

NS POWER 2020 IRP DRAFT FINDINGS WORKSHOP

SEPTEMBER 10, 2020

AGENDA

SAFETY MOMENT

RELIABILITY & OPERABILITY SCREENING

FINAL PORTFOLIO STUDY

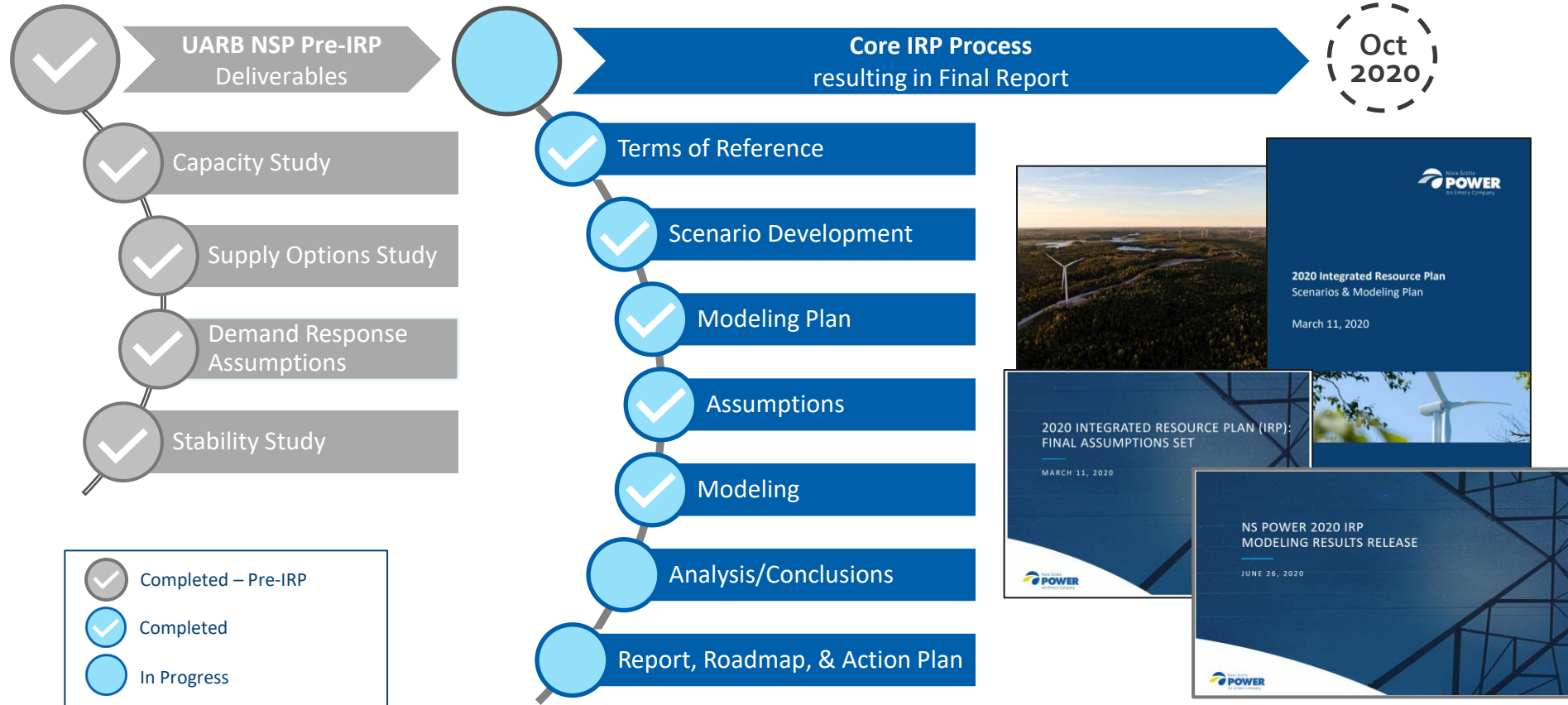
- **COMPARISONS, METRICS & INSIGHTS**
- **SENSITIVITY ANALYSIS**

