



# Integrated Resource Plan Action Plan Update

January 2022

# Introduction

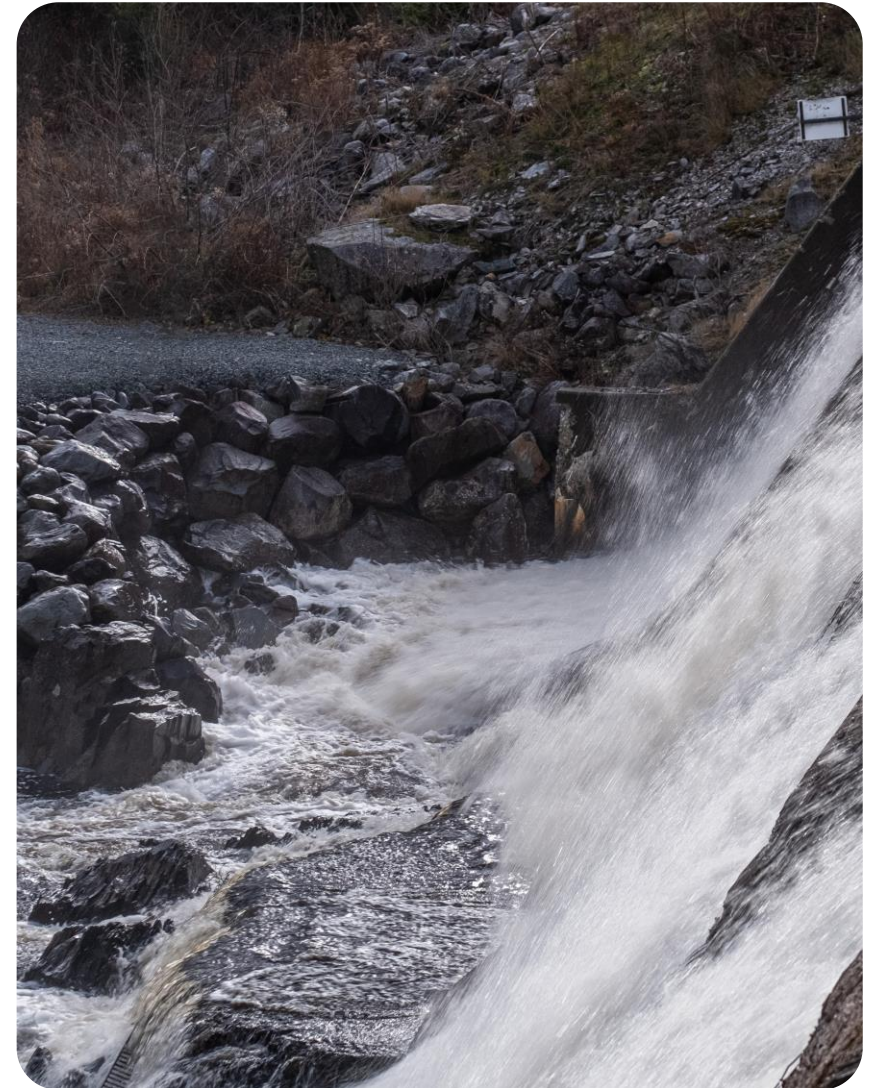
**Nova Scotia Power is pleased to provide this update to its IRP Action Plan.**

On November 30, 2020, Nova Scotia Power submitted **Powering A Green Nova Scotia, Together: 2020 Integrated Resource Plan** to the Nova Scotia Utility and Review Board.

The IRP Final Report provided the findings and recommendations following an intensive, collaborative project. It set out both an Action Plan and a Roadmap to advance the findings of the IRP.

This first annual Action Plan Update covers the progress on implementation of the IRP Action Plan and Roadmap items during the first year of the 2020 IRP Planning Period.

**Nova Scotia Power is committed to meeting the challenge of transforming to a low carbon electricity system while maintaining reliability and affordability**



# IRP Action Plan Overview

- Nova Scotia Power's 2020 IRP Action Plan consists of 5 Action Plan Items, some of which include multiple elements:



- The IRP also identified 8 Roadmap items that NS Power is monitoring for potential impact on Action Plan execution
- This Annual Report provides an update on each of these Action Plan Items; Roadmap items have been integrated under the Action Plan item to which they most directly relate
- Updates on changes in the electricity planning environment and on NS Power's Evergreen IRP process are also provided



# Planning Environment Updates

# An Evolving Planning Landscape

## Nova Scotia Power operates in an evolving planning environment.

The 2020 Integrated Resource Plan (IRP) discussed the challenges of electricity system planning in a dynamic and complex environment. Since the IRP Final Report was published in November 2020, the planning environment has continued to evolve.

Announced policies and new environmental goals, legislation, and regulations at the federal and provincial levels are described in this update.

Updates on additional planning inputs are provided throughout the remainder of the IRP Action Plan update.

**The IRP Action Plan is built on those resource planning elements that were found to be common across a wide range of future planning scenarios**

# 2030 Renewable Electricity Standard

- The Province of Nova Scotia amended the Renewable Electricity Regulations on July 9, 2021 (N.S. Reg. 110/2021). The update was published in the Royal Gazette Part II on July 30, 2021.
- The amendment added a Renewable Electricity Standard for 2030 which provides that:
  - Beginning in calendar year 2030, load-serving entities must supply customers with 80% renewable electricity.
  - NS Power must acquire at least an additional 1,100 GWh from independent power producers to meet this new requirement.
  - NS Power may incorporate contributions from renewable low-impact electricity acquired from a source outside Nova Scotia.
- The Province also announced on July 10, 2021 that it was initiating a procurement to be administered by CustomerFirst Renewables to procure 350 MW of electricity from renewable resources. The Province advised that the RFP results are expected to result in achievement of 70% renewable electricity, with the remaining 10% to be reached by 2030. (<https://novascotia.ca/news/release/?id=20210710001>).



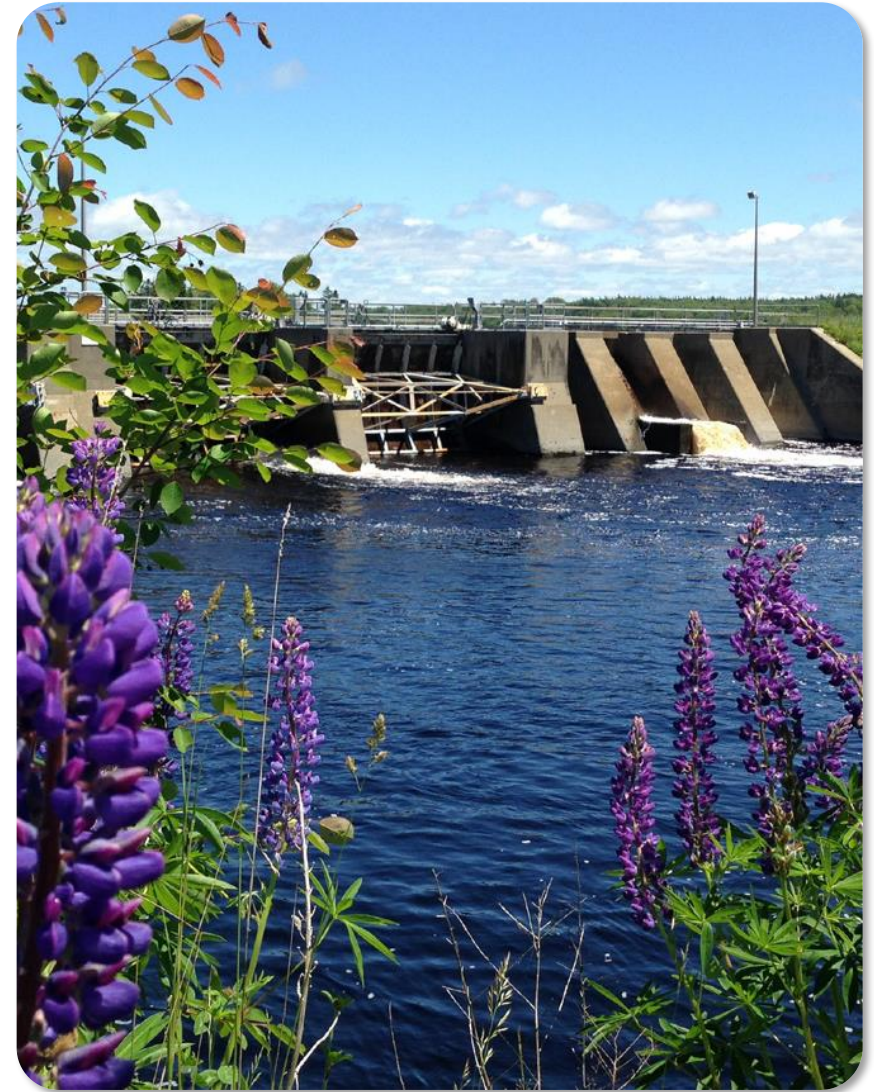
# Environmental Goals and Climate Change Reduction Act

- The Province of Nova Scotia introduced the *Environmental Goals and Climate Change Reduction Act* on October 27, 2021. The legislation received Royal Assent on November 5, 2021 (S.N.S. 2021, c. 20 (Bill No. 57)).
- This act includes the following elements that will influence Nova Scotia Power's system planning requirements:
  - Provincial GHG reduction targets of 53% below 2005 levels by 2030 and Net Zero by 2050.
  - To have 80% of electricity in the Province supplied by renewable energy by 2030.
  - To phase out coal-fired electricity generation in the Province by the year 2030.
  - A zero-emission vehicle mandate that ensures, at a minimum, that 30% of new vehicle sales of all light duty and personal vehicles in the Province will be zero-emission vehicles by 2030



# Federal and Provincial Carbon Price Frameworks

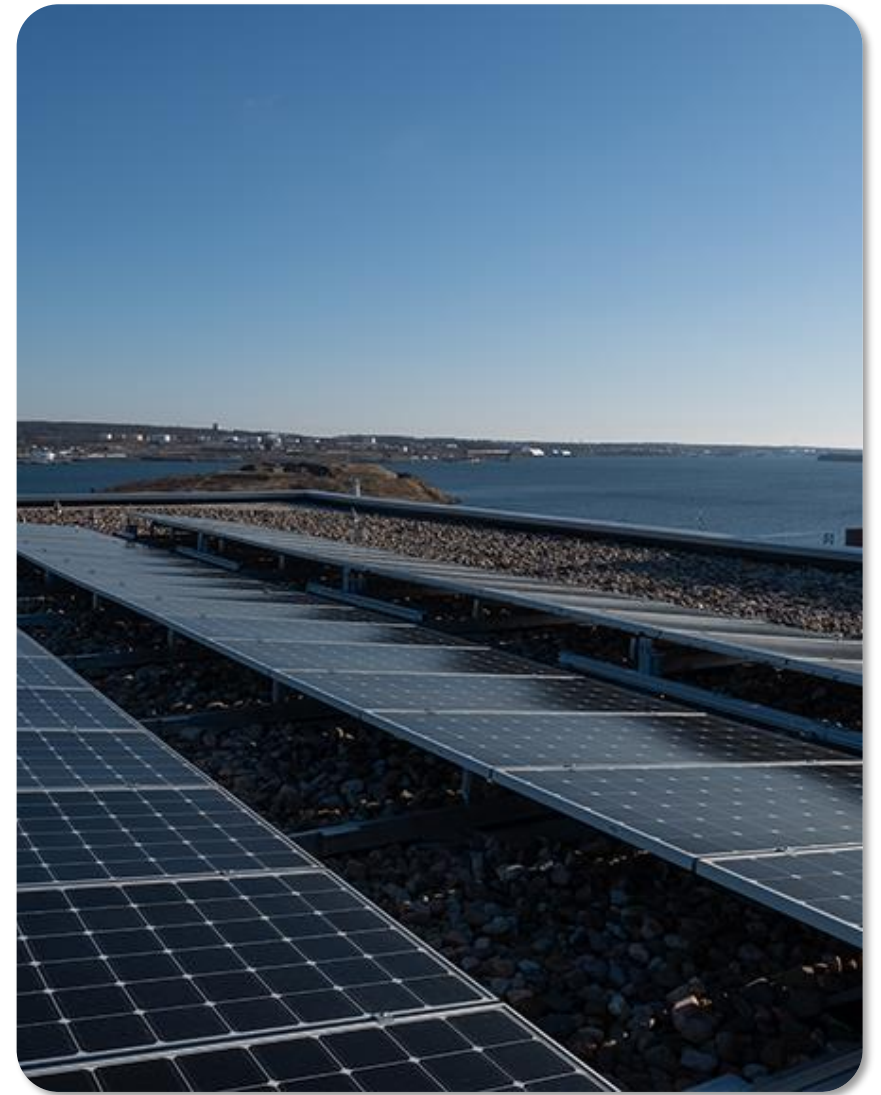
- The Government of Canada introduced a new proposed trajectory for carbon pricing in Canada in its report [A Healthy Environment and a Healthy Economy](#) in December 2020, pending further consultations. The proposed trajectory starts at \$65/tonne in 2023, rising to \$170/tonne in 2030.
- In July 2021, the Federal Government provided [additional information](#) that following engagement with provinces, territories and Indigenous organizations, the proposal for the benchmark post-2022 has been confirmed. The requirements for a provincial system to be found equivalent to the benchmark carbon price were also updated in that document.
- The Province of Nova Scotia has not yet provided guidance on the carbon pricing framework that will be adopted post-2022. The Province has the option to continue with a cap-and-trade program, develop its own carbon pricing program, or utilize the federal carbon pricing program. A provincial program must be evaluated as compliant with the federal benchmark.
- NS Power is currently modeling multiple options for GHG compliance beyond 2022, including the federal Output Based Pricing System (OPBS) and a revised hard cap trajectory similar to those used in the 2020 Integrated Resource Plan.





# Canada's Net Zero 2035 Electricity System Target

- At the November 2021 COP26 conference, Canada announced a commitment to achieve a net-zero emissions electricity sector by 2035.
- Further information on the policy framework for this target has not yet been made available; consultation is expected beginning in 2022.
- In the NS Power 2020 IRP, an annual emissions cap of 0.5MT CO<sub>2</sub>e from the electricity sector (a 95% reduction from 2005 levels) was used to represent a net zero framework.
- In 2022 NS Power will examine potential approaches to developing resource plans to meet this 2035 requirement under similar modeling constraints to the 2020 IRP approach, pending further detail from Environment and Climate Change Canada.





# 1

## Regional Integration Strategy

# Regional Integration Strategy

IRP Action Plan Item 1 is:

**Develop a Regional Integration Strategy to provide access to firm capacity and low-carbon energy while increasing the reliability of Nova Scotia's interconnection with North America.**

The Regional Integration Strategy has three elements, each of which has been advanced in 2021:

- Near Term Firm Imports
- Reliability Tie Development
- Regional Interconnection Analysis

**Nova Scotia Power is committed to developing a Regional Integration Strategy that can contribute to the phase-out of coal generation by 2030**

# Near Term Firm Import Opportunities

Part 1a of the Regional Integration Strategy is:

*Identifying opportunities for near-term firm import over existing transmission infrastructure.*

The 2020 IRP evaluated options to import firm capacity and energy over existing transmission interties from both New Brunswick (NB) and Newfoundland (NL). These firm imports were shown to be beneficial when available, subject to the commercial assumptions incorporated into the IRP model.

