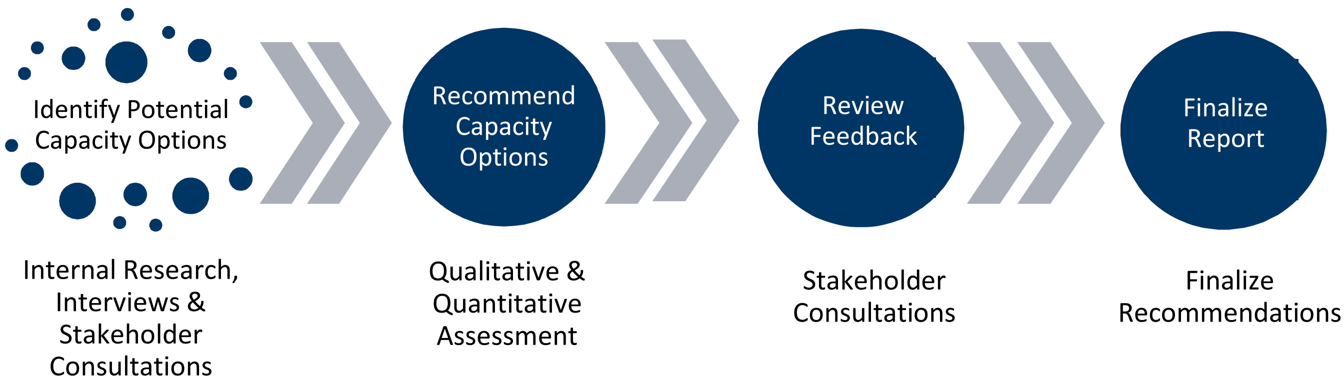
These considerations are important components of Summerside's capacity planning and were therefore included in the analysis. In the Methodology section, we outline how they were included and added additional considerations provided by stakeholders. We note, however, that these considerations, while important, are not like NERC requirements in that they are not necessary for operating a functioning system and can therefore be subject to trade-offs.

METHODOLOGY

In this section, we outline our methodology for completing the study, including an overview of the high-level process and the analytical framework used.

PROCESS

The following figure outlines the process our team has used and will continue to follow to develop the draft and final recommended capacity options for the City of Summerside:



1. **Identify Potential Capacity Options.** Dunsky reviewed the NERC requirements for capacity resources to narrow the resource options available. We also held consultations with various stakeholder groups in Summerside to present the initial NERC-compliant capacity resources and to solicit feedback on the options and other considerations we should take into account. Finally, we conducted interviews with utilities and others across North America to ensure the list of capacity resources to be assessed did not exclude viable or emerging options, to flag important issues and considerations, and to obtain cost information for the quantitative assessment.

2. **Recommend Capacity Options.** Based on the feedback received by City of Summerside councillors and various stakeholder groups (see Appendix A for a summary of stakeholder feedback), Dunsky developed a qualitative assessment of the capacity options. The assessment was used to narrow the list of candidate capacity resources for the quantitative assessment.

   A comparative analysis was then conducted to determine the cost of the selected capacity options (using net-present value or NPV) as well as their potential capacity contribution, impact on rate/revenues, and other associated avoided costs or benefits. This information was used to develop Dunsky's initial recommendations with respect to the City of Summerside's capacity options going forward.

3. **Review Feedback**. Dunsky presented our initial recommendations to City of Summerside staff, Council, and stakeholders for review and comment during public consultations (see Appendix B for a summary of stakeholder feedback).

4. **Final Dunsky Report** – Based on the feedback received, Dunsky finalized its recommendations prior to submission of the final report to the City of Summerside.

ANALYTICAL FRAMEWORK

This section outlines the key considerations, inputs, and assumptions used in Dunsky's analysis.

SUMMERSIDE LOAD

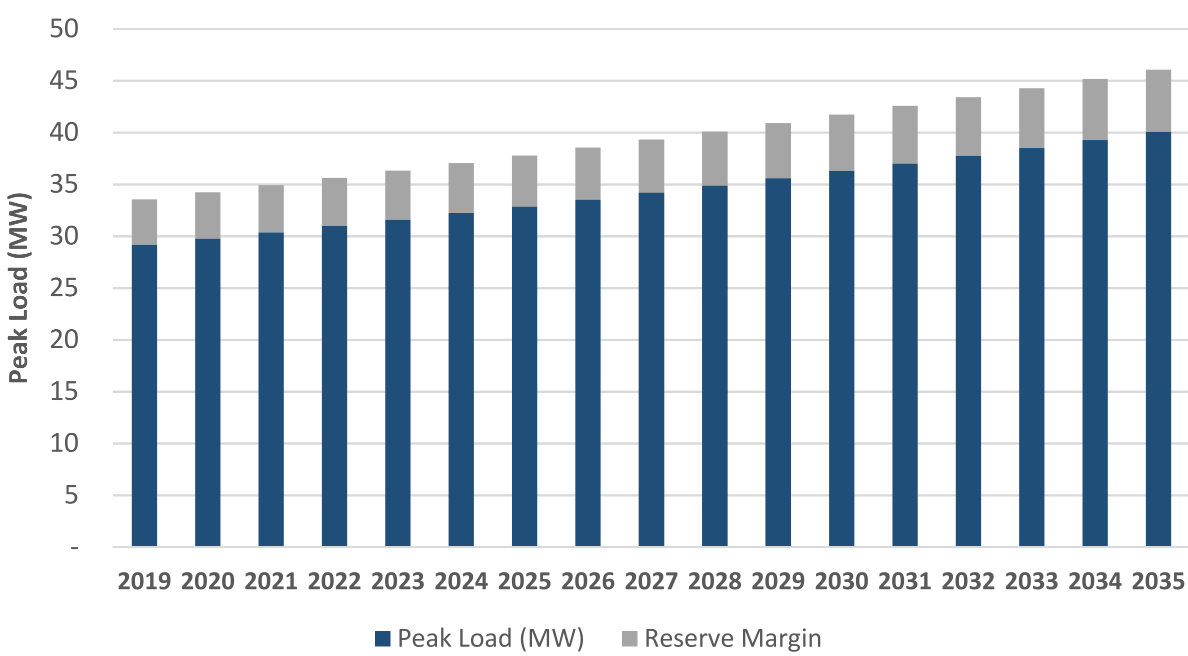
The study currently uses Summerside's existing load forecast as the basis for assessing capacity adequacy under the various scenarios. Based on historical trends, a 29.2 MW peak capacity is projected for 2019. Summerside currently uses a 2% annual load growth assumption. As per NERC requirements, the utility must also include an additional 15% of peak capacity as reserve margin. Figure 3 below highlights Summer's total capacity requirement between 2019 and 2035.

Summerside's 2 % annual load growth projection is based on historical trends. However, shifting load patterns can impact required capacity resources, either upward or downward:

- Demand-side management can shift lower peak load and reduce required capacity through such initiatives as energy efficiency or more stringent building codes, time-based rates, and demand-response programs.
- Increased electrification of transportation and heating systems can raise peak load and increase required capacity.
- Changing load patterns (such as an increased demand for cooling in the summer due to an increased penetration of heat pumps) can shift peak or create a summer peak in addition to a winter peak.

For reasons such as these, **some jurisdictions have needed to revisit their approach to load forecasting, as they can no longer rely solely on historical drivers.** Summerside could consider enhancing its current forecast methodology to account for recent and expected penetration of new electricity technologies having the potential to significantly impact grid operations. For example, a modified base-load growth that accounts for heat pumps, EVs, and planned-for DSM opportunities may provide a more nuanced picture of future constraints.

Figure 3. Summerside's forecasted capacity requirements, 2019-2035



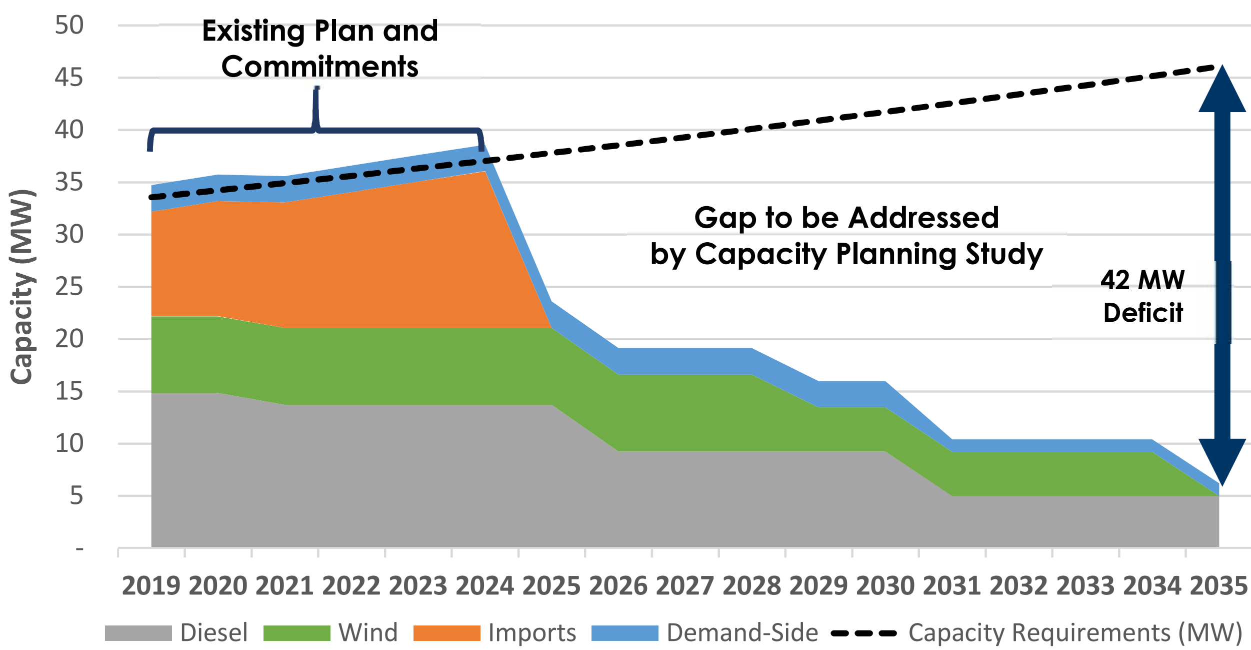
SUMMERSIDE SUPPLY

Using data on the capacity contribution of Summerside's generation assets and lifetime as well as import contracts, as highlighted in Appendix C, we projected available capacity out to 2035. The utility has a diverse resource mix:

- Diesel currently accounts for 40% of Summerside's capacity resources, but only 1% of energy consumption.
- Existing wind provides 6.8 MW of capacity.
- Capacity imports account for 30% today and with increasing contract capacity to 15 MW by 2024, will contribute to 38% of Summerside's required capacity.
- Additional demand-side capacity through interruptible load and utility-controlled thermal storage units from HFLN contribute to 1.2 MW and 1.3 MW, respectively.

With the end of the current NB Power contract in 2024 and end-of-life of some existing assets, Summerside faces a capacity deficit of 15 MW in 2025 going up to 42 MW by 2035 (see Figure 4).

Figure 4. Summerside's existing capacity mix, 2019-2035



CAPITAL INVESTMENTS

For each of the capacity options under consideration, the analysis annualizes the capital cost over the asset's lifetime using the utility's forecasted discount rate of 3.75%, provided by the city's finance team as an estimate of the interest rate the city would incur for new debt. Dunsky then calculated all annual revenue and cost streams to obtain an annual cashflow associated with each scenario. The analysis also uses the costs associated with capacity imports, which is used as the baseline for the analysis. This means that avoided energy and capacity costs resulting from the investment are considered benefits. The Net Present Value (NPV) for each option is calculated using the utility's discount rate.

REVENUE REQUIREMENT IMPACTS

Revenue requirement impacts refer to required changes in Summerside's electricity rates to ensure enough revenues are collected to recover expenses and capital expenditures. for this analysis we analyzed projected increases or decreases in revenue requirements resulting from the proposed capacity options relative to the baseline option (capacity imports). In other words, an increase in revenue requirement means that the costs are greater than if capacity is imported, and a decrease means that costs are lower than they would be by importing capacity.

Figure 5. Revenue requirement impact examples

An investment with a net cost of $1M by Summerside Electric means the utility could either:

- Raise rates to generate an additional $1M in revenue.
- Reduce dividends paid to the City.

Similarly, an investment with a net cost *reduction* of $1M over the alternative means the utility could

- Reduce rates since the $1M is no longer needed.
- Increase dividends by $1M.

However, it is important to note that **the results are highlighting shifts in *revenue requirements* resulting from the option being analyzed** using the assumptions described in this report. For example, the revenue requirement impacts fluctuate throughout the analysis period. However, **this does not mean that rates would fluctuate in the same way**; for example, once the costs for a particular option are finalized, a single rate increase/decrease (or a smoother adjustment over time) would likely occur as a result of Summerside's capital investment rather than multiple "ups and downs". Alternatively, rates may not change at all; rather, the City may decide to change the dividend paid to the City rather than adjust rates (see Figure 5 for an example). These examples of *how* the revenue requirement is collected are implementation considerations, not investment considerations, so they have not been factored in to our analysis.

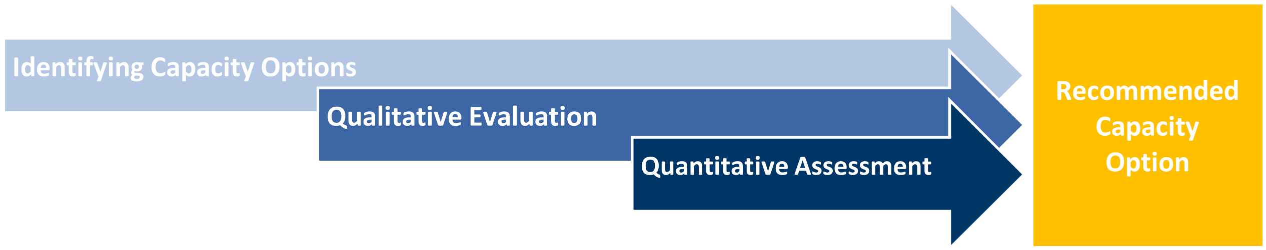
Similarly, we have not addressed changes in revenue requirement from present-day rates. Our analysis focuses on comparing multiple future options against a baseline of capacity imports. That baseline could result in a higher revenue requirement than that currently required, but this study does not address that scenario – it focuses solely on the differences between future options.

Summerside's existing 20-year plan for revenue and operating costs was used as a basis for an analysis of the revenue requirement impacts of the assessed options. Dunsky assumed the utility must maintain the same net surplus/deficit as in the 20-year plan to avoid any changes to revenue requirements. We therefore added annual cash flows from each investment option to the City's revenue and expense streams to calculate the net change and compute the required increase/decrease in revenue to maintain the same net surplus/deficit.

CAPACITY OPTIONS

In this section, we provide an overview of all options that were initially considered, as well as the process used for narrowing them down to those that were quantitatively analyzed.

At a high level, our process was as follows:



IDENTIFYING CAPACITY OPTIONS

The initial step in the analysis was to identify a "long list" of potential options for consideration. These options were developed based on existing options for Summerside and Maritime Electric, common capacity options for utilities in Canada and the United States, and our interviews with other jurisdictions on emerging opportunities for capacity supply.

While the list includes all options that were included in the initial scan, some were immediately identified as being unsuitable for Summerside. For example, solar power is ineligible for capacity planning purposes for winter-peaking systems under NERC requirements (because the sun is not shining during periods of peak demand). These unsuitable options were not moved to the qualitative analysis stage but are included in the overview provided in Table 1 along with explanations as to why they were excluded.

This long list did not include options focused on energy efficiency specifically. While these options (for example, the installation of energy-efficiency appliances or adding insulation to reduce heat loss) reduce peak demand, their purpose is not focused on demand reduction and was therefore out of scope. It also did not include new technologies that are still in research and development stages.

Conservation Voltage Reduction

Conservation Voltage Reduction, or CVR, is the practice of lowering the voltage on a utility distribution circuit while remaining within the acceptable range defined by the American National Standards Institute (ANSI). Peak reduction occurs when certain end-use loads draw less power when the voltage is lowered. Although CVR has peak load reduction impacts, it is primarily an energy efficiency measure so has not been specifically analyzed within this study. However, Summerside Electric may consider examining it as a cost-effective energy efficiency option that may also reduce peak demand (which can be in the range of 0.5-4%), according to Evaluation of Conservation Voltage Reduction (CVR) on a National Level*, a 2010 Pacific Northwest National Laboratory (PNNL) study.*

Table 1. Initial capacity options identified and reviewed

Capacity Option	NERC Category	Description	Applicable for Further Analysis?	Rationale
Capacity Imports	Supply	Energy at peak periods is available via contract for capacity purposes	Yes	Possible and Scalable
Diesel Generator - Petrodiesel	Supply	Uses petrodiesel (made from crude oil) as a fuel to run the engine for an electric generator	Yes	Scalable; Does not align with Provincial Energy Strategy
Diesel Generator - Biodiesel	Supply	Uses biodiesel (alternative fuel developed from biological matter) as a fuel to run the engine for an electric generator	Yes	Possible if a source can be delivered
Grid-Scale Battery Storage	Supply	A battery large enough for utility operation that stores energy from periods of excess generation (e.g. when more wind is blowing than is required to serve electricity demand) and releases it in periods of high demand	Yes	Scalable
Behind-the-Meter Battery	Supply	A customer-sized battery that stores energy from customer sources (e.g. solar or during reduced-rate periods) and releases it in periods of high demand	Yes	Possible; No business case for customers and higher capital cost relative to grid-scale due to economies of scale
Expand Heat for Less Now (HFLN)	Demand - Direct Load Control Management	Customers install Electric Thermal Storage units and benefit from lower rates when the utility connects time-based controls; units store energy during off-peak (lower-rate) periods and supplies it during on-peak (higher-rate) periods	Yes	Possible
Expand Interruptible Load Program	Demand - Interruptible Loads	Electricity that customers make available to the utility via contract or agreement for curtailment	Yes	Possible
Compressed-Air Energy Storage	Supply	Ambient air is compressed and stored under pressure in an underground cavity; when electricity is required, the pressurized air is heated and expanded in an expansion turbine that drives a generator	No	Not being pursued due to PEI's ground formation considerations
Wind	Supply	Wind turns turbine blades that are connected to a main shaft via a rotor; the main shaft spins a generator to create electricity	Yes	Due to the existing high penetration of wind, there is a declining capacity value for each incremental MW of installed wind (only 14% of all new supply will be count towards capacity, so 7 times as much wind is required must be built to meet NERC requirements).

Capacity Option	NERC Category	Description	Applicable for Further Analysis?	Rationale
Biomass	Supply	Biological waste is burned to heat a water boiler; associated steam powers a turbine connected to a generator	Yes	Possible
Municipal Solid Waste	Supply	Municipal waste is burned to heat a water boiler; associated steam powers a turbine connected to a generator	Yes	Possible
Solar	Supply	Converts the sun's light to electricity, either directly through photovoltaics or via concentrated solar thermal, which uses lenses or mirrors to concentrate sunlight and use the resulting heat to power a turbine connected to a generator	No	Not eligible under NERC (does not offer capacity value for winter-peaking jurisdictions) - while it can be installed for the purposes of charging a battery, it is the battery that must be assessed for capacity purposes (because the charging source is irrelevant for peak reduction purposes)
Coal	Supply	Coal is burned to heat a water boiler; associated steam powers a turbine connected to a generator	No	Too large for existing need, does not align with Provincial Energy Strategy or Summerside's innovation/ sustainability goals.
Geothermal	Supply	Hot steam from underground reservoirs is pumped directed into turbines connected to a generator	No	Not available on-Island
Hydro and Pumped Storage	Supply	Pumps are used during low-demand time periods to transport water from a lower-elevation reservoir to a higher-elevation reservoir; during high-demand periods the water is released through turbines connected to a generator	No	Not available on-Island
Natural Gas	Supply	Natural gas is burned to heat a water boiler; associated steam powers a turbine connected to a generator	No	Not available on-Island
Nuclear	Supply	Nuclear reactors are used to generate heat, which heats a water boiler; associated steam powers a turbine connected to a generator	No	Too large for existing need; already imported

As indicated in Table 1 above, the following options were selected for further analysis:

- Capacity imports;
- Diesel or biodiesel generator;
- Grid-scale battery storage;
- Expansion of the Heat For Less Now program;
- Expansion of the Interruptible Load program;
- Wind;
- Biomass;
- Behind-the-Meter Batteries;
- Municipal Solid Waste

QUALITATIVE EVALUATION

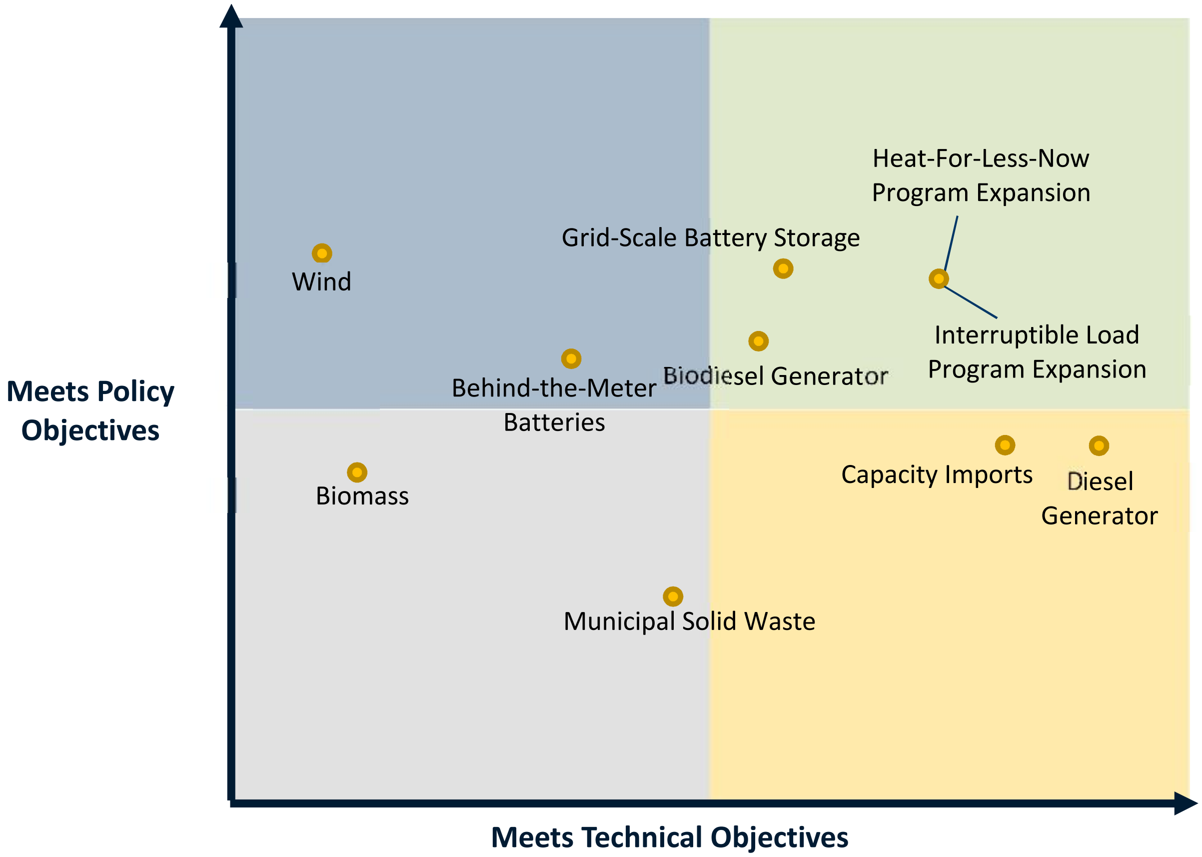
Once the long list of options was narrowed down to viable opportunities, we developed a set of attributes based on Summerside's specific considerations and long-term goals. These considerations were based on the utility's and City's existing expectations and plans as well as input received from stakeholders during targeted consultations. The following were the attributes used to evaluate the different identified capacity options:

Table 2. Capacity planning objectives and definitions/descriptions

Type of Objective	Attribute	Definition/Description
Policy	**Approvable**	Acceptable to policy makers and citizenry
	Low Cost	Does not significantly increase electric rates
	GHG Intensity	Qualitative assessment of level of GHG emissions in comparison to other options
	Renewable	Resources that are replenished on a human timescale
Technical	**Black Start**	Provides the ability to restore an electrical system's operations without relying on an external transmission network to recover from a shutdown (known as "black start" capability)
	Reliable	Available to serve winter peak load; meets NERC requirements
	Resilient	Available during long-duration outage events
Policy & Technical	**Secure**	Located on-Island
	Diversity	Contributes to greater fuel and/or technology diversity on the system
	Modular & Scalable	Can be installed in smaller increments over time instead of in one large investment

When assessed qualitatively based on preliminary research and our interviews, the results provided options that addressed the greatest number of attributes or in the most appropriate way. These results are provided in Figure 6.

Figure 6. Results of qualitative analysis of options



Based on this initial qualitative analysis, the following options, all of which met enough technical requirements to be considered for a quantitative analysis, were selected for further analysis:

- Expansion of the Heat For Less Now program;
- Expansion of the Interruptible Load program;
- Grid-scale battery storage;
- Biodiesel generator;
- Capacity imports (baseline option); and
- Diesel generator.

The options not selected were as follows:

- **Wind:** New wind only has a capacity value of 14%, meaning that for every megawatt of added wind capacity, only 14% of it will count towards NERC requirements, making it extremely expensive for capacity planning, as opposed to energy, purposes.

- **Biomass:** The option is cost-prohibitive for capacity purposes.

- **Behind-the-Meter Batteries:** These are currently cost-prohibitive (grid-scale provides economies of scale). Could be examined in the future if avoided or deferred transmission and distribution infrastructure investments can be analyzed as a value stream.

- **Municipal Solid Waste:** This option is cost-prohibitive for capacity purposes.