DRAFT FINDINGS

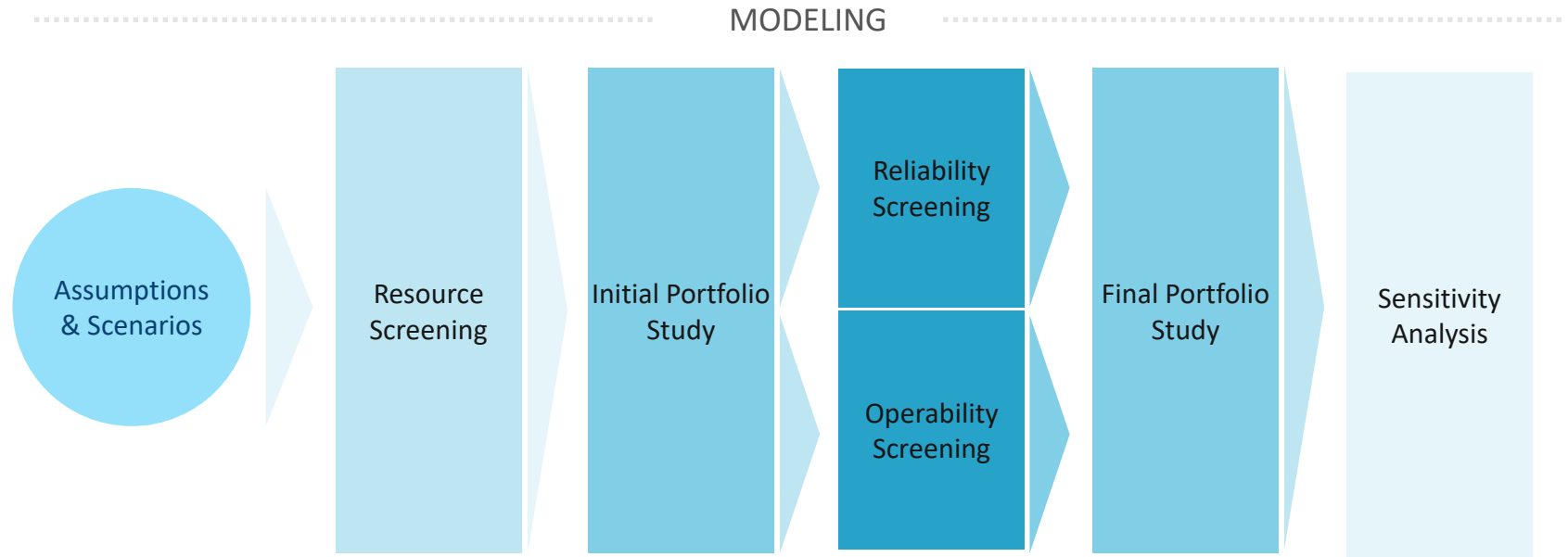
DRAFT ACTION PLAN

DRAFT ROADMAP

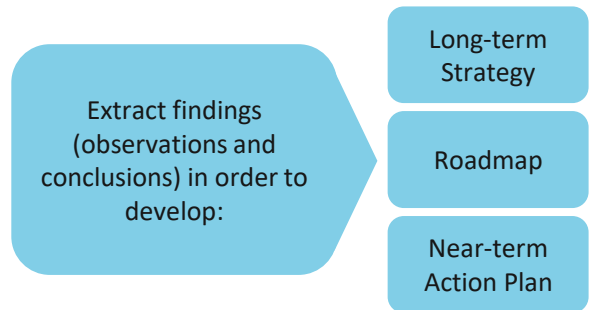
PROCESS UPDATE & WORK COMPLETED



IRP MODELING PLAN



POST-MODELING



IRP DRAFT FINDINGS, ROADMAP, & ACTION PLAN

RELIABILITY AND OPERABILITY SCREENING

RELIABILITY & OPERABILITY SCREENING

NS Power reviewed sections of slides 5-27 from Draft Findings release 2020-09-02

QUESTIONS & DISCUSSION

RELIABILITY & OPERABILITY SCREENING

FINAL PORTFOLIO STUDY & SENSITIVITY ANALYSIS

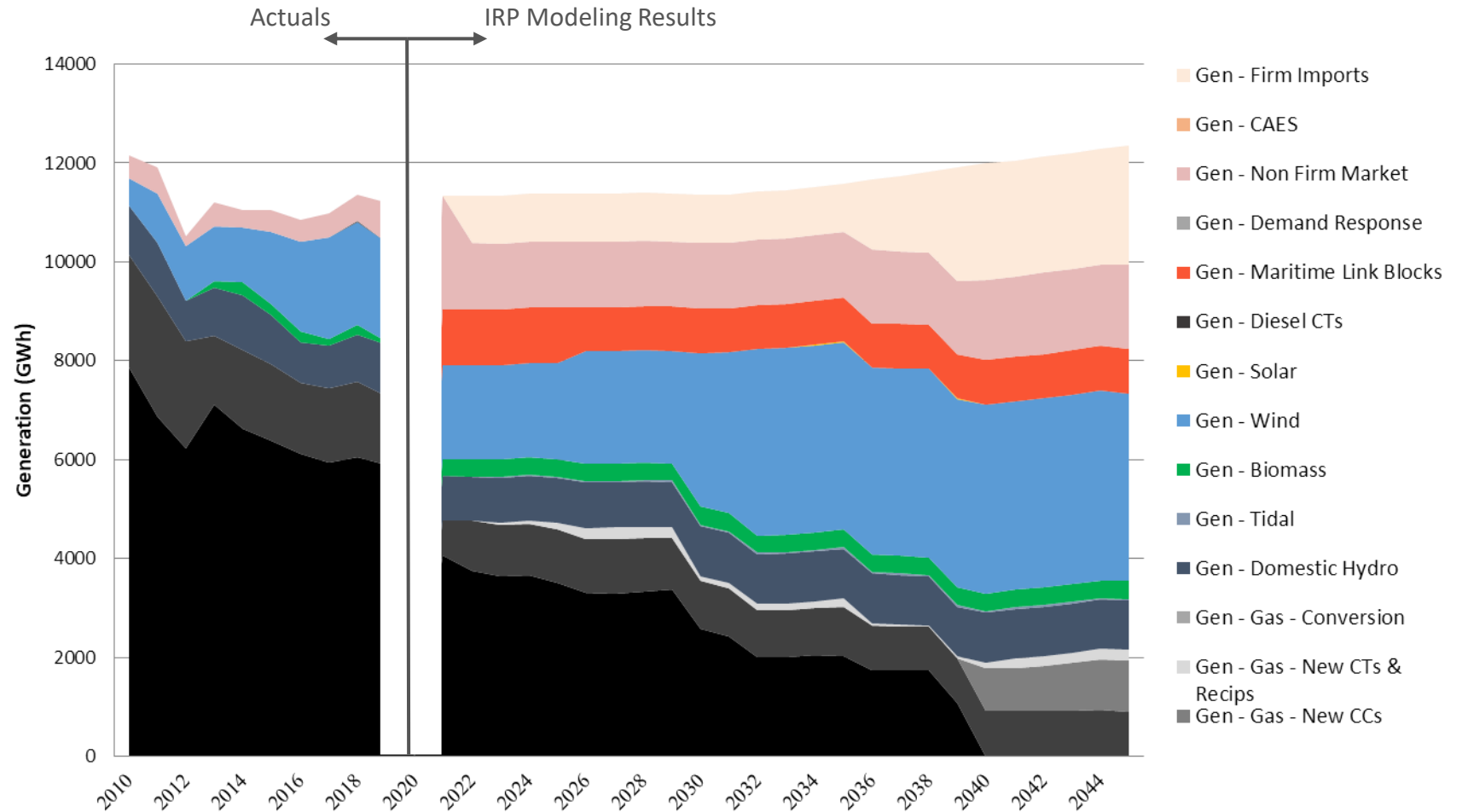
FINAL PORTFOLIO STUDY

- The following slides provide an overview comparison of the Final Portfolio Study results from PLEXOS for the key scenarios
- Outputs presented here consist of capacity expansion optimizations in PLEXOS LT, supplemented by hourly production cost simulations in PLEXOS MT/ST
- The section includes several summary comparison slides; detailed model outputs for each run are provided in a second presentation “*IRP Modeling Results 2020-09-02*” and in the accompanying data tables
- NPVs presented in these results are partial revenue requirements that consider modeled costs (i.e. production, O&M, abatement, sustaining capital, and capital investment) and specific costs considered outside of the long-term model optimization (i.e. energy efficiency costs)

IRP IN THE CONTEXT OF ONGOING GENERATION TRANSFORMATION

- The graph to the right includes actual annual generation for 2010-2019 and forecast generation from PLEXOS MT/ST for 2021-2045 (2020 is left blank)
- This chart highlights the increasing penetration of renewables on the Nova Scotia system since 2010 as well as the anticipated changes due to the availability of energy over the Maritime Link beginning in 2021

Energy Balance
2010-2019 Actuals & 2021-2045 Scenario 2.1C



IRP RESOURCE PLAN INSIGHTS

Regional Integration

Reliability Tie* and Regional Interconnection investments enable incremental renewable integration as well as new access to firm capacity & energy imports (respectively), and are common to low-cost resource plans.



Electrification

Increased electricity sales due to electrification can help to reduce upward pressure on electricity rates while facilitating carbon reductions in other sectors.



Firm Capacity Resources

New firm capacity resources will be a key requirement of the developing power system; efficient combustion turbines replace retiring thermal capacity to quickly respond to changes in wind output & non-firm imported energy and ensure reliability.



Coal Retirements

Coal units operate with declining capacity factors in line with GHG emissions caps. Many resource plans incorporate economic retirement of one coal unit in the near term (as early as 2023 if replacement capacity and energy can be procured).



Wind Energy

Wind energy continues to increase in all IRP resource plans; new wind is assumed to contribute to grid essential services (e.g. ramping reserve, SCADA control) to enable additional renewable integration.



Solar Energy

There is very limited solar generation in the resource plans due to low capacity factor (relative to wind), lower winter output, and lack of firm capacity contribution; limited solar is built in 2043+ in the most aggressive GHG reduction scenarios.



Demand Response & Efficiency

The aggregated Demand Response programs modeled in the IRP have economic value to the Nova Scotia system, offsetting requirements for firm generation capacity with controllable customer load. Focused DSM is required.