# Near Term Firm Import Opportunities

- The 2020 IRP tested the availability of up to 150MW of firm capacity available over the existing interconnections to New Brunswick and Newfoundland; these capacity options were components of the optimal resource plan in all Regional Integration scenarios during the IRP.
- Discussions with NB Power have identified that firm transmission capacity over the existing NS/NB interface continues to be unavailable in significant quantities at the present time; NS Power will continue to pursue technical solutions in collaboration with NB Power.
- NS Power has continued to advance commercial discussions with potential counterparties across both transmission interfaces for near term firm import opportunities with a target of sourcing firm capacity in advance of winter 2023/24.



# Reliability Tie Development

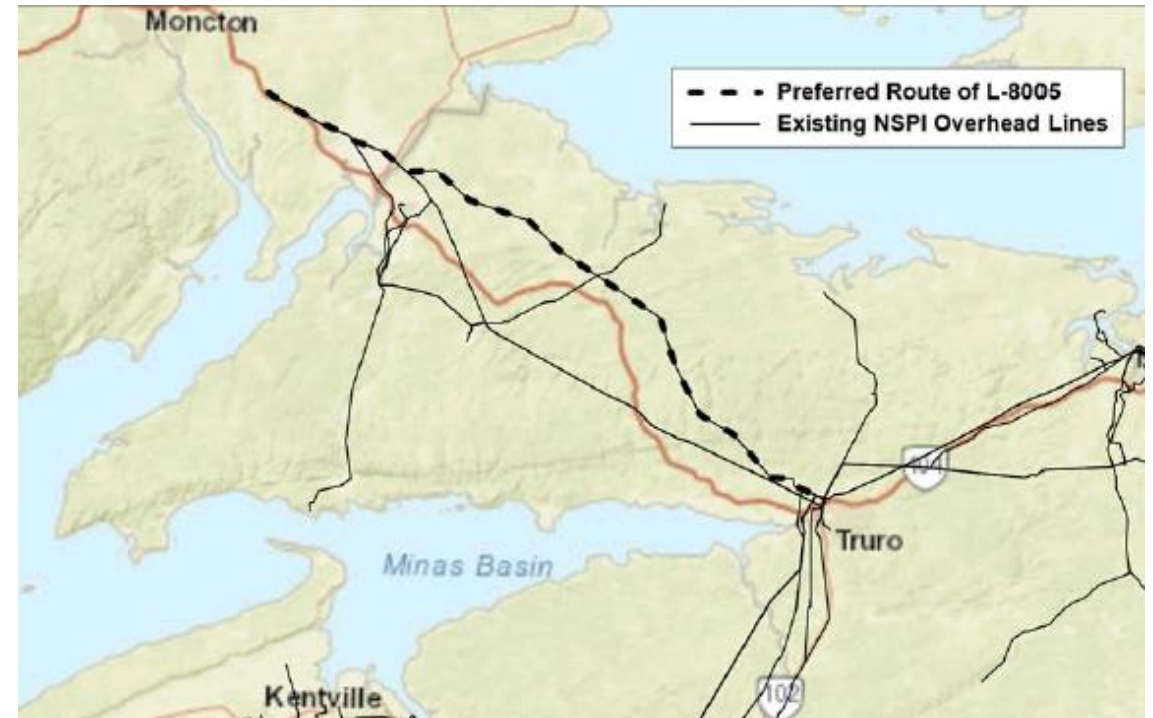
Part 1b of the Regional Integration Strategy is:

*Immediately commencing the development of a Reliability Tie and Regional Interconnection via an appropriate regulatory process with target in-service dates as follows:*

- *Reliability Tie: 2025-2029 (or earlier if practical and feasible)*
  - *Regional Interconnection: 2027-2035*
- The Reliability Tie is a second 345kV AC transmission line from Onslow, NS to Salisbury, NB. For internal planning purposes, this new transmission line has currently been designated as L-8005.
  - This enhanced transmission interconnection is anticipated to provide the following system benefits:
    - Increased integration / reduced curtailment of domestic wind (or other inverter-based) generation.
    - Reductions to minimum online generation constraints in order to meet system synchronous inertia requirements.
    - Allow for expansion into a Regional Interconnection via further transmission expansion beyond Salisbury, NB.

# Reliability Tie Development

- In order to advance the Reliability Tie on the timelines indicated in the IRP Action Plan, NS Power engaged an engineering firm to complete a conceptual study of the Nova Scotia portion of the line, including the following:
  - Weather Study, incorporating climate projection data.
  - Conceptual Design for line components (e.g. towers, conductor, foundations).
  - Class 4 Cost Estimate of the NS portion of the line.
- NS Power has also begun environmental studies along the proposed route (e.g. wetland and waterway surveys, bird surveys, species-at-risk).
- In addition, NS Power has continued to refine line routing and ROW option.



# Reliability Tie Development

- In addition to the engineering study work, NS Power has developed an updated project schedule that estimates a timeline of approximately 4.5 years to complete the project from current state through commissioning.
- Portions of this project have been included as a subsequent submittal project in NS Power's 2022 ACE Plan under C0044391 (Eastern Clean Energy Initiative (ECEI) – Transmission).
- NS Power has incorporated the Reliability Tie into the ongoing development activity related to the Atlantic Loop (see next section, Regional Interconnection Analysis).
  - In all of its project planning NS Power maintains the optionality to construct the Reliability Tie as a stand-alone project separate from the Atlantic Loop or other Regional Interconnection.
- Development activity on this project will continue in 2022 including design and environmental studies and engagement with NB Power.





# Regional Interconnection Analysis

Part 1c of the Regional Integration Strategy is:

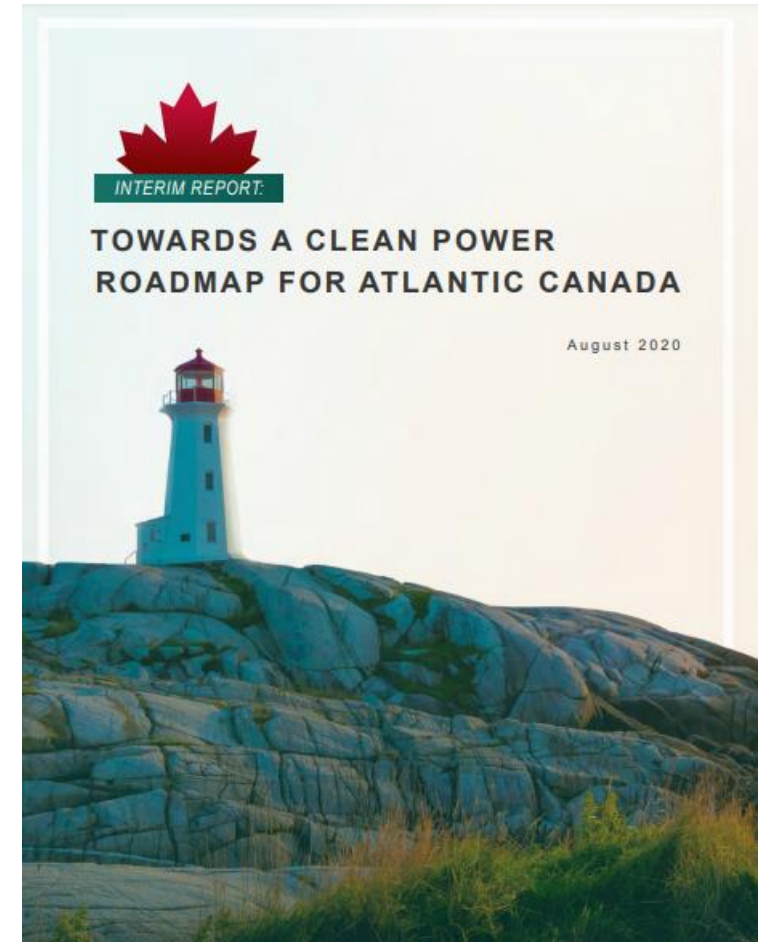
*In parallel with Regional Interconnection development, and working with neighbouring jurisdictions, conducting detailed engineering and economic studies for firm import options requiring new transmission investment and strengthened regional interconnections, including evaluations of availability and security of supply, emissions intensity, and dispatch flexibility. This work will proceed in parallel with the wind procurement strategy (Action Item 3d, below) and will include supporting transmission planning studies.*

NS Power, working with neighbouring utilities and governments, has proceeded with analysis to advance the concept of Regional Integration into the Maritimes.

# Atlantic Clean Power Roadmap

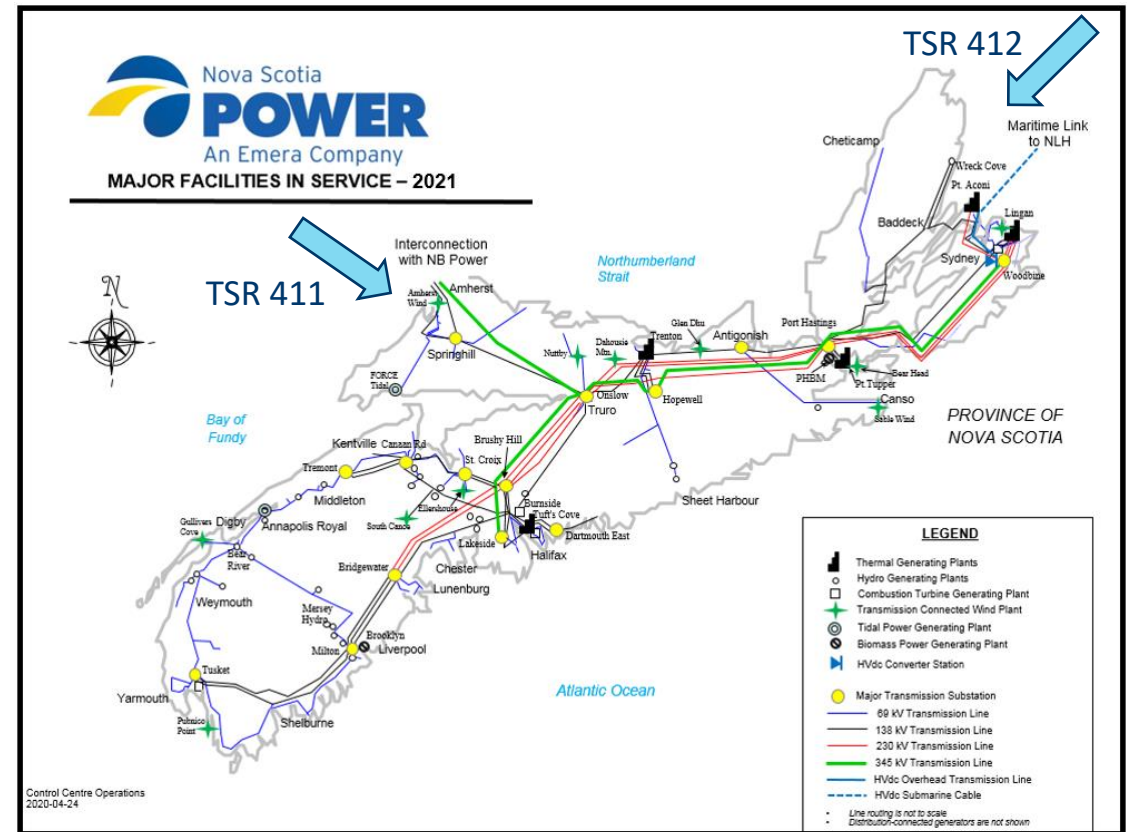
- Through 2020 and 2021, significant work was undertaken as part of the Atlantic Clean Power (ACP) Planning Committee.
- The goal of this work has been to understand the potential benefits of new transmission interconnections capable of supplying clean energy to the Maritimes region, in an electrifying and decarbonizing world.
- The ACP Planning Committee includes utility and government representatives from Atlantic Canada and Quebec, including Nova Scotia Power.
- One of the important early action items of the ACP Planning Committee was to trigger the initiation of Transmission Service Requests in each jurisdiction; these requests will inform transmission facilities required to support the projects under consideration in the ACP Roadmap to bring clean energy from other Canadian jurisdictions into Nova Scotia.
- The committee's interim report was issued in August 2020<sup>1</sup> and the final report is expected to be published early in 2022.

<sup>1</sup> <https://www.canada.ca/en/atlantic-canada-opportunities/atlanticgrowth/reports/cleanpower.html>



# TSR 411 and TSR 412

- Transmission Service Requests (TSR) 411 and 412 were initiated as part of Nova Scotia Power's participation in the Atlantic Clean Power Roadmap.
- TSR 411 is a request for Point-to-Point transmission service from NB to NS, initially submitted at 800MW and later amended to 550MW.
- TSR 412 is a request for Point-to-Point transmission service from NL to NS to be studied at the levels of 250MW and 500MW.
- TSR 411 is targeted for completion by February 28, 2022.
- TSR 412 was withdrawn prior to commencement of the study.



# Regional Integration and the Atlantic Loop

- The Atlantic Loop is envisioned as a series of transmission expansion projects that would increase transfer capabilities between Hydro Québec and New Brunswick, and between New Brunswick to Nova Scotia. It can facilitate the import of non-emitting energy and capacity into Nova Scotia and is aligned with the Regional Integration strategy evaluated in the IRP.
- Nova Scotia Power is encouraged by discussions with the Federal and Provincial Governments, our neighboring utilities, and key stakeholders about the Atlantic Loop and our entire Eastern Clean Energy Initiative.
- Affordability is a key consideration when discussing the potential of the Atlantic Loop to contribute to decarbonization and coal phase-out. We are looking for support from the federal government to assist in this.
- Nova Scotia Power will continue to actively support the multi-jurisdictional work in support of the Atlantic Loop project in 2022.

# Regional Integration Alternatives

- In addition to discussions aimed at advancing the Atlantic Loop project, Nova Scotia Power continues to monitor other potential sources of imported firm capacity and energy, consistent with the Regional Integration analysis from the IRP.
- The New England market was identified during the IRP as another potential source of capacity and energy imports to Nova Scotia under the Regional Integration strategy; Nova Scotia Power continues to monitor developments in that market through 2021.
  - ISO New England notes in their 2021 Regional System Plan<sup>1</sup> (RSP) that continued electrification load growth, particularly from home heating, will cause the region's summer and winter peaks to converge; they note that the region may return to a winter peaking sometime after 2030. This correlates with the Maritimes region system peak and could influence the availability and price for capacity and energy imports from New England over the long term.
  - The 2021 RSP also indicates that New England expects to continue to be a net importer of both capacity and energy based on current obligations and current interconnection queue requests and that winter on-peak capacity is reduced due to gas pipeline constraints in the region.
- Due to the anticipated energy mix in the region, the import of system energy from the ISO-NE region is not anticipated to be classified as renewable energy under the Nova Scotia 80% Renewable Energy Standard in 2030<sup>2</sup>.
- Overall, these conditions indicate that the ability to import long-term capacity and energy from New England may be reduced relative to the assumptions used in the 2020 IRP. Nova Scotia Power will continue to monitor developments in the New England region as they relate to import opportunities.