ASSESSMENT OF FINAL OPTIONS

This section provides a summary of the quantitative analysis conducted for each of the final options. Each option was analyzed in isolation to determine its ability to address Summerside Electric's capacity needs, and the key takeaways and summary of results are presented here. A more detailed explanation of the analysis and results can be found in Appendix D.

For the purposes of assessing cost-competitiveness between options, we used capacity imports as a baseline. This means the costs that Summerside would have incurred in contracting the capacity from an external source (such as New Brunswick) are treated as avoided costs that would be displaced by other capacity options. Imports were used as the baseline as it is the existing "status quo".

Once we had the results, we were able to assess them in different combinations; that step is presented in the Recommendations section.

CAPACITY IMPORTS

DESCRIPTION

30% - 40% of Summerside's capacity requirements are currently met through contractual agreement with New Brunswick Power (NB Power) for firm capacity. Under the current agreement, NB Power will provide Summerside with 10 MW of firm capacity in 2019, increasing over the contract's lifetime to 15 MW by 2024. Further contractual agreements for imports beyond 2024 have not yet been discussed.

Available Capacity

In this scenario, capacity imports are assumed to increase annually to fully meet capacity deficit requirements resulting from increase in peak load as well as Summerside's asset retirement. Our analysis assumes that no constraints are placed on future import capacity and that Summerside can increase imports. This assumption could have material impacts if Summerside's final decision is to maximize imports.

Costs

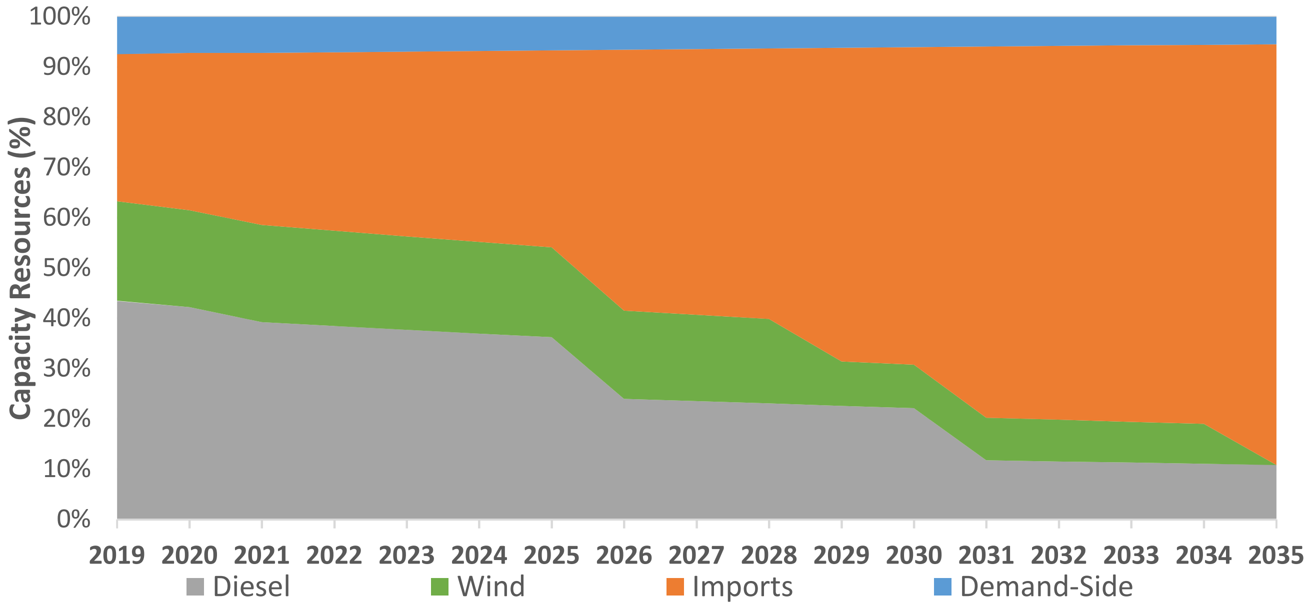
The study used a forecasted increase in import costs between 2019 and 2035 based on a New England Avoided Energy Supply Components study and other factors (details are included in Appendix D: Capacity Imports).

ANALYSIS RESULTS

Resource Adequacy

As a result of Summerside's growing load as well as diesel and wind assets reaching the end of their expected lives, under this scenario Summerside would significantly increase capacity imports to meet capacity requirements to 2035. By the end of the analysis period, imports would represent more than 80% of Summerside's capacity resources, up from 30% in 2019.

Figure 7. Status quo scenario: capacity deficit addressed solely with imports



Financial Impacts

Expanding imports by 2025 to meet capacity requirements will cost the utility an estimated $1 million annually. With the forecasted increases in capacity costs as well as the increasing required capacity, Summerside's imports could cost the utility as much as $4 million annually by 2035.

KEY TAKEAWAYS

The analysis of capacity import options highlight that:

- Continued imports without any investment in on-Island supply would result in Summerside being heavily dependent (up to 80% by 2035) on off-Island resources.
- The high reliance on imports increases the exposure of the utility and ratepayers to volatility and uncertainty of capacity and energy costs and makes it potentially prone to significant impacts on revenue requirements.

DIESEL GENERATOR

DESCRIPTION

To address load growth, asset retirement and increased in cost of capacity imports, Summerside has considered the addition of a 16 MW diesel generator.[6] The proposed diesel generator is intended to serve as a peaking unit, meaning it will be primarily used for the provision of capacity, not energy. For example, current diesel generators in Summerside provide about 50% of required capacity, but only 1% of energy requirements.

APPROACH

Our analysis built on Summerside's existing analysis of a 16 MW diesel generator, using sizing and costing parameters, as it is the most detailed, having already been subject to RFP. Our analysis assessed the diesel generator in two different time slices (2020 and 2025) to determine the most appropriate time for the investment; however, no changes in investment costs were assumed, regardless of the generator's construction year.

Two of the city's oldest diesel generators (put in service in the 1960s) are expected to reach end-of-life by 2025. When planning any new generation, City staff may choose to expedite or delay the decommissioning of older units approaching end-of-life for operational benefits and optimizing the overall value and performance of the utility's assets.

ANALYSIS RESULTS

Resource Adequacy

Overall, the diesel generator creates a capacity surplus that can eliminate some of the contracted imports in the short-term; however, in the longer term, 51% of required capacity will still be met through imports.

Moving the generator investment to 2025 rather than 2020 maintains the short-term reliance on imports and reaches the originally planned 15 MW in 2024, as highlighted in Figure 8. The long-term impact is similar, with 50% of capacity requirements being met through imports.[7]

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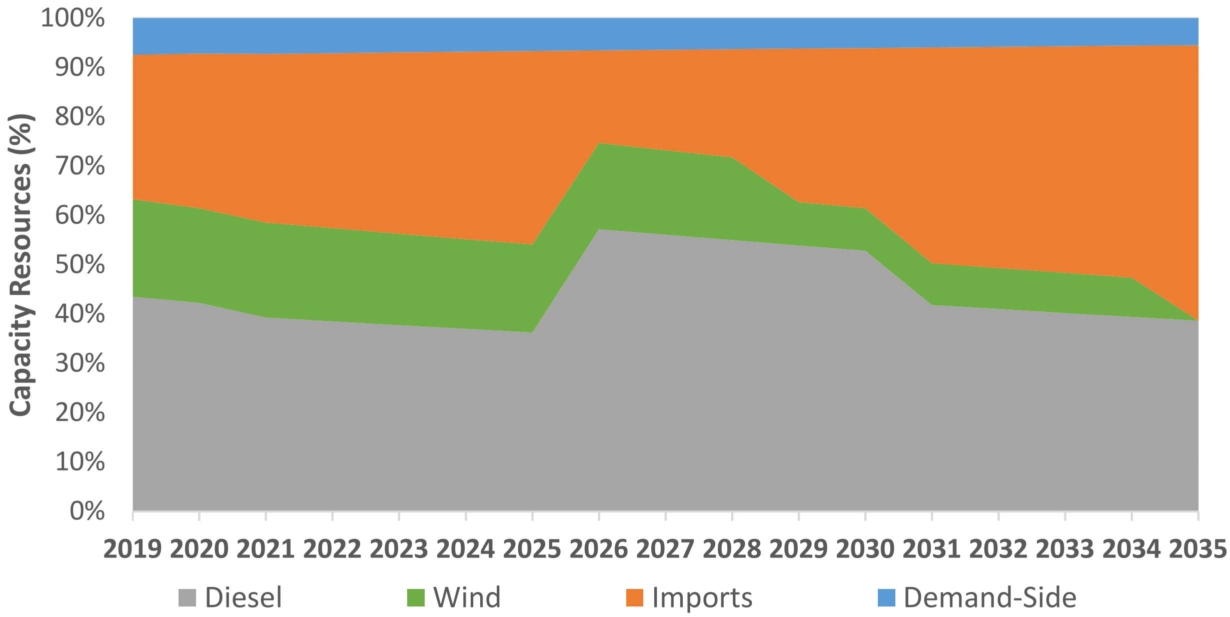
[6] 16 MW is the size selected for analysis by Summerside because it allows for a black start of Summerside's largest circuit (which is 5 MW), and staff identified a required 3:1 ratio to meet the utility's Low Voltage Ride Through (LVRT) requirements.

[7] For this reason, the 2025 results are included in the summary results, although both the 2020 and 2025 scenarios are included in Appendix D.

Figure 8. Share of Capacity Resources under Diesel Generator 2025 Investment Scenario



Financial Impacts

The business case for the diesel investment improves by 2025 due to the increasing cost of imports and the need for the increased capacity with asset retirement.

Despite some negative cash-flow in early years, as the investment has a net positive NPV, and a negative rate pressure would be observed over the project's lifetime.

Table 3 provides the summary of impacts of this option.

Table 3. Summary impacts of diesel generator option

	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
2020	$96	$0.15 M	-0.21 %	49%
2025	$96	$3.24M	-0.55%	49%

EXPANSION OF HEAT FOR LESS NOW PROGRAM

DESCRIPTION

Since 2011, Summerside's Heat for Less Now (HFLN) program has been successful in generating revenue for the utility and resulting in community-wide GHG emission reductions through electrification of space and water heating. The program offers Summerside's customers with Electrical Thermal Storage (ETS) systems for space and water heating through a purchase or leasing arrangement. Subscribed customers benefit from reduced electricity rates for their heating units for a five-year period, paying $0.08/kWh as opposed to their regular retail rate ($0.11 - $0.17/kWh depending on customer rate class and consumption group). To date, the program has supported 223 customers in installing 385 units, corresponding to 3.88 MW of demand and roughly 7 GWh of increasing electricity sales.

The program was developed by the city to address the increasing amount of excess wind generation that was historically exported. Despite the lost revenue margin from the reduced rates to program subscribers, HFLN generates a net-positive margin for Summerside because of the differential with the export rate for excess wind energy. Additionally, the program encourages fuel switching and the adoption of electric space and water heating. Because Summerside has a relatively clean electricity mix, it displaces other carbon-intensive heating fuels and generates GHG emission reductions.

In addition to the revenue generation and GHG emissions reductions, HFLN could serve as a capacity option for offsetting a portion of Summerside's peak. ETS units sold under HFLN can serve as controllable load through time-based scheduled control and real-time utility control. Under NERC's requirements for capacity resource options, Direct Load Control Management (DCLM) are eligible demand-side resources for capacity planning purposes. Under DCLM, electric appliances or equipment on customer premises must be controlled by the system operator to be eligible. Of the deployed 3.88 MW HFLN capacity, 2.3 MW are estimated to be on time-based controls and 1.6 MW under utility control.

Direct utility-controlled ETS requires connectivity capability, often achieved through a fibre backbone network. To date, Summerside is estimated to have spent $4.1M for covering roughly 40% of the city with fibre connectivity. Sales generated from HFLN are also allocated to fibre capital investments. The City also generates revenue from the network through sharing the infrastructure with Internet Service Providers (ISPs). In addition to the fibre network, investments are required for service drop from the curb to the customer's meter.

APPROACH

Estimated Achievable Potential

3.9 MW of HFLN capacity are currently deployed with roughly 60% (2.3 MW) estimated to be on time-based controls and 40% (1.6 MW) under direct control. In this scenario, we assume the existing 2.3 MW of time-based control will be converted to direct

An alternative to this approach would be to analyze the existing time-based customers. If they are turning their units off during peak, they could be kept on existing contracts rather than upgraded to direct-load-control in the short term and their impacts captured under Summerside's load forecast rather than as a NERC capacity supply option.

control and 4.6 MW of additional capacity can be deployed over the next 4 – 5 years[8], which would result in a cumulative installed capacity of 8.5 MW.

The migration of the 2.3 MW and the additional 4.6 MW of new capacity are assumed to be implemented incrementally over the period of five years between 2019 and 2024.

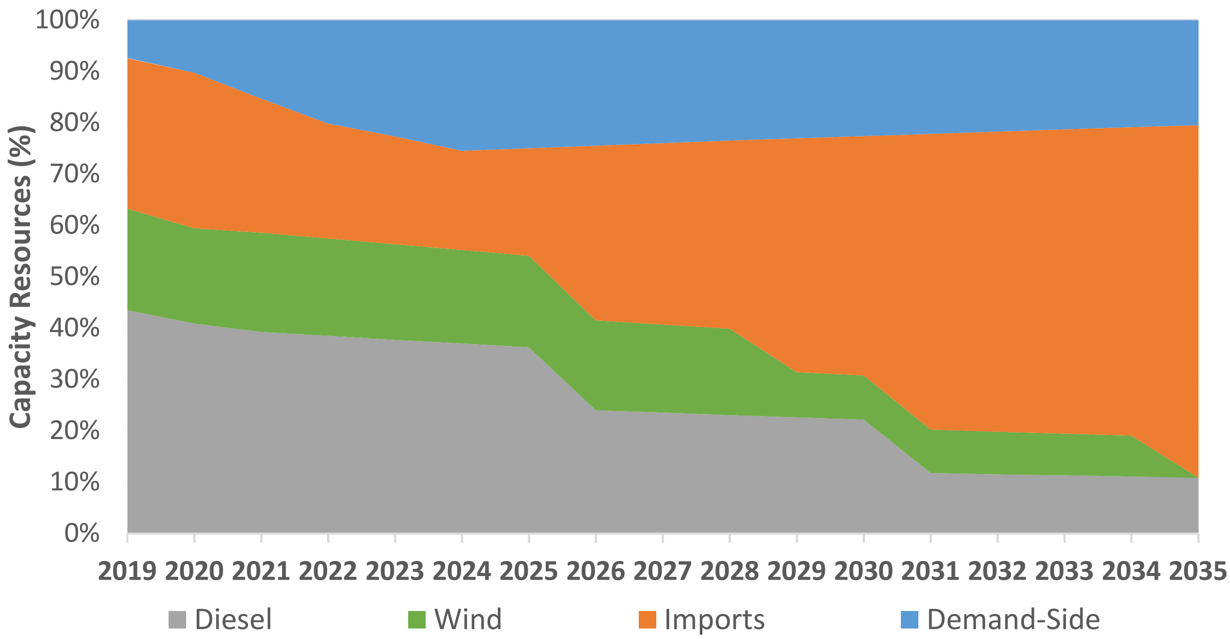
To achieve these estimated savings, Summerside could examine the potential for new HFLN program offerings. One example could include behind-the-meter battery storage combined with heat-pump installations. This type of expansion would maintain and build on Summerside's leadership in deploying and managing demand-side capacity resources, although it would require changes to the existing program model. For example, it would likely require incentives from the utility and would also require aggregation of the batteries. Customers with existing solar PV panels that could be used to charge the systems would be one area to target if the program were expanded in this direction.

ANALYSIS RESULTS

Resource Adequacy

HFLN can mitigate capacity constraints in the short-term and reduce reliance on imports; however, in the longer term, the impact is small relative to the scale of required capacity by 2035, as demonstrated in Figure 9.

Figure 9. Share of capacity resources under HFLN program expansion scenario



[8] Between 2015 and 2017, 45 units are estimated to have been sold annually corresponding to 0.46 MW of capacity.

Financial Impacts

Investment in an HFLN program expansion (through additional customer acquisition and migration of existing capacity to direct-control analysis highlights that the investment is net positive to Summerside and could result in reduced revenue requirements (i.e. lower rates and/or higher dividend to the City).

Table 4. Summary impacts of the HFLN expansion option

Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
$72	$7.0M	- 2.2%	36%

EXPANSION OF INTERRUPTIBLE LOAD PROGRAM

DESCRIPTION

Under the Interruptible Load Program (ILP), large customers are on stand-by for curtailment during peak demand or system critical hours. By shedding load upon request during those peak demand hours, interruptible customers reduce the utility's capacity requirement. Participating customers are compensated through guaranteed payments, whether or not they are called upon. Summerside currently has 6 interruptible customers that contribute to 1.2 MW of peak load. On average, interruptible customers participate in 4 events per year, with each lasting 6 hours or less.

APPROACH

Estimated Achievable Potential

Our analysis considered Summerside's top 25 demand-based customers as potential candidates for participation in the interruptible load program. Currently, only 2 of the 25 top customers are interruptible. 3 customers have been identified as having backup generators as well as 10 additional customers assumed to have interest in serving as interruptible customers, resulting in 13 additional customers who can be potential participants in the program. Considering the average loads of the identified customers during peak months (December, January, February and March), 3.33 MW of additional interruptible capacity was deemed an achievable target for additional interruptible load. It is important to note that interruptible customers are not necessarily limited to the top 25 customers and other customer groups can serve as interruptible load.

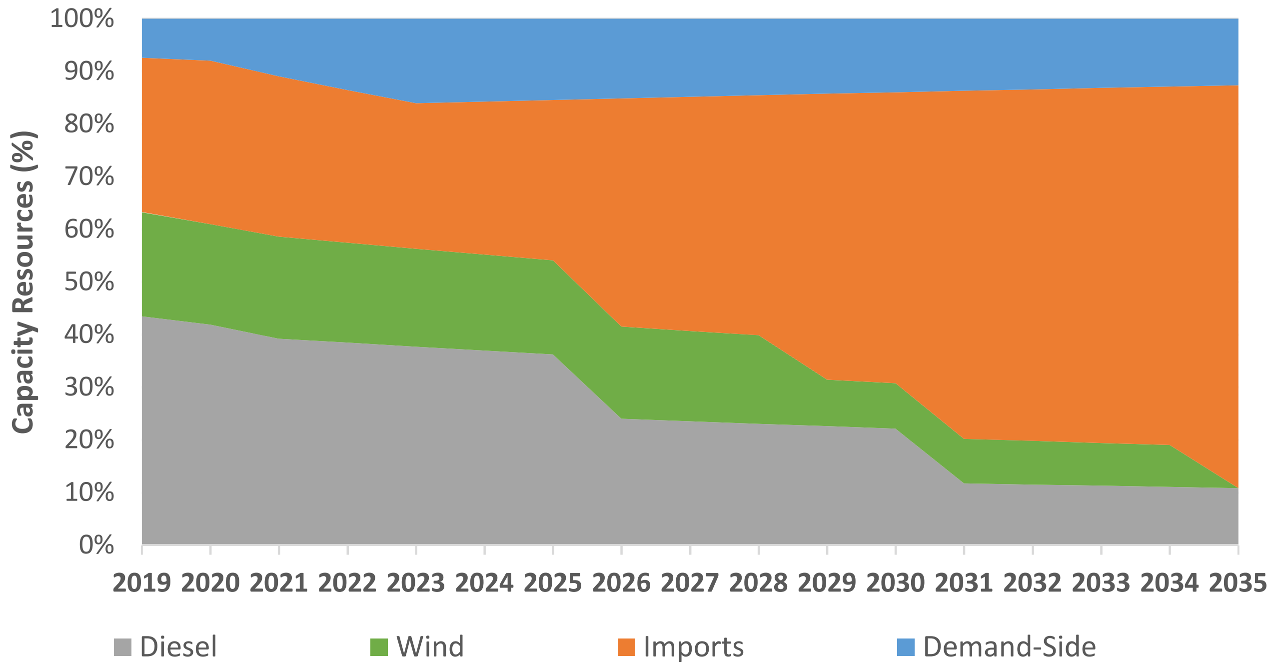
The 3.33 MW of new capacity is assumed to be implemented incrementally between 2020 to 2023 (0.3 MW in 2020 with 1 MW annual increments).

ANALYSIS RESULTS

Resource Adequacy

As with HFLN expansion, ILP expansion results in additional capacity in the short-term and reduced reliance on important, with limited long-term impact due to the small magnitude of capacity relative to significant gaps in 2035. Under the ILP investment, 72% of Summerside's capacity will be provided through imports.

Figure 10. Share of capacity resources under Interruptible Load expansion scenario



Financial Impacts

Due to the lack of capital and administrative costs, and the program's compensation costs being linked to avoided capacity costs, the ILP expansion will always be net-positive to Summerside. The net benefit to the utility resulting from the program corresponds to a decline in revenue requirements (i.e. lower rates and/or higher dividend to city).

Table 5. Summary impacts of the ILP expansion option

Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements over Lifetime	% of Capacity Resources on-Island by 2035
$12	$3.4M	- 0.53%	28%

BATTERY STORAGE

DESCRIPTION

Historically, energy storage penetration was largely in the form of large-scale pumped hydro storage. With the increased penetration in renewable energy, along with significant technological improvements and cost reductions in battery storage over the past few years, there has been a growing interest from utilities, regulators and industry in the role batteries can play in achieving the vision for a secure, reliable and low-carbon future grid. Batteries have several distinct features that make them stand out as a unique grid asset compared to other traditional capacity options:

- **Scalability**: Battery systems can be sized to be as small or as large as desired and can be located along the entire electricity value chain, ranging from small distributed behind-the-meter (i.e., customer-sited) systems to large-scale batteries at the distribution or transmission levels.

- **Versatile and stackable value**: Storage systems can provide multiple and stacked services and values to the customers and utilities including
  - *Reducing peak capacity requirement* through discharging during peak load hours
  - *Energy arbitrage* opportunities through benefiting from price differential between peak and off-peak hours.
  - *Providing ancillary grid* services such as voltage and frequency regulation, spinning and non-spinning reserves, black start capability among other values.
  - *Potential reduction in GHG emissions* through optimising use of renewable energy production and reducing curtailment and/or exports.
  - Deferring investments in transmission and distribution (T&D) infrastructure upgrades and investments through reducing local peaks.
  - *Bill reduction* for customers through reducing peak demand charges and energy arbitrage opportunities in the case of time-of-use (TOU) rates and other market price signals.
  - *Provision of back up power* as well as ability to reduce frequency and severity of power outages.

Summerside stakeholders indicated their support for increased renewable sources of energy and capacity, provided that the utility's system remained stable and secure. One option is to charge batteries using renewable energy resources such as solar and wind. This study has not addressed these pairings because from a capacity-planning perspective, the charging source is outside of the required analysis. However, from a policy perspective, Summerside can consider a pilot implementation of solar in combination with batteries, similar to the Credit Union Place installion and the upcoming project in partnership with Samsung.

The scalability of battery storage systems allows them to be placed behind-the-meter (BTM); in other words, located at a customer's facility. Behind-the-meter storage is often used by customers 1) for managing time-of-use rates as well as peak demand charges, 2) in combination with solar systems to increase self-consumption and reduce grid exports, and 3) to serve as a back-up resource for increased resiliency during outages. In addition to the value batteries provide to customers who adopt them, BTM storage assets can also bring value to utilities. Distributed behind-the-meter batteries can be aggregated and controlled by the utility for capacity purposes, ancillary services and other purposes that a grid-scale battery may be used for. Additionally, BTM batteries may bring benefits related to avoided or deferred transmission and/or distribution infrastructure investments.

Utility-controlled, behind-the-meter batteries are in very early stages, with a number of utilities across North America piloting different models and configurations. In addition, because of their smaller size, they do not usually benefit from the same economies of scale that utility-scale batteries do, resulting in higher unit costs. For these reasons, this analysis focused on utility-scale batteries, although monitoring advancements in behind-the-meter options will be beneficial for capacity-planning purposes in the near future.

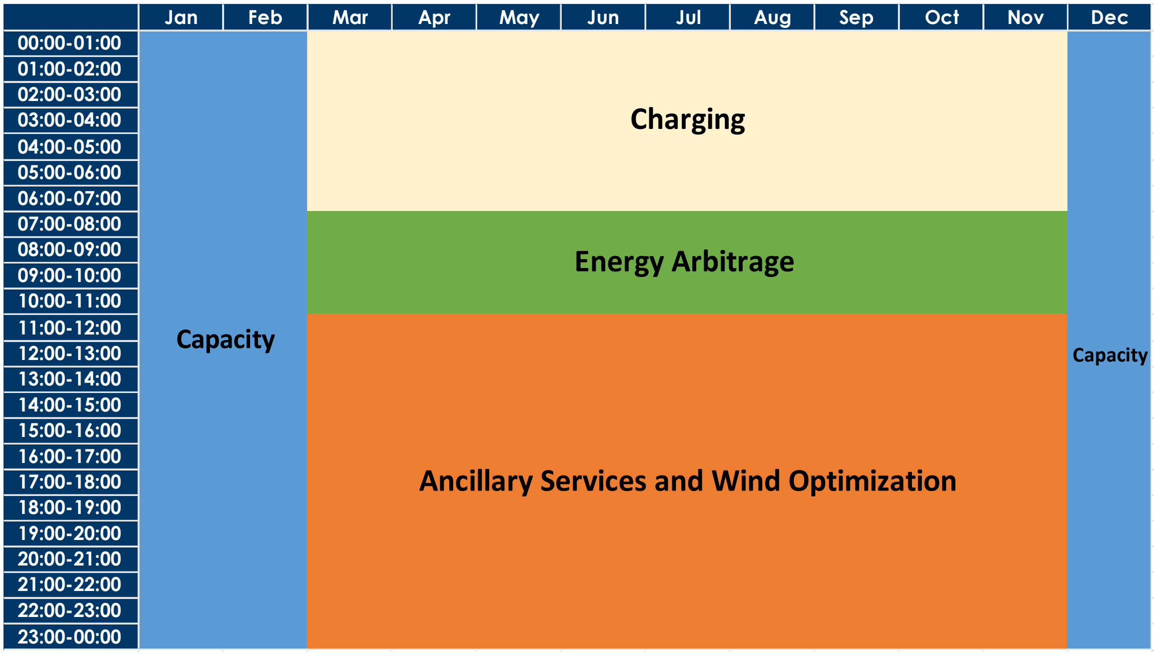
APPROACH

*Battery Siz*e

To determine the appropriate battery size required for Summerside, we focused on the minimum required capacity contribution that the battery needs to provide. The analysis identified two peak windows up to 4 hours of consecutive peak hours in each (8 – 11 AM and 4 – 8 PM) in the months of January, February and December. The battery was sized to contribute 5 MW for up to 4 hours, resulting in a battery size of 5 MW and 20MWh.