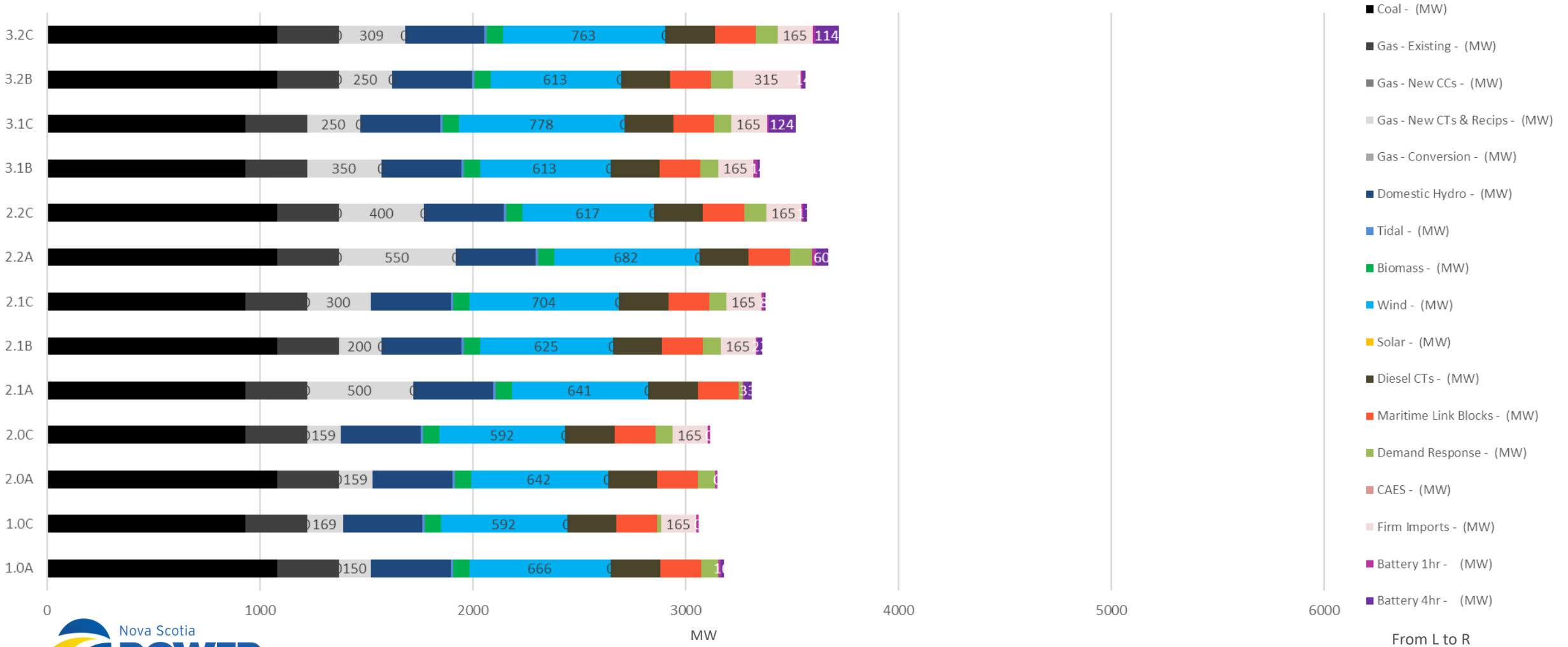


Hydro Resources

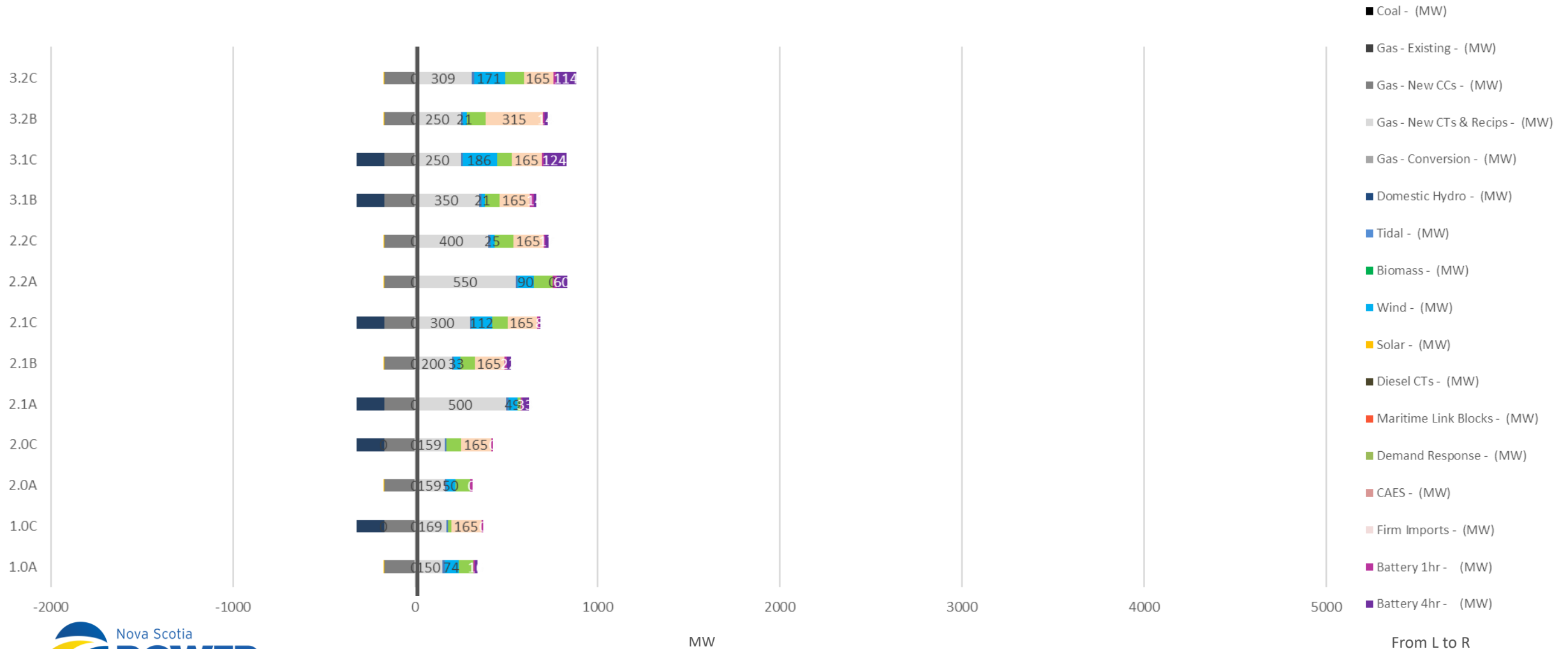
NS Power's existing Hydro resources provide economic benefit to customers and are retained through the planning horizon with appropriate sustaining investment as a source of renewable generation.



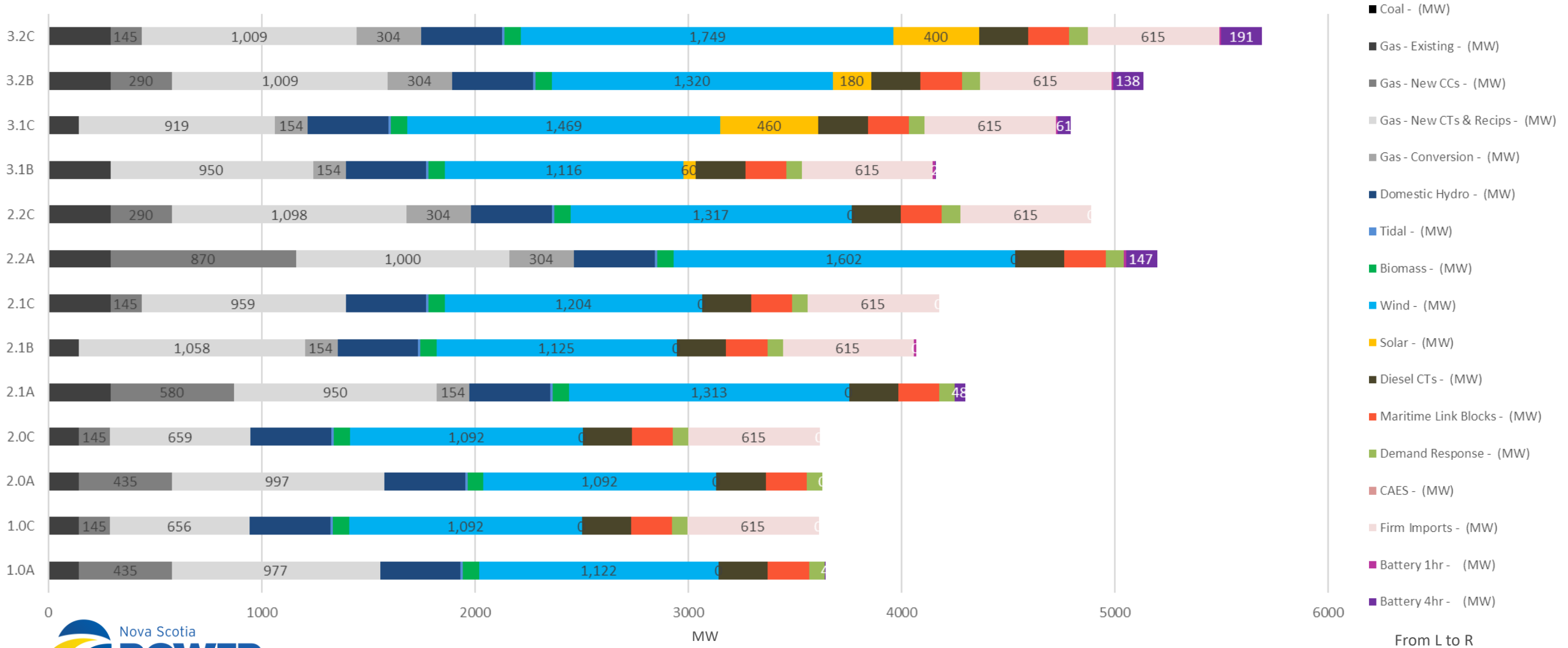
RESOURCE PORTFOLIO COMPARISON (2026)