<sup>1</sup><https://www.iso-ne.com/system-planning/system-plans-studies/rsp>

<sup>2</sup>See Figure 6-7 in ISO-NE 2021 RSP



# 2

## Electrification Strategy

# Electrification Strategy

IRP Action Plan Item 2 is:

**Electrification is a key variable in this IRP and results indicate that under economic resource plans it can support provincial decarbonization while reducing upward pressure on electricity rates for customers.**

The Electrification Strategy included three components:

- Initiation of an Electrification Strategy
- Initiate a Data Collection Program
- Address electrification impacts on the T&D system

Nova Scotia Power's efforts in 2021 have focused on the first of these elements.

**The IRP shows that economy-wide deep decarbonization can be supported by Nova Scotia Power through investment in a diverse, low-carbon resource portfolio**

# Electrification Strategy

Part 2a of the Electrification Action Item is:

*Initiate an Electrification Strategy to develop options for encouraging beneficial electrification with the goals of maintaining rate stability while decarbonizing the Nova Scotia economy consistent with the Sustainable Development Goals Act. The Electrification Strategy will:*

- Incorporate industry best practices such as those identified by the Regulatory Assistance Project as well as other relevant work, for example, electrification programs in other jurisdictions and the details already contained in the Deep Decarbonization Pathways report.*
- Develop and propose pilots and/or programs that focus initially on transportation and building electrification as identified in the Deep Decarbonization Pathways report as key sectors for early electrification adoption. These pilots and programs will be subject to UARB oversight.*



# Electrification Strategy Approach

- During 2021 NS Power has engaged Energy and Environmental Economics, Inc. (E3) to support the development of an Electrification Strategy for NS Power.
- This work is ongoing and is focused on the transportation and building sectors; these were identified in NS Power's Pathways report (2019) as being the most significant early sectors where significant electrification opportunity was identified.
- E3 has developed incremental scenario-based load shapes that can be layered on to NS Power's existing load forecasts to produce a holistic view which is consistent with updated provincial and federal policy (e.g. Provincial target of 30% non-emitting vehicle light duty sales by 2030, corresponding Federal proposed target of 100% sales by 2035).
- This strategy development will result in a strategic plan, shared with stakeholders, that lays out:
  - Short-term electrification priorities and evaluation metrics, including program options, rate impacts, benefit-cost tests, and customer affordability measures that will be used to inform prioritized actions and program design.
  - Long-term planning inputs, including potential peak load and load shape impacts from building and transportation electrification.
- NS Power anticipates engaging with stakeholders on this topic in 2022 as part of consultations on its 2022 Load Forecast Report and via one-on-one discussions with interested parties.

# Electrification Strategy Components

- The approach to developing NS Power’s Electrification Strategy has been divided into 5 tasks, each with corresponding deliverables:
  - Task 1: **Objectives and Analysis Plan**
  - Task 2: **Jurisdictional Scan and Electrification Load Shapes**
  - Task 3: **Revenue Requirement Model and Customer Affordability Calculator**
  - Task 4: **Beneficial Electrification Modeling Tool and Program Option Modeling Results**
  - Task 5: **Electrification Roadmap**
- The project plan anticipates substantial completion of this work by Q2 2022.



# Electrification Strategy

## Jurisdictional Scan

In order to ensure that current industry best practices are incorporated into NS Power's Electrification Strategy, E3 has completed a jurisdictional scan. Key findings include:

- Nova Scotia's economy-wide Net-Zero target is consistent with both Canadian federal policy and a growing number of U.S. states (~10 states so far).
- In jurisdictions with economy-wide deep decarbonization goals (i.e., 80% by 2050 or more), building and transportation policy implementation lags the pace required to reach GHG goals.
- Utilities with decarbonization targets are supporting deployment of electrified technologies, with different messages, regulatory guidance, and levels of support/partnership with local government, private companies.
- Transportation: Most utilities in Net Zero jurisdictions are proactively planning for Electric Vehicle (EV) adoption; utility focuses on smart / managed charging, infrastructure make-ready, EV rate pilots, and filling charging infrastructure gaps.
- Transportation: EV targets in Canada are in-line with California, NY, MA; other jurisdictions expected to follow.
- Buildings: Utilities are planning for building electrification, with policy and incentives driving heat pump adoption in Net Zero jurisdictions.
- Buildings: Building decarbonization policies are (mostly) not here yet, but coming, and utility can influence roll-out (e.g. all-electric ready building codes).
- Ensuring low and stable electric rates is important to driving customers to electrify.
- Coordination with policymakers and third-parties (e.g., manufacturers, fleet owners) is valuable.

# Electrification Strategy Pilots and Programs

E3's jurisdictional scan has also identified utility programs and activities that are typically well supported by economics and/or stakeholders:

- Rebate programs targeted at Light Duty Vehicles (LDVs) typically provide both significant participant cost and ratepayer benefits.
- Charging infrastructure for underserved communities (e.g. more remote areas, low/moderate income areas, or multi-family units) – required for sector transformation, and meet a clear “gap” in what the private market will fund.
- Public fast charging deployment to improve geographic coverage.
- Support homebuilder ‘EV-ready’ construction & building codes.
- All-electric new building construction – economics are typically better than retrofits, and can be supported when compared to costs of decarbonized fuel.
- Time-of-use rate structures that encourage charging in off-peak hours and lower the total costs of ownership to promote EV adoption.
- Grid-interactive programs that enable smart charging and/or utility direct control (smart / managed charging).
- Partnerships or incentives for workplace charging.
- EV education and marketing.



# Monitor Electrification Growth

Roadmap Item 7 states:

*Monitor electrification growth in Nova Scotia to understand at what point the provincial load profile starts to move from Low, to Mid, to High levels of electrification as defined in the IRP Assumptions for firm peak and/or annual energy requirements. An observed transition will, among other impacts, inform the use of DSM avoided costs in related proceedings and trigger a PRM study using actual peak, energy, and load shape data.*

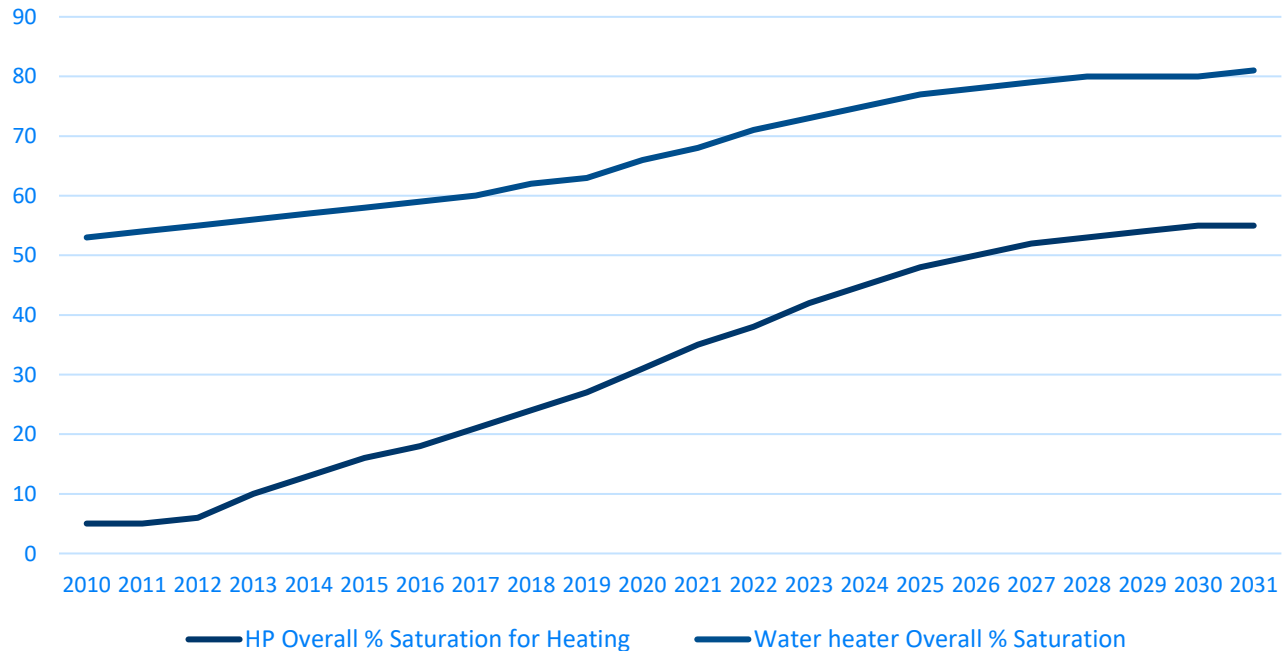
# Monitor Electrification Growth

Key electrification parameters include space heating, hot water heating and EV sales. NS Power continues to see growth in sales/installations of electrified end uses.

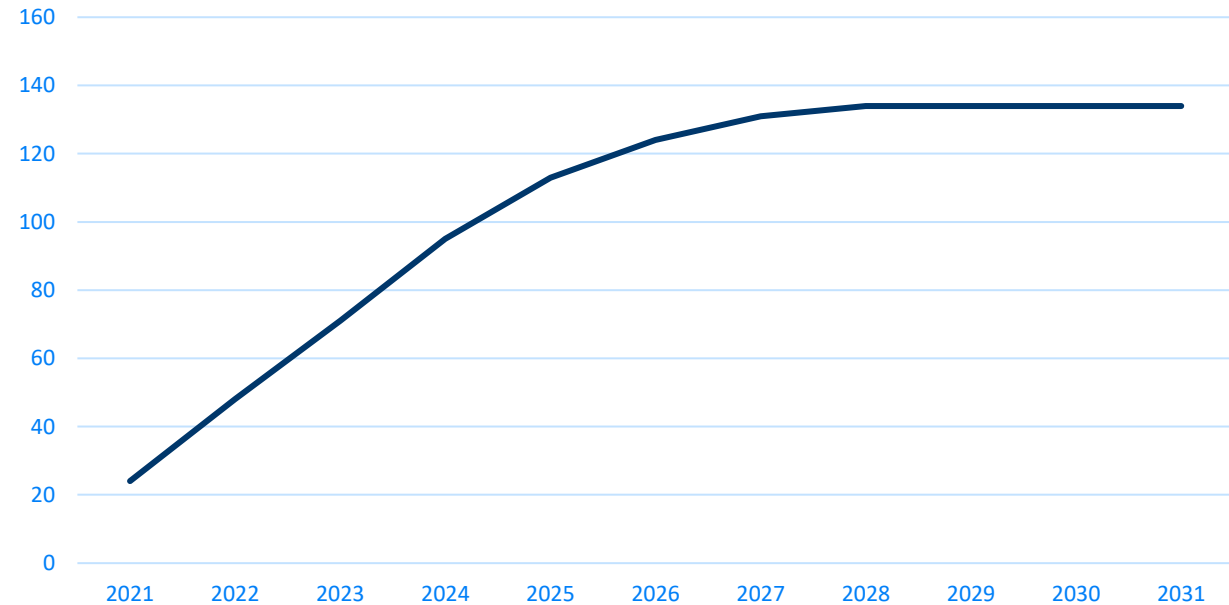
- Electric heating growth is mainly driven by heat pump installations, which are estimated based on annual distributor surveys and periodic end use surveys. The data is being collected on the contribution of heat pumps to load and demand through an ongoing project that will conclude in 2022.
- Hot water heater growth is estimated through periodic end-use surveys.
- NS Power is also working with Statistics Canada to obtain annual EV sales numbers.

# Projected Growth (Load Forecast)

## Heat Pump and Water Heater Saturations (10 Year Load Forecast)

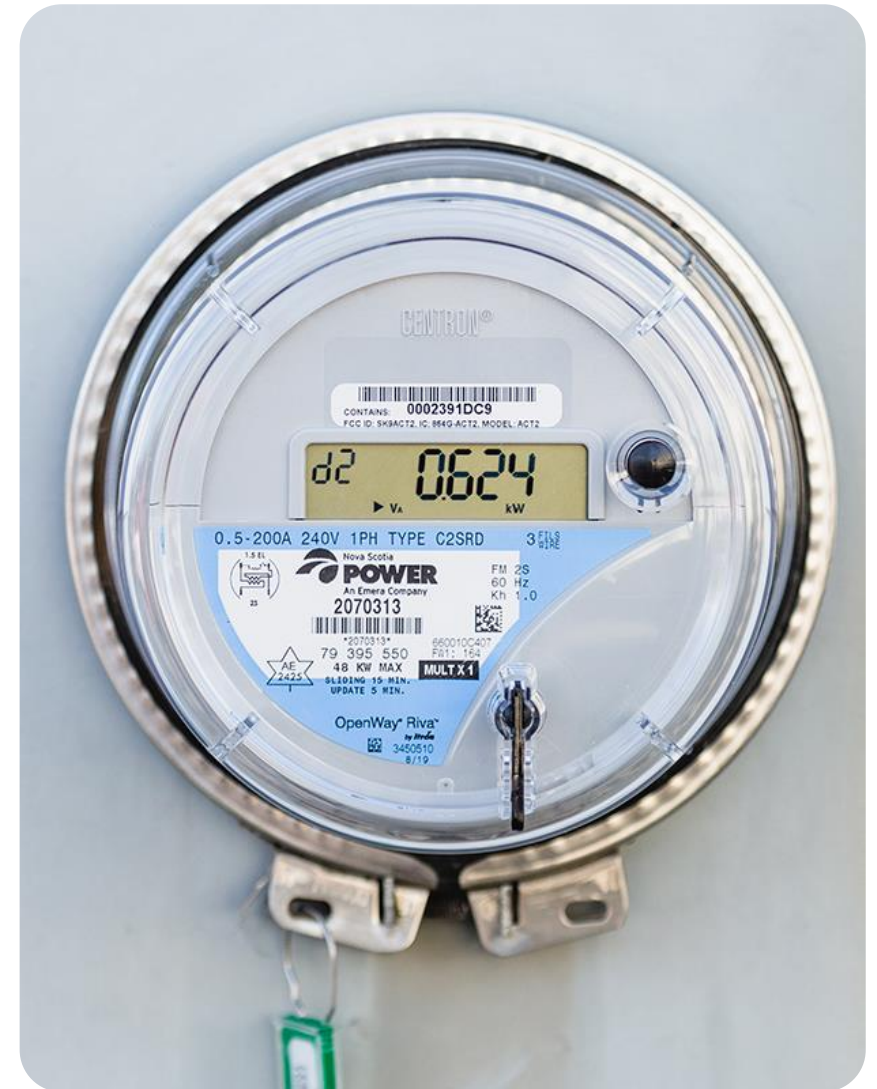


## C&I Electrification Growth (Cumulative GWh)



# Updated Electric Vehicle and Heat Pump Forecasts

- As part of the Electrification Strategy project, E3 has developed sales and stock rollover forecasts for EV LDVs, Residential Heat Pumps, and Commercial Heat Pumps.
  - These enhanced modeling inputs will enable NS Power to better assess the resource and cost impacts of beneficial electrification initiatives.
- These are informed by specific provincial and federal targets (e.g. EV sales) as well as broader decarbonization targets (heat pumps).
- Stock forecasts incorporate the stock rollover model used in NS Power's pre-IRP Pathways report.
- These stock profiles will inform the electrification components of future load forecasts.