As shown in Figure 11, we developed a simple dispatch strategy to accurately determine the value of battery storage, the study considered capacity provision, energy arbitrage, and ancillary services/wind optimization (details are provided in Appendix D).

Figure 11. Assumed battery storage dispatch during weekdays

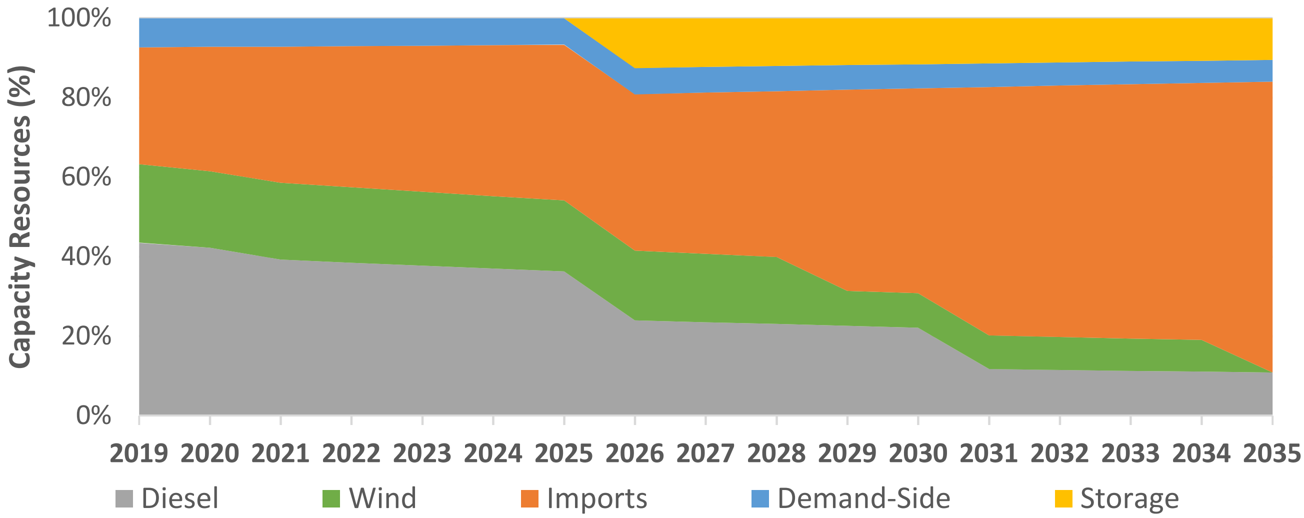


ANALYSIS RESULTS

Resource Adequacy

The modeled 5 MW contributes to reducing off-island imports equivalent to its capacity contribution. However, the impact is minimal in the long-term due to the small relative contribution of the proposed battery. Given the scalability of battery technology, installed capacity can be increased incrementally as required. As highlighted earlier, in addition to capacity/resource adequacy, the battery can be used for provision of ancillary services and ensuring grid stability. Figure 12 highlights the results for this option if implemented in 2025 (when storage is expected to be cost-effective); additional results for 2020 and 2030 are provided in Appendix D.

Figure 12. Share of capacity resources under battery storage investment in 2025



Financial Impacts

Battery investments will not be cost effective in the short-term; however, favourable economics suggest battery investment could be financially advantageous in the mid-2020s. Further battery cost reductions to 2030 improve the business case for storage.

The cost-effectiveness of batteries is sensitive to uncertainty in system costs. Additionally, uncertainty around the market demand and value of ancillary services that battery provides would impact the economics.

Table 6. Summary impacts of the battery storage option

Investment Year	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
2020	$249	$-4.2M	1.42%	31%
2025	$166	$1.7M	-0.70%	31%
2030	$120	$4.4M	-1.83%	31%

BIODIESEL GENERATOR

DESCRIPTION

An alternative to diesel generation could be the use of alternative bio-based fuels, produced from biological matter. Depending on the fuel characteristics, some conventional diesel generators can use biodiesel for power generation with minimal conversion requirements.

APPROACH

The analysis is based on a 16 MW biodiesel generator, with an assumption that the capital costs of the biodiesel generator are equal to those of the proposed diesel generator. Due to limited supply of biodiesel in PEI, fuel suppliers have identified that biodiesel fuel costs would be approximately 50% higher than regular diesel due to the cost premium and high transportation costs. Although this may be viewed as an aggressive assumption, it has limited impact on the economics of the biodiesel generator due to the projected low run time of the generator as it serves a peaking capacity unit. As with the diesel generator, the analysis was conducted for a potential investment in 2020 and 2025, with 2025 results being provided here and 2020 results included in Appendix D.

Because the capacity-planning study is a high-level analysis rather than a detailed implementation plan, the evaluation of option did not include detailed implementation considerations such as the potential need for environmentally controlled storage and potential warranty concerns if converting a generator to use biofuel. These considerations would need to be addressed through a request for information (RFI) process prior to commissioning this option.

ANALYSIS RESULTS

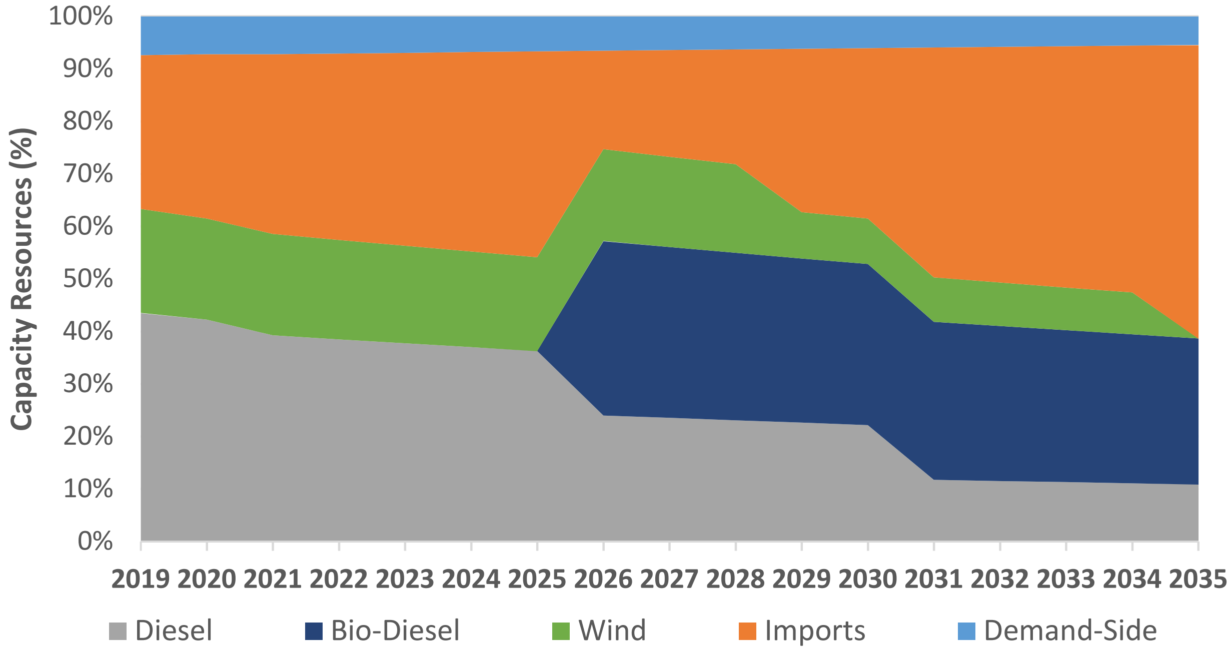
Resource Adequacy

Biodiesel generator may be a cleaner substitute for the proposed diesel generator, with very similar business case.

The impact of the biodiesel generator is identical to the proposed diesel generator; creating a capacity surplus that can completely eliminate contracted imports by 2021[9]. However, in the longer-term, with growing load and other assets reaching end-of-life, further imports will be required to fully meet system requirements.

[9] The analysis is a financial one and does not address the feasibility of reducing imports prior to the end of the existing contract.

Figure 13. Share of capacity resources under biodiesel generator investment in 2025



Financial Impacts

Accounting for the avoided costs of imported capacity and energy, the generator has a positive NPV over the project's lifetime. Despite negative cash flow in the early years, over the lifetime of the project a decline of 0.4% is observed if it is installed in 2025 rather than 2020.

Table 7. Summary impacts of biodiesel generator option

Investment Year	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
2020	$97	$-0.8M	-0.05 %	49%
2025	$97	$2.4M	-0.40%	49%

SUMMARY

The conducted analysis highlighted the capacity adequacy and financial impacts under the baseline scenario (capacity imports) as well as under five distinct alternative capacity options in isolation. Table 8 on the following page presents the summary of obtained results and indicates the following key takeaways:

- **No single capacity option except for capacity imports is capable of covering all of Summerside's future capacity deficit**, meaning that any option besides relying exclusively on imports to address the deficit will require the use of a "stacked approach" that features several options.
- **Based on projected cost assumptions for imports,[10] every assessed option has a positive economic case relative to imports either immediately or in the medium term (2025)**, as indicated by the net positive NPV for each modeled scenario. We note, however, that since energy and capacity prices can fluctuate, there is uncertainty regarding the cost assumptions, and it is therefore prudent to monitor changes to capacity market prices in the region, as changes to the forecast could impact the timing and feasibility of specific options.
- **All analyzed capacity options result in a reduction in revenue requirements**, which would correspond to rate decreases to the utility's customers or an increase in dividends paid to the city when compared to importing capacity. These include a diesel generator, the expansion of the HFLN and Interruptible Load programs, and battery storage (provided it is installed in 2025 or later and that current cost assumptions hold true).
- **Demand-side options have the most advantageous business case to Summerside**, with the Interruptible Load and Heat For Less Now program expansions having the lowest capacity cost and highest NPV.

[10] The study used a forecasted increase in import costs between 2019 and 2035 based on a New England Avoided Energy Supply Components study and other factors (details are included in Appendix D: Capacity Imports).

Table 8. Summary of analysis results for all options as compared to capacity imports

Options		Levelized Unit Cost ($/kW/year)	Net Present Value (NPV)	Average Revenue Requirement Impacts (% over lifetime)	% of Capacity Resources On-Island (by 2035)	Relative GHG Emissions (qualitative)
Imports		(Baseline against which alternatives are compared)				
Diesel	2020	$ 96	$ 0.2 M	-0.2%	49%	High
	2025	$ 96	$ 3.2 M	-0.6%	49%	High
Heat for Less Now		$ 72	$ 7.0 M	-2.2%	36%	Low
Interruptible Load		$ 12	$ 3.4 M	-0.5%	28%	Medium
Battery Storage	2020	$ 249	($ 4.2 M)	+ 1.4%	31%	Low
	2025	$ 166	$ 1.7 M	-0.7%	31%	Low
	2030	$ 120	$ 4.4 M	-1.8%	31%	Low
Biodiesel	2020	$ 97	($ 0.8 M)	-0.1%	49%	Medium
	2025	$ 97	$ 2.4 M	-0.4%	49%	Medium

Most desirable	Least desirable

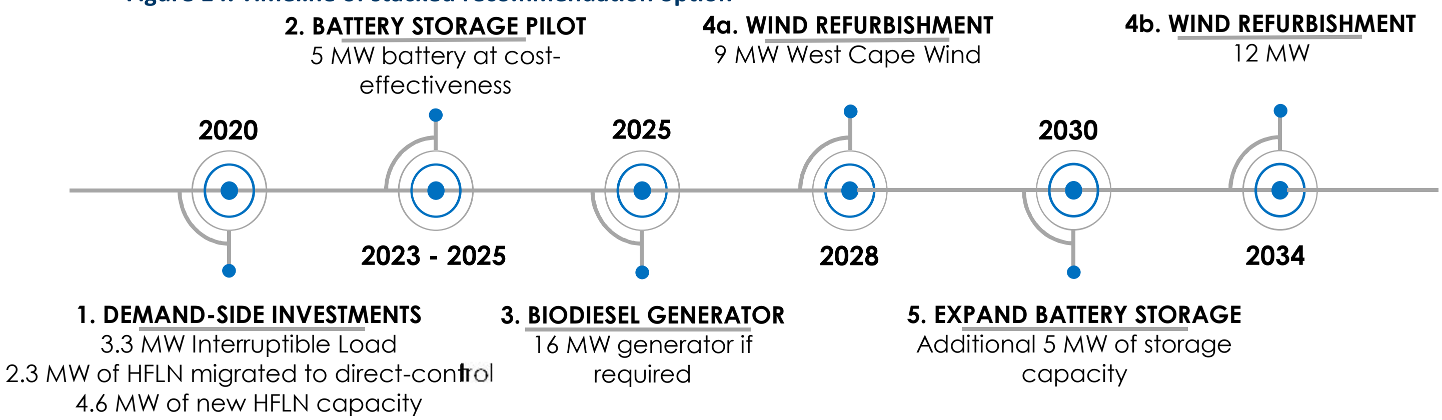
RECOMMENDATION

OPTION ONE: NO IMPORTS

Based on the results of our analysis, **Dunsky proposes that Summerside take a staged approach to capacity resource planning by implementing multiple options**. If the utility "stacks" multiple capacity sources rather than relying on one option only, Summerside has the potential to meet its goal of supplying a greater share of its capacity needs with on-Island resources.

Figure 14 below provides an overview of this stacked option, should the City wish to move off of imports altogether; additional details follow.

Figure 14. Timeline of stacked recommendation option



The benefits of this recommendation are detailed in the section below. However, at a high level, it provides the following benefits. Specifically, the recommendation:

- Provides a secure, reliable and diverse resource mix;
- Enhances flexibility on a go-forward basis, despite fast-paced technological, by avoiding technology lock-in (e.g. investing in an option that may become too outdated in comparison to other emerging opportunities);
- Hedges against technology innovation (e.g., emerging technologies or significant cost reductions in relatively new options such as battery storage);
- Allows Summerside to adapt its system to changing conditions (e.g. electrification of heating and transportation);
- Enables adaptation to changing policy directions such as potential future constraints placed on specific technologies by federal or provincial governments, as well as an increasing demand for renewable energy; and
- Allows additional analysis prior to any particular option being implemented (for example, the ability to decommission existing diesel generators earlier or adding imports for diversity purposes).

APPROACH

In this section, we explain the approach for this option, addressing the considerations and timing included in our recommendation.

1. INVEST IN DEMAND-SIDE CAPACITY OPTIONS

Summerside already has cost-effective, available demand-side capacity options through its Heat For Less Now and Interruptible Load programs. HFLN and ILP are "low-hanging-fruit" with a proven business case and significant achievable potential to cover Summerside's needs in the short-term.

The **HFLN and ILP** are not only the most cost-effective options, but they also are **under Summerside's direct influence and control**. As a result, we recommend **developing and expanding these programs** so that they reach their maximum potential in the coming few years. Our team has estimated 10.2 MW of potential deployment under both programs between 2020 and 2024.

Because the demand-side programs alone cannot meet Summerside's capacity needs, developing supply-side options in parallel is necessary. Both battery and diesel systems are scalable and readily developed within a two-year development process. As a result, they provide flexibility to react to changes in demand and to potential changes in HFLN and ILP participation levels.

2. PILOT BATTERY STORAGE WHEN IT BECOMES COST-EFFECTIVE

We recommend piloting battery storage in the early-to-mid 2020s. While research and existing cost trends indicate that batteries should be cost-effective at that time, Summerside should issue a Request for Information (RFI) to gauge the cost-effectiveness and business case for the battery system. In addition to receiving additional granularity on investment cost, a battery storage pilot would also provide Summerside with actual data-based evidence on the potential value streams from the use of batteries for capacity provision, ancillary services, energy arbitrage, and others.

A competitive RFI process is important. Immature technology and markets can often produce a small set of respondents who are making operational and cost claims based on early-stage or pre-commercial technology. A competitive RFI or RFP process would be characterized by multiple, experienced, and credit-worthy bidders whose proposals are not considerably different from each other, either in terms of cost or operational capability.

In the event an RFI produces promising and competitive* results, then an RFP can be issued that results in an Engineering, Procurement and Construction (EPC) contract. Alternatively, the city could consider soliciting a Power Purchase Agreement (PPA) instead of an EPC contract. PPAs typically shift the construction cost risk to the developer, and can provide fixed, long-term prices for services on an *as-delivered basis*. In other words, a PPA can relieve the city of any construction cost risk as well as be structured such that the city does not pay unless the capacity is delivered. Therefore, PPAs can offer all of the reliability and energy security benefits that are needed while also minimizing cost and performance (operational) risk. This is what other jurisdictions we spoke with who are piloting batteries have done.

In the event that the RFI does not result in satisfactory results, then Summerside is free to pursue other sources of capacity, as envisioned in the following subsection.

Next, additional long-term capacity requirements to accommodate growing loads and assets approaching end-of-life can be addressed by Summerside.

3. CONSIDER BIODIESEL GENERATION AS A SUBSTITUTE FOR DIESEL

With similar capital investment as a diesel generator, a 16 MW biodiesel generator may be a cleaner substitute to Summerside's initial proposal. The major challenge will be securing a low-cost and reliable supply of fuel, as these costs are anticipated to be higher for biodiesel. The trade-off for this expense is improved alignment with Provincial and federal energy goals, and it is of greater interest to Summerside stakeholders.

The reason this option is later in the implementation timeframe is so that the benefits and drawbacks of both diesel and biodiesel can be examined at a future date, as emerging technology and changing regulations mean that investing in a diesel generator (even if using biodiesel) while on the cusp of these changes may lead to an undesired technology lock-in.

In addition to newly built capacity, Summerside could also consider refurbishment of existing diesel generators reaching end of life and converting them to biodiesel.

4. REFURBISH WIND ASSETS NEAR END OF LIFE*

Summerside's wind farms, with 9 MW and 12 MW capacity, are set to reach end-of-life by 2028 and 2034 respectively. While not part our analysis, our team proposes that refurbishment of these assets be considered as an option to extend capacity benefits from the assets for the future.

*Costs associated with the refurbishment projects are not included in the analysis and assumed to be part of Summerside's existing capital planning.

5. EXPAND STORAGE CAPACITY BY 2030

After gaining experience and evaluating learnings from the earlier suggested battery storage pilot, Summerside will be well positioned to expand installed storage capacity and maximize value by optimizing battery dispatch for capacity and ancillary service provision. The projected low cost of storage during this timeframe suggests battery storage will have significant benefits to the utility and its customers, as well as help serve as a valuable grid asset for ensuring grid reliability.

PROJECTED IMPACTS

In this section, we summarize the projected impacts of the stacked recommendation.

Resource Adequacy

The recommended strategy enables Summerside to fully meet capacity requirement with on-Island resources, gradually reducing the utility's reliance on imports from the current 30% down to 10% in 2023 and 0% by 2025 (see Figure 15 and Figure 16 for the MW changes and percentage changes, respectively, over time). Another notable change is the increased diversity in Summerside's capacity mix, with the introduction of biodiesel generation and battery storage.

Figure 15. Recommended capacity resource mix in MW

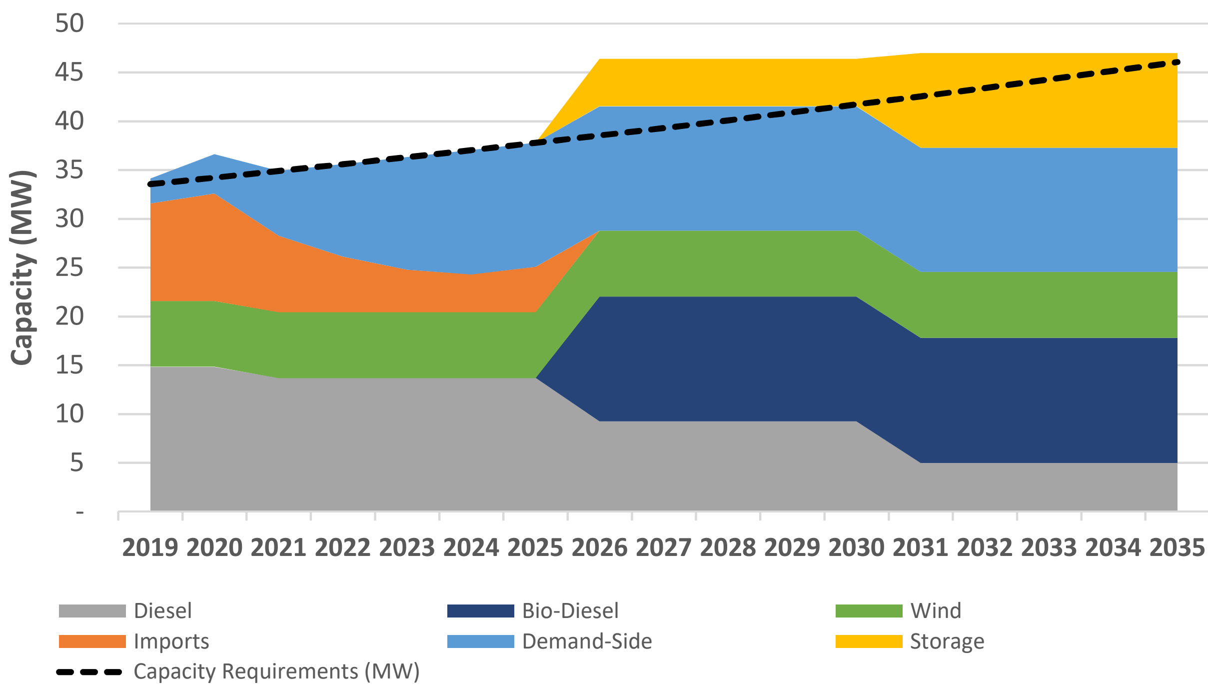
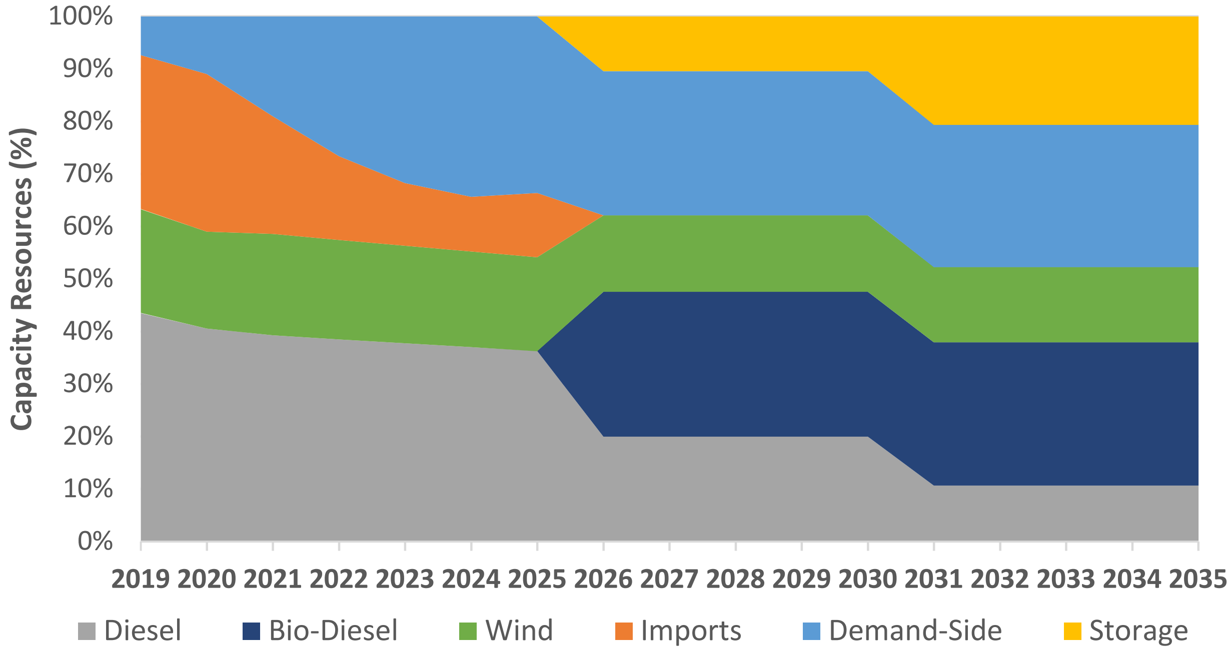


Figure 16. Recommended capacity resource mix in %



The proposed staged approach provides Summerside with the flexibility to adapt its system and react accordingly under changing market and technology conditions, while still securing the city's long-term capacity needs.

