2020 IRP
INTERIM MODELING PROGRESS WORKSHOP

APRIL 28, 2020

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AGENDA

- **INTRODUCTIONS & SAFETY MOMENT**
- **PROCESS UPDATE & WORK COMPLETED**
- **KEY ASSUMPTIONS & POLICY DRIVERS**
  - Environmental
  - Electrification & Load Growth
  - Resource Strategies
- **KEY MODELING SCENARIOS**
- **MODELING PLAN & STATUS UPDATE**
  - Resource Screening Update
  - Initial Portfolio Study Update & Results Preview
- **T&D AVOIDED COSTS METHODOLOGY UPDATE**
- **NEXT STEPS**

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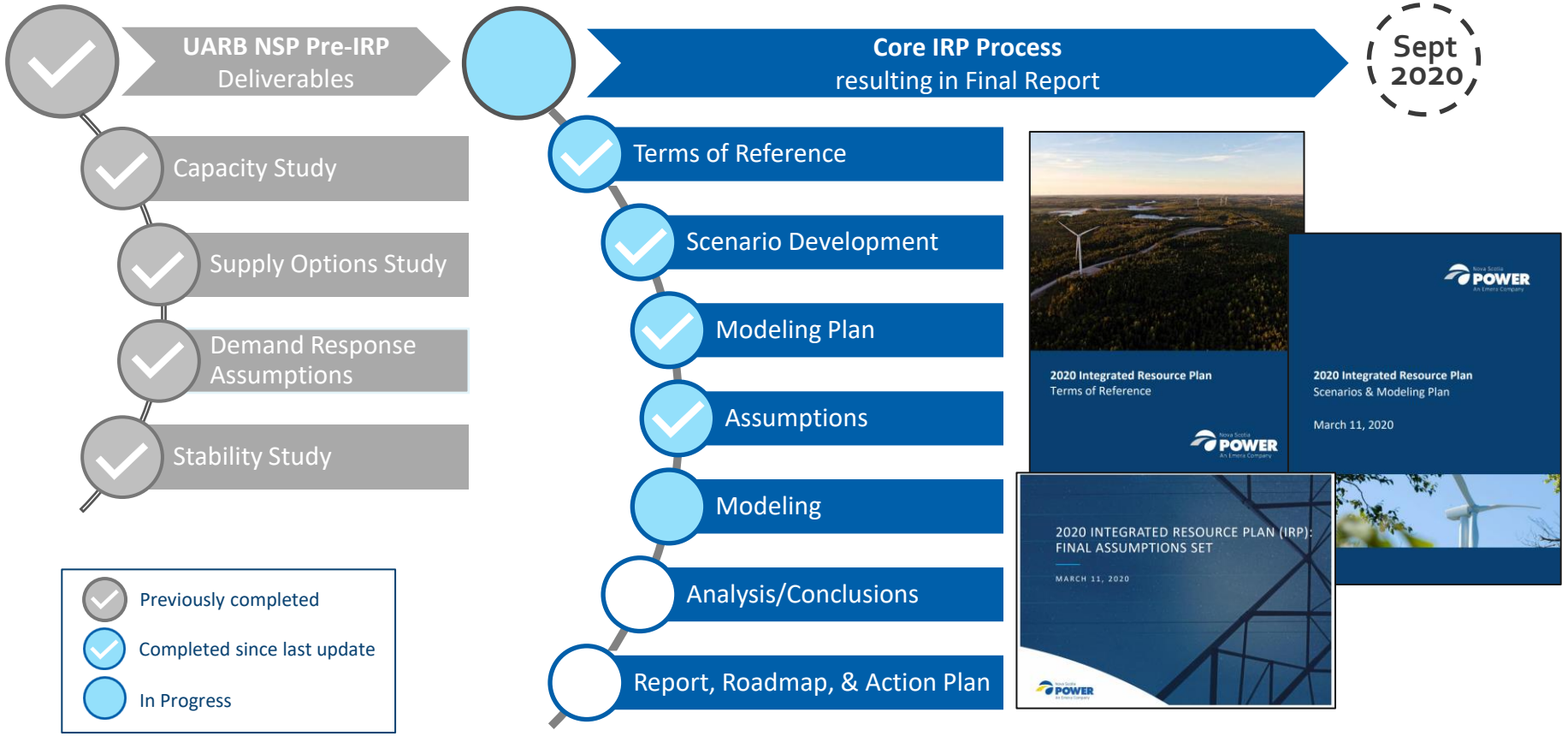