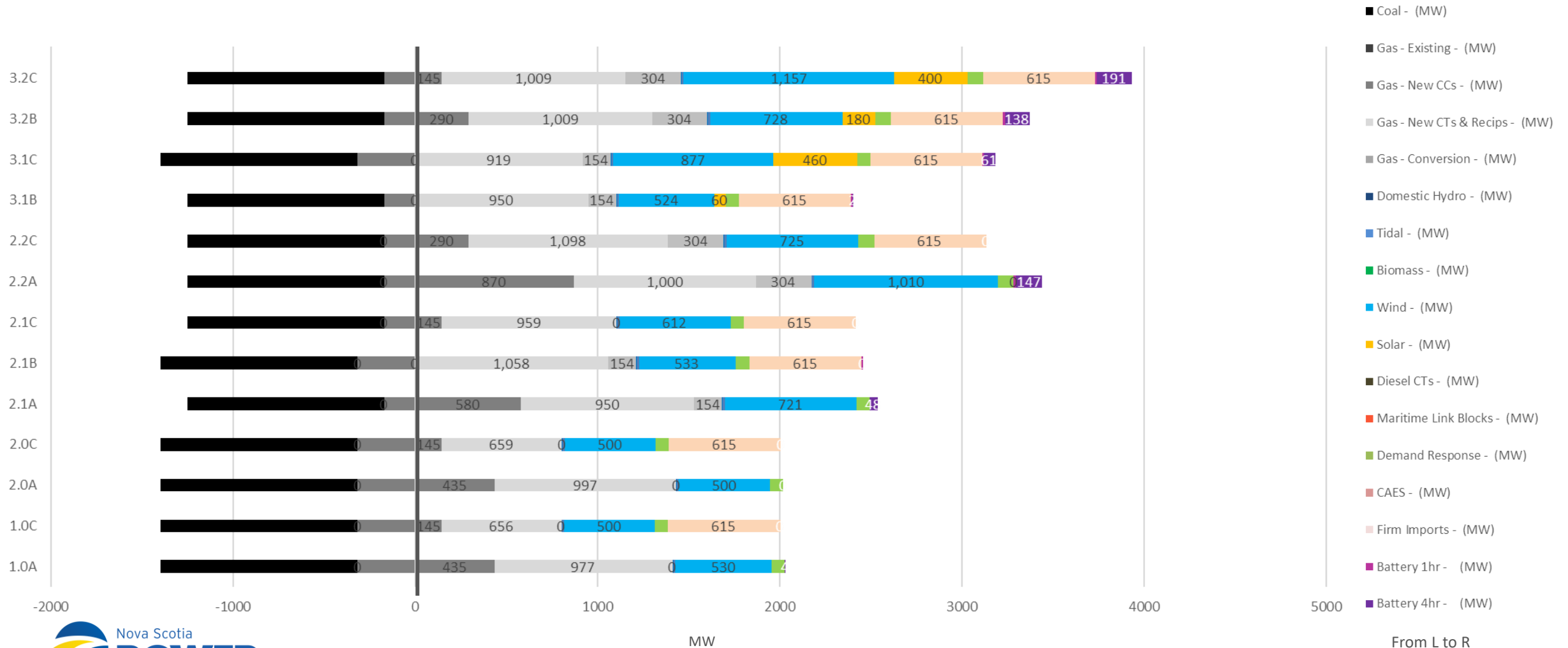
RESOURCE PORTFOLIO CHANGES (2026)



RESOURCE PORTFOLIO COMPARISON (2045)



RESOURCE PORTFOLIO CHANGES (2045)



QUESTIONS & DISCUSSION

RESOURCE PLAN INSIGHTS

FINAL PORTFOLIO STUDY - METRICS

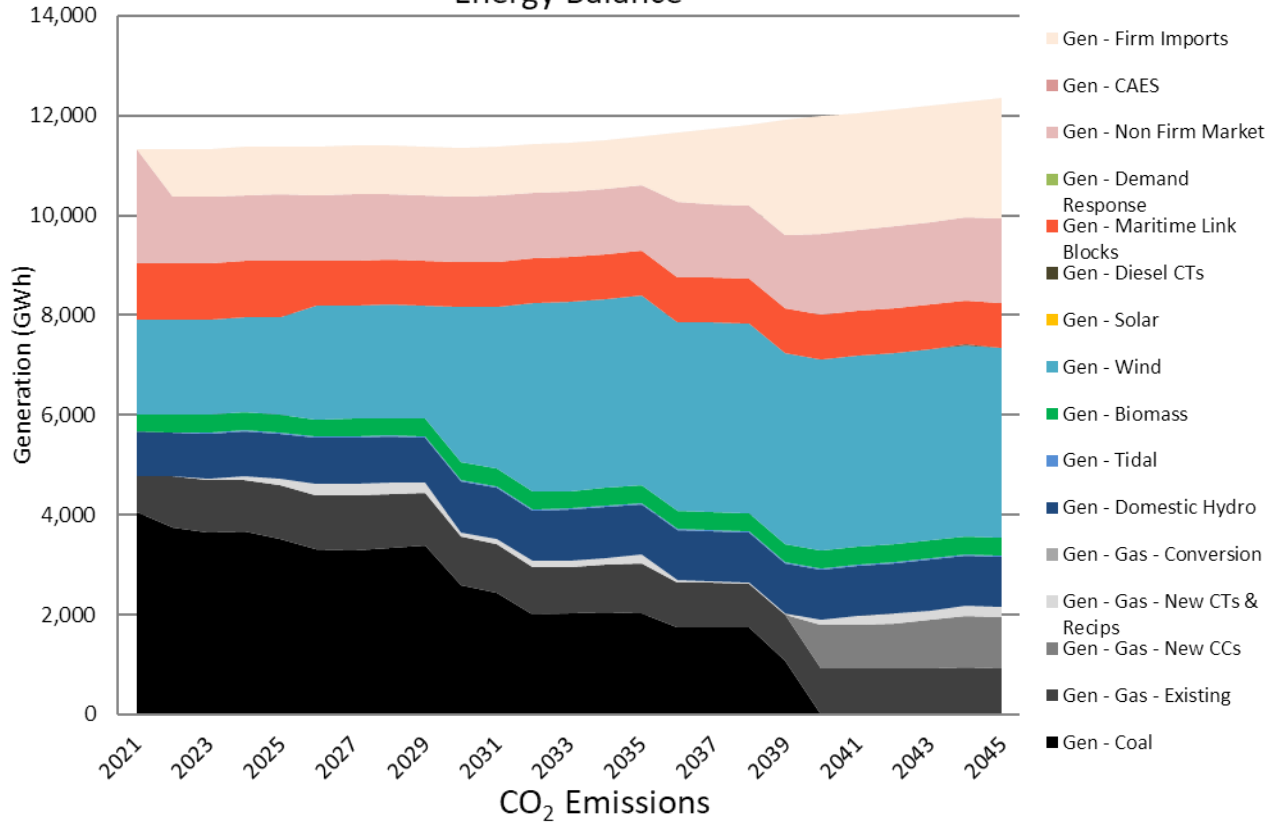
The following metrics are being used to evaluate each portfolio studied; updates from the Scenarios and Modeling Plan release based on ongoing work and stakeholder feedback are shown in **purple text**.