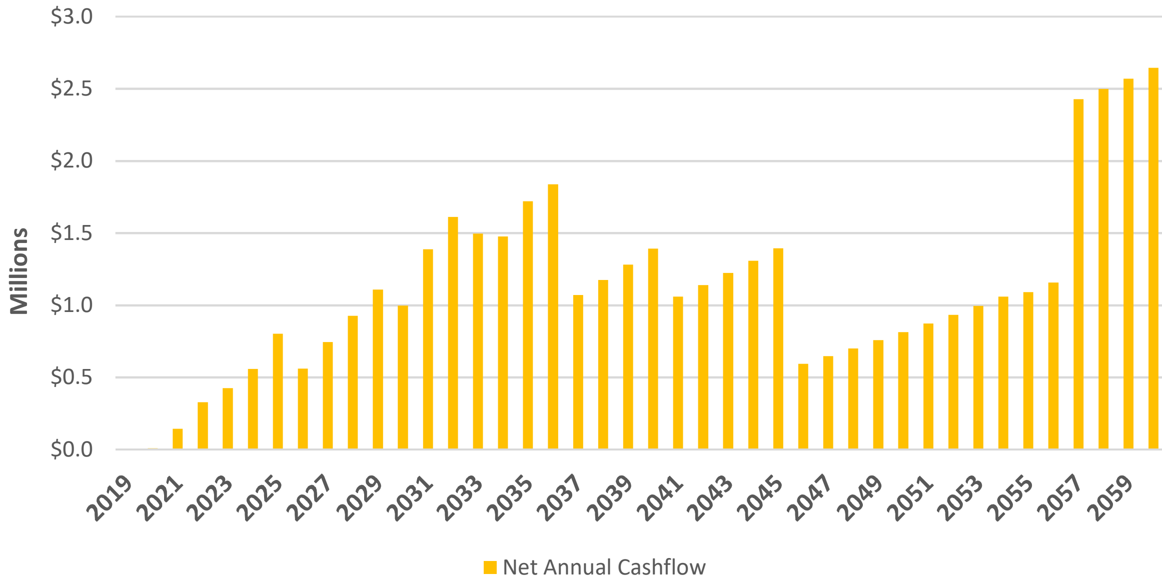
During the period of 2025 to 2035, additional planned capacity serves as a buffer that allows Summerside to closely monitor its requirements and resources and react to unforeseen shifts such as increased peak demand due to electrification of heating and transportation or lower than projected demand-side savings. Additionally, it reduces Summerside's reliance on the proposed battery during early years of the piloting phase.

Financial Impacts

The proposed option has a positive NPV and net-positive cash-flow beginning in 2020. This results in a decline in Summerside's revenue requirement as a result of the avoided energy and capacity import costs. Compared to other capacity options, the recommendation has the highest NPV, second-lowest aggregate levelized cost of capacity and the lowest decline in revenue requirements.

Figure 17 shows that the revenues (avoided costs and miscellaneous benefits) and costs (capital and operational) associated with the recommended option provide Summerside with a net positive cash flow by 2020, meaning that when compared to the baseline capacity imports option, the recommendation improves the City's financial position.

Figure 17. Annual cash flow of recommendation



In the figure above, the net annual cashflow consists of revenues after expenses have been paid (2019 and 2020 are neutral). Additional details can be found in the cash flow details (figures 48 and 49 in Appendix D). It is important to note, however, that these are not actual forecasted revenues; rather, they are revenues *in comparison to the baseline option* (capacity imports), meaning that Summerside would save money by implementing the recommended option if import prices materialize as assumed.

Considering this option is cash-flow and NPV positive, there is an immediate corresponding decline in the utility's revenue requirement (in other words, its costs) as well as average annual life-time reduction of 2.96%, as shown in Figure 18.

Figure 18. Annual revenue requirements of recommended option

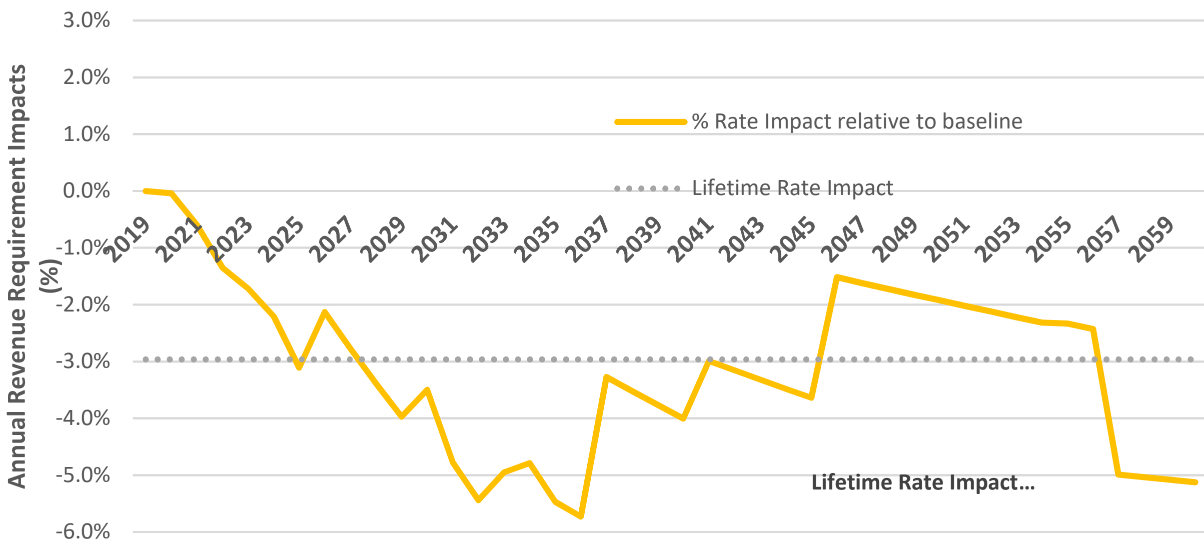


Table 9 provides the summary values of this option.

Table 9. Summary values of recommended option

Capacity Options	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
Recommendation	$52	$18.9M	-2.9%	100%

We note, however, that as energy and capacity prices can fluctuate, there is uncertainty regarding the cost assumptions for the baseline option of capacity imports. It is prudent to monitor changes to capacity market prices in the region, as changes to the forecast could impact timing and feasibility of specific options.

CONSIDERATIONS AND TRADE-OFFS

While the first option maximizes energy security by ensuring 100% of capacity requirements are met through on-Island resources, there are several trade-offs to consider before choosing this path, including changing technology, the uncertainty of cost changes to battery systems and import price projections, and the changing requirements for sustainability and renewability of energy, both in PEI and Canada. Examining the trade-offs of the recommendation is therefore prudent and advisable.

Technology Advancements

Having 100% on-Island capacity would lock in today's technology and costs for the coming twenty years or more. Given the rapid pace of change in the industry, and in battery technology in particular, this path could end up being both costlier and less operationally effective over the long term. For example, there is the possibility that Summerside could build a battery in 2025, but the price and performance of battery systems improve considerably by 2030.

Costs and Diversity of Supply

The recommended scenario outcome, while expanding the diversity of Summerside's capacity mix, does reduce Summerside's ability to call on a larger supplier in times of unanticipated capacity needs. The more diverse a system and the more varied the capacity resources are, the more reliable the system is expected to be. In other words, additional diversity is generally considered valuable.

For example, more diversity could be created by signing a short-term (less than five years) import contract. This would improve reliability by protecting Summerside against equipment failures and unexpected increases in demand. It would also provide financial exposure to the regional capacity market, which invariably includes some of the lowest-cost resources available. In the long run, this market exposure is also likely to include new renewable capacity sources. Foreseeable renewable capacity sources in the coming decades include off-shore wind, hydro, and large-scale battery systems.

By keeping some imports in the mix, Summerside retains the flexibility to tap into these capacity sources. In other words, it can be considered as an insurance policy so that a certain level of capacity is guaranteed for the City. Importantly, these import contracts can be made with almost any owner of capacity, as long as the contract includes a provision by which transmission capacity is procured through NB Power's Open Access Transmission Tariff.

Demand-Side Opportunities Analysis

Expanding the HFLN and ILP programs is a low-cost, high-value source of capacity for Summerside. The fact that demand-side options are NERC-compliant and are able to be bid into capacity markets indicates their credibility within North American electricity systems; in other words, they are considered "an established tool for supporting optimization and grid-based generation or transmission."[11] It may also be an increasingly important tool in future utility capacity planning if EVs begin to make up a larger part of Summerside's electricity demand.

Nevertheless, this study did not include an in-depth analysis of the potential of demand-side opportunities. The assumptions used are conservative and reasonable; however, actual levels of participation may vary based on the investment Summerside makes into customer enrollment and timing of implementation. This potential variance (which could result in either higher or lower participation), combined with the fact that demand-side options cannot meet Summerside's needs in isolation, support the recommendation that a flexible, diverse system with multiple sources of capacity will provide the most stable, resilient system for the City on a go-forward basis.

Policy Considerations

Given the changing political landscape of investment in climate change mitigation and renewable energy, as well as potential future constraints placed on specific technologies by federal or provincial governments, it is important that any implemented option considers these potential future constraints and how they can impact operations on a go-forward basis.

For these reasons, we outline an alternative option in the following section.

OPTION TWO: MAINTAIN IMPORTS AS PART OF AN OVERALL DIVERSE SUPPLY MIX

Despite the feasibility of developing a capacity supply consisting of 100% on-Island resources, imports can be an important and appropriate element to balance local security and resilience against the need to procure low-cost capacity and retain future flexibility. While the levels of import to purchase is ultimately a decision for policy makers, portfolio theory does provide some guidance:

- **No single resource should exceed 50% of the portfolio**. By this measure, the city's reliance on diesel and imports is not ideal, and expanding into demand-side and battery resources makes particular sense.
- **The performance of the resources should not be closely correlated**, so that the failure of one resource does not happen at the same time as any other. Presently, imports are backed by the entire NB Power system (not just a single generator). Plus, transmission lines are highly reliable with availability factors usually in the high 90% range. This makes imports a very reliable source of capacity that would not be expected to correlate with the availability of Summerside's HFLN, ILP, wind or diesel resources.
- **Expiration of resources should be staggered in time such they do not overlap** with other (large) resources. Staggering expiration dates serve two purposes. First, it avoids circumstances in which too

[11]Accenture. The future of demand response in electricity distribution: The growing importance and role of demand-side management, user participation and demand flexibility in the era of the digitally enabled grid. April 2017. https://www.accenture.com/t20170406T202722Z__w__/us-en/_acnmedia/PDF-48/Accenture_Future-Demand-Response-POV.pdf. p. 4.

many resources are expiring all at once, which can cause cost volatility and increase the risk of finding replacement resources. Second, it provides flexibility to replace resources at regular time intervals, which enables policy makers the ability to shift their preferences and the make-up of the portfolio over time.

In addition to utility portfolio theory, Summerside's history and existing relationship with NB Power is not something to discard lightly. The contract between the two utilities provides security and stability for the City, particularly given the changing landscape of technology and general utility planning outlined in the section above. In addition:

- From an energy perspective and for the purposes of balancing wind resources, NB Power is likely to continue as a valued partner into the future, so synergies and efficiencies may be leveraged on the capacity side as well, as they are now.
- Summerside will continue paying the amortized costs of the upgraded transmission infrastructure from New Brunswick, so utilizing the asset would be appropriate.

For these reasons, we recommend that Summerside consider retaining some level of imports in Summerside's portfolio of capacity resources. Imports could be reduced to allow for a greater diversity of capacity supply, but nevertheless, some level of imports would be beneficial. It would also allow Summerside to continuously evaluate its needs and determine the appropriate time to implement other stacked options, all of which are still valid in a scenario with continued imports.

While this study was not designed to optimize a particular level of imports, Figures 19, Figure 20, and Figure 21 provide some examples of what Summerside's capacity mix could look like if some imports were maintained.

Figure 19. Sample capacity supply mix in which imports are used in place of a biodiesel generator

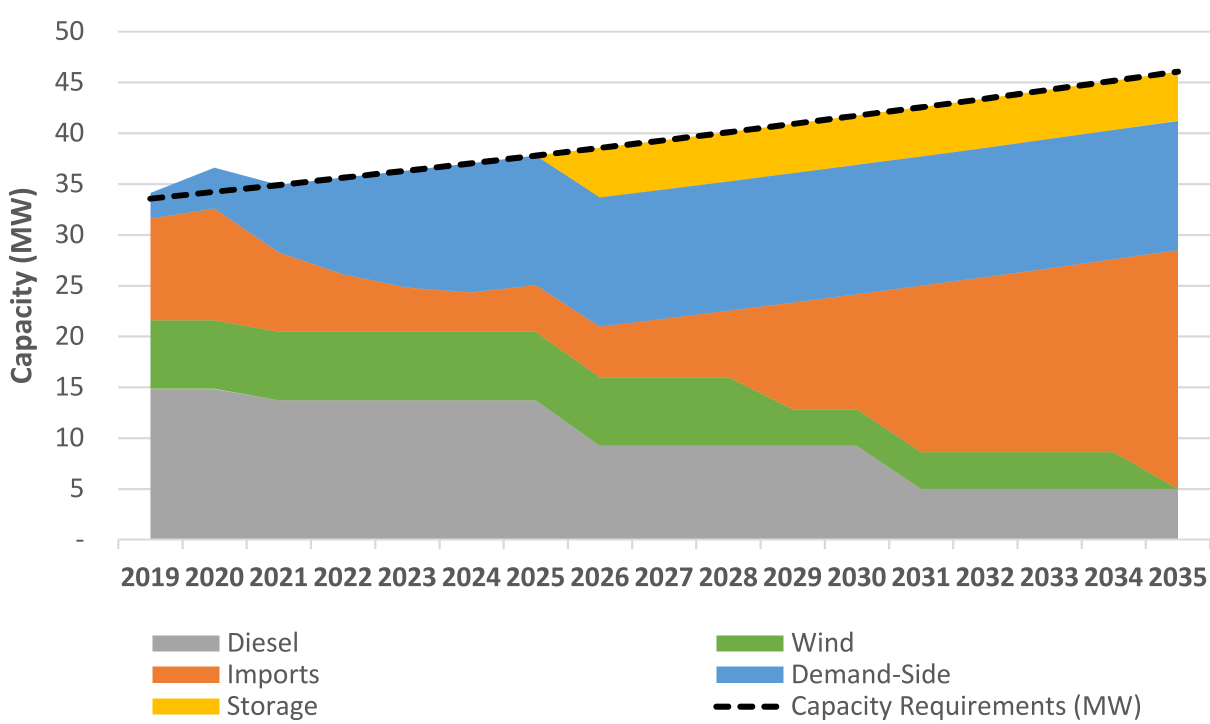


Figure 20. Sample capacity supply mix in which imports are used to defer a biodiesel generator

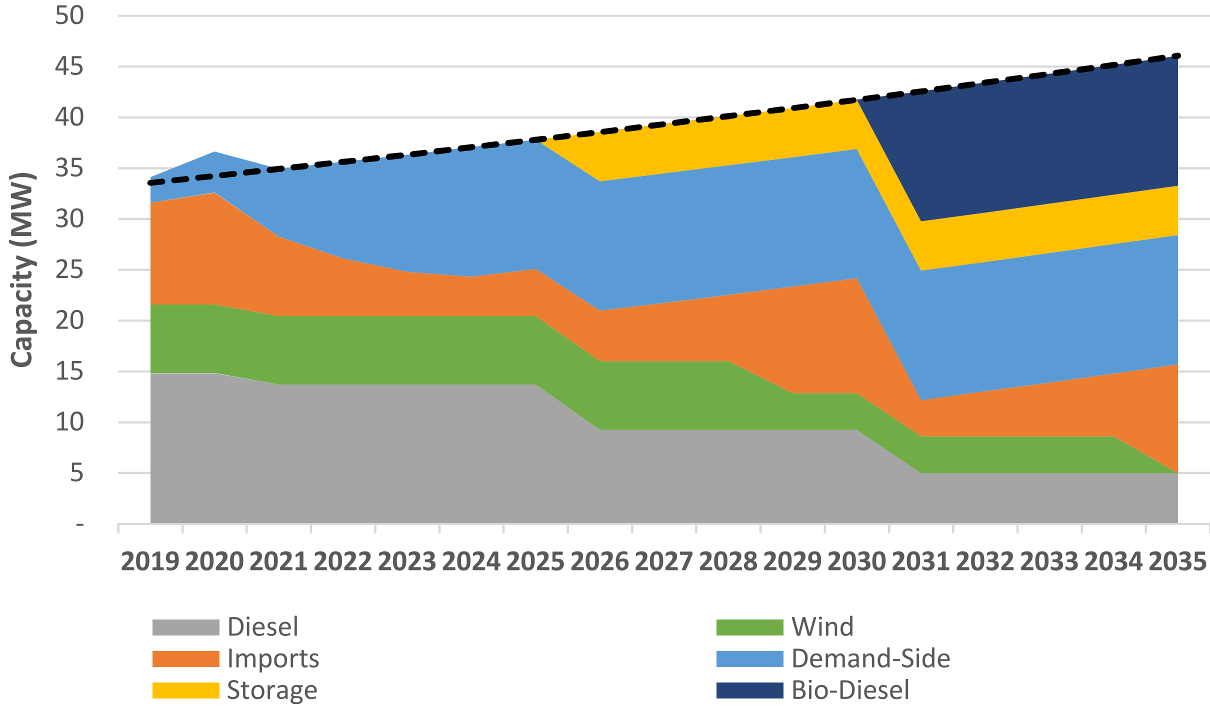
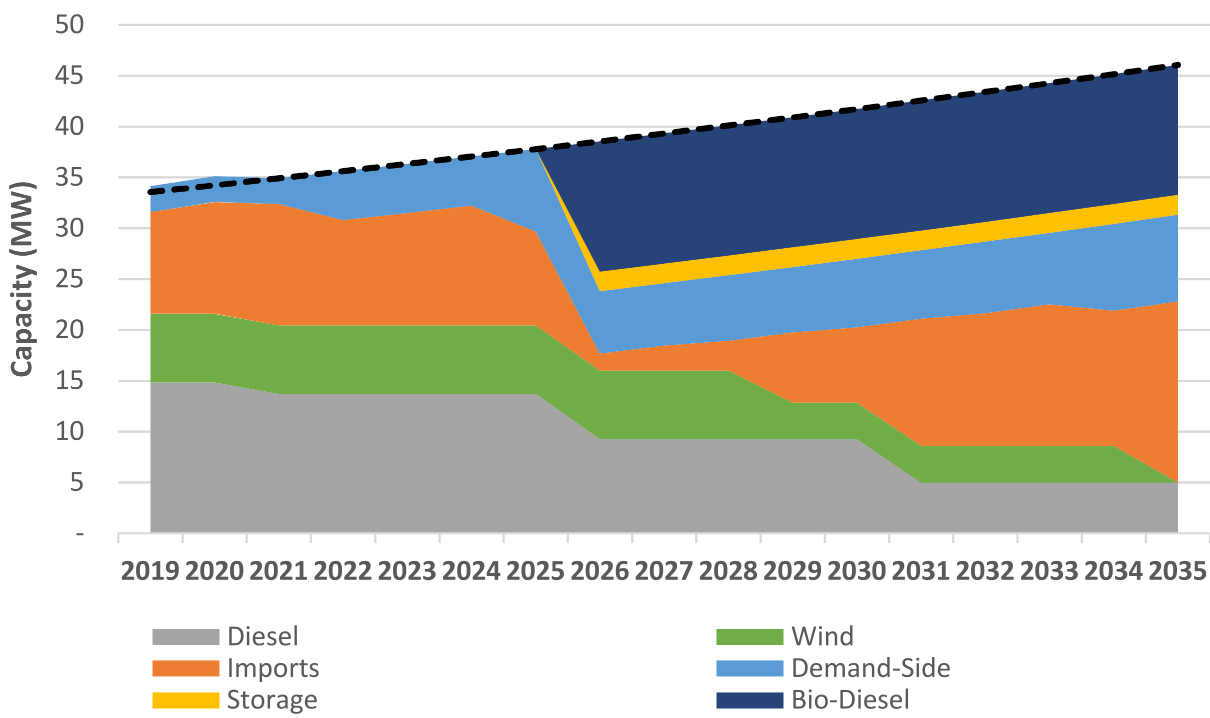


Figure 21. Sample capacity supply mix in which imports are used as a buffer if demand-side opportunities take longer to achieve projected uptake



NEXT STEPS AND CONCLUSION

NEXT STEPS FOR SUMMERSIDE

If the City implements these recommendations, there are some short-term and intermediate steps that are required for implementation. These include:

- **Developing a marketing and outreach strategy for demand-side programs:** The analysis accounts for additional costs of marketing and outreach to increase participation in Summerside's demand-side programs, as the participation targets are more aggressive than historical sign-up rates indicate will occur without specific recruitment campaigns.
- **Assessing staffing needs and resources:** While demand-side resources are the most cost-effective option, they can require more human resources than technology options on an ongoing basis. In addition, managing multiple capacity installations instead of just one adds complexity to the system. Thus, Summerside Electric should conduct an analysis of its existing staffing resources and capacity and consider adjusting as necessary.
- **Prepare for each stage of implementation in advance:** Each new option that comes online requires lead-up time and should be planned in detail 2-3 years in advance. Preparation should include issuing requests for information and seeking quotations from suppliers that will inform a more detailed analysis of each option being implemented.
- **Revisit and adjust the capacity plan on a recurring basis:** Given the fast-paced nature of changes in technology and utility forecasting, it is prudent to reassess Summerside's context and landscape on a regular basis. Indeed, Dunsky's recommendation is built on the assumption that information and requirements five years from now will be very different from the outlook today. Monitoring these changes will allow the utility to adjust its plans based on updated information and address changes accordingly. While larger utilities conduct these exercises with detailed Integrated Resource Plans, a more limited analysis may serve Summerside's needs, as long as it addresses the full picture of utility operations and potential changes to its customers' needs and demand for electricity.

CONCLUSION

Dunsky's analysis led to a recommendation that Summerside consider a stacked approach to address current and future capacity needs. Under this approach, multiple capacity options and sources are planned for and built over the coming years to ensure a stable and diverse resource mix that will meet peak demand and serve the City's needs. In addition to meeting the city's future demand, the recommended approach results in significant cost savings when compared to a high reliance on capacity imports, maintains Summerside's leadership in implementing cutting-edge technologies, and meets the requests of residents and businesses for a clean energy mix without jeopardizing security, reliability or resiliency of supply.

In addition to meeting the City's objectives of having a **secure, reliable and diverse resource mix**, the proposed approach allows the city to **maintain flexibility moving forward,** which is critical when forecasting capacity needs in a time of fast-paced technological and policy changes. In other words, it:

- **Avoids technology lock-in** (e.g. investing in an option that may become too outdated in comparison to other emerging opportunities) and hedges against technology innovation (e.g., emerging technologies or significant cost reductions in newer options). Newer technologies that are not yet commercialized may change the landscape even further in the future.

- **Allows Summerside to adapt its system to changing conditions,** which may include uncertainty around future load growth in the context of electrification of heating and transportation.
- **Provides an ability to adapt to changing policy directions** and considerations related to increasing demand for renewable energy.
- **Allows additional considerations**, important for policymakers but out of scope of this analysis, to be included prior to any particular option being implemented (for example, the ability to decommission existing diesel generators earlier or adding imports for diversity purposes as included in our Plan B).

These drivers for a diverse and flexible capacity supply also mean that actual implementation decisions and preferred timing of each stage can be made closer to specific milestones to ensure that Summerside does not make a short-term decision with long-term unintended consequences. The recommendation provided here enables this continued monitoring of the changing context of grid operations and opportunities, as well as costs and policy considerations before specific, all-or-nothing decisions are made.

Dunsky's analysis led to a recommendation that Summerside implement a stacked capacity resource system, in which multiple options and sources are planned for and built over the coming years to ensure a stable, diverse capacity system that will meet peak demand and serve the City's needs. Doing so will also result in significant cost savings when compared to continuing to import capacity; it will also maintain Summerside's leadership in implementing cutting-edge technologies as well as meet the requests of residents and businesses for a clean energy mix without a loss of stability and reliance.

APPENDIX A: SUMMARY OF INITIAL STAKEHOLDER COMMENTS

The sections below provide a summary of the comments received during the stakeholder sessions on October 10 and 11, 2018. The stakeholder groups that were consulted included:

	Area of Focus
Session 1	Technical Group
Session 2	Industry Group
Session 3	Policy Group
Session 4	Maritime Electric
Session 5	City Council
Session 6	Environmental Group
Session 7	Student Group

Dunsky also spoke to the PEI Energy Corporation following the stakeholder consultations (in addition to interviews with utilities and others across North America to discuss their approaches to capacity resources).

KEY THEMES

A number of important issues were articulated (and reiterated) during the stakeholder sessions. These themes are the basis of the Qualitative Evaluation used to assess a short-list of capacity resource options – an important step in Dunsky overall evaluation process.

The stakeholder comments, organized by key theme, are summarized below.

- **Cost**: Dunsky heard general agreement regarding the need to balance cost, values, and other goals (e.g. sustainability, reliability, diversity, etc.). Price certainty (e.g. electricity rate increases in-line with inflation) is important to businesses; however, it was noted that labour costs are the City's biggest competitive advantage – energy prices are important to a degree but not a major factor. While there may be some flexibility in terms of the cost of new capacity resources, maintaining electricity rates at the level of Maritime Electric's while providing sufficient revenues is a priority of the city. In addition, energy bills are a critical consideration as there is a high percentage of lower income customers in the City.
- **Reliability:** Security of energy supply is critical for communities. Businesses and other customers struggle when there are prolonged outages – on a go-forward basis, reliability could be an important factor in the City's economic development. The ability to keep the lights on (and provide back-up generation options) is a selling point for business/industry. However, Summerside could put some of the reliability/security onus back on customers – there may be some back-up sources onsite at hospitals and large industrial customers who could supplement electricity from the system as needed (this could work with a favourable program/pricing scheme). In addition, stakeholders acknowledge that the capacity resources need to be available during peak periods and meet NERC reliability standards.

- **Diversity of Resources**: Stakeholders believe that a diversity of assets can support the City's multiple priorities and improve system stability and reduce risk; however, they noted that the pursuit of diversity should not jeopardize reliability.

- **Environmental Benefits**: All stakeholder groups indicated their support for Summerside to continue its leadership role in terms of developing a sustainable and innovative electricity system. There is general interest in adding more renewable green options to the energy mix, and some expressed concern regarding new fossil fuels. In addition, from an economic development standpoint, environmentally oriented projects help drive interest from industry and potential partners that are considering locating or expanding operations in Summerside. Related, green initiatives help further innovative opportunities ("innovation drives innovation").