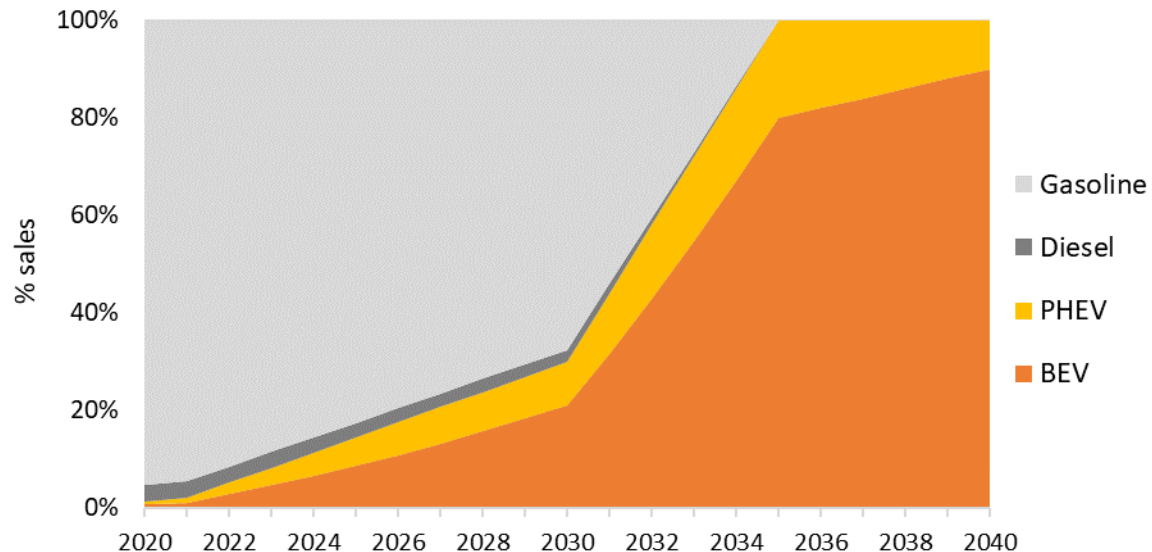


# Modeled Light-Duty EV Adoption

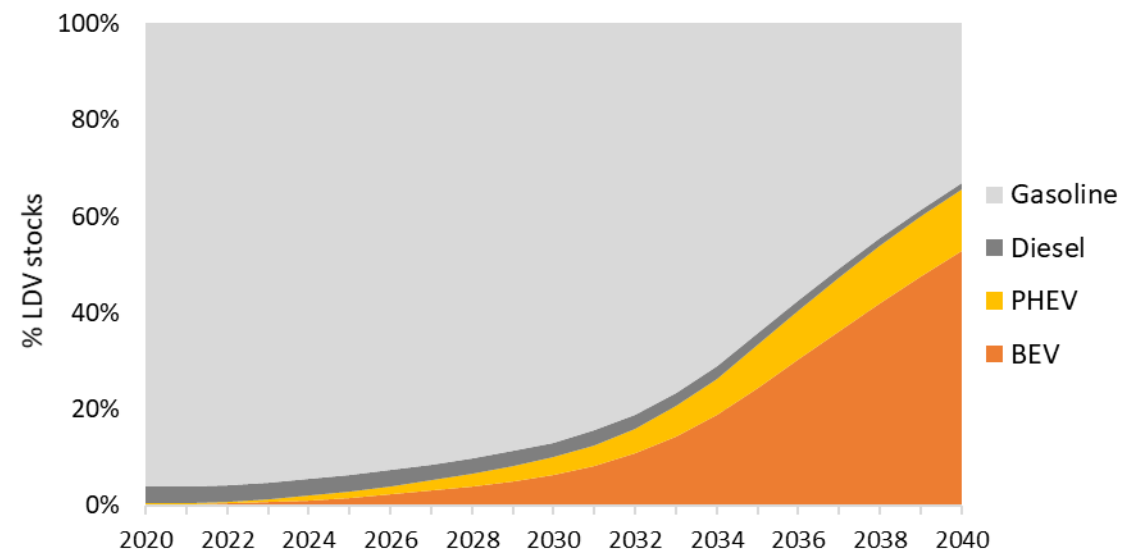
Light duty EV adoption/stock estimate was developed in E3's PATHWAYS stock rollover model.

- Base case forecasts that follow currently rely on a “slow sales ramp” scenario, which assumes 30% electric LDV sales reached by 2030 (provincial target) and 100% by 2035 (federal announced target).

## Sales



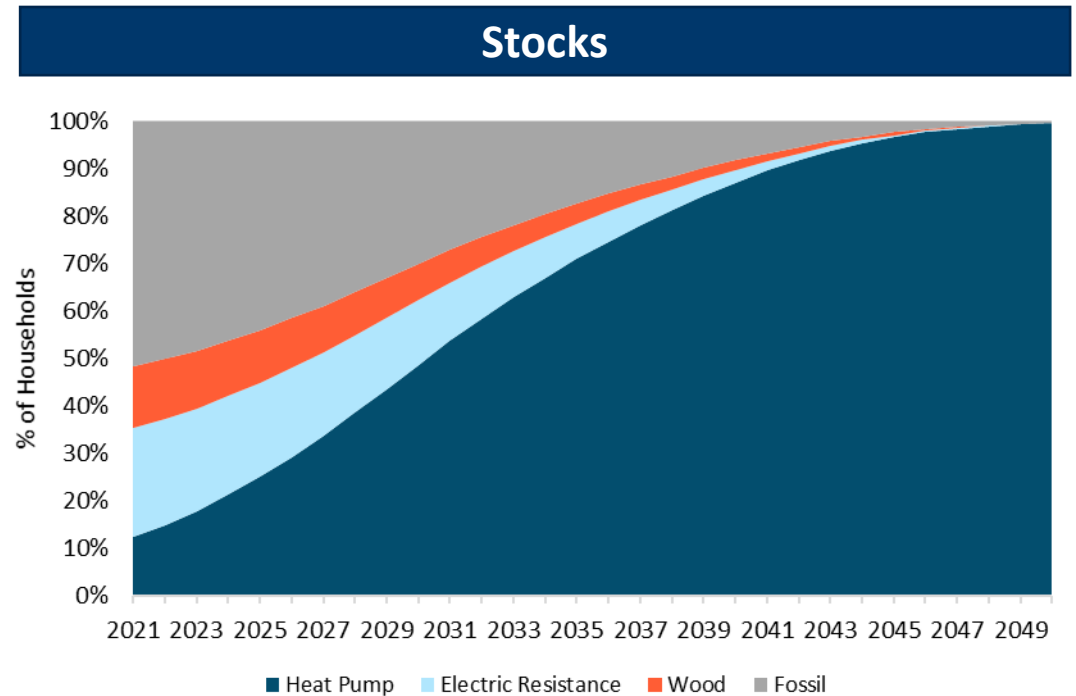
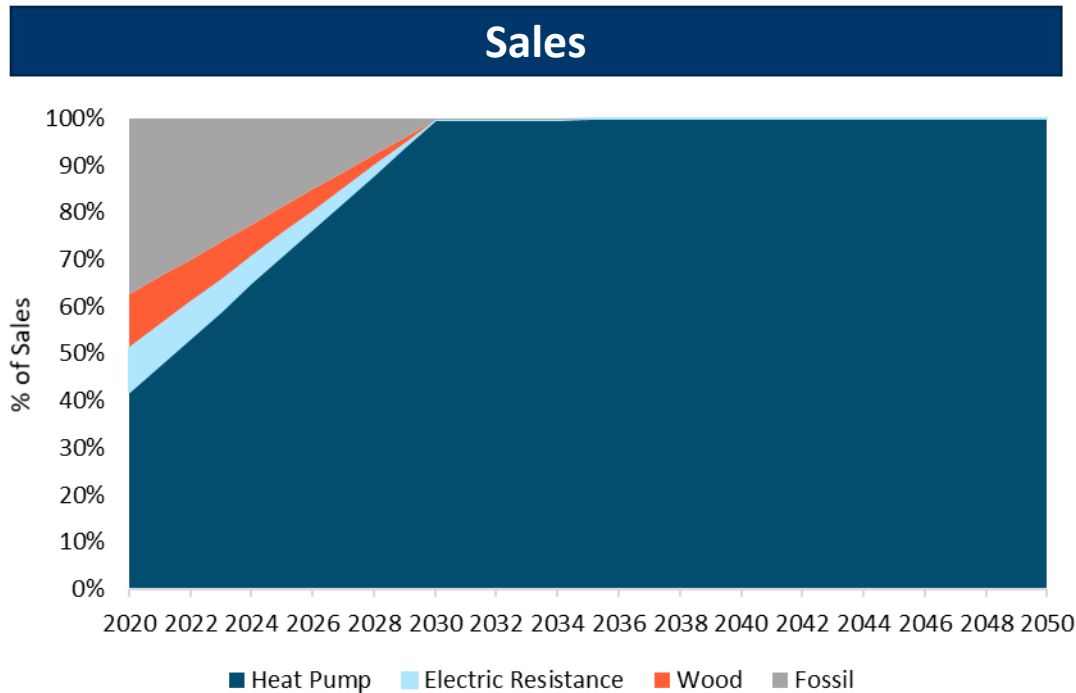
## Stocks



# Modeled Residential Heat Pump Sales

Residential HP adoption/stock estimate was developed in E3's PATHWAYS stock rollover model, based on assumption of nearly 100% HP sales by 2030.

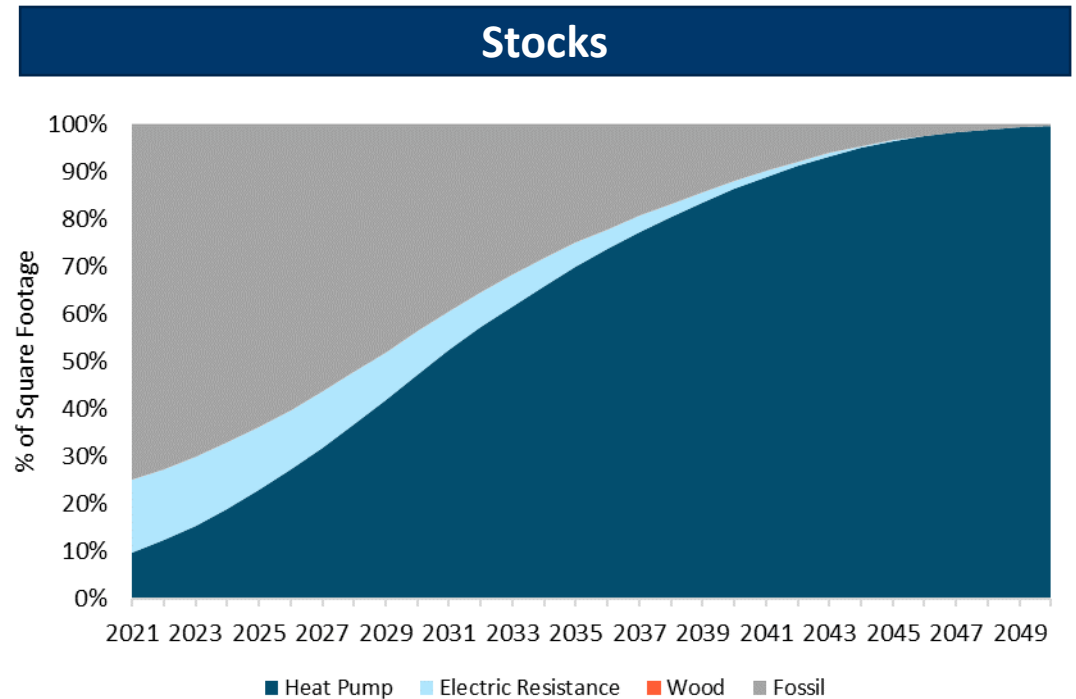
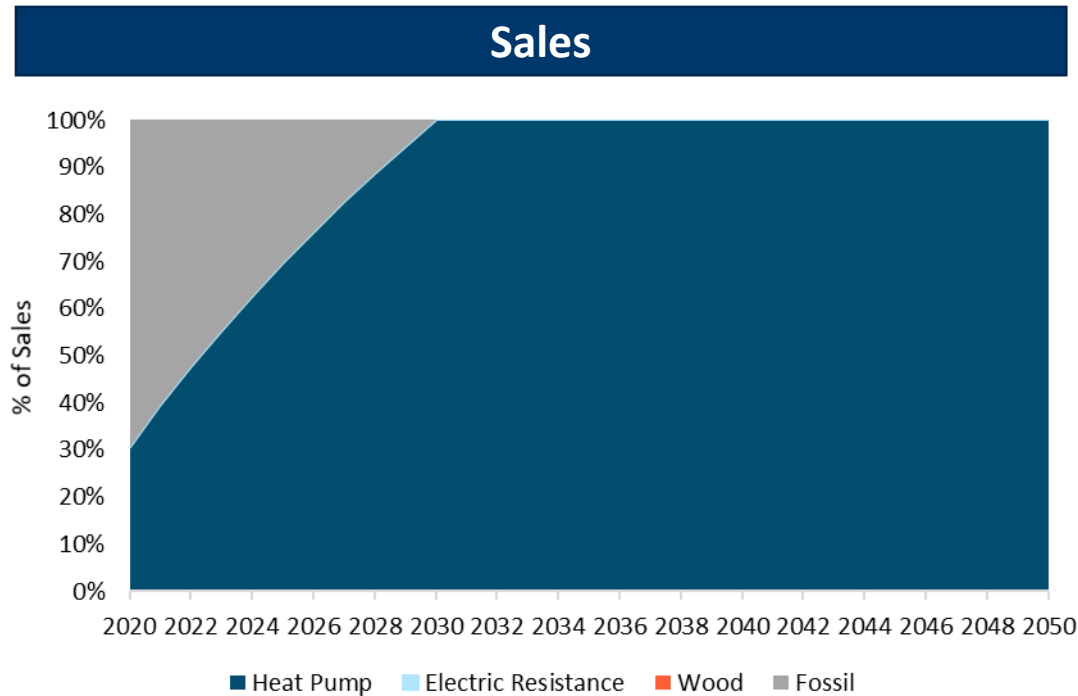
- The stock of HP reaches nearly 64% by 2030 and 100% by 2050.
- These are scenario assumptions rather than economics-driven forecasts; these defined scenarios are consistent with what a net zero/deep decarbonization future in Nova Scotia would require in order to meet the targets that have been set.