Metric	Description
Minimization of the cumulative present value of the annual revenue requirements over the planning horizon (with and without end-effects adjustment)	25 year NPV Revenue Requirement Average Annual Partial Rate Impact - 25-yr
Magnitude and timing of electricity rate effects	10 year NPV Revenue Requirement Average Annual Partial Rate Impact - 10-yr
Reliability requirements for supply adequacy	Evaluation of PRM, resource capacity adequacy, operating reserve requirements, etc.
Provision of essential grid services for system stability and reliability	Quantitative and qualitative assessment of the status of essential grid services provision for each portfolio. Many plans are similar in this respect, so only key differences will be noted at this time.
Plan robustness (the ability of a plan to withstand plausible potential changes to key assumptions)	Magnitude of the plan's exposure to changes in key assumptions (via sensitivity analysis) as well as resiliency to risks
Reduction of greenhouse gas and/or other emissions	Quantitative reductions as output by Plexos; total emissions over planning horizon.
Flexibility (limitation of constraints on future decisions arising from the selection of a particular path)	Qualitative assessment of timing of investments

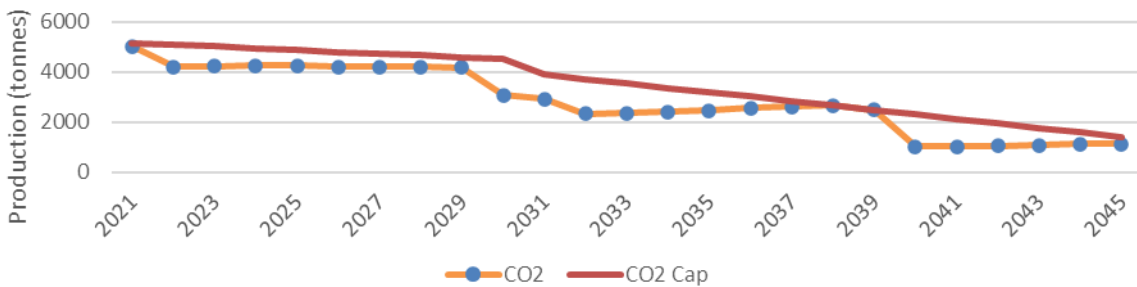