- **Modular & Scalable**: Instead of locking into one larger resource, stakeholders wondered if it was possible to approach the capacity need with a modular and scalable resource or set of resources. These solutions could be more flexible and iterative over time as needs and technologies evolve. For example, demand side options such as energy efficiency and controllable demand response plus diesel and/or other supply-side resources.

- **Approvable**: Some stakeholders acknowledged that adding new fossil fuel supply options – regardless of whether they are energy or capacity resources – would be challenging to approve, given the province's greenhouse gas emissions targets and the current regulatory climate on PEI.

- **Resilience**: Related to Reliability and Diversity of Supply, stakeholders indicated support for building an energy system that was resilient to storms and other system events. This includes adding technologies and measures that are available (and help minimize) long-term outages.

- **Security**: A driving factor for the City is security of supply. A number of stakeholders, including the City, indicated that new capacity resources should be located on-Island to help increase access and security over the longer term. As one stakeholder said: as long as the City is buying power from someone else, they are exposed to cable issues, contract termination, etc. However, it was noted that NB Power remains an important potential source of capacity going forward, and that capacity price increases are in line with regional price increases (i.e. Forward Capacity Market in New England).

- **Other:**

    - *Black Start* – One of the more technical considerations raised during the stakeholder consultations was the need for "black start" capability – i.e. having sufficient capacity located near load centers to "jump start" the system after an outage. Smaller, dispersed resources raise some concerns in this area; however, it is a policy decision as to whether maintaining this ability is a priority.

    - *Existing Programs* – Existing City of Summerside programs could be considered NERC compliant and "tapped" for additional savings – for example the Heat for Less Now program. In addition, existing energy efficiency programs help reduce demand and thus the City's overall capacity needs.

    - *Demand Forecast* – Summerside (and Prince Edward Island) is experiencing increasing demand for electricity, and the system peak is forecast to increase over the next ten years. This is primarily due to demographic changes, significant uptake of heat pumps (i.e. fuel switching from heating oil to electricity for heating), and other public policy factors. This will have an important impact on the electricity system and Dunsky's assessment.

- *Load Factor* – Summerside's load factor is already 65% and sometimes 72% in the winter. In other words, there is already a high utilization rate on the system, which is favourable. However, this does impact the resources – and their size – that would be needed to meet peak demand requirements (e.g. need more than 4 hrs of battery capacity for the Summerside system). In addition, based on the structure of the NB Power contracts, reducing the differential between volume and capacity purchased could increase the price of its contracts.

- *Capacity versus Energy* – Stakeholders acknowledged that there is a lack of understanding between capacity versus energy needs/resources. Clear communication will be key going forward.

APPENDIX B: SUMMARY OF STAKEHOLDER FEEDBACK ON DRAFT REPORT

In general, feedback on the draft capacity plan was positive, with community members accepting that new resources are required for capacity purposes. Below is a summary of key themes and questions raised by stakeholders during the February 27th and 28th sessions on the draft capacity planning study. These sessions were held for City Council, the media, and the public.

Summary of Comment/Question	**Response and If/How Addressed in Final Report**
Load forecast questions: - How were new customers addressed? - How were increased loads from electrification of transportation considered?	- Summerside's existing load forecast was used, which estimates increasing load of ~2% per year, which could come from new customers and/or increased load from new technologies or increasing penetration of existing technology such as electric vehicles. - Existing text box on the load forecast has been expanded.
How does this study compare to ones conducted for other jurisdictions and what are their best practices?	- Every jurisdiction has different requirements and contexts in terms of capacity planning. - Because the utility industry and forecasting/planning is changing significantly due to new technologies and shifting load patterns, there are few reports that would show similar results to Summerside specifically or to studies from even 10 years ago. - Many utilities conduct integrated resource planning (IRPs) processes that allow them to assess impacts of energy and capacity plans on future utility needs and abilities to serve the load. These include more considerations than just capacity planning (e.g. energy, demand-side management, etc.), which are all integrated to help develop a holistic path forward. - Reference to value of IRPs added to report.
Consider noting that upgrades to the NB Power transmission line have been amortized and must be paid for over a 40-year timeframe in the report.	- Added to report.
Discussion of rate structures (e.g. portion of bill related to base or fixed charges and portion related to energy/demand use).	- The study was based on an assumption of no changes to Summerside's existing rate structure.
Why has behind-the-meter battery storage not been analyzed but utility-scale has?	- Battery costs are higher for behind-the-meter storage, so draft report focused on utility-scale.

Summary of Comment/Question	Response and If/How Addressed in Final Report
	- The potential for considering behind-the-meter storage options have been added to the report.
Questions about options that were not included in the draft report: - Hydrogen extraction from seawater - Conservation Voltage Reduction (CVR)	- The hydrogen extraction process is at pre-prototype stages so was not considered for the purposes of a required capacity source at this time; CVR is an energy efficiency option rather than demand response (although it has peak reduction impacts) so was out of scope of the study. - CVR is now referenced in the report.
Discussion of time-of-use rates and other strategies for reducing and shifting loads.	- No change required
The report does not address the continued importance of Summerside's partnership with New Brunswick Power (e.g. for energy purposes and for balancing wind production).	- Added to report

APPENDIX C: EXISTING CAPACITY RESOURCES

Unit Name	Type	In Service Date	Retirement Date	Installed Capacity (MW)	Net Rating (MW)	Derated Value (MW)
COS Unit #1	Diesel	1960	2025	2.8	2.2	**2.20**
COS Unit #2	Diesel	2013	2038	2.5	2	**2.00**
COS Unit #3	Diesel	2015	2040	2.5	2	**2.00**
COS Unit #5	Diesel	1961	2025	2.8	2.2	**2.20**
COS Unit #6	Diesel	2010	2035	1.3	1	**1.00**
COS Unit #7	Diesel	1950	2020	1.4	1.1	**1.10**
COS Unit #8	Diesel	1983	2030	5.3	4.2	**4.20**
Wind Farm (Summerside)	Wind	2009	2034	12	12	**3.60**
Interruptible Load	Diesel	2010	2100	1.2	1.2	**1.20**
Demand Response (HFLN Direct Control)	Demand - Side	2012	2037	3.3	3.3	**1.30**
Balancing Contract (PPA)	Imports	2019	2024	10	10	**10.00**
Wind Farm (West Cape)	Wind	2008	2028	9	9	**3.20**

APPENDIX D: ANALYSIS DETAILS

Based on Dunsky's initial qualitative analysis, the following options, all of which met enough technical requirements to be considered for a quantitative analysis, were selected for further analysis:

- Expansion of the Heat For Less Now program;
- Expansion of the Interruptible Load program;
- Grid-scale battery storage;
- Biodiesel generator
- Capacity imports (baseline option); and
- Diesel generator.

Each of these options is detailed below, following a similar structure:

- Description
- Approach
- Analysis Results
- Key Takeaways

CAPACITY IMPORTS

DESCRIPTION

30% - 40% of Summerside's capacity requirements are currently met through contractual agreement with New Brunswick Power (NB Power) for firm capacity. Under the current agreement, NB Power will provide Summerside with 10 MW of firm capacity in 2019, increasing over the contract's lifetime to 15 MW by 2024. Further contractual agreements for imports beyond 2024 have not yet been discussed.

APPROACH

Available Capacity

In this scenario, capacity imports are assumed to increase annually to fully meet capacity deficit requirements resulting from increase in peak load as well as Summerside's asset retirement. Our analysis assumes that no constraints are placed on future import capacity and that Summerside can increase imports. This assumption could have material impacts if Summerside's final decision is to maximize imports.

Costs

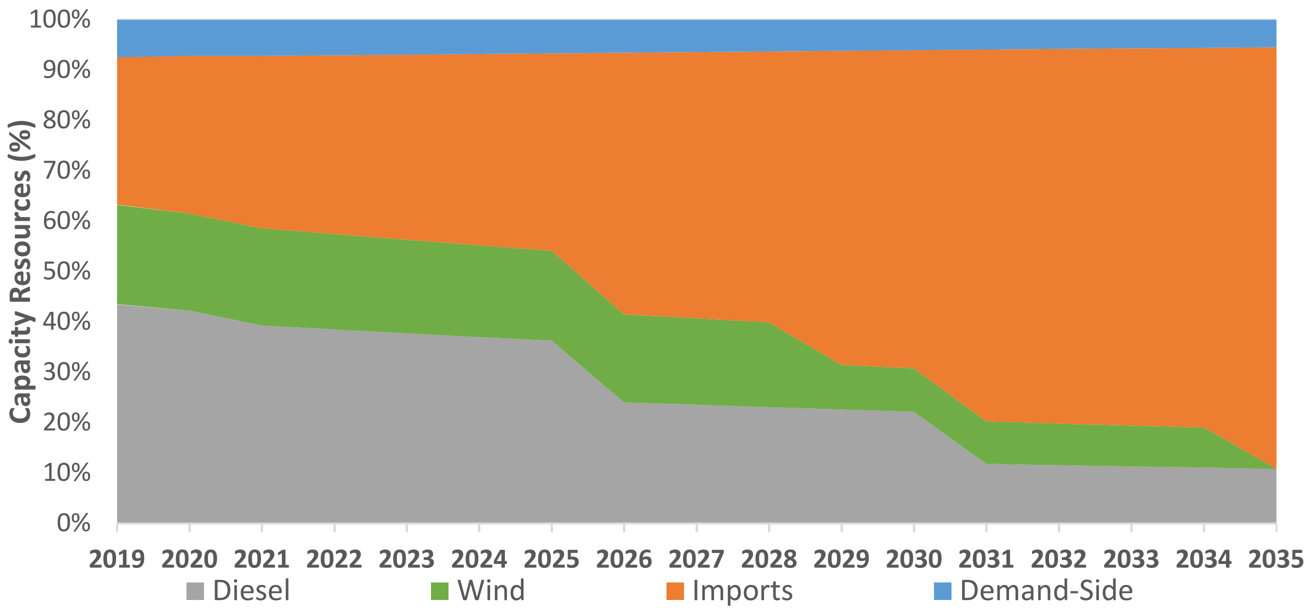
Using current contract terms from 2019 to 2024 and cost escalation projections from New England's Avoided Energy Supply Components (AESC) 2018 study, the cost of capacity and energy between 2019 and 2035 were estimated. Beyond 2035, costs were escalated at the Compound Annual Growth Rate (CAGR) between 2025 and 2035.

ANALYSIS RESULTS

Resource Adequacy

As a result of Summerside's growing load as well as diesel and wind assets reaching the end of their expected lives, under this scenario Summerside would significantly increase imports to meet capacity requirements to 2035. By the end of the analysis period, imports would represent more than 80% of Summerside's capacity resources, up from 30% in 2019.

Figure 22. Share of capacity resources under imports scenario



Financial Impacts

Expanding imports by 2025 to meet capacity requirements will cost the utility an estimated $1 million annually. With the forecasted increases in capacity costs as well as the increasing required capacity, Summerside's imports could cost the utility as much as $4 million annually by 2035.

KEY TAKEAWAYS

The analysis of capacity import options highlight that:

- Continued imports without any investment in on-Island supply would result in Summerside being heavily dependent (up to 80% by 2035) on off-island resources.
- The high reliance on imports increase the exposure of the utility and rate payers to volatility and uncertainty of capacity and energy costs and potentially prone to significant impacts on revenue requirements.

DIESEL GENERATOR

DESCRIPTION

To address load growth, asset retirement and increased in cost of capacity imports, Summerside has considered the addition of a 16 MW diesel generator. The proposed diesel generator is intended to serve as a peaking unit, meaning it will be primarily used for the provision of capacity, not energy. For example, current diesel generators in Summerside provide about 50% of required capacity, but only 1% of energy requirements.

APPROACH

Our analysis built on Summerside's existing analysis of a 16 MW diesel generator, using sizing and costing parameters, as it is the most detailed, having already been subject to RFP. Our analysis assessed the diesel generator in two different time slices (2020 and 2025) to determine the most appropriate time for the investment, however no changes in investments costs were assumed regardless of the generator's construction year.

Two of the city's oldest diesel generators (put in service in the 1960s) are expected to reach end-of-life by 2025. When planning any new generation, city staff may choose to expedite or delay the decommissioning of older units approaching end-of-life for operational benefits and optimizing the overall value and performance of the utility's assets.

ANALYSIS RESULTS

Resource Adequacy

The diesel generator commissioned in 2020 creates a capacity surplus that can completely eliminate contracted imports by 2021[12]. However, in the longer-term, with growing load and other assets reaching end-of-life, further imports will be required to fully meet system requirements. Although the diesel plant reduces future dependence on imports relative to the baseline scenario, 50% of required capacity will still be met through imports.

Moving the generator investment to 2025 rather than 2020 maintains the short-term reliance on imports and reaches the originally planned 15 MW in 2024. The long-term impact is similar with 50% of capacity requirements being met through imports.

[12] The analysis is a financial one and does not address the feasibility of reducing imports prior to the end of the existing contract.

Figure 23. Share of capacity resources under diesel generator 2020 investment scenario

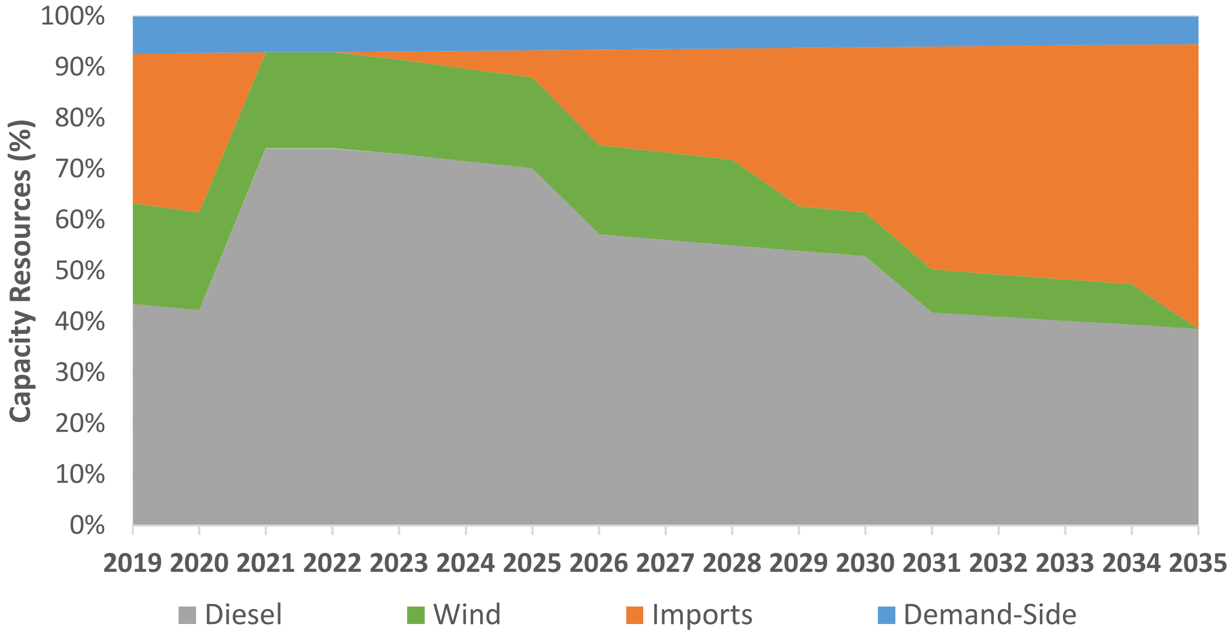
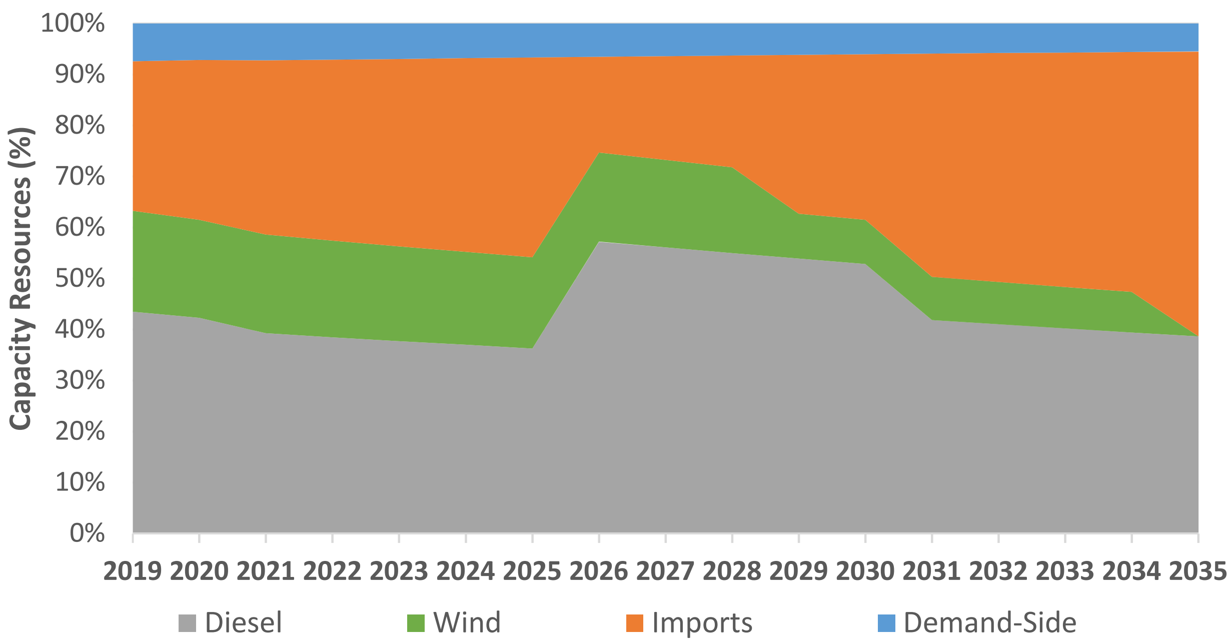


Figure 24. Share of capacity resources under diesel generator 2025 investment scenario



Financial Impacts

The diesel generator is estimated to have a capital cost of $23M, with annualizing capital payments over the asset's lifetime result annual $1.1M of capital spending. Additionally, annual operational costs of the unit are estimated at $110K.

Accounting for the avoided costs of imported capacity and energy, the diesel generator has a positive NPV over the project's lifetime. However, net negative cash flow between 2021 and 2027 result in an impact on revenue requirements (which would correspond to a rate increase or reduction in city dividend payments); see Figure 22 and Figure 23. That being said, over the generator's lifetime, the positive NPV corresponds to an average of 0.21% - 0.5% decline in revenue requirements.

Figure 25. Annual cash flows under diesel generator scenario in 2020

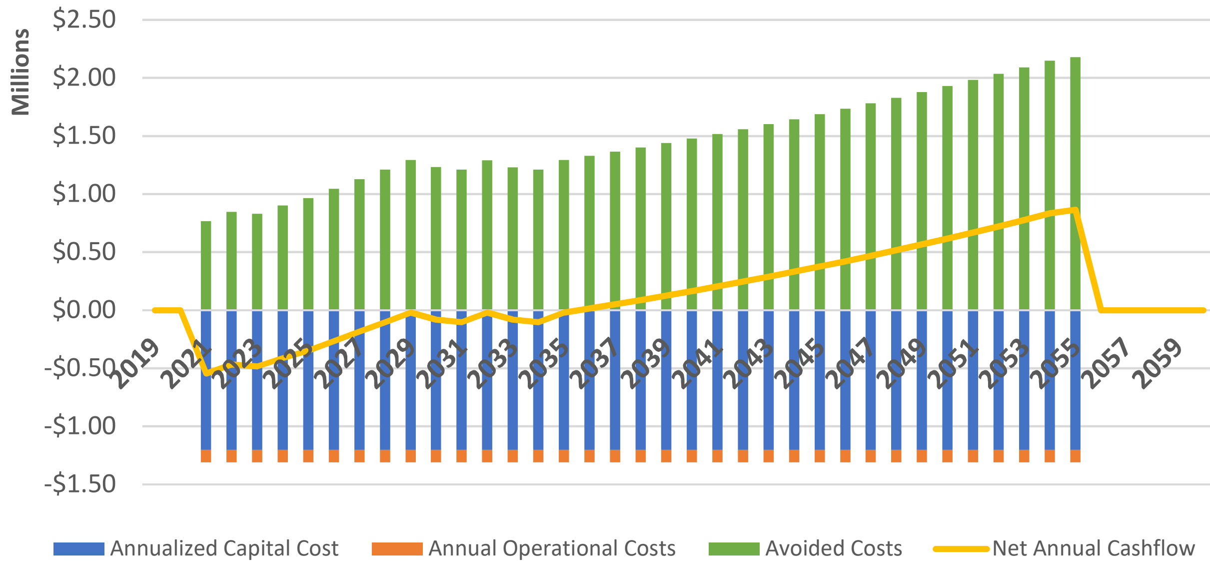
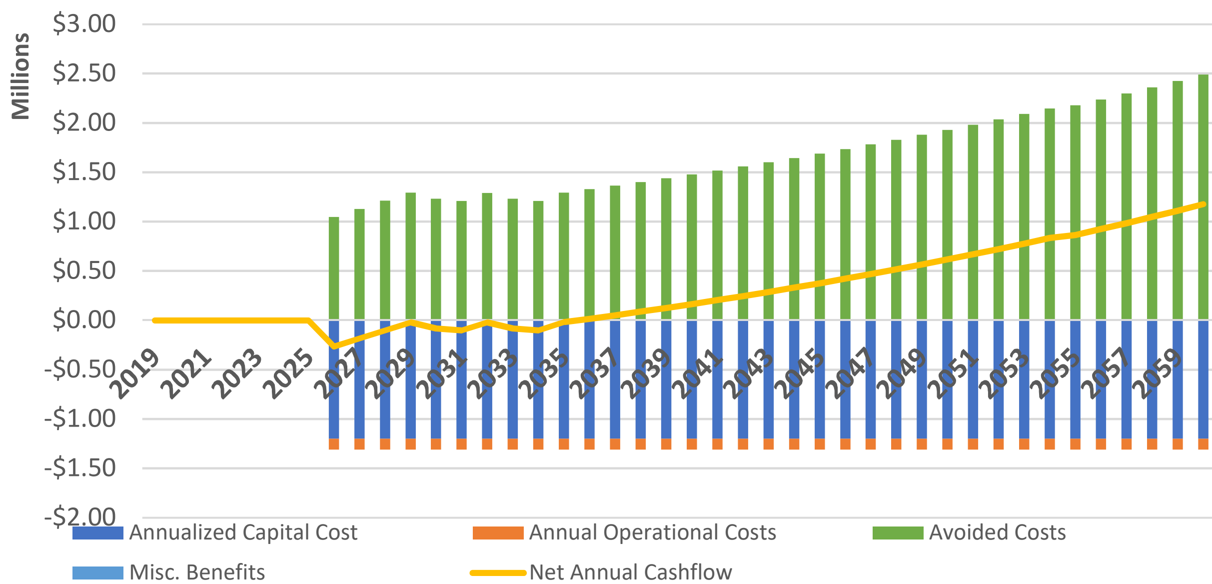


Figure 26. Annual cash flows under diesel generator scenario in 2025



We note that revenue requirement impacts (Figure 24 and Figure 25) highlight projected increase/decrease in revenue requirements relative to the baseline option (capacity imports). Actual revenue requirement impacts would follow a similar trend; however, impacts may not be as discrete (i.e. a single rate increase/decrease, rather than multiple rate changes, may result from utility capital investment).