# Modeled Commercial Heat Pump Sales

Commercial HP adoption/stock estimate was developed in E3's PATHWAYS stock rollover model, based on assumption of nearly 100% HP sales by 2035.

- The stock of HP reaches nearly 43% by 2030 and 96% by 2050.
- The stock of HPs does not reach 100% due to the challenges of switching all commercial buildings to heat pumps.





# 3

## Thermal Plant Retirement, Redevelopment, and Replacement Plan

# Thermal Plant Retirement, Redevelopment, and Replacement Plan

IRP Action Plan Item 3 is:

**Initiate a thermal plant retirement, redevelopment and replacement plan.**

This Action Plan item has 4 elements that are updated on the following slides. In addition, updates on 5 Roadmap items are provided in this section.

**Transitioning to a low carbon generating fleet and meeting the 80% Renewable Energy Standard in 2030 will require new sources of low carbon firm capacity and renewable energy.**

**Our focus is making this transition while maintaining reliability and affordability for customers.**

# Trenton 5 Retirement Plan

Part 3a of the Thermal Plant Retirement item is:

*Develop a plan for the retirement and replacement of Trenton 5, targeting 2023, while identifying required replacement capacity and energy in parallel. Begin decommissioning studies for NS Power's other coal assets and develop and execute a coal retirement plan including associated regulatory approval process; this coal retirement plan will include significant engagement with affected employees and communities.*

# Trenton 5 Retirement Plan

- In order to meet ongoing firm peak load and planning reserve margin requirements, replacement firm capacity is required before Trenton 5 can be economically retired in order to maintain adequate system reliability.
  - In the 2020 IRP the primary source of replacement firm capacity for Trenton 5 was the acquisition of near-term firm imports from neighbouring jurisdictions; please see slides 12-13 for an update on near-term firm imports.
  - A secondary source of replacement firm capacity is a new combustion turbine (CT); NS Power is advancing its planning for CT additions as described on slide 44. At this time, it is not anticipated that a new CT will be in-service in 2023.
- The impact of this ongoing planning and commercial work is a shift in the planned retirement of Trenton 5 by one year to 2024.
  - Operating restrictions will be implemented on the unit to avoid the sustaining capital investment that was included in the original IRP assumptions for 2024.
- In addition, a Transmission Planning study is underway to assess the impacts of this unit retirement on transmission corridor limits and evaluate potential replacement assets required to maintain limits and system contingency performance.
- NS Power is committed to engaging with our employees who may be affected by coal unit retirements; this has progressed throughout the past year with the formation of employee transition teams at each coal facility and will continue to be a strong focus for NS Power in 2022 and going forward.

# Trenton 5 Retirement Plan

## Sustaining Capital Investments

- In order for Trenton Unit 5 to operate through 2023/2024 winter operational restrictions will be required to avoid a turbine major refurbishment interval. These operational restrictions will consist of a maximum 1000 operating hours with minimal starts per year in 2022, 2023 and 2024.
- If Trenton Unit 5 is required for the 2024/2025 winter, a major refurbishment interval would be required in the summer/fall of 2024 which includes a boiler life extension and turbine refurbishment.





# Thermal Plant Depreciation Strategy

Part 3b of the Thermal Plant Retirement item is:

*Complete a thermal plant Depreciation Study to update depreciation rates and a recovery strategy to better align depreciation with updated useful lives for generation assets. Invest sustaining capital into individual thermal units appropriate to their retirement categorization.*

This part of the Action Item will be reported on in the 2022 IRP Annual Report in order to maintain alignment with recent changes in the planning environment regarding coal phase-out targets.

# Fast-Acting Generation Strategy

Part 3c of the Thermal Plant Retirement item is:

*Develop a plan for the redevelopment or replacement of existing natural gas-powered steam turbines to provide low-cost, fast-acting generating capacity to the Nova Scotia system. Fuel flexibility is a component of this work, including consideration for low/zero carbon alternative fuels.*

NS Power has advanced this work considering both Battery Energy Storage Systems (BESS) and Combustion Turbines.

# Battery Energy Storage System (BESS) Update

Battery storage was evaluated in the 2020 IRP and IRP Finding 3d notes that:

*Battery storage can enable wind integration while providing firm capacity and energy storage; however, its ability to substitute for firm capacity resources is limited by its relatively short duration. Up to 120 MW of storage by 2045 is selected in the portfolios with deployments of 30-60 MW by 2025 in many plans.*

- Since the conclusion of the IRP, NS Power has continued to study the potential benefits of grid-scale BESS systems and has worked to advance the modeling of BESS facilities in its PLEXOS modeling tool.
- NS Power has evaluated multiple locations for suitability for the installation of BESS sites while providing system benefits such as:
  - Supporting system voltage at high load levels by adding resources near system load centre.
  - Avoiding constrained transmission corridors and reducing overall system losses.
  - Supporting energy flows on the bulk transmission system and providing reliability support to customers.
- Potential deployments up to 200MW are currently being analyzed by NS Power for feasibility.
- NS Power anticipates filing a BESS subsequent submittal capital item in 2022 (C0045132 in the 2022 ACE Plan).

# Combustion Turbine Update

- The 2020 IRP found that significant Combustion Turbine (CT) additions were required, including under accelerated coal retirement and more stringent emissions reduction scenarios.
  - For example, Scenario 3.1C cumulatively adds 650MW of CTs by 2030 in addition to one coal to gas conversion.
- These CTs enable the system to meet firm capacity requirements and maintain supply reliability and balance variable renewable generation; these resources operate at low capacity factors (generally <10%) and as such are not significant contributors to electricity system carbon emissions.
- NS Power continues to evaluate options for CT deployment that are compliant with the evolving planning and policy landscape.
- NS Power is studying a number of potential locations for CT deployment in Nova Scotia; this work includes evaluating and co-optimizing gas supply and transmission interconnection requirements and discussions with potential CT manufacturers to identify candidate units.
- NS Power is prioritizing alternatives such as BESS and coal to gas conversions that may reduce the total CT resource requirements by 2030, however new CT resources are still expected to be required.

# Wind Procurement Strategy

- Part 3d of the Thermal Plant Retirement item is:

*Initiate a wind procurement strategy, targeting 50-100 MW new installed capacity by 2025 and up to 350 MW by 2030. This strategy will solicit Nova Scotia-based market pricing information which will inform the selected wind capacity profile and timing, informed by the IRP wind sensitivities.*

*In parallel with other elements of the wind procurement strategy, complete system stability studies to determine whether additional dynamic system inertia constraints, operating limits, and/or provision of alternate services like Fast Frequency Response (FFR), are required to enable higher levels of wind integration on the Nova Scotia system, particularly in advance of the commissioning of integration measures such as the Reliability Tie.*

- This work also incorporates Roadmap Item 2 – System Stability Studies

*Complete detailed system stability studies under various current and future system conditions, reflective of both stressed system states and normal operating conditions, while considering higher quantities of installed wind capacity as seen in the IRP modeling results. This work will also consider the impacts of grid service provision from inverter-based generators (such as wind turbines) and how the introduction of new ancillary grid services like Fast Frequency Response might affect existing services such as Synchronized Inertia. Monitor results for significant divergence from wind integration assumptions modeled in the IRP and trigger an update as needed.*

# Nova Scotia Rate Base Procurement

- On July 9, 2021 the Province of Nova Scotia announced the 'Rate Base Procurement' program to acquire low-cost renewable generation to serve Nova Scotia Power customers.
- Customer First Renewables (CFR) has been engaged by the Province of Nova Scotia to act as the Procurement Administrator.
- The procurement is active; most recently Draft 2 of the RFP was released on November 17, 2021 for stakeholder comment.
- CFR submitted its Application for Approval of a Standard Form Power Purchase Agreement to the UARB on December 3, 2021.
- Procurement parameters from the latest draft RFP include:
  - A target of 1100 GWh of renewable energy from wind and solar assets, with a maximum project size of 100 MW.
  - Projects must be in-service by December 31, 2025.
  - Projects will be required to provide ancillary services to the Nova Scotia Power system.

Nova Scotia Power has engaged collaboratively with CFR through the procurement process to date and is also completing Interconnection Feasibility Studies as requested by proponents via the Generation Interconnection Procedure (GIP) process

# Nova Scotia Power Wind

- Nova Scotia Power continues to examine opportunities for wind development in Nova Scotia, including examining opportunities for federal and provincial funding (e.g. Smart Renewables and Electrification Pathways Program) in order to lower costs for customers.
- A project for subsequent submittal (C0044771) has been included in ACE 2022; this project is for work on wind assets as part of the ECEI and the transition to 80% renewable electricity in Nova Scotia by 2030.



# Wind Integration Studies

In parallel with the wind procurement strategy for additional renewable resources, a series of studies are ongoing to determine what system or operational supports are required to enable the highest levels of wind integration.

The recommendations and learnings from industry experience in integrating renewables, regulatory body white papers and criteria, and adverse system events on grids with a high penetration of inverter-based generation are taken into consideration in developing the scope of work:

- Recommendations from the studies supporting the 2020 IRP plan.
- North American Electric Reliability Corporation (NERC) and other regulatory body white papers, criteria and other recommendations on performance of studies and system requirements.
- System events such as the Texas Odessa event and the blackout event in South Australia have been reviewed for lessons learned.

**Replacing some traditional synchronous generating units with Inverter-Based Resources is a challenging task that must be supported by good planning to ensure adequate levels of support for the Nova Scotia Power system**



# Wind Integration Studies

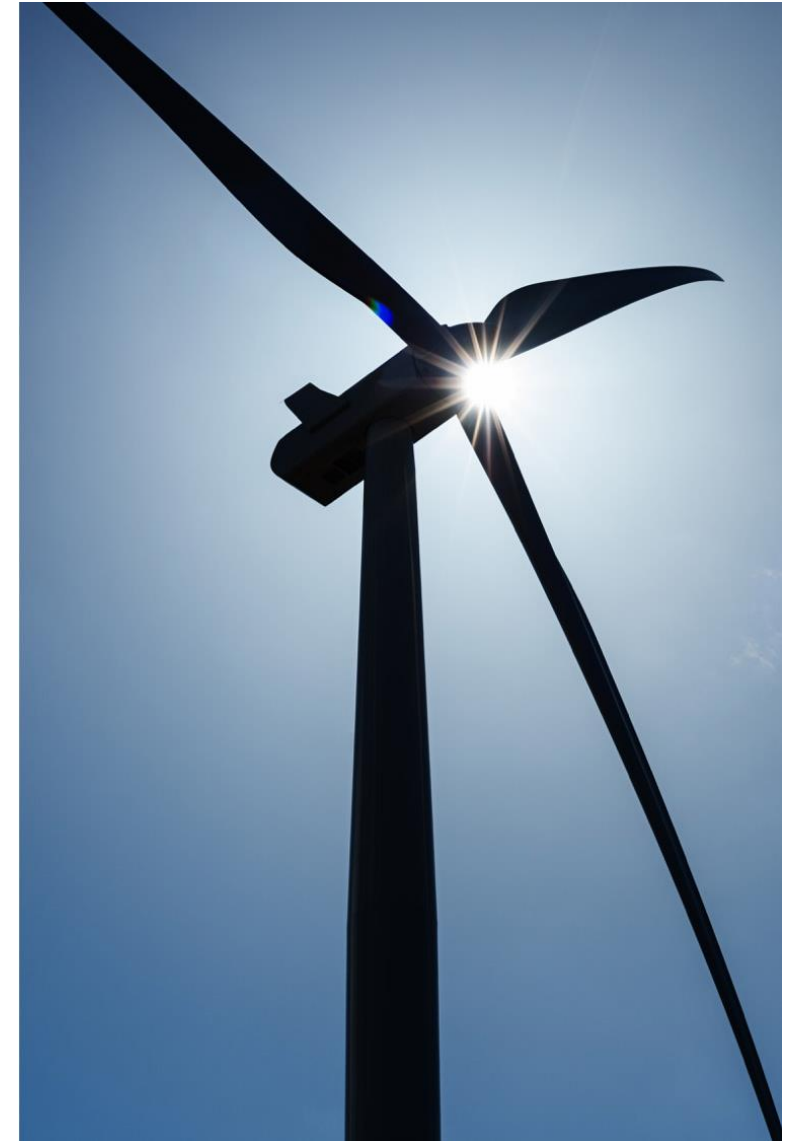
## Scope of Work

- A Consultant with global expertise in the study of high penetrations of Inverter Based Resources has been engaged to support the following scope of work:
  - Development of robust PSCAD™ and PSSE simulation models for the scope of studies.
  - Detailed Reliability Tie study building on the PSC Renewable Integration Report (2019):
    - PSSE detailed study - maximum wind without Reliability Tie
    - PSSE detailed study - maximum wind with Reliability Tie
  - Perform studies and document the following initial cases:
    - PSCAD™ review of System Strength
    - PSCAD™ review of System Inertia
    - PSCAD™ review of reliability for motor load customers
  - Develop documentation and guidelines for Nova Scotia Power Planning and Operations.

# Wind Integration Studies

## 2022 Workplan

- Complete the development of robust transmission planning models required for the scope of studies.
- Perform studies identified in the Scope of Work.
- Develop documentation and guidelines including:
  - Planning study modelling and methodology guidelines.
  - Develop specification for tuning of Inverter Based Control Systems to ensure there are no adverse impact due to control interactions between IBR plants.
  - Modelling of new technology plants.
  - System Strength recommendation to address loss of fault current provided by traditional synchronous generators.
  - System Inertia guidelines and Operational practices for each level of retirement or reduced output from traditional units.



# Coal Unit Conversions

Roadmap Item 1 states:

*Advance engineering study work on coal to gas conversions at Trenton and Point Tupper Generating Stations. Monitor cost outputs of this work relative to IRP assumptions and update the balance of new and converted capacity resources accordingly.*

The 2020 IRP resource plans selected coal to gas conversions in roughly half of the key scenarios examined, indicating that converted units may be a cost-effective source of dispatchable firm capacity at relatively low capacity factors (generally <10%).

# Coal Unit Conversions

Since the conclusion of the 2020 IRP, NS Power has undertaken two parallel work streams examining the conversion of coal-fired units at Point Tupper and Trenton generating stations to natural gas fuel supply.