2.1C

MID ELEC. / BASE DSM / NET ZERO 2050 / REGIONAL INTEGRATION

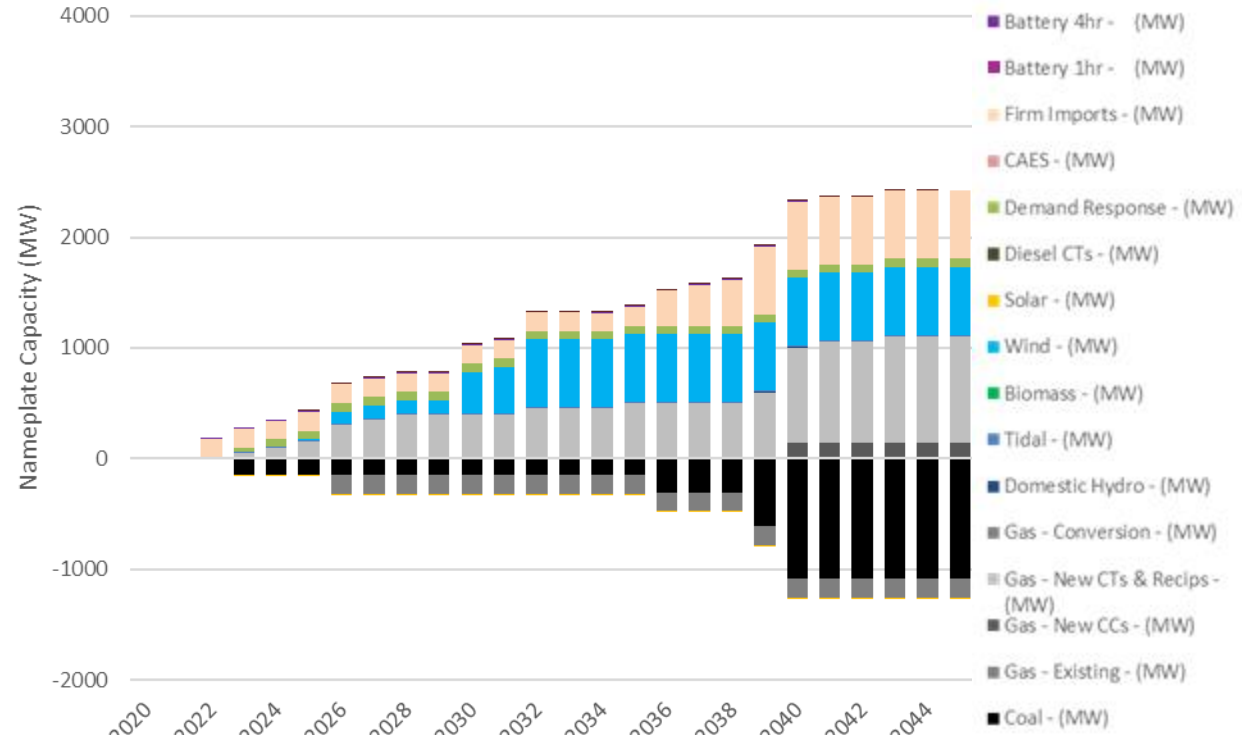
Energy Balance



CO₂ Emissions



New Installed Capacity



UCAP Planning Reserve Margin



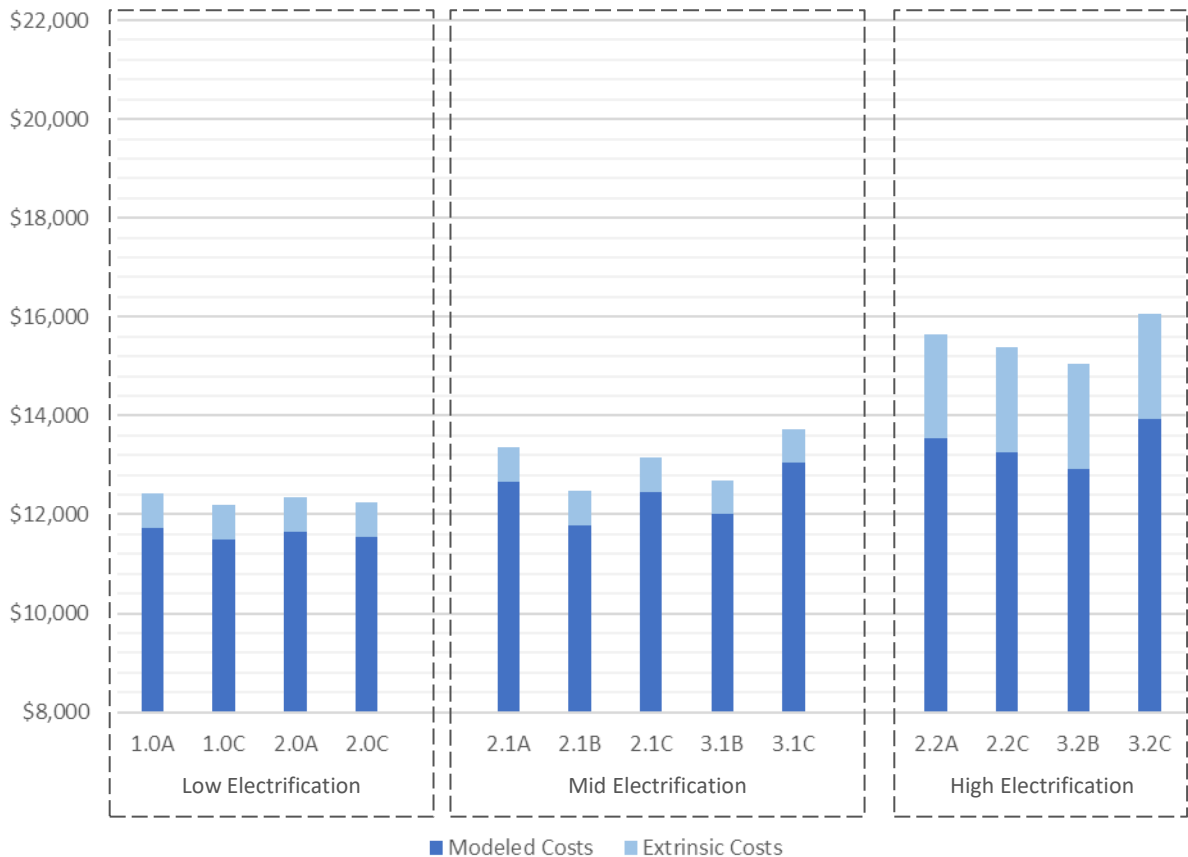
2.1C

MID ELEC. / BASE DSM / NET ZERO 2050 / REGIONAL INTEGRATION

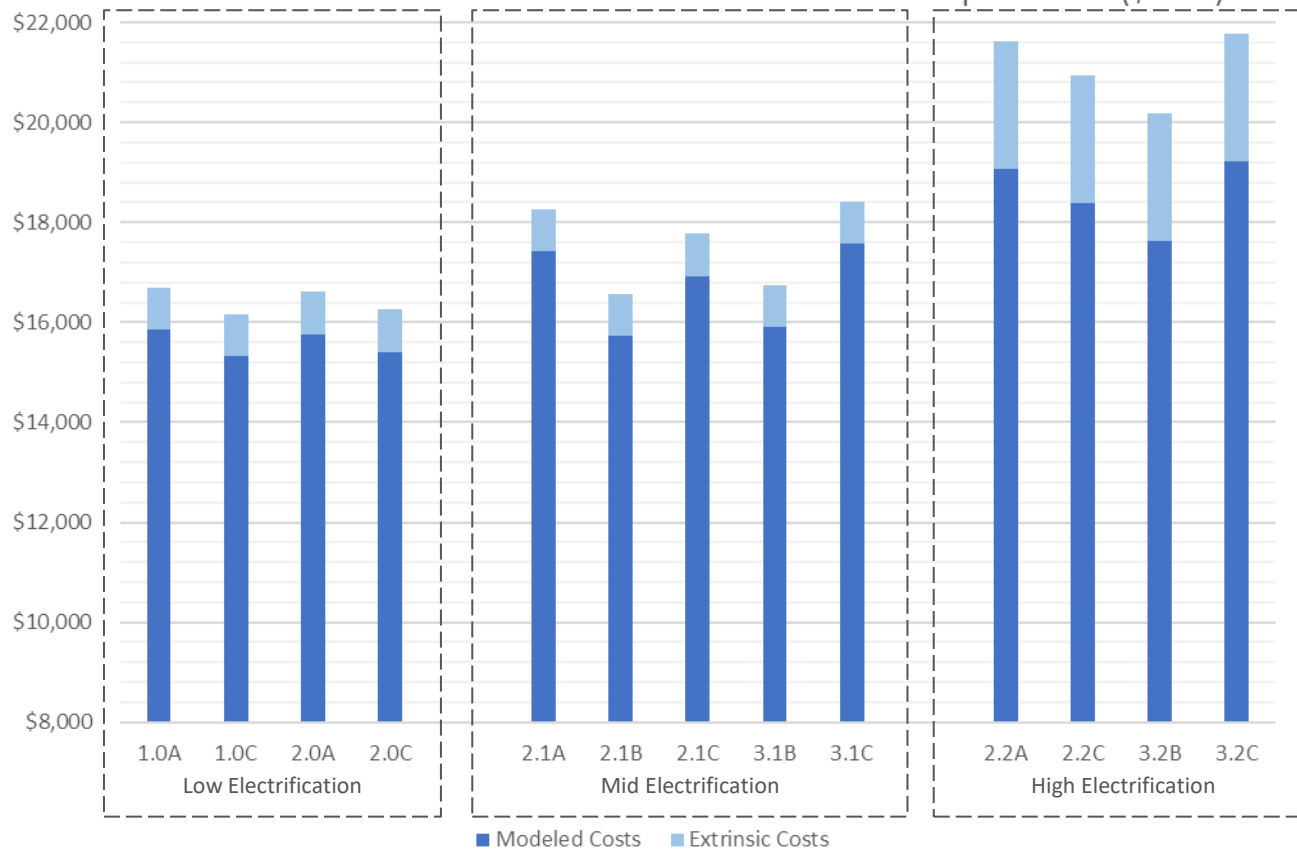
Scenario Metrics & Evaluation		
25-yr NPVRR (\$MM)	\$13,141	<u>General Notes</u> <ul style="list-style-type: none"> Reliability Tie built in 2031 (earlier than previous runs) enables wind integration 1 coal unit retired economically in 2020s 1 less combined cycle unit in 2040 than seen in previous runs
25-yr NPVRR with End Effects (\$MM)	\$17,767	
10-yr NPVRR (\$MM)	\$7,067	
Average Annual Partial Rate Impact		<u>Essential Grid Services</u> <ul style="list-style-type: none"> Essential Grid Service requirements are met as modeled
2021-2030 (%)	0.6%	
2021-2045 (%)	0.7%	<u>Resource Adequacy & PRM</u> <ul style="list-style-type: none"> Reliability Tie: 2030 Regional Integration: 2036
Total CO ₂ Emissions 2021-2030 (MT)	41.8	
Total CO ₂ Emissions 2031-2045 (MT)	29.1	<u>Plan Robustness & Flexibility</u> <ul style="list-style-type: none"> Regional Integration provides flexible ability to meet emissions constraints
Total CO ₂ Emissions 2021-2045 (MT)	70.9	