Figure 27. Annual revenue requirements under diesel generator scenario in 2020

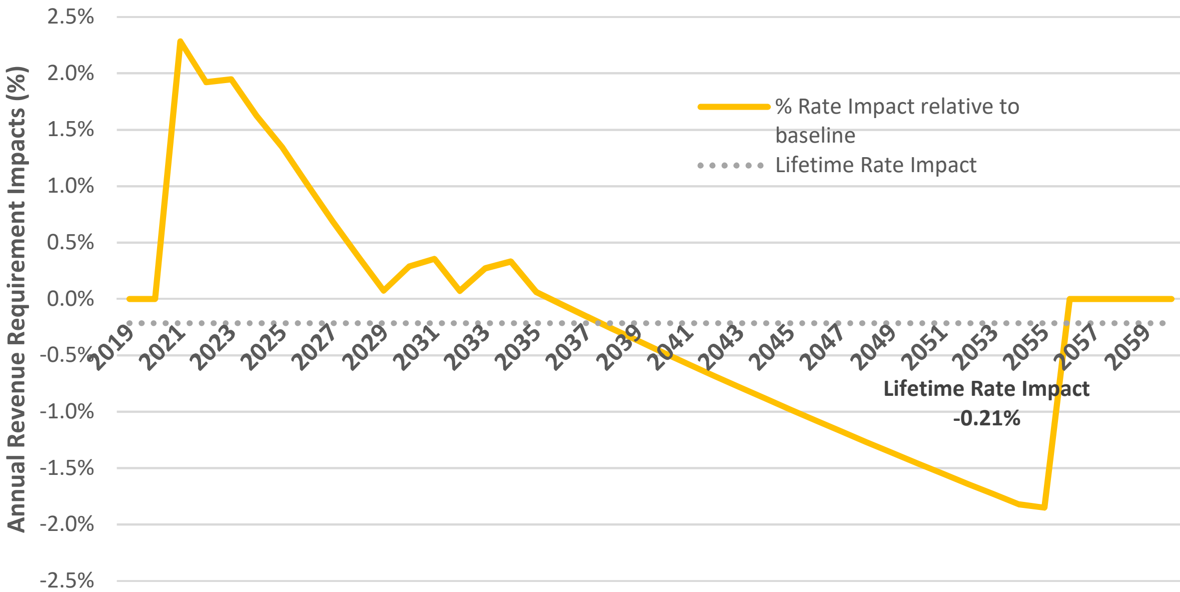
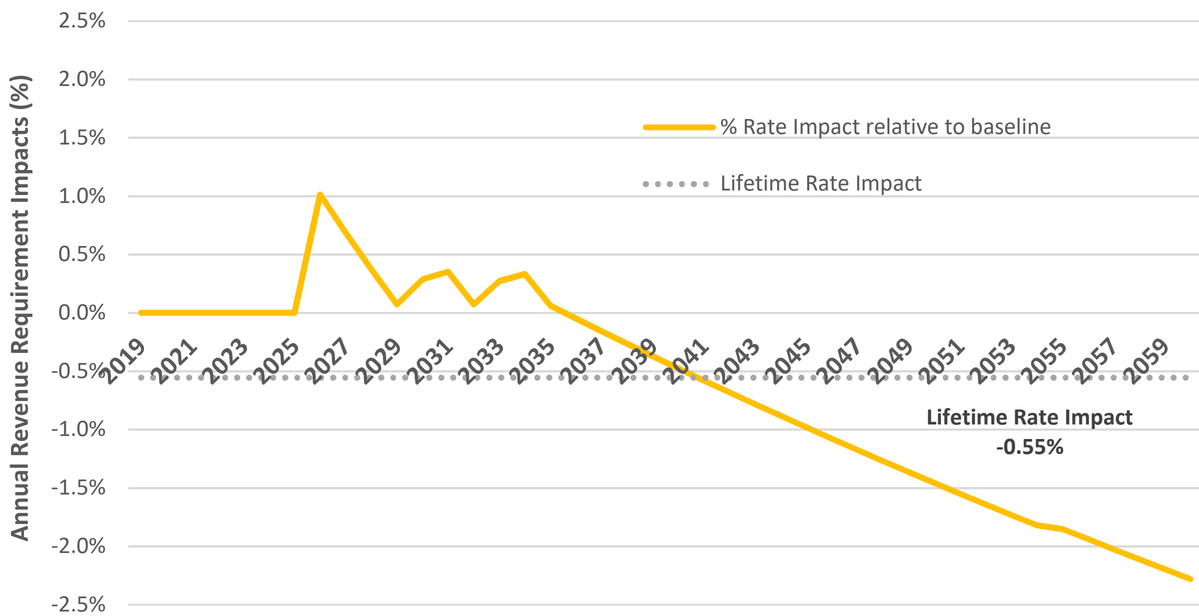


Figure 28. Annual revenue requirements under diesel generator scenario in 2025



KEY TAKEAWAYS

Overall, the analysis of the diesel generator highlights the following takeaways:

- The diesel generator creates a capacity surplus that can eliminate some of the contracted imports in the short-term; however, in the longer term, 51% of required capacity will still be met through imports.
- The business case for the diesel investment improves by 2025 due to the increasing cost of imports and the need for the increased capacity with asset retirement
- Despite some negative cash-flow in early years, as the investment has a net positive NPV, a negative rate pressure would be observed over the project's lifetime.

	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
2020	$96	$0.15 M	-0.21 %	49%
2025	$96	$3.24M	-0.55%	49%

EXPANSION OF HEAT FOR LESS NOW PROGRAM

DESCRIPTION

Since 2011, Summerside's Heat for Less Now (HFLN) program has been successful in generating revenue for the utility and resulting in community-wide GHG emission reductions through electrification of space and water heating. The program offers Summerside's customers with Electrical Thermal Storage (ETS) systems for space and water heating through a purchase or leasing arrangement. Subscribed customers benefit from reduced electricity rates for their heating units for a five-year period, paying $0.08/kWh as opposed to their regular retail rate ($0.11 - $0.17/kWh depending on customer rate class and consumption group). To date, the program has supported 223 customers in installing 385 units, corresponding to 3.88 MW of demand and roughly 7 GWh of increasing electricity sales.

The program was developed by the city to address the increasing amount of excess wind generation that was historically exported. Despite the lost revenue margin from the reduced rates to program subscribers, HFLN generates a net-positive margin for Summerside because of the differential with the export rate for excess wind energy. Additionally, the program encourages fuel switching and the adoption of electric space and water heating. Because Summerside has a relatively clean electricity mix, it displaces other carbon-intensive heating fuels and generates GHG emission reductions.

In addition to the revenue generation and GHG emissions reductions, HFLN could serve as a capacity option for offsetting a portion of Summerside's peak. ETS units sold under HFLN can serve as controllable load through time-based scheduled control and real-time utility control. Under NERC's requirements for capacity resource options, Direct Load Control Management (DCLM) are eligible demand-side resources for capacity planning purposes. Under DCLM, electric appliances or equipment on customer premises must be controlled by the system operator to be eligible. Of the deployed 3.88 MW HFLN capacity, 2.3 MW are estimated to be on time-based controls and 1.6 MW under utility control.

Direct utility-controlled ETS requires connectivity capability, often achieved through a fibre backbone network. To date, Summerside is estimated to have spent $4.1M for covering roughly 40% of the city with fibre connectivity. Sales generated from HFLN are also allocated to fibre capital investments. The City also generates revenue from the network through sharing the infrastructure with Internet Service Providers (ISPs). In addition to the fibre network, investments are required for service drop from the curb to the customer's meter.

APPROACH

Estimated Achievable Potential

3.9 MW of HFLN capacity are currently deployed with roughly 60% (2.3 MW) estimated to be on time-based controls and 40% (1.6 MW) under direct control. In this scenario, we assume the existing 2.3 MW of time-based control will be converted to direct control and 4.6 MW of additional capacity can be deployed over the next 4 – 5 years[13], which would result in a cumulative installed capacity of 8.5 MW.

An alternative to this approach would be to analyze the existing time-based customers. If they are turning their units off during peak, they could be kept on existing contracts rather than upgraded to direct-load-control in the short term and their impacts captured under Summerside's load forecast rather than as a NERC capacity supply option.

[13] Between 2015 and 2017, 45 units are estimated to have been sold annually, corresponding to 0.46 MW of capacity.

	All	Time-based	Direct-control
Existing	**3.9 MW**	2.3 MW	1.6 MW[14]
Migration		- 2.3 MW	+ 2.3 MW
Additional	**4.6 MW**		4.6 MW
Total	**8.5 MW**	**0 MW**	**8.5 MW**

The migration of the 2.3 MW and the additional 4.6 MW of new capacity are assumed to be implemented incrementally over the period of five years between 2019 and 2024.

Program Costs and Revenues

Based on program evaluation documents and discussions with Summerside staff, two capital cost streams were identified relating to HFLN capacity deployment: costs for fibre backbone network and a service drop from curb to meter. Using historical program data, capital costs were identified by $14k/customer for fibre network and $1.4k/customer for service drop to meter. Additionally, the program is estimated to have $200k in annual operational costs during the proposed five-year capacity expansion period (2020-2024).

In addition to avoiding capacity and energy imports, HFLN generates additional revenue for Summerside that are used to compensate the investment costs. As HFLN units are charged using excess wind energy that would have otherwise been exported at a lower price, the program generates revenue equivalent to the price differential of $0.048/kWh from the HFLN energy sales[15]. Additionally, an estimated $10/customer/year in revenue is generated through sharing the fibre infrastructure with Internet Service Providers (ISPs).

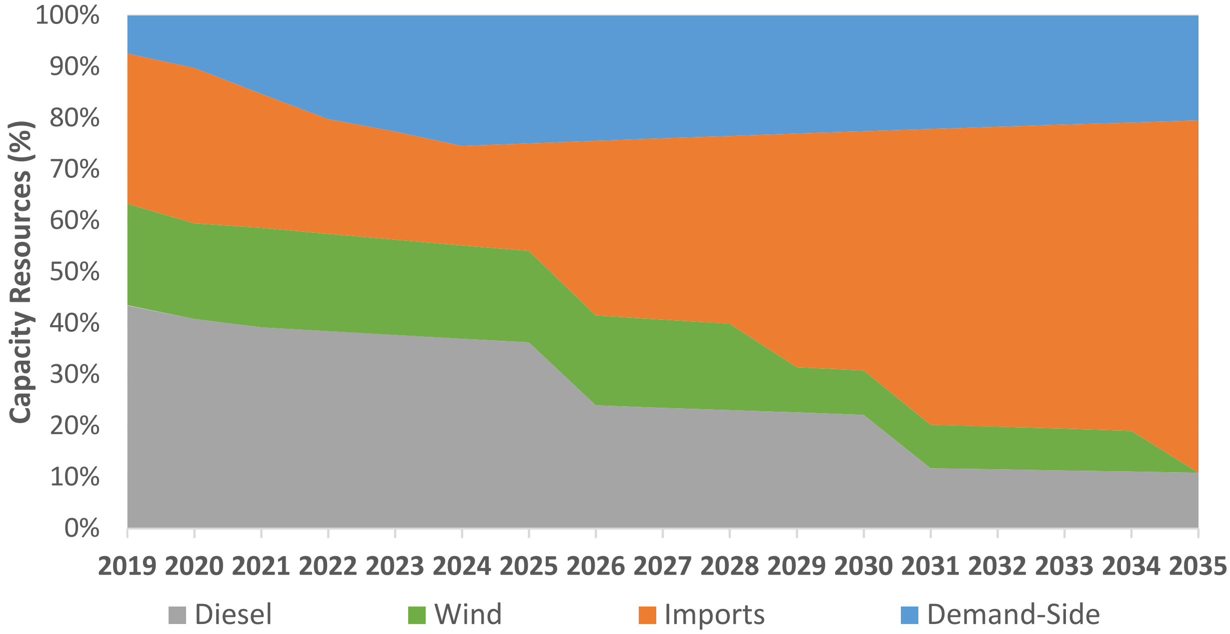
ANALYSIS RESULTS

Resource Adequacy

HFLN program expansion generates a capacity surplus with as much as 25% of Summerside's capacity requirements being met through demand-side options by 2024. Under this scenario, reliance on imports is reduced annually between 2020 and 2024.However, in the long-term, with the increasing load and asset retirement, the HFLN expansion has a very small impact relative to Summerside's overall capacity gap, with 64% of Summerside's required capacity still being met through imports.

[14] Summerside does not currently claim capacity credit for the 1.6 MW of available direct-control HFLN capacity.
[15] Revenue from HFLN energy sales is contingent on the availability of excess wind production. In the case where exports are limited, a lower price differential (< $0.038/kWh) will result in lower program revenues.

Figure 29. Share of capacity resources under HFLN program expansion scenario



Financial Impacts

The required capital investments for HFLN capacity expansion was estimated at $5.4M, with annualized capital payments over asset lifetime of $0.4M. Additionally, $200K in annual program operational costs are estimated for the five-year program expansion period.

Revenues from ISP and HFLN energy sales are projected to contribute $0.5 - $0.6M annually. Accounting for the avoided costs, the program is projected to have a net-positive cashflow and NPV, which corresponds a decline in revenue requirements (i.e. lower rates and/or higher dividend to city) of 2.23% over the investment's lifetime.

Figure 30. Annual cash flows under HFLN program expansion scenario

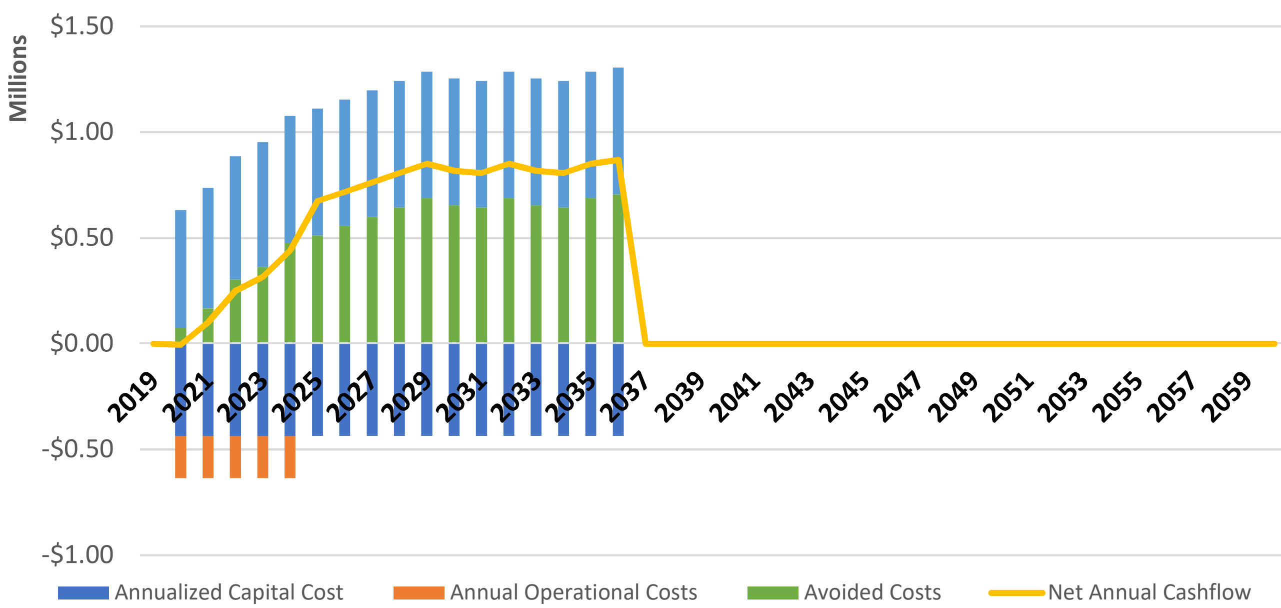
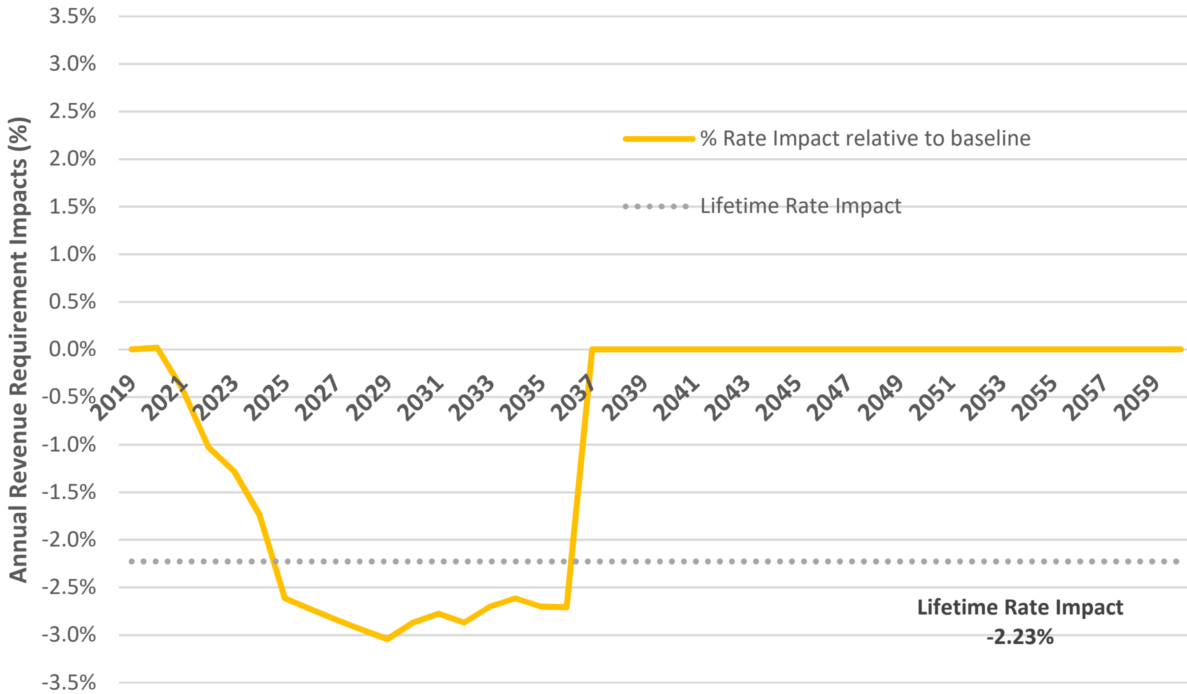


Figure 31. Annual revenue requirements under HFLN program expansion scenario



KEY TAKEAWAYS

The HFLN program expansion (through additional customer acquisition and migration of existing capacity to direct-control analysis highlights:

- HFLN can mitigate capacity constraints in the short-term and reduce reliance on imports; however, in the longer term the impact is negligible relative to the scale of required capacity by 2035.
- The investment is net positive to Summerside and could result in reduced revenue requirements (i.e. lower rates and/or higher dividends to the City).

Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
$72	$7.0M	- 2.2%	36%

EXPANSION OF INTERRUPTIBLE LOAD PROGRAM

DESCRIPTION

Under the Interruptible Load Program (ILP), large customers are on stand-by for curtailment during peak demand or system critical hours. By shedding load upon request during those peak demand hours, interruptible customers reduce the utility's capacity requirement. Participating customers are compensated through guaranteed payments, whether or not they are called upon. Summerside currently has 6 interruptible customers that contribute to 1.2 MW of peak load. On average, interruptible customers participate in 4 events per year, with each lasting 6 hours or less.

APPROACH

Estimated Achievable Potential

Our analysis considered Summerside's top 25 demand-based customers as potential candidates for participation in the interruptible load program. Currently, only 2 of the 25 top customers are interruptible. 3 customers have been identified as having backup generators as well as 10 additional customers assumed to have interest in serving as interruptible customers, resulting in 13 additional customers who can be potential participants in the program. Considering the average loads of the identified customers during peak months (December, January, February and March), 3.33 MW of additional interruptible capacity was deemed an achievable target for additional interruptible load. It is important to note that interruptible customers are not necessarily limited to the top 25 customers and other customer groups can serve as interruptible load.

	Existing ILP Customers	Potential Additions			Total ILP Customer
		Customers with Generators	Achievable	Total Additions	
Number of Customers	6	3	10	**13**	**19**
Peak (MW)	1.2 MW	1.65 MW	1.68 MW	**3.33 MW**	**4.53 MW**

The 3.33 MW of new capacity is assumed to be implemented incrementally between 2020 to 2023 (0.3 MW in 2020 with 1 MW annual increments).

Program Costs and Revenues

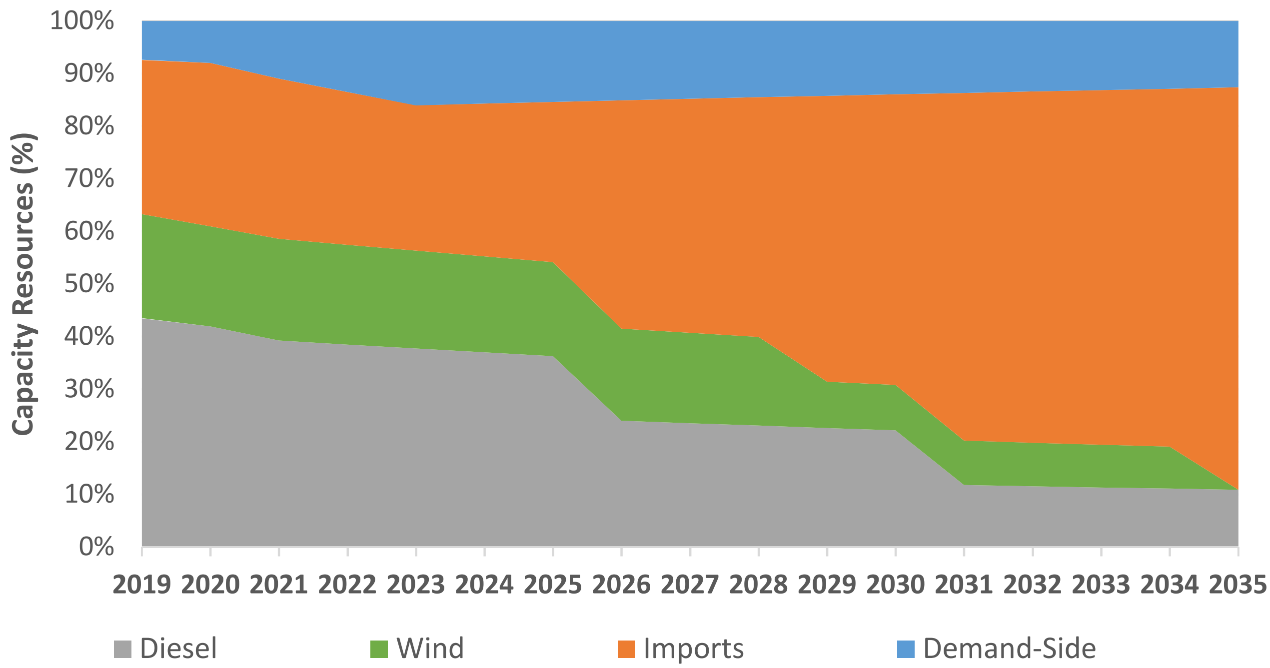
The ILP is assumed not to have any capital costs associated with its expansion. As compensation for serving as interruptible load, participating customers are paid an amount equal to 50% of capacity costs Summerside would have procured elsewhere. The compensation is treated as a guaranteed payment for stand-by, regardless of whether or not an interruption event takes place.

ANALYSIS RESULTS

Resource Adequacy

As with HFLN expansion, ILP expansion results in additional capacity in the short-term and reduced reliance on important, with limited long-term impact due to the small magnitude of capacity relative to significant gaps in 2035. Under the ILP investment, 72% of Summerside's capacity will be provided through imports.

Figure 32. Share of capacity resources under Interruptible Load expansion scenario



Financial Impacts

Due to the lack of capital and administrative costs, and the program's compensation costs being linked to avoided capacity costs, the ILP expansion will always be net-positive to Summerside. The net benefit to the utility resulting from the program corresponds to a decline in revenue requirements (i.e. lower rates and/or higher dividend to city).

Figure 33. Annual cash flows under Interruptible Load expansion scenario

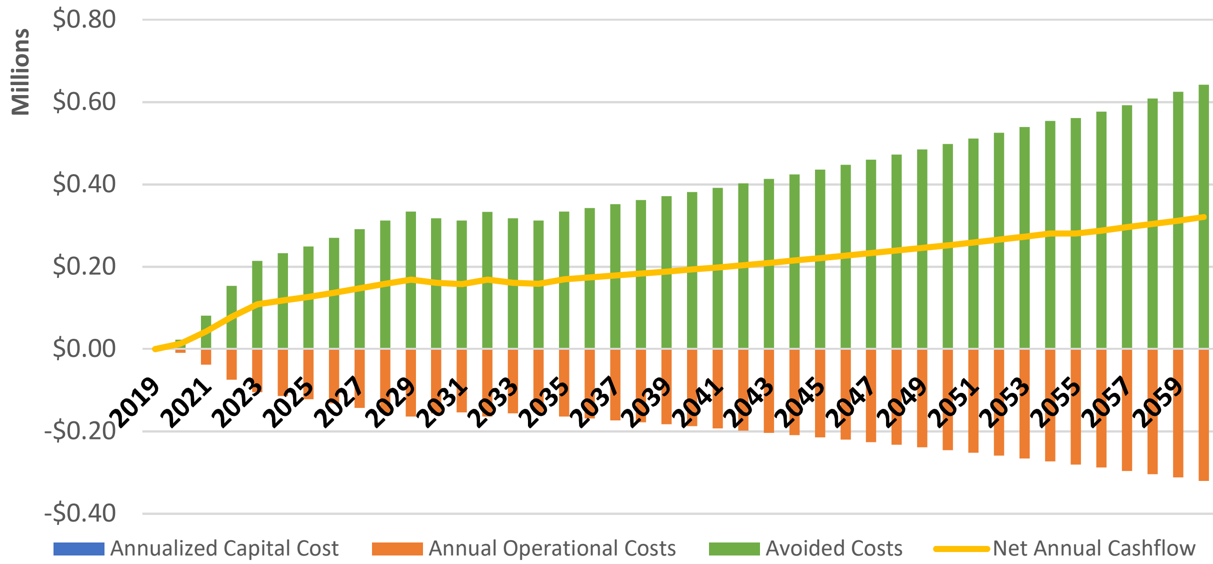
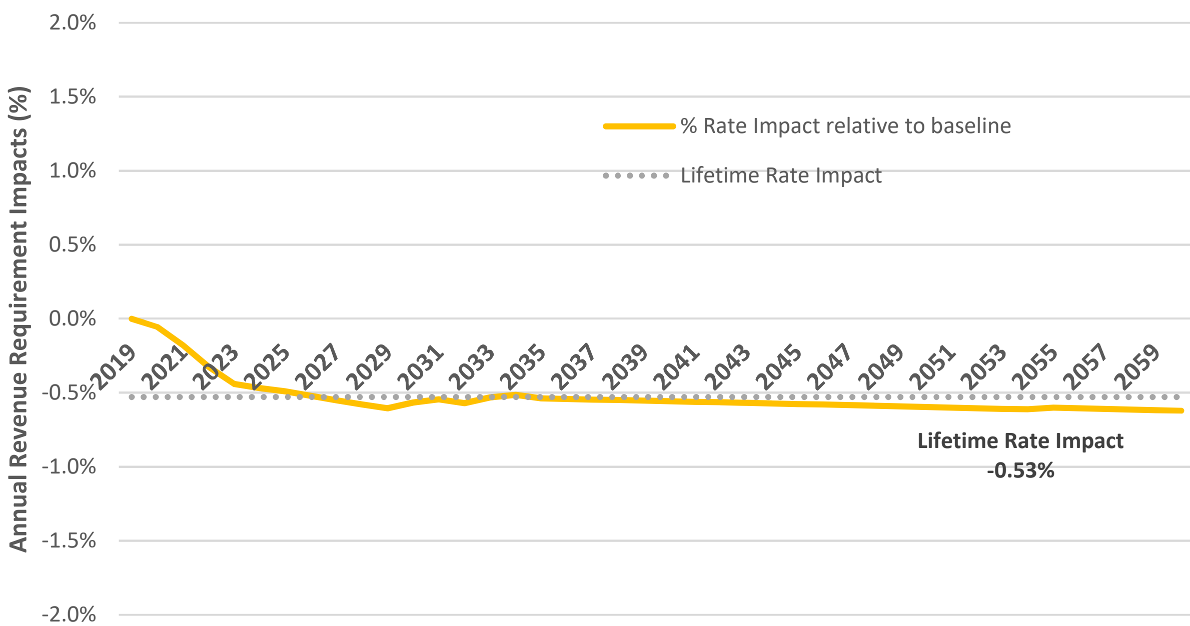


Figure 34. Annual revenue requirements under Interruptible Load expansion scenario



KEY TAKEAWAYS

The ILP program expansion analysis highlights that:

- The program can mitigate capacity constraints in the short-term and reduce reliance on imports; however, in the longer term the impact is negligible relative to the scale of required capacity by 2035.
- The investment is net positive to Summerside and could result in negative rate pressure (i.e. lower rates and/or higher dividend to the City).

Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements over Lifetime	% of Capacity Resources on-Island by 2035
$12	$3.4M	- 0.53%	28%

BATTERY STORAGE

DESCRIPTION

Historically, energy storage penetration was largely in the form of large-scale pumped hydro storage. With the increased penetration in renewable energy, along with significant technological improvements and cost reductions in battery storage over the past few years, there has been a growing interest from utilities, regulators and industry in the role batteries can play in achieving the vision for a secure, reliable and low-carbon future grid. Batteries have several distinct features that make them stand out as a unique grid asset compared to other traditional capacity options:

- **Scalability**: Battery systems can be sized to be as small or as large as desired and can be located along the entire electricity value chain, ranging from small distributed behind-the-meter (i.e., customer-sited) systems to large-scale batteries at the distribution or transmission levels.

- **Versatile and stackable value**: Storage systems can provide multiple and stacked services and values to the customers and utilities including

    - *Reducing peak capacity requirement* through discharging during peak load hours
    - *Energy arbitrage* opportunities through benefiting from price differential between peak and off-peak hours.
    - *Providing ancillary grid* services such as voltage and frequency regulation, spinning and non-spinning reserves, black start capability among other values.
    - *Potential reduction in GHG emissions* through optimising use of renewable energy production and reducing curtailment and/or exports.
    - Deferring investments in transmission and distribution (T&D) infrastructure upgrades and investments through reducing local peaks.
    - *Bill reduction* for customers through reducing peak demand charges and energy arbitrage opportunities in the case of time-of-use (TOU) rates and other market price signals.
    - *Provision of back up power* as well as ability to reduce frequency and severity of power outages.

APPROACH

Battery Size

To determine the appropriate battery size required for Summerside, we focused on the minimum required capacity contribution that the battery needs to provide. Using 2017 hourly (8760) load data for Summerside, a load duration curve was developed to highlight the 100 hours with highest load and identify peak hours and days within the top 100 hours. The highest number of consecutive peak hours and the frequency of occurrence in those time slices was used to determine the battery's minimum size. ***The analysis identified two peak windows up to 4 hours of consecutive peak hours in each (8 – 11 AM and 4 – 8 PM) in the months of January, February and December. The battery was sized to contribute 5 MW for up to 4 hours, resulting in a battery size of 5 MW and 20MWh.***

Value Streams

To accurately determine the value of battery storage, hourly load simulation with a battery dispatch algorithm is needed. For the purpose of this analysis, a simple dispatch model was developed to determine a high-level estimate of the battery's value:

- **Capacity Provision**: The battery's operations were fully reserved for capacity adequacy during the identified peak months (January, February and December), with peak hours during these months identified as 8 – 11 AM and 4 – 8 PM. While in reality the battery can be utilized for other services during off-peak hours in those months, we assumed that the battery will be fully dedicated to providing peak capacity due to the changing peak load trends identified by Summerside staff in recent years[16]. This assumption may *underestimate* some of the potential value of battery storage during peak months; however, it highlights likely uncertainty in peak occurrence in the absence of perfect foresight., Additionally, the analysis assumes the battery is sufficiently charged between the two-peak period (i.e. between 11 AM and 4 PM) to meet the afternoon peak demand.

- **Energy Arbitrage**: Summerside energy procurement from NB Power is subject to peak and off-peak electricity rates, with peak defined as Monday – Friday between 7 am and 11pm. The developed dispatch algorithm assumes the battery will be charged sufficiently overnight on week days in off-peak times and will discharge during peak hours; resulting in an economic benefit equivalent to the differential between the two prices.

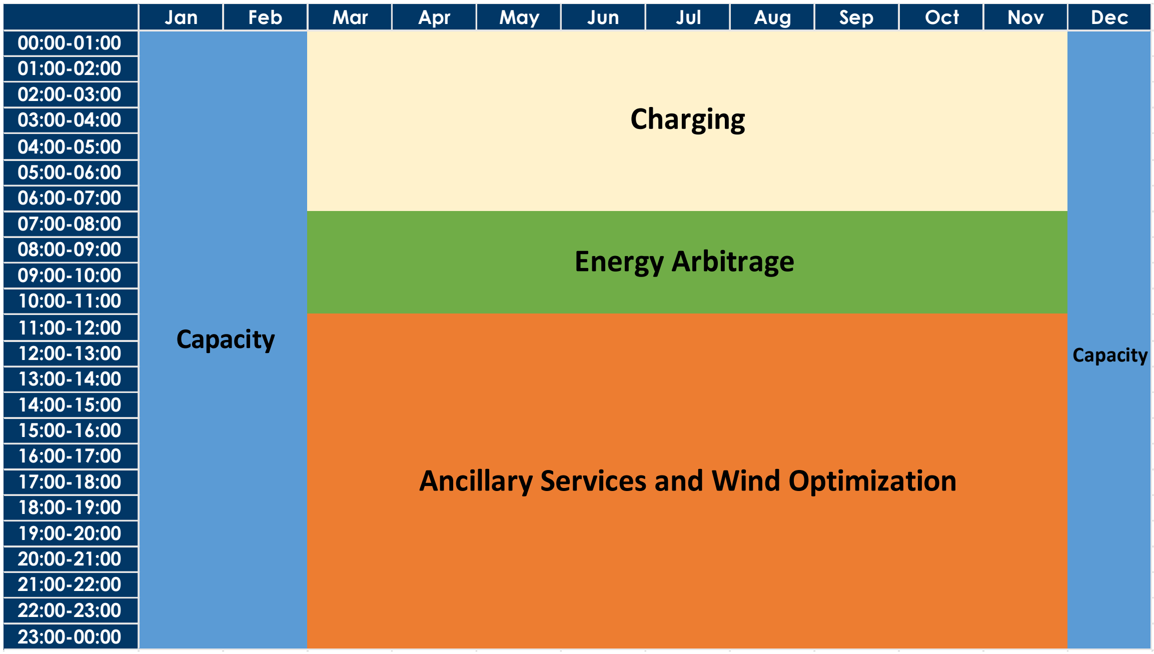
- **Ancillary Services and Wind Optimization:** When not in charging, capacity or energy arbitrage mode, it was assumed that the battery will provide ancillary services; including frequency/voltage regulation and spinning reserves. Considering value of each service and to ensure longevity of batteries, it was deemed that the highest value service would be operating reserves, followed by voltage regulation and load following. Additionally, the battery's black start capability can result in additional revenue; however, the market does not currently require the service for the foreseeable future. Additionally, the battery can be dispatched appropriately to keep excess wind production within Summerside's territory and avoided NB Power's generation backstop fees for balancing services. The approximate value of services the proposed 5 MW battery can provide is approximately $550,000 per year.

The analysis of the battery assumes the full value from ancillary service provision can be obtained; however, several factors could impact the actual value received, including:

- Variation between modeled and actual battery dispatch: Detailed hourly load simulation as well as pilot projects under different battery dispatch strategies are needed to accurately determine the level of capacity the battery can provide
- Uncertainty around the market demand and value: In addition to meeting Summerside's self-supply ancillary services requirements, the battery is assumed to sell some of these services in the wider balancing area; therefore, the regional demand and price of such grid services would impact the economics.

[16] Summerside's peak load can historically been in the identified time slices (week days 8 – 11 AM and 4 – 8 PM in the months of January, February and December), however in recent years, system peaks have been observed in what traditionally is considered to be off-peak hours (for example weekdays: 11AM – 3PM, and weekends as well as critical hours in March and November).

Figure 35: Assumed battery storage dispatch during weekdays



Battery Costs

The U.S. Energy Information Administration's (EIA's) overnight capital costs[17] as well as operational and maintenance costs for battery storage was used and converted from USD to CAD to estimate project capital costs. The used costs include interconnection costs as well as contingency cost. Additionally, battery costs are expected to decline significantly over the next decade, therefore projected cost reductions from Bloomberg New Energy Finance (BNEF)[18] were used to estimate project's capital costs until 2030 as shown in the table below.

	Battery Costs ($/kW)	Fixed O&M ($/kW/Yr)	Variable O&M ($/MWh)
2020	$2,542.05	$45.56	$9.06
2025	$1,669.09	$38.12	$7.39
2030	$1,191.74	$31.90	$6.02

Technical Parameters

The modeled battery system was assumed to be a Lithium Ion (Li-on) battery with a roundtrip efficiency of 90% and a lifetime of 15 years. The battery is also assumed to be maintained at above 10% state of charge (SOC).

[17] U.S. Energy Information Administration (2018), *Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2018*

[18] Bloomberg New Energy Finance (2017), *Lithium-ion Battery Costs and Market*

ANALYSIS RESULTS

Resource Adequacy

The modeled 5 MW contributes to reducing off-island imports equivalent to its capacity contribution. However, the impact is minimal in the long-term due to the small relative contribution of the proposed battery. Given the scalability of battery technology, installed capacity can be increased incrementally as required. As highlighted earlier, in addition to capacity/resource adequacy, the battery can be used for provision of ancillary services and ensuring grid stability.

Figure 36. Share of capacity resources under battery storage investment in 2020

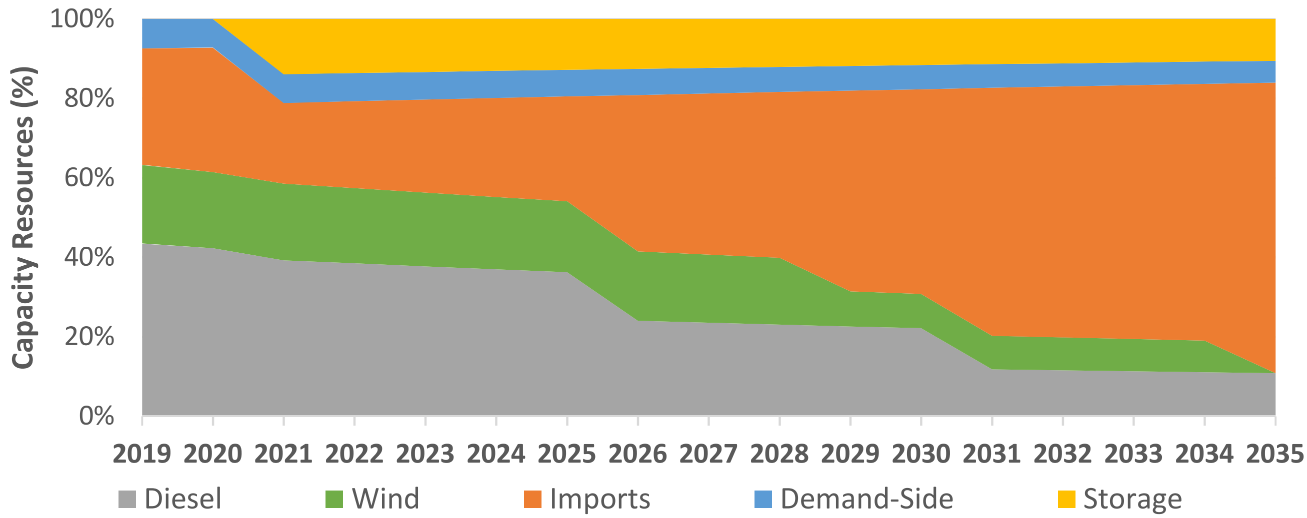


Figure 37. Share of capacity resources under battery storage investment in 2025

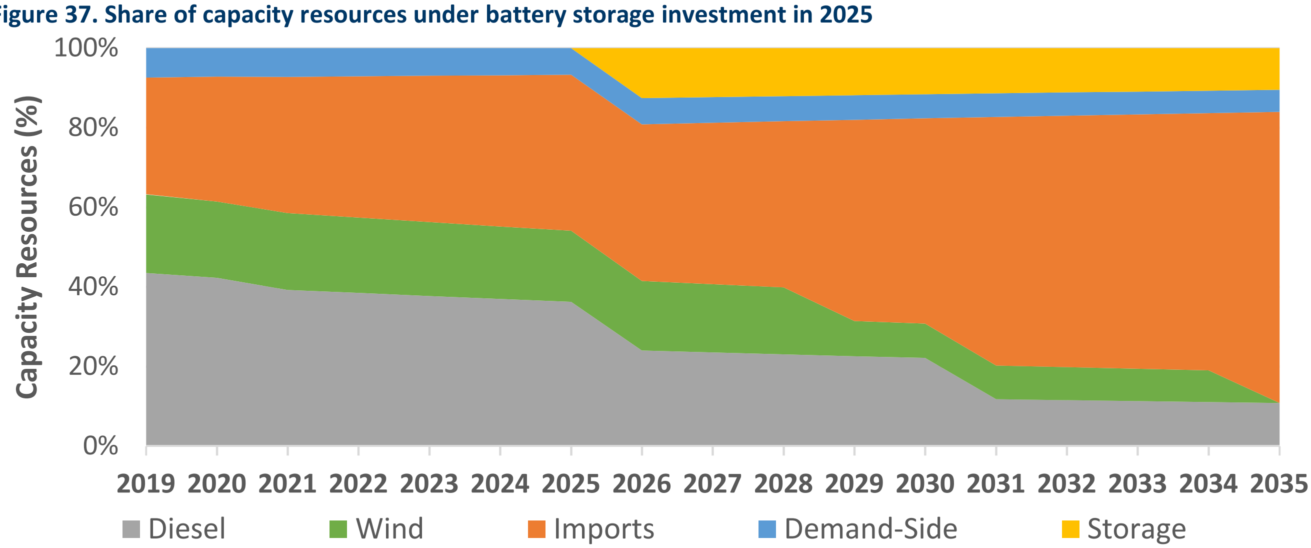
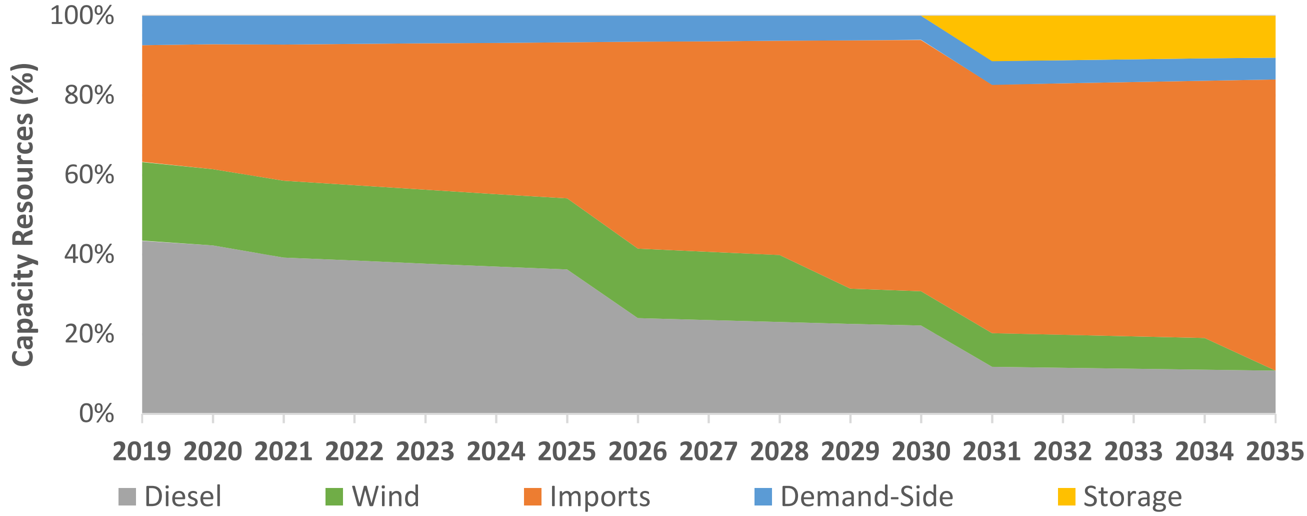


Figure 38. Share of capacity resources under battery storage investment in 2030



Financial Impacts

Using projected cost declines, we ran the analysis over three timeframes: 2020, 2025 and 2030. In 2020, the significant upfront costs of the battery result in the scenario not being cost-competitive, resulting in negative revenue requirement impacts. The analysis shows that the battery investment will be a cost-effective capacity option between 2023 and 2026, suggesting that this timeframe will be a realistic for a battery investment.

The cost-effectiveness of batteries is sensitive to uncertainty in system costs. Additionally, as highlighted earlier, uncertainty around the market demand and value of ancillary services that battery provides would impact the economics.

Figure 39. Annual cash flows under battery storage scenario in 2020

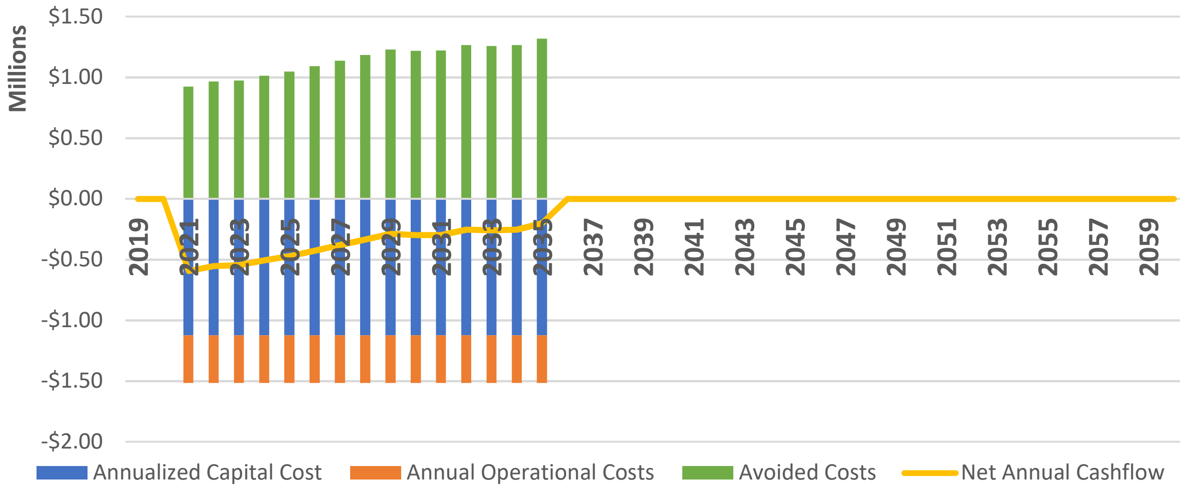


Figure 40. Annual cash flows under battery storage investment in 2025

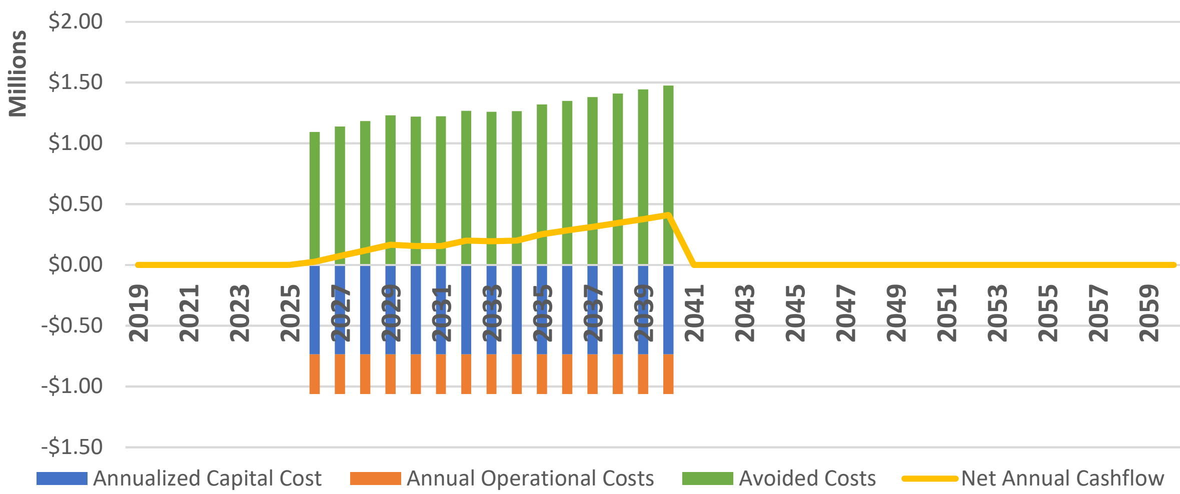


Figure 41. Annual cash flows under battery storage investment in 2030

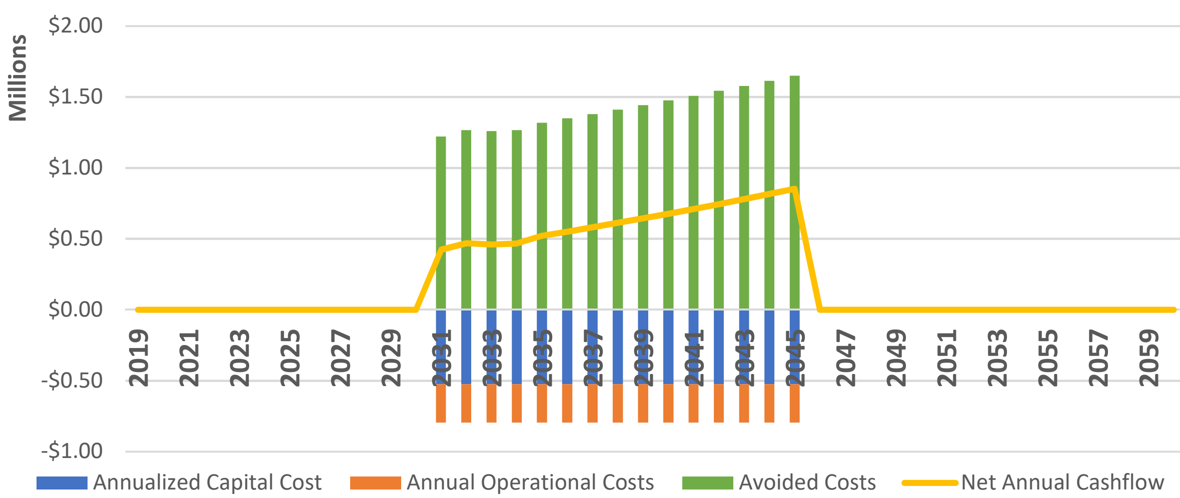


Figure 42. Annual revenue requirements under battery storage investment in 2020

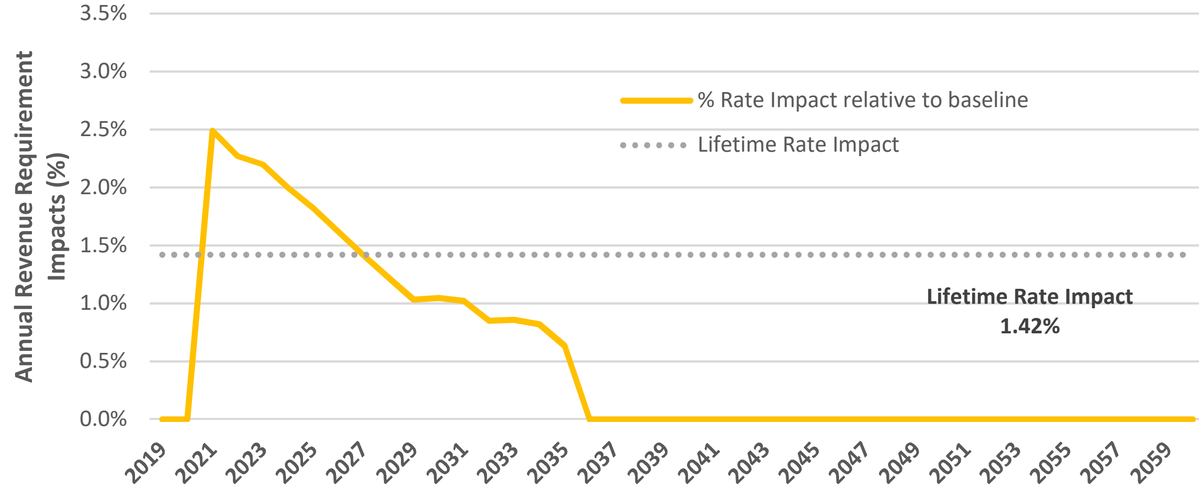


Figure 43. Annual revenue requirements under battery storage investment in 2025

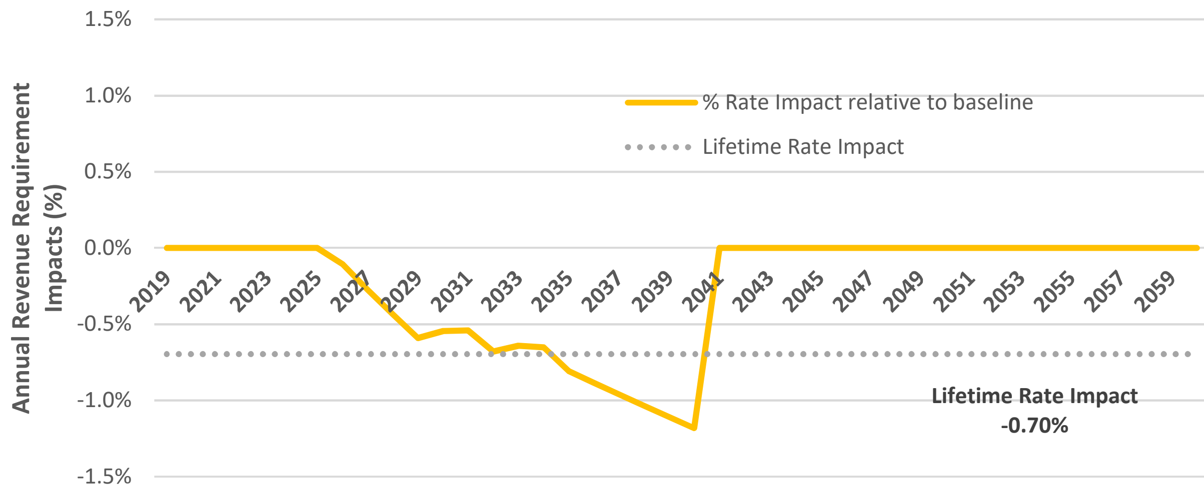
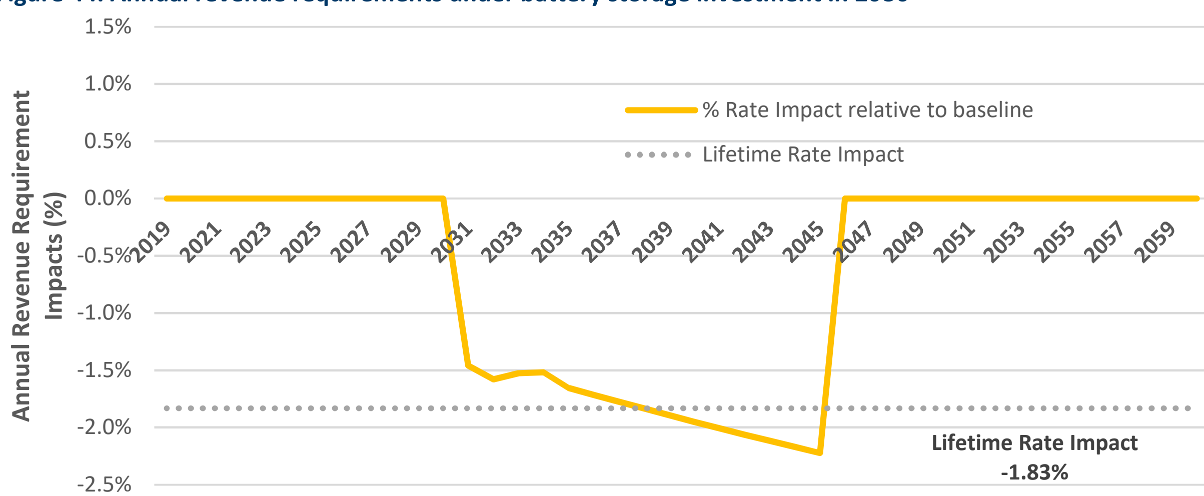


Figure 44. Annual revenue requirements under battery storage investment in 2030



KEY TAKEAWAYS

The analysis of battery storage concludes that:

- Batteries can provide capacity and reduce dependence on imports; however, the impacts are limited with the proposed 5 MW deployment.
- In addition to serving as a capacity resource, a battery can provide a wide range of ancillary services. However, the market demand and value for these grid services is uncertain.
- Battery investments will not be cost effective in the short-term; however, favourable economics suggest battery investment could be financially advantageous as early as 2023. Further battery cost reductions to 2030 improve the business case for storage.