## Supply of Natural Gas

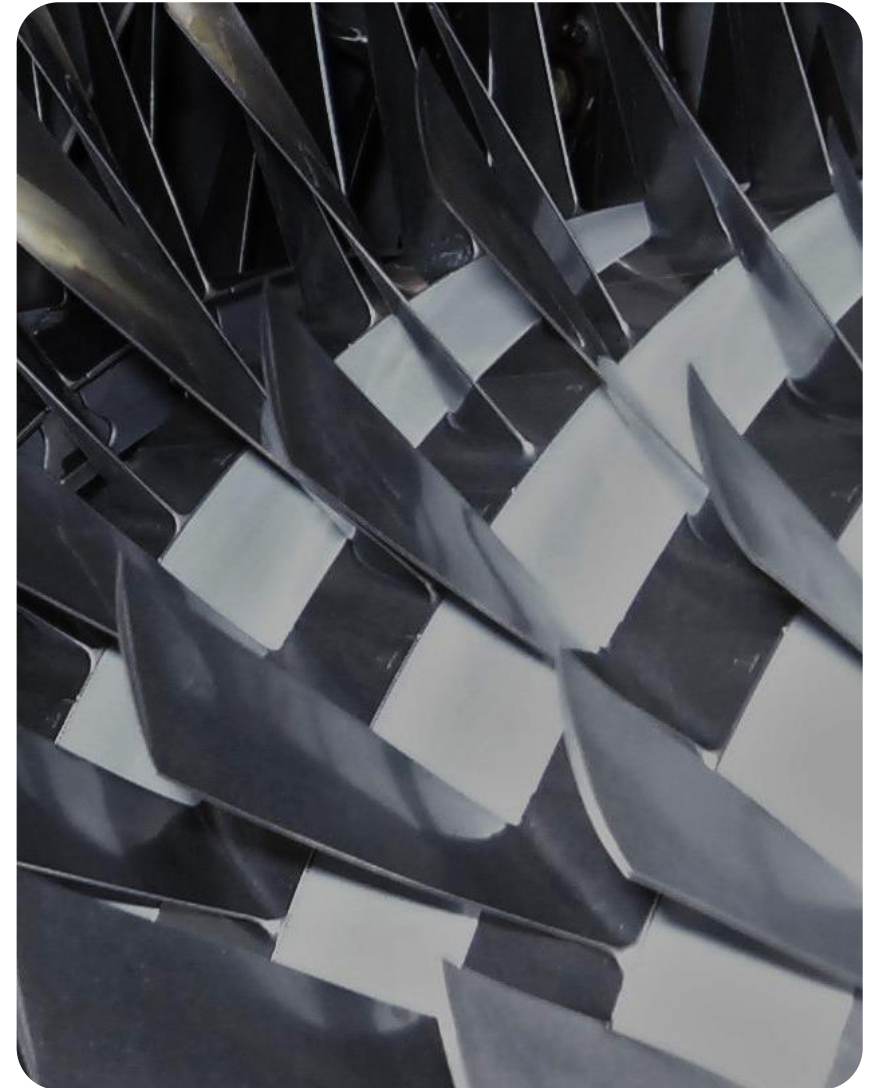
- Trenton 6 (TRE6) and Point Tupper 2 (POT2) units are both located close to existing natural gas supply sources. Additional infrastructure is required in both cases to deliver sufficient gas; infrastructure requirements vary with maximum expected flow rate and lateral delivery pressure levels.
- NS Power has completed a third-party study on gas availability to both locations; this work informed subsequent service requests that have been submitted to Heritage Gas and Maritimes & Northeast Pipeline.

## Plant Conversion

- Conceptual design and boiler studies have commenced and will continue into 2022.
- Work in progress includes boiler circulation model development, outline of burner design and controls, plant pipe routing preliminary design and valve skid design.

# Coal Unit Conversions

- NS Power is currently determining the least cost conversion option for which gas can be readily available.
- The work to date has served to validate key IRP assumptions, indicating that coal unit conversion continues to be a low-cost option for customers.
- Accordingly, NS Power has included one conversion in the 2022 ACE Plan for subsequent submittal (C0044392).



# Hydro and Combustion Turbine Investment

Roadmap Item 3 states:

*Pursue economic reinvestment in existing hydro and combustion turbines with individual capital applications as applicable; economic justification as part of a capital application will be required to confirm decision to pursue Mersey hydro redevelopment. Continue sustaining capital investment in thermal units, aligned with their projected retirement classification. Monitor required levels of sustaining capital investment for significant changes from IRP assumptions and, if observed, trigger a unit-specific analysis of alternatives. Monitor unit reliability for significant changes from IRP assumptions and, if observed, trigger an ELCC calculation and/or PRM study as required.*

# Combustion Turbine Investment

CT investment continues to be aligned with IRP assumptions for sustaining capital through 2021-2026

- In 2021, spend related to Diesel CTs was within 1 percent of the IRP Capital Assumptions for the same year. The LM 6000 spend was higher than the forecast due to project carryover and the advancement from 2026 of TUC 4 Rotor inspection and rewind.
- Sustaining capital for the LM6000s (TUC 4,5) in 2022-2026 projected to be at or below the IRP levels.
- The sustaining capital for the diesel units in 2022-2026 is projected to be within the range of the sustaining capital assumptions tested in the IRP.

High Level Changes from IRP Assumptions – all within ranges tested in the IRP:

- VJ1 Generator Replacement project was initiated in 2021 to facilitate the timely completion of the project in 2022, and the majority of spend still planned for 2022 had been identified in the IRP.
- 2022 Plans for Tusket exhaust stack were not incorporated into IRP assumptions for 2021-2026, but is being advanced based on the latest condition assessments.
- Burnside Unit 2 and 3 investment in 2022 under IRP accounted for control upgrades and vibration system upgrades. These upgrades were re-prioritized to the TUS and VJ units.
- TUC 4 engine 191-253 work planned in 2022 in IRP is now expected in 2023.
- TUC5 rotor out work being advanced in 2022 from 2027 based on previous condition assessments.

The updated sustaining capital investments are within the range of materiality of IRP inputs and as such do not indicate further analysis at this time. The units continue to perform consistent with the reliability assumptions used in the IRP.

# Hydro Investment

In 2021, Small Hydro Investment (excluding Mersey) is forecast to be below the IRP input assumptions by approximately 10 percent.

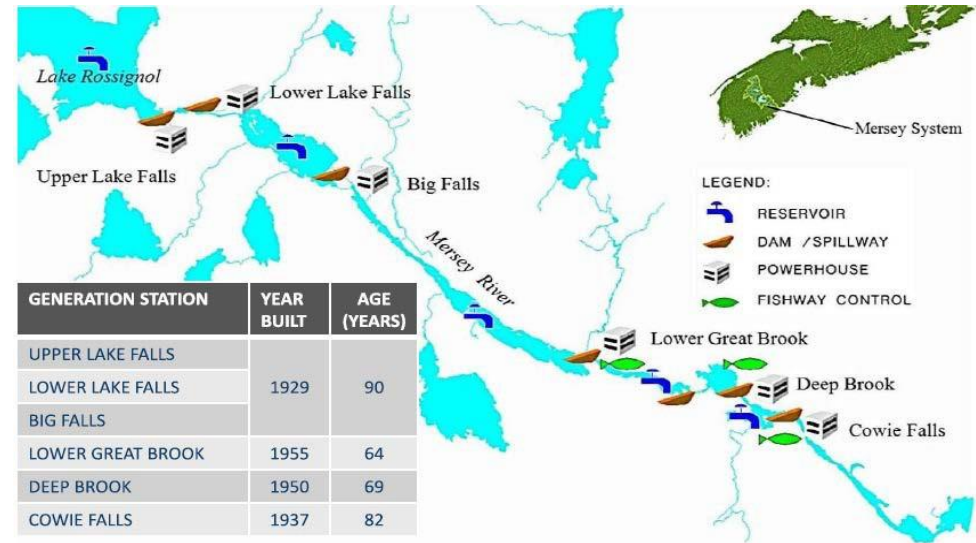
- The forecast spend on the Mersey System in 2021 has been deferred due to continued project analysis and design work.
- The forecast for 2022-2026 is generally aligned with IRP assumptions with the exception of the following:
  - Tusket – Main Dam Deferral
  - Black System – Deferral of Gaspereau Main Dam
  - Sheet Harbour System – Deferrals of Ruth Falls and Marshall Falls Dams

The changes in sustaining capital investments are within the range of materiality of IRP inputs and as such do not indicate further analysis at this time. The units continue to perform consistent with the reliability assumptions used in the IRP.



# Mersey Hydro Redevelopment

- The planning and design for the Mersey Redevelopment Project continues as does the environmental permitting process.
- In parallel, NS Power continues engage with the Mi'kmaq with regard to areas of interest including fish passage and archeology.
- Analysis on this project will continue in 2022, with a plan to reengage with stakeholders with an update when ready.



# Thermal Investment

In 2021 the Actual Investment in thermal steam fleet is forecast to be 28 percent below the 2020 IRP assumptions:

- As outlined in the 2022 ACE Section 11.1.2 *Sustaining Capital – 2022 ACE Plan Alignment with the 2020 Integrated Resource Plan (IRP)*, the thermal forecast for 2022 is approximately 33 percent lower than the IRP assumptions for 2022.
- It is forecast the thermal steam fleet will continue to be below the IRP Capital Assumptions. This variance is expected as the IRP used a top-down approach with unit-specific high utilization factors for all the units (to ensure higher capital thresholds were tested in the IRP), while current forecasts are built bottom up from current risk assessments with projected utilization factors.

The changes in sustaining capital investments are within the range of materiality of IRP inputs and as such do not indicate further analysis at this time. The units continue to perform consistent with the reliability assumptions used in the IRP.

# Low Carbon Fuels

Roadmap Item 4 states:

*Monitor the development of low/zero carbon fuels that could replace natural gas in powering generating units to provide firm, in-province capacity.*

NS Power's focus on this item has been largely in understanding the potential future value of Hydrogen to the power system via participation in the Atlantic Hydrogen Alliance.

# Atlantic Hydrogen Alliance

- The Atlantic Hydrogen Alliance (AHA) has been created to support the development of an economically viable clean hydrogen value chain that will enable the transition to a prosperous low-carbon economy in Atlantic Canada.
- Work of the AHA will focus on four key deliverables with dedicated working groups for each:



## Key Deliverables of the Atlantic Hydrogen Alliance:

1. Hydrogen Roadmap
2. Creation of Hydrogen Hub
3. Identify Key Enabling Conditions
4. Raise Awareness for Hydrogen



- NS Power will participate as a member of the AHA with working group participation in the first two deliverables.
- NS Power will also continue to investigate fuel flexibility, including Hydrogen co-firing or dual fuel options, for new combustion turbine resources.

# Renewable and Storage Costs

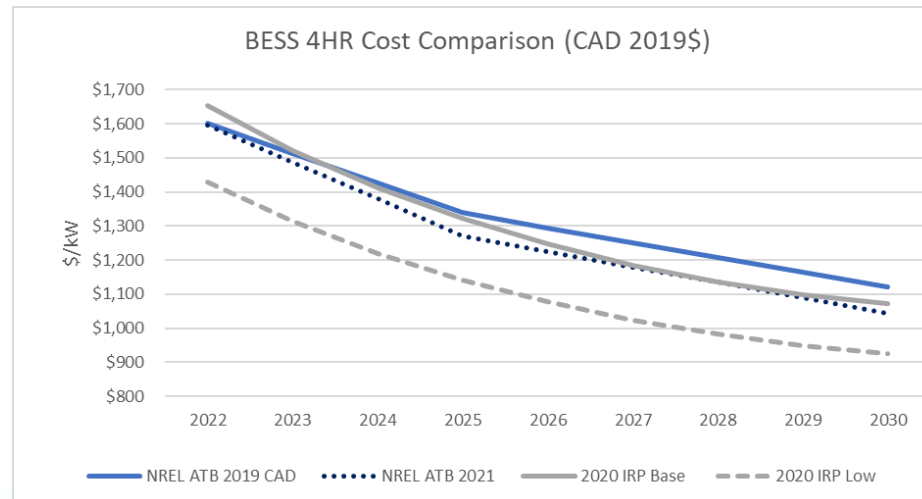
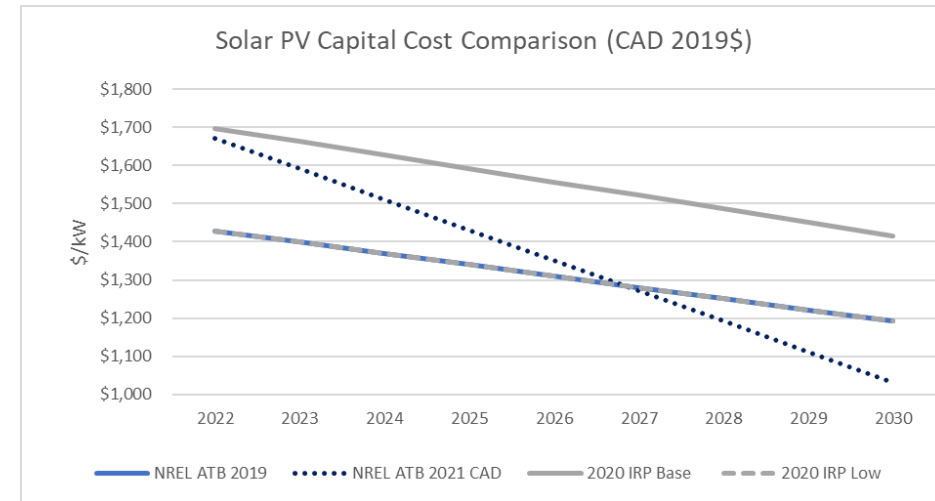
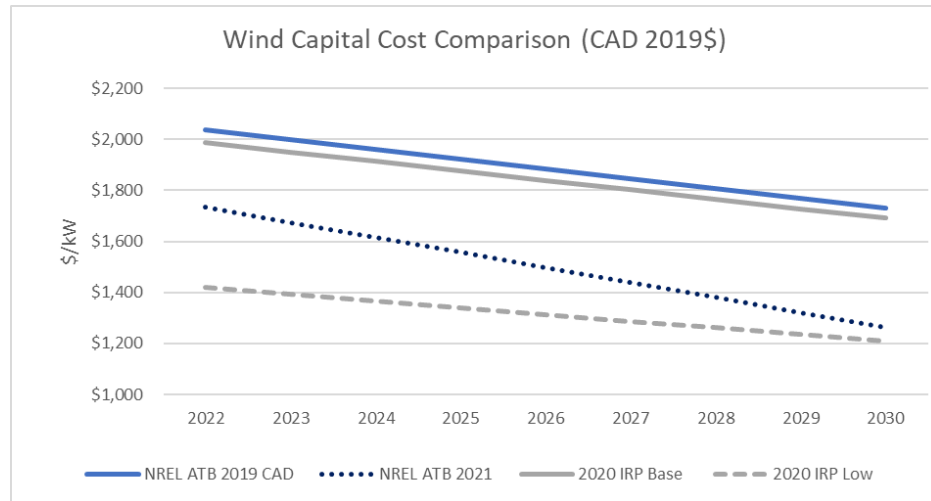
Roadmap Item 5 states:

*Continue to track the installed costs of wind, solar, and energy storage to look for variations from the trajectories established in the IRP (in particular, monitoring for divergence from the “Base” to the “Low” pricing scenarios as defined in the IRP Assumptions). Nova Scotia Power will solicit Nova Scotia-based market information which will inform this as needed. Work with E1 to monitor ongoing operational unit costs of DSM in Nova Scotia.*

# Renewable and Storage Costs – Capital Costs

- NS Power reviewed NREL’s Annual Technology Baseline (ATB) forecasts for renewables (onshore wind, solar) and storage (4HR Li-ion) to gauge capital cost changes from the 2020 IRP (ATB 2019 vs ATB 2021).
  - NREL’s ATB forecasts provide price forecasts trajectories, which is consistent with the pricing used in the 2020 IRP and is thus, useful for more fulsome comparison.
- Capital Costs are presented in \$/kW and consist of the ATB overnight capital cost and construction financing costs.
  - All costs are presented in constant 2019 dollars provide a consistent baseline for comparing costs versus the those presented in the E3’s Resource Option Study and updated in Final Assumptions document for the 2020 IRP (note -all costing in the 2020 IRP converts real dollar inputs (2019\$) into nominal dollars using a long term 2% inflation assumption).
- This review is intended to compare current estimates to those used in the 2020 IRP analysis and look for material differences from the ranges previously studied.