NPV PARTIAL REVENUE REQUIREMENT COMPARISON

25 Year NPV Partial Revenue Requirement (\$MM)

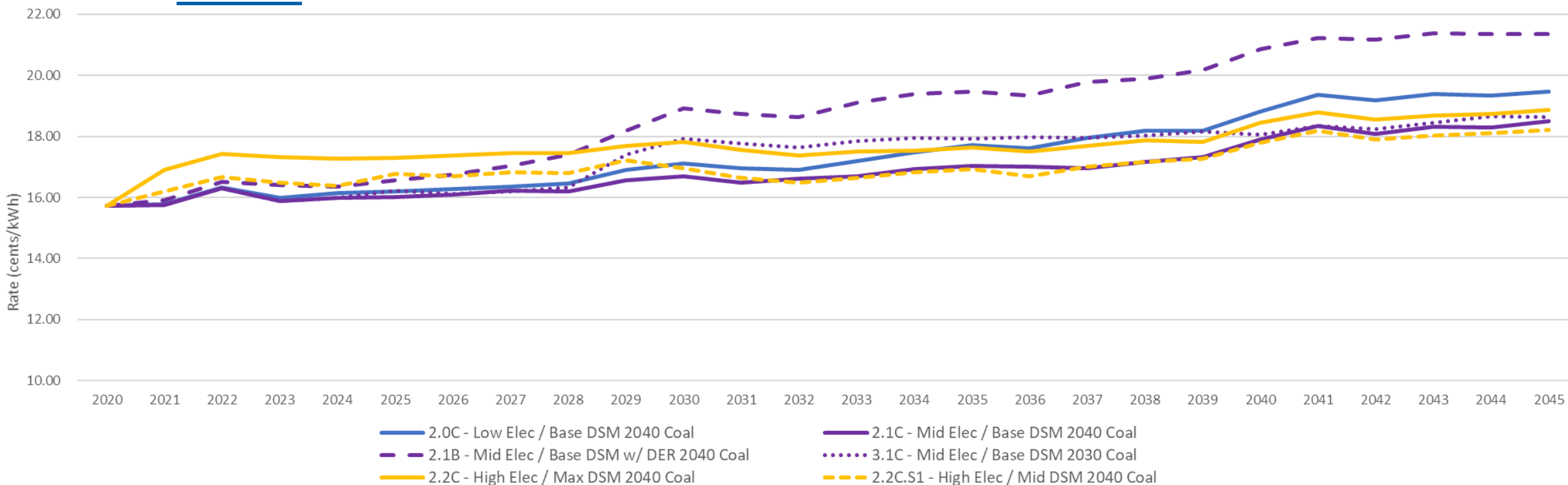


25 Year NPV with End Effects Partial Revenue Requirement (\$MM)



Due to differences in forecast system load affecting production costs, resource plan partial revenue requirement results should not be compared across electrification scenarios

RELATIVE RATE IMPACT COMPARISON



This analysis approximates the resource plan impact to customer rates over time, incorporating the effects of load changes due to Electrification and Resource Strategy.

- Higher levels of electrification, when paired with appropriate DSM investments, leads to lower rates for customers over time
- Conversely, significant penetration of DER (Distributed Energy Resources, e.g. rooftop solar) will lead to increased rate pressure
 - Note that the cost of the DER installations modeled in this scenario is not included in the calculation shown here and would be incremental
- 2030 and 2040 coal closures will have similar rate impacts by 2045, but the 2030 closure date has added pressure during the 2030s without other mitigation

QUESTIONS & DISCUSSION

FINAL PORTFOLIO STUDY & METRICS

SENSITIVITY ANALYSIS OVERVIEW

In addition to the Final Portfolio Study, a series of model sensitivities has been studied to understand how model outputs will vary with adjustments to key input parameters of interest.

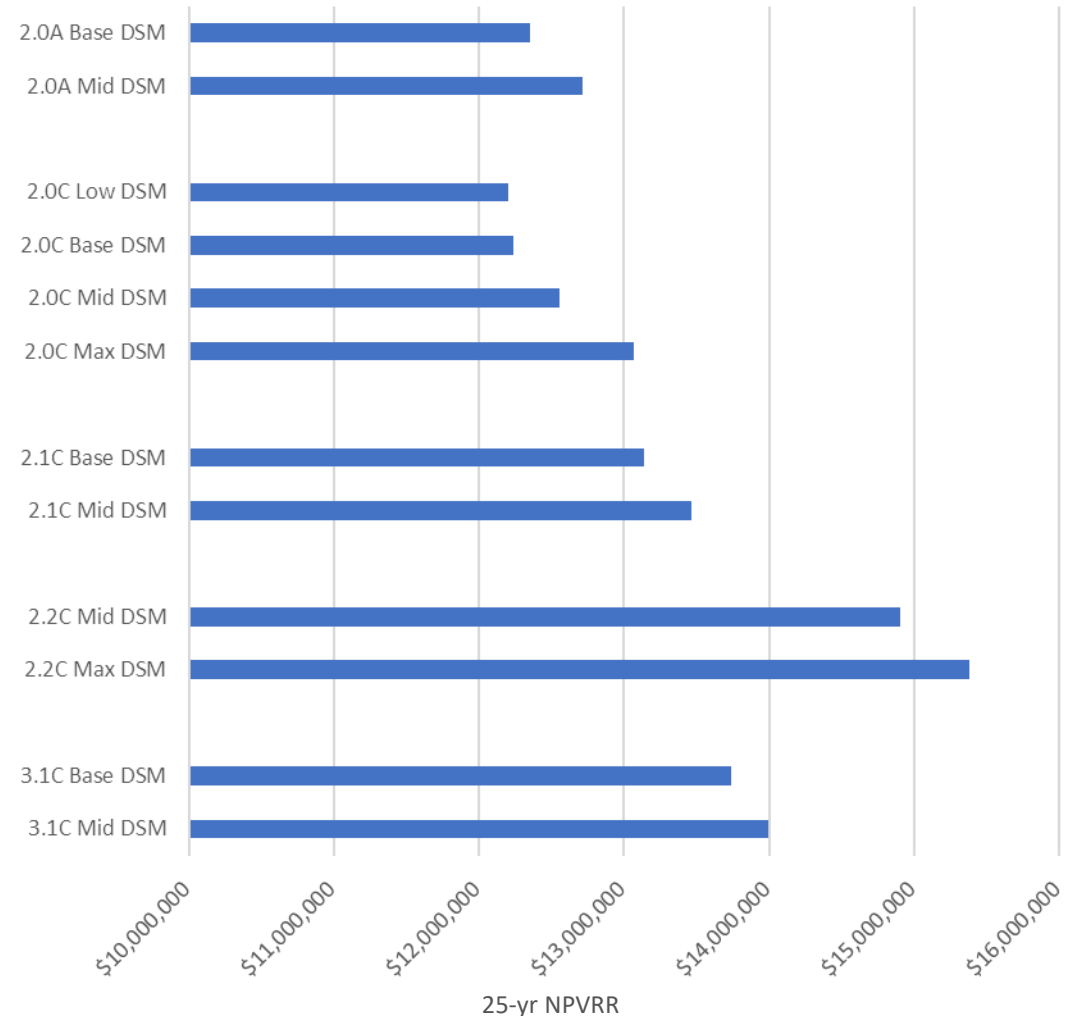
The IRP Modeling Results Release (2020-09-02) includes the full output of these sensitivity runs.