Investment Year	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
2020	$249	$-4.2M	1.42%	31%
2025	$166	$1.7M	-0.70%	31%
2030	$120	$4.4M	-1.83%	31%

BIODIESEL GENERATOR

DESCRIPTION

An alternative to diesel generation could be the use of alternative bio-based fuels, produced from biological matter. Depending on the fuel characteristics, some conventional diesel generators can use biodiesel for power generation with minimal conversion requirements.

APPROACH

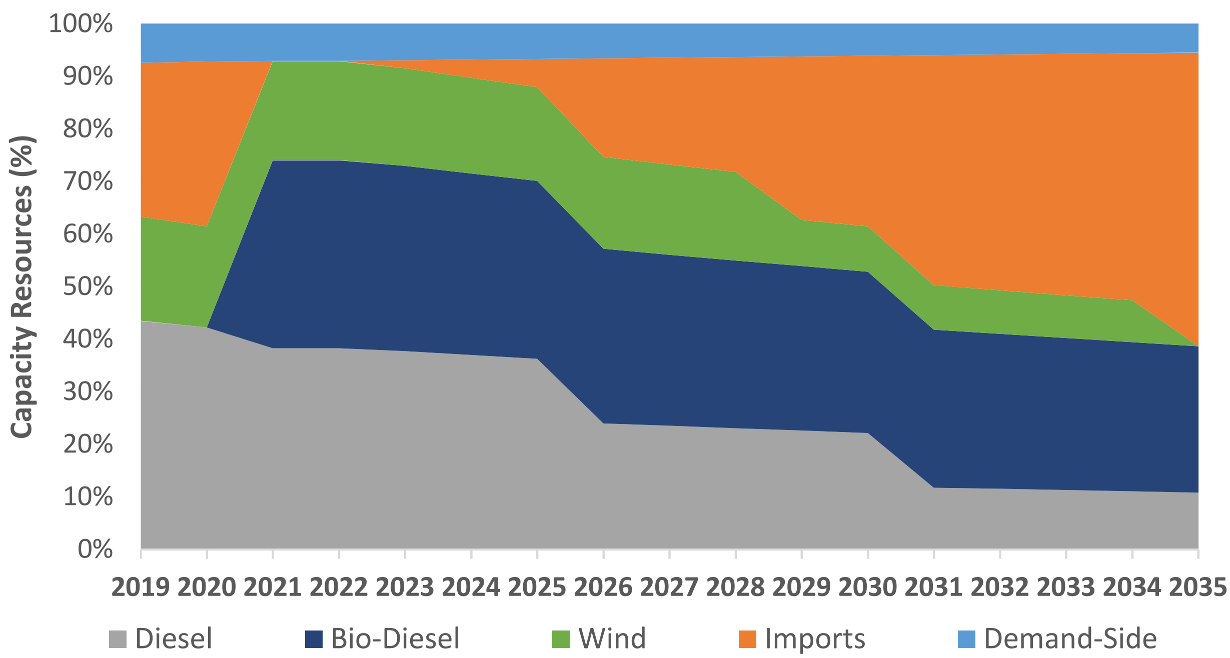
The analysis is based on a 16 MW biodiesel generator, with an assumption that the capital costs of the biodiesel generator are equal to those of the proposed diesel generator. Due to limited supply of biodiesel in PEI, fuel suppliers have identified that biodiesel fuel costs would be approximately 50% higher than regular diesel due to the cost premium and high transportation costs. Although this may be viewed as an aggressive assumption, it has limited impact on the economics of the biodiesel generator due to the projected low run time of the generator as it serves a peaking capacity unit. As with the diesel generator, we run the analysis for a potential investment in 2020 and 2025.

ANALYSIS RESULTS

Resource Adequacy

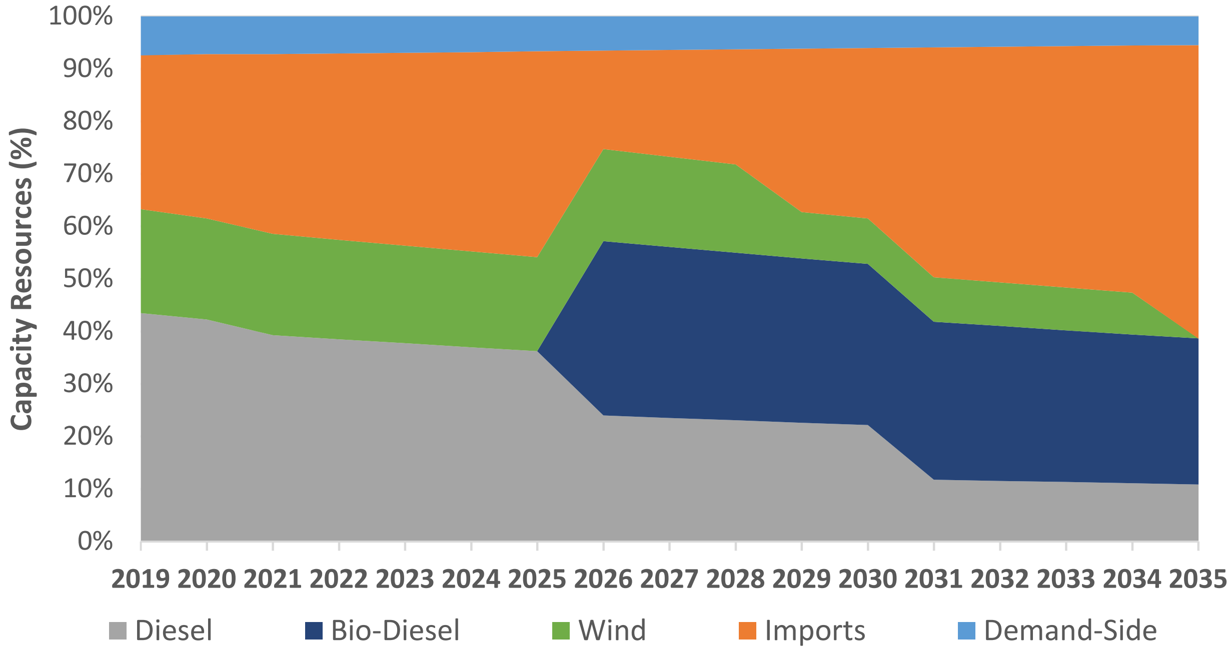
The impact of the biodiesel generator is identical to the proposed diesel generator; creating a capacity surplus that can completely eliminate capacity imports by 2021[19]. However, in the longer-term, with growing load and other assets reaching end-of-life, further imports will be required to fully meet system requirements.

Figure 45. Share of capacity resources under biodiesel generator investment in 2020



[19] The analysis is a financial one and does not address the feasibility of reducing imports prior to the end of the existing contract.

Figure 46. Share of capacity resources under biodiesel generator investment in 2025



Financial Impacts

The bio-diesel generator is estimated a capital cost of $23M and annual operational costs of $165K (50% higher than the diesel generator). Accounting for the avoided costs of imported capacity and energy, the generator has a positive NPV over the project's lifetime. However, net negative cash flow between 2021 and 2027 result in an increase on revenue requirements (which would correspond to a rate increase or reduction in dividend payments to the City). Nevertheless, over the lifetime of the project a decline of 0.05% to 0.4% is observed, depending on the year the investment is made.

Figure 47. Annual cash flows under biodiesel generator investment in 2020

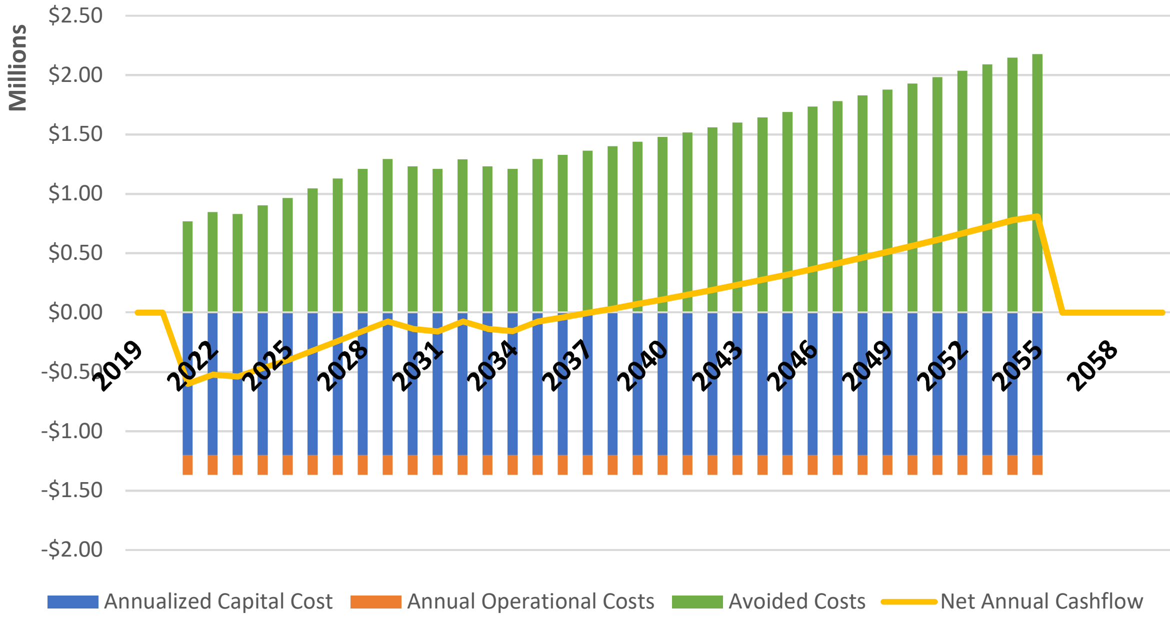


Figure 48. Annual cash flows under biodiesel generator investment in 2025

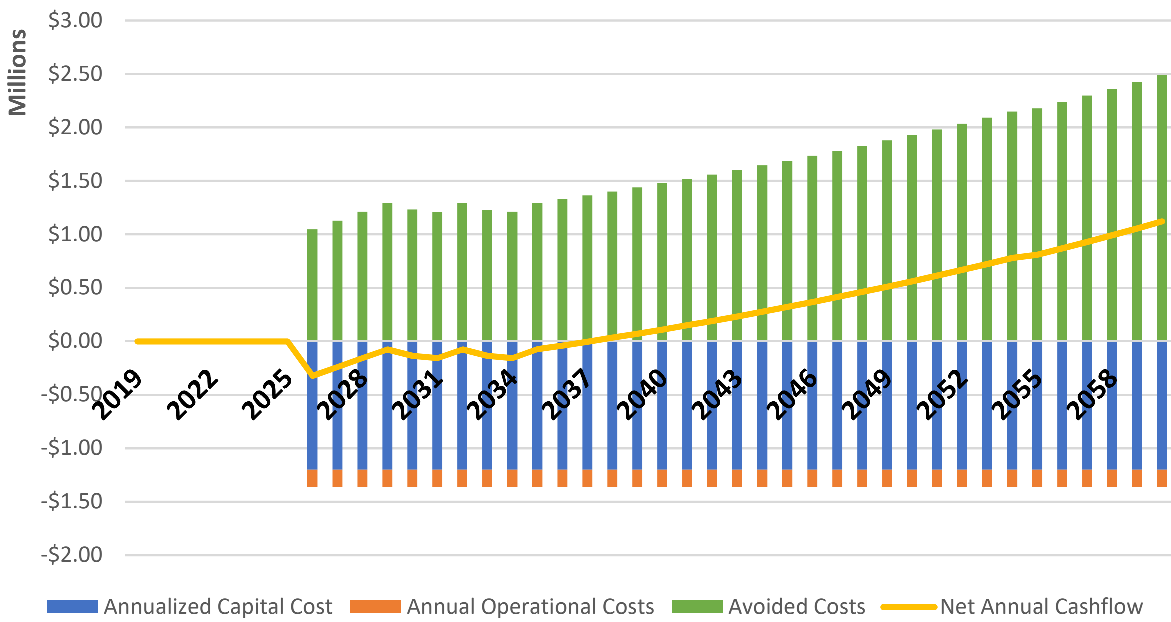


Figure 49. Annual revenue requirements under biodiesel generator scenario

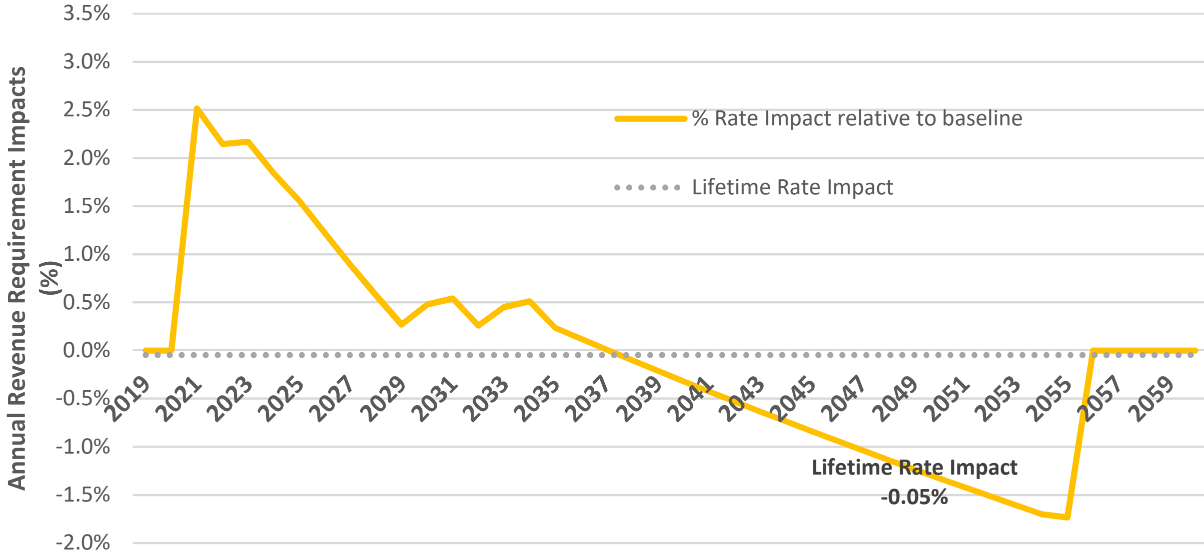
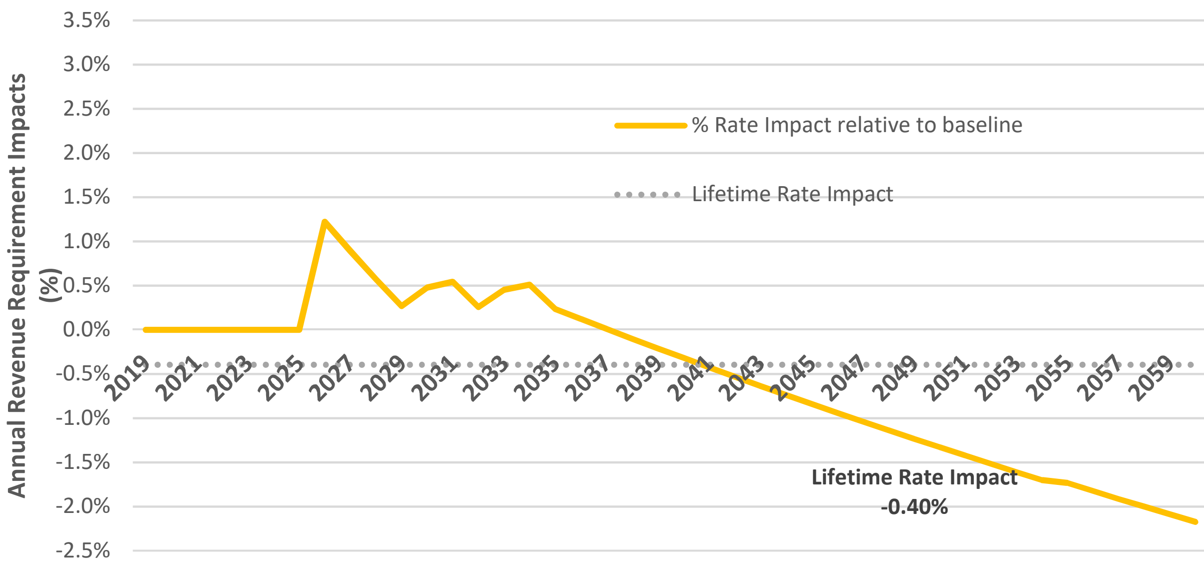


Figure 50. Annual revenue requirements under biodiesel generator scenario



KEY TAKEAWAYS

- Biodiesel generator may be a cleaner substitute for the proposed diesel generator, with a very similar business case.
- Although the plant reduces future dependence on imports relative to the baseline scenario, 51% of required capacity will still be met through imports.
- Fuel supply and costs may serve as barriers for deployment of the biodiesel generator.

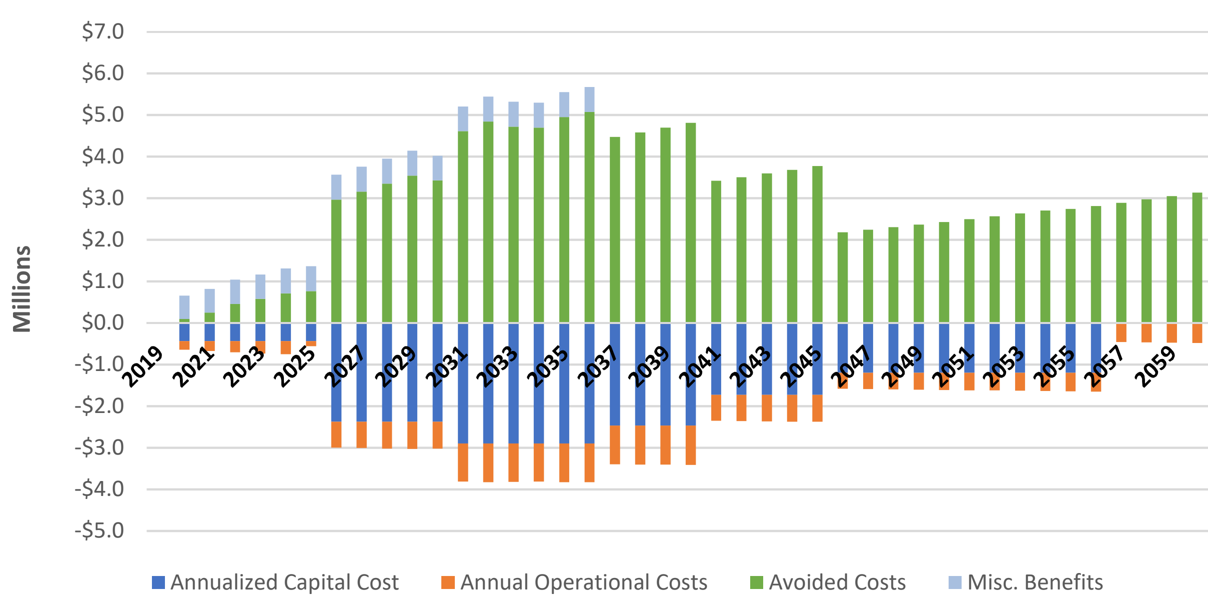
Investment Year	Levelized Cost of Capacity ($/kW/year)	Net Present Value	Average Revenue Requirements Impacts Over Lifetime	% of Capacity Resources on-Island by 2035
2020	$97	$-0.8M	-0.05 %	49%
2025	$97	$2.4M	-0.40%	49%

CASH FLOW DETAILS OF RECOMMENDED OPTION

The proposed option to address Summerside's capacity deficit has a positive NPV and net-positive cash-flow beginning in 2020 when compared to the baseline imports scenario. This results in a decline in Summerside's revenue requirement as a result of the avoided energy and capacity import costs. Compared to other capacity options, the recommendation has the highest NPV, second-lowest aggregate levelized cost of capacity and the lowest decline in revenue requirements.

Figure 48 shows details of the revenues (avoided costs and miscellaneous benefits) and costs (capital and operational) associated with the recommended option provide Summerside with a net positive cash flow by 2020, meaning that when compared to the baseline capacity imports option, the recommendation improves the City's financial position.

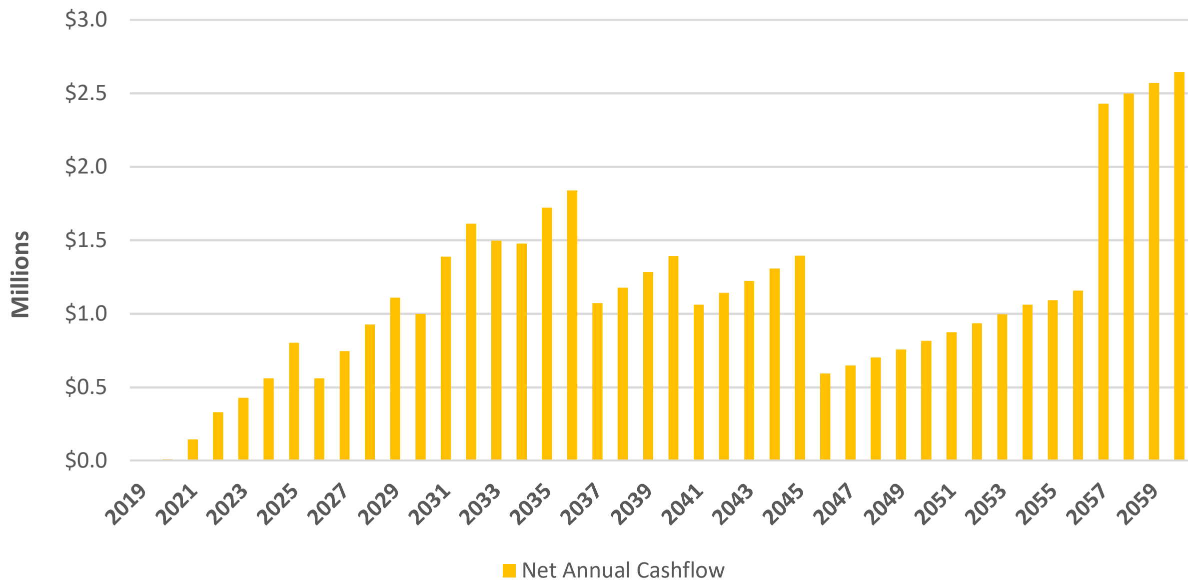
Figure 51. Breakout of cash flow inputs (costs and revenues)



In the figure above, the costs (darker blue and orange) show the reduction of the utility's cash flow (in the negative numbers). The revenues, which are essentially *costs not paid* for the baseline imports option (the gray avoided costs) plus additional benefits in lighter blue (e.g. revenue from the HFLN program) show the additional funds available to the City given the baseline alternative.

Figure 49, below, highlights the net impact of all costs and revenues, or revenues after expenses have been paid (2019 and 2020 are neutral). Once again, it is important to note that these are not actual project revenues; rather, they are revenues *in comparison to the baseline option* (capacity imports), meaning that Summerside would save money by implementing the recommended option if import prices materialize as assumed.

Figure 52. Net annual cash flow of recommended option

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