# Renewable and Storage Costs – Capital Costs



# Renewable and Storage Costs – Capital Costs

## Wind

- ATB 2021 shows lower current costs (2022) and a more aggressive declining trajectory on a 2019\$ basis vis-à-vis ATB 2019 and related IRP forecasts.
- ATB 2021 is still bound within NS Power’s Base/Low capital cost range on a 2019\$ basis.
- The current wind procurement, when complete, will provide NS Power with more accurate, jurisdiction-specific costing.

## Solar

- ATB 2021 shows higher near-term costs vis-à-vis ATB 2019, which was used to generate the 2020 IRP low solar cost sensitivity.
- Like wind, a more aggressive cost decline trajectory is seen in ATB 2021.

## BESS

- ATB 2021 shows moderately lower BESS capital costs, with a moderately slower cost decline trajectory on a 2019 \$ basis.
- Like wind, the IRP Base/Low estimates encompass the updated forecast/
- As discussed in the Fast-Acting Generation Strategy update, NS Power is analyzing BESS projects up to 200MW which will source updated cost estimates from suppliers.



# Nova Scotia Cap and Trade Program

Roadmap Item 6 states:

*Track the ongoing development of the Nova Scotia Cap-and-Trade Program, including auction results and developing regulations. In particular, monitor GHG market size for indications that value from incremental allowance sales (beyond the projected economic emissions reductions shown in the IRP results) can be incorporated into long-term resource planning decisions with greater certainty. Significant changes in the value of incremental GHG reductions could influence resource plan components including non-emitting generation procurement, DSM levels, and coal retirement trajectories.*

# Nova Scotia Cap and Trade Program

- Since the conclusion of the 2020 IRP, there has been no update to the provincial cap and trade program for the 2019-2022 compliance period.
- There have been two auctions completed under the Cap and Trade program in 2021:

| Auction Date  | Allowances Sold | Floor Price | Settlement Price |
|---------------|-----------------|-------------|------------------|
| June 2021     | 767,000         | \$21.09     | \$36.71          |
| November 2021 | 790,000         | \$21.09     | \$21.09          |

- NS Power looks forward to engaging with the Province on a carbon framework for 2023 and beyond.



# 4

## Demand Response Strategy

# Demand Response Strategy

IRP Action Plan Item 4 is:

**Create a Demand Response Strategy targeting 75 MW of capacity, for deployment by 2025. Available resource cost, flexibility, and reliability may inform pursuit of additional Demand Response capability.**

This Action Plan item is considered under one element but has multiple tasks underway. The Action Plan describes this approach noting:

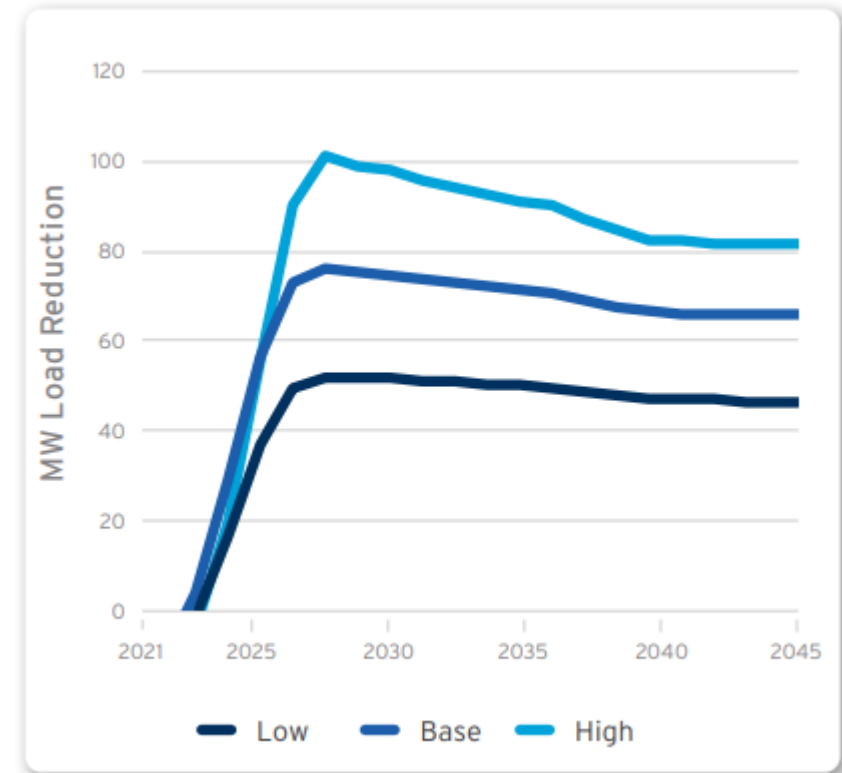
*The strategy will be closely linked to the Electrification Strategy being developed in parallel. The strategy will build on learnings from NS Power's Smart Grid Project, NS Power's Time Varying Pricing application, the DR Joint Working Group between NS Power and EfficiencyOne, the ELIADC tariff, and the Large Industrial Interruptible Rider.*

**Demand Response (DR) technologies can affect system operations by changing the timing of electricity consumption, allowing greater load control and customer response**

# Demand Response Strategy Components

- The 2020 IRP assessed aggregated demand response programming (“DR”) developed by E1 (Three profiles: Low, Base High). These profiles provided a stream of annual costs and associated capacity of available load reduction over the IRP period (2021-2045).
  - DR was offered to the optimization model in the same way as other supply-side resources. The modeling results showed that DR programming with a target program capacity of approximately 75 MW was economic.
- Sub-programs included in the aggregated potential profiles were those programs that that passed E1’s cost effectiveness testing from the 2019 DSM Potential study and include (for ‘Base’)
  1. Direct Load Control.
  2. Critical Peak Pricing.
  3. Business/Non-Profit/Institutional (BNI) curtailment.

Aggregated Demand Response – Achievable Potential (Nameplate)



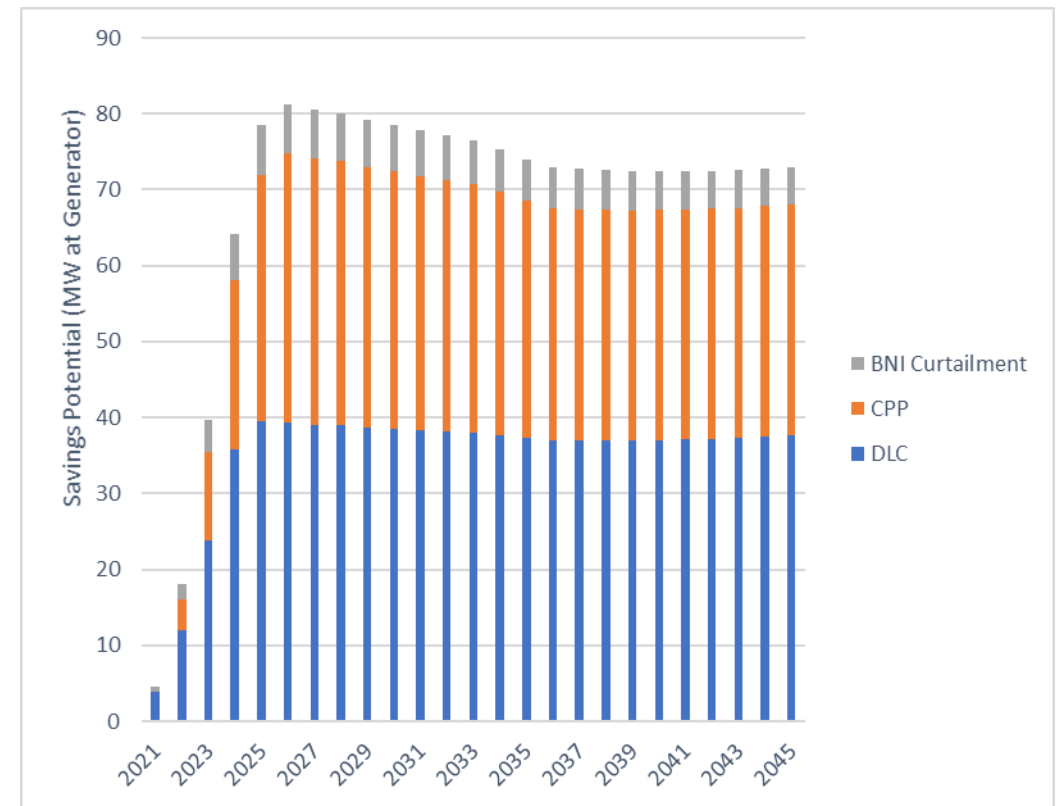
# Demand Response Strategy Components

The Base DR strategy selected in the IRP Reference Plan incorporates three main components:

- DLC – Direct Load Control includes control of electric loads by a thermostat and/or load control switch.
- CPP – Critical Peak Pricing describes a rate schedule with pricing that discourages consumption during peak times.
- BNI Curtailment – Firm capacity reduction commitments from large commercial or large industrial customers.

Since the completing of the IRP, NS Power has been actively pursuing the largest components, DLC and CPP.

DR Program Components (Base) – 2020 IRP



# Direct Load Control: NS Power/E1 Demand Response Working Group

- NS Power and E1 have formed a Demand Response Working Group (DRWG). The objective of the group is to collaboratively plan, implement, and evaluate Demand Response (DR) activities across Nova Scotia.
- In April 2021, a smaller E1/NSP DR technical team was formed, which reports to the larger NSP/E1 DRWG. The focus of this technical group to date has been on direct control Water Heaters (WH).
- Direct load control of water heaters was found in the 2019 DSM Potential Study to make up the second highest potential of the DR programs evaluated.
  - Water Heater direct load control technologies can provide value by dynamically adjusting the timing of electricity consumption in response to grid conditions.
  - Water Heater consumption periods typically align with daily grid peak demand periods.
  - Significant demand savings potential of aggregated solution due to high market penetration of electric water heaters.
  - Creates opportunity for low-income customers to participate in DR activities.
- The group is also evaluating Commercial load control options; further details on both pilot programs are on the next slide.

# NS Power / E1 Pilot Programs

## Water Heater DR Pilot

- Pilot goal: demonstrate DR potential of directly controlling electric WHs of residential customers, and inform viability of a future, large-scale program.
- Request for Proposal (RFP) process completed, and two vendors were selected to provide WH control devices and associated control applications.
- Pilot live period taking place from Nov 2021 to Nov 2022.
- Target number of customer controllers is 200 for full pilot deployment.
- Customer recruitment is currently ongoing.
- 118 installations have been completed.
- Pilot testing has been ongoing since Nov 15, 2021.

## Commercial DR Pilot

- Pilot goal: demonstrate DR potential of aggregating and controlling various loads for commercial customers, and inform viability of a future, large-scale program.
- Phase 1 will involve integration of customers' Siemens Desigo Building Management System with NSP's Energy System Platform (ESP), being developed as part of the Smart Grid Nova Scotia Project
  - The recruitment of commercial customers is currently ongoing (targeting up to 4).
  - Pilot live period is planned to begin during winter 2021/2022 and continue until Mar 2024.
- Phase 2 will involve the procurement of a turnkey DR aggregator.
  - Preliminary Market Consultation (PMC) has been completed.
  - RFP was issued on Nov 26, 2021.
  - Pilot live period is planned to take place from Dec 2022 to Mar 2024.



# Critical Peak Pricing / Time Varying Pricing

- Two-year Time Varying Pricing (TVP) pilots were approved by NSUARB effective November 1, 2021.
  - TVP pilots include Critical Peak Pricing (CPP) and Time-of-Use (TOU) tariffs available to Domestic, Small General and General Demand rate classes.
- 1,000+ customers have signed up for pilots.
- Customer Energy Management Platform was activated for all TOU and CPP Pilot customers in November 2021.
  - Platform enables hourly, daily, monthly visualizations of energy usage and energy end-use disaggregation.



# 5

## Avoided Costs of DSM

# Avoided Cost of DSM

IRP Action Plan Item 5 is:

**NS Power will calculate Avoided Costs of DSM (capacity and energy) for scenarios 2.0C and 2.1C. 2.0C will be used as the Reference Plan and 2.1C will be available for additional reference.**