Sensitivities that are included in this results release are listed below:

2.0A.DSM-1	Low Electrification / Mid DSM
2.1C.DSM-2	Mid Electrification / Mid DSM
2.2C.DSM-3	High Electrification / Mid DSM
2.0C.DSM-4	Low Electrification / Low DSM
2.0C.DSM-5	Low Electrification / Mid DSM
2.0C.DSM-6	Low Electrification / Max DSM
3.1C.DSM-7	Mid Electrification / Mid DSM / 2030 Coal Retirement
2.1C.Wind-1	Low Wind Cost
2.1C.Wind-2	Low Wind + Low Battery Cost
2.1C.Wind-3	Low Inertia
2.1C.Wind-4	No Inertia / No Wind Integration Requirements
2.1C.Mersey	Mersey Hydro Retired
2.1C.Import-1	Limited Non-Firm Imports
2.0A.Import-2	Current Landscape case without Reliability Tie
2.1C.Import-3	Limited Reliability Tie Inertia (provides 50% of inertia requirement)

SENSITIVITY ANALYSIS – DSM LEVELS

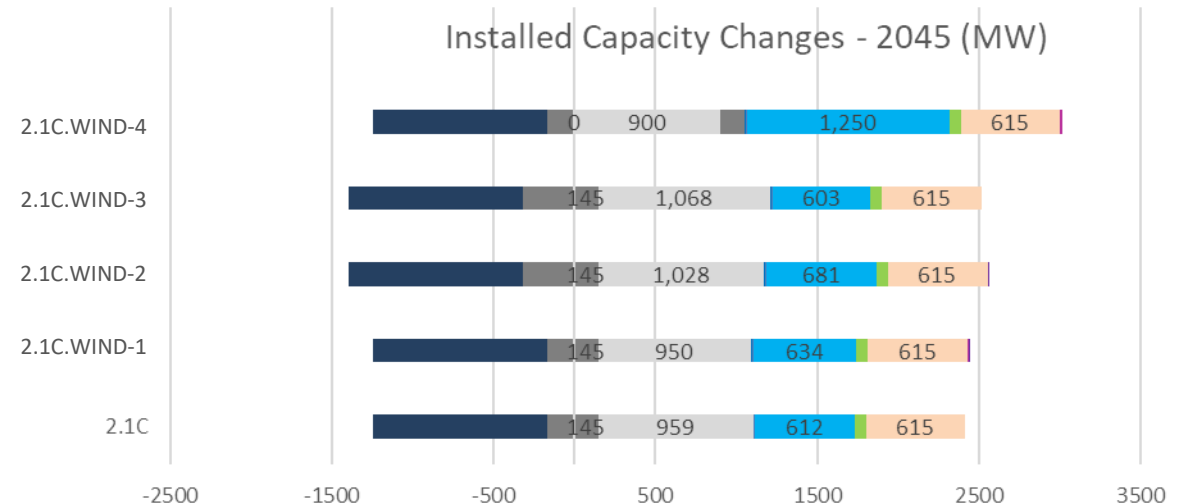
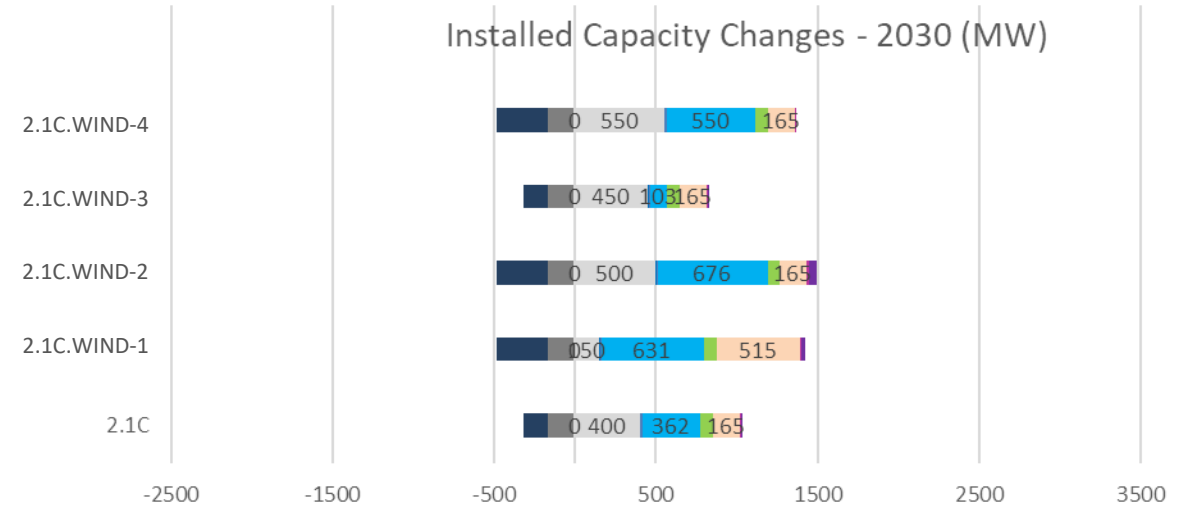
- 7 Sensitivities for DSM were completed, including runs selected in collaboration with E1, to evaluate combinations of DSM level and Electrification level
- Under **Low Electrification**, Base DSM and Low DSM are very close in cost while Mid DSM and Max DSM have higher NPVs
- Under **Mid Electrification**, Mid DSM has a higher NPV than Base DSM
- Under **High Electrification**, Mid DSM has a lower NPV than Max DSM
- Conclusions hold under 2030/2040 coal retirement and under Current Landscape and Regional Integration resource strategies



SENSITIVITY ANALYSIS – WIND ASSUMPTIONS

- 4 model sensitivities and test runs completed on wind pricing, system inertia constrain, and wind integration:
 - 2.1C.WIND-1 – Low Wind Price
 - 2.1C.WIND-2 – Low Wind & Battery Price
 - 2.1C.WIND-3 – Low Inertia Constraint
 - 2.1C.WIND-4 – No Inertia / No Integration*
- General model behaviour is that under lower wind and wind battery prices, the ultimate wind build out does not change but it does start earlier in the Planning Horizon (excluding 2.1C.WIND-4)
- Effect of reducing inertia constraint was limited
- Significant wind penetrations (beyond what was modeled in the PSC study) will require additional study work to confirm system stability
 - Identified in Draft IRP Action Plan

**This run is an assumption test case and is not considered an operable system configuration currently*



QUESTIONS & DISCUSSION

SENSITIVITY ANALYSIS



BREAK

DRAFT FINDINGS

IRP DRAFT FINDINGS - SUMMARY

1

Steeply **reducing carbon emissions** in line with Nova Scotia's Sustainable Development Goals Act will require significant efforts from each sector of the economy, **with the electricity sector playing a major role.**

2

Decarbonizing Nova Scotia Power's electricity supply will require investment in a **diverse portfolio of non- and low-emitting resources.**

3

Firm capacity resources will be a key requirement of the developing NS Power system in both the near and long term.

4

Similar resource plans are selected when considering both 2030 and 2040 coal unit retirement dates. The earlier retirement scenarios are higher cost on an NPV basis but have similar cumulative rate implications by 2045.

IRP DRAFT FINDINGS

NS Power reviewed slides 45-51 from Draft Findings release 2020-09-02

QUESTIONS & DISCUSSION

DRAFT FINDINGS

DRAFT ACTION PLAN

IRP DRAFT ACTION PLAN - SUMMARY

1

Develop a **Regional Integration Strategy** to provide access to firm capacity and low carbon energy, increase the reliability of Nova Scotia's interconnection with North America, and enable economic coal unit retirements.

2

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.

3

Initiate a **Thermal Plant Retirement, Redevelopment and Replacement Plan**

4

Create a **Demand Response Strategy** with a target capacity of 75MW, for deployment by 2025.

IRP DRAFT ACTION PLAN

NS Power reviewed slides 53-57 from Draft Findings release 2020-09-02

QUESTIONS & DISCUSSION

DRAFT ACTION PLAN

DRAFT ROADMAP

IRP DRAFT ROADMAP

NS Power reviewed slides 59-61 from Draft Findings release 2020-09-02

QUESTIONS & DISCUSSION

DRAFT ROADMAP

NEXT STEPS

- Stakeholder Comments on Draft Findings are invited (requested by Sept. 18– next Friday)
- Draft IRP Report Circulated – Sept. 29

QUESTIONS & DISCUSSION

GENERAL

A night sky filled with stars, with a silhouette of a power line tower and its cables in the foreground. The cables form a V-shape pointing towards the top of the frame. The sky transitions from a dark blue at the top to a lighter blue near the horizon.

THANK YOU