**Avoided Costs of DSM (Energy and Capacity) are important inputs to EfficiencyOne's DSM scenario development**

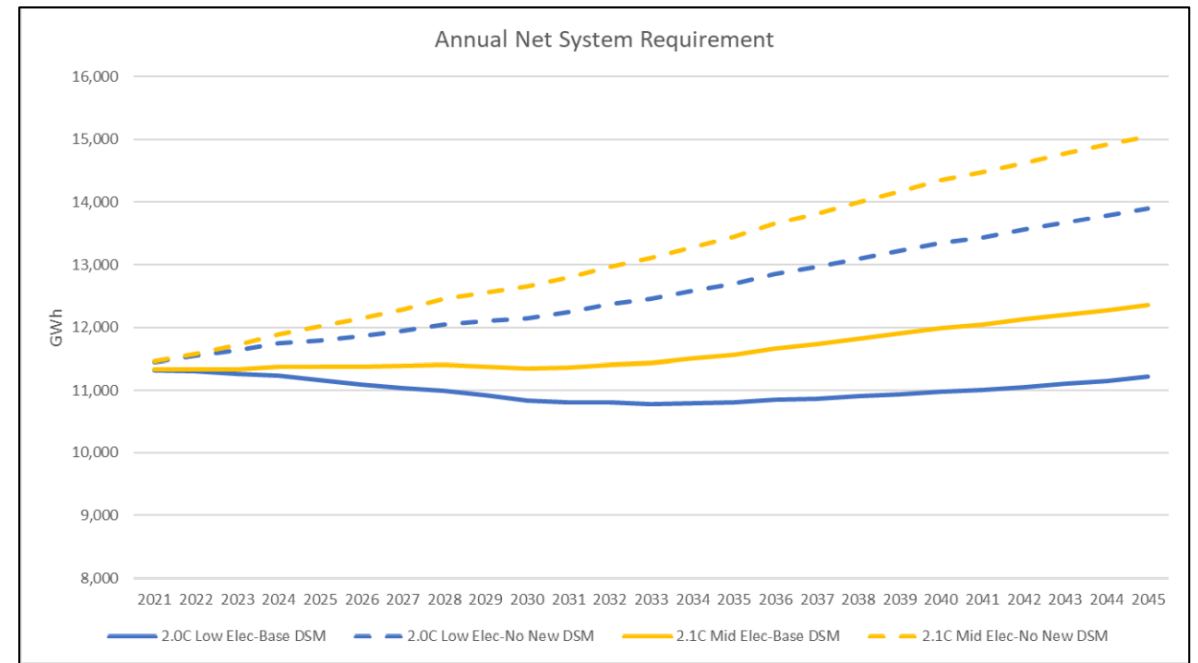
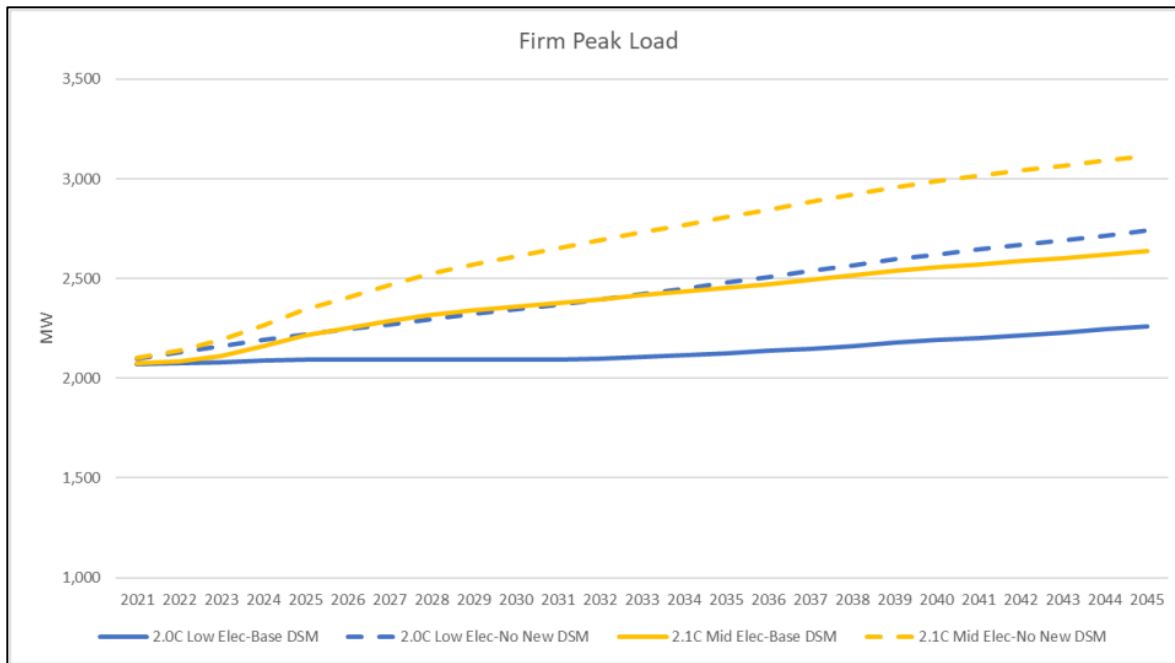
# Avoided Cost of DSM

- The Avoided Cost of DSM calculation includes the incremental cost of generating or purchasing electricity and/or the incremental cost of procuring capacity resources that will not be incurred if Demand Side Management (DSM) programming is implemented.
- NS Power calculated Avoided Costs via the Difference in Revenue Requirement methodology (DRR).
  - The DRR method calculates the difference in Partial Revenue Requirement<sup>1</sup> by comparing
    - i) optimized resource plans (Reference Plan 2.0C and 2.1C) with embedded DSM programming assumptions (collectively “With DSM Plans”) as described in the 2020 IRP and
    - ii) for avoided costs purposes, a newly optimized resource plan with same set of modeling parameters as *With DSM plan*, except with higher annual loads and firm peaks that would result if no new DSM programming were undertaken (collectively “Without DSM Plans”).
  - See accompanying slide for load and peak demand assumptions.

<sup>1</sup>Partial Revenue Requirement are those costs that have been included in the IRP cost reporting and include; production costs, generation O&M costs, abatement, and capital costs

# Avoided Cost of DSM

The load assumptions below (from the 2020 IRP) were used to develop the “No New DSM” resources plans as part of the Avoided Cost calculations.



# Avoided Cost of DSM

- On March 3, 2021 and May 28, 2021 NS Power shared the results of its analysis of the Avoided Cost of DSM to the DSM Advisory Group (DSMAG).
  - The methodology for capacity and energy allocation applied the principals of the Cost-of-Service Study (COSS).
  - The details of the No DSM Plans in similar format to Appendix K of the IRP as requested by stakeholders (e.g. Energy Balance, Installed Capacity, Emissions, and various cost reporting metrics).
  - Excel workbook with formulas was provided for transparency of methodological approach to cost allocations.
- Cost allocations for both Energy and Capacity were provided in three different metrics (actual annual costs, levelized, equivalent escalating series). The latter two formats are smoothing approaches designed to minimize the actual annual variability in avoided costs due to timing differences of resource additions/retirements. These calculations were refined based on stakeholder feedback at the several DSMAG forums where this analysis was discussed.
  - The cost allocation methodology produces an annual series of avoided costs that, when applied to the annual differences in energy/capacity between plans (with and without DSM), is equivalent to the total Net Present Value cost delta between plans (i.e. the NPV cost delta between *With* and *Without DSM* Plans has been fully allocated to capacity and energy).

# Avoided Cost of DSM

- Through the DSMAG review process, Synapse Energy Economics recommended the use of a fitted curve methodology for the avoided cost of capacity to reflect the intertemporal value throughout the modeling horizon.
  - NS Power agreed with the approach and on produced a fitted polynomial trend line reflecting values of avoided capacity while closely preserving the NPV of the actual annual values.
- NS Power concluded the Avoided Cost process by recommending to the DSMAG that E1 use in their DSM scenario analysis:
  - i) equivalent escalating series values for energy AVC
  - ii) polynomial trend values for capacity AVC
- The recommended values are shown in green on the following slides.

# Avoided Cost of DSM - Energy

| IRP Scenario | 2.0C (Reference Case) |                                   |                                 | 2.1C  |                                   |                                 |
|--------------|-----------------------|-----------------------------------|---------------------------------|---|-----------------------------------|---------------------------------|
|              | Year                  | Actual Annual AVC Energy (\$/MWh) | Levelized AVC - Energy (\$/MWh) | Equiv. Escal. Series - AVC -Energy (\$/MWh) | Actual Annual AVC Energy (\$/MWh) | Levelized AVC - Energy (\$/MWh) |
| 2023         | \$92                  | \$88                              | \$70                            | \$101                                       | \$90                              | \$71                            |
| 2024         | \$65                  | \$88                              | \$71                            | \$76  | \$90                              | \$73                            |
| 2025         | \$77                  | \$88                              | \$72                            | \$90  | \$90                              | \$74                            |
| 2026         | \$83                  | \$88                              | \$74                            | \$76  | \$90                              | \$76                            |
| 2027         | \$85                  | \$88                              | \$75                            | \$73  | \$90                              | \$77                            |
| 2028         | \$76                  | \$88                              | \$77                            | \$78  | \$90                              | \$79                            |
| 2029         | \$76                  | \$88                              | \$78                            | \$87  | \$90                              | \$80                            |
| 2030         | \$89                  | \$88                              | \$80                            | \$89  | \$90                              | \$82                            |
| 2031         | \$85                  | \$88                              | \$82                            | \$85  | \$90                              | \$83                            |
| 2032         | \$85                  | \$88                              | \$83                            | \$80  | \$90                              | \$85                            |
| 2033         | \$85                  | \$88                              | \$85                            | \$81  | \$90                              | \$87                            |
| 2034         | \$84                  | \$88                              | \$87                            | \$72  | \$90                              | \$89                            |
| 2035         | \$85                  | \$88                              | \$88                            | \$75  | \$90                              | \$90                            |
| 2036         | \$91                  | \$88                              | \$90                            | \$86  | \$90                              | \$92                            |
| 2037         | \$94                  | \$88                              | \$92                            | \$95  | \$90                              | \$94                            |
| 2038         | \$91                  | \$88                              | \$94                            | \$88  | \$90                              | \$96                            |
| 2039         | \$88                  | \$88                              | \$96                            | \$87  | \$90                              | \$98                            |
| 2040         | \$87                  | \$88                              | \$97                            | \$102                                       | \$90                              | \$100                           |
| 2041         | \$96                  | \$88                              | \$99                            | \$106                                       | \$90                              | \$102                           |
| 2042         | \$98                  | \$88                              | \$101                           | \$111                                       | \$90                              | \$104                           |
| 2043         | \$101                 | \$88                              | \$103                           | \$114                                       | \$90                              | \$106                           |
| 2044         | \$103                 | \$88                              | \$105                           | \$116                                       | \$90                              | \$108                           |
| 2045         | \$102                 | \$88                              | \$108                           | \$116                                       | \$90                              | \$110                           |



# Avoided Cost of DSM - Capacity

| IRP Scenario | 2.0C (Reference Case) |                                       |   |  | 2.1C   |                                       |   |  |
|--------------|-----------------------|---------------------------------------|---|--|--|---------------------------------------|---|--|
|              | Year                  | Actual Annual AVC Capacity (\$/kW-Yr) | Levelized AVC-Capacity (\$/kW-Yr)(PRM Adj.) | Equiv. Escal. Series - AVC - Capacity (\$/kW-yr)(PRM Adj.) | Fitted Series - AVC - Capacity (\$/kW-yr) (PRM Adj.) | Actual Annual AVC Capacity (\$/kW-Yr) | Levelized AVC-Capacity (\$/kW-Yr)(PRM Adj.) | Equiv. Escal. Series - AVC - Capacity (\$/kW-yr)(PRM Adj.) |
| 2023         | \$80                  | \$132                                 | \$105                                       | \$26   | \$72   | \$135                                 | \$108                                       | \$42   |
| 2024         | -\$16                 | \$132                                 | \$107                                       | \$40   | \$17   | \$135                                 | \$110                                       | \$58   |
| 2025         | \$39                  | \$132                                 | \$109                                       | \$54   | \$67   | \$135                                 | \$112                                       | \$72   |
| 2026         | \$59                  | \$132                                 | \$111                                       | \$67   | \$93   | \$135                                 | \$115                                       | \$85   |
| 2027         | \$80                  | \$132                                 | \$114                                       | \$80   | \$92   | \$135                                 | \$117                                       | \$97   |
| 2028         | \$86                  | \$132                                 | \$116                                       | \$91   | \$104  | \$135                                 | \$119                                       | \$108  |
| 2029         | \$91                  | \$132                                 | \$118                                       | \$102  | \$102  | \$135                                 | \$122                                       | \$119  |
| 2030         | \$118                 | \$132                                 | \$121                                       | \$112  | \$126  | \$135                                 | \$124                                       | \$128  |
| 2031         | \$106                 | \$132                                 | \$123                                       | \$122  | \$112  | \$135                                 | \$127                                       | \$136  |
| 2032         | \$101                 | \$132                                 | \$125                                       | \$130  | \$106  | \$135                                 | \$129                                       | \$143  |
| 2033         | \$102                 | \$132                                 | \$128                                       | \$138  | \$107  | \$135                                 | \$132                                       | \$150  |
| 2034         | \$134                 | \$132                                 | \$130                                       | \$145  | \$152  | \$135                                 | \$134                                       | \$155  |
| 2035         | \$157                 | \$132                                 | \$133                                       | \$152  | \$154  | \$135                                 | \$137                                       | \$159  |
| 2036         | \$155                 | \$132                                 | \$136                                       | \$157  | \$104  | \$135                                 | \$140                                       | \$162  |
| 2037         | \$125                 | \$132                                 | \$138                                       | \$162  | \$139  | \$135                                 | \$143                                       | \$164  |
| 2038         | \$156                 | \$132                                 | \$141                                       | \$167  | \$207  | \$135                                 | \$145                                       | \$166  |
| 2039         | \$210                 | \$132                                 | \$144                                       | \$170  | \$219  | \$135                                 | \$148                                       | \$166  |
| 2040         | \$182                 | \$132                                 | \$147                                       | \$173  | \$148  | \$135                                 | \$151                                       | \$165  |
| 2041         | \$150                 | \$132                                 | \$150                                       | \$174  | \$145  | \$135                                 | \$154                                       | \$163  |
| 2042         | \$138                 | \$132                                 | \$153                                       | \$176  | \$146  | \$135                                 | \$157                                       | \$160  |
| 2043         | \$146                 | \$132                                 | \$156                                       | \$176  | \$144  | \$135                                 | \$161                                       | \$157  |
| 2044         | \$152                 | \$132                                 | \$159                                       | \$176  | \$135  | \$135                                 | \$164                                       | \$152  |
| 2045         | \$168                 | \$132                                 | \$162                                       | \$175  | \$110  | \$135                                 | \$167                                       | \$146  |



# Evergreen IRP Process

# Evergreen IRP Process

Roadmap Item 8 states:

*Continuously refine the Action Plan and Roadmap items via an evergreen IRP process. This process should facilitate annual updates as conditions change and technology or market options develop, and as Action Plan items are completed or significantly advanced. NS Power will include a summary of updates as part of IRP Action Plan reporting and will incorporate the opportunity for stakeholder comment and feedback as part of the update process.*

# Evergreen IRP Process

- The IRP Action Plan and Roadmap items that were identified in the 2020 IRP and advanced in the first year of Action Plan implementation continue to reflect appropriate planning activities for Nova Scotia Power at this time.
  - This reflects the comprehensive planning process undertaken during the 2020 IRP, resulting in an IRP Action Plan that is robust to a wide range of potential outcomes, including the evolution of the planning environment that has occurred over the course of year one.
- Notwithstanding this continued alignment and ongoing value in advancing the identified Action Plan, NS Power recognizes that the significant planning environment changes that have been seen over the past year warrant an Evergreen IRP update be undertaken in 2022.
  - NS Power has begun work to incorporate the planning environment changes identified in this Annual Report, including requirements for 2030 coal phase-out, 80% Renewable Electricity Standard and related procurement initiatives, increasing carbon stringency, and impacts of revised economy-wide decarbonization and electrification targets.

# Evergreen IRP Process

- Nova Scotia Power will engage with stakeholders in an Evergreen IRP update in 2022, including:
  - A workshop session to review the content of this IRP Action Plan Annual Report with stakeholders.
    - This workshop scheduled for February 11, 2022.
  - Development of updated modeling assumptions and scope for an Evergreen IRP update:
    - NS Power will undertake an update reflecting the most significant changes in the planning environment since the completion of the 2020 IRP; it is not intended to repeat the full IRP process and where updates are not made, assumptions and inputs from the 2020 IRP will be retained.
    - NS Power will present updated assumptions and inputs, as well as a proposed set of modeling scenarios, to stakeholders for feedback in Q2 2022.
  - Completion of modeling work, incorporating these updates, will be completed before the end of 2022.
- NS Power will continue to progress the 2020 IRP Action Plan in parallel with this Evergreen IRP update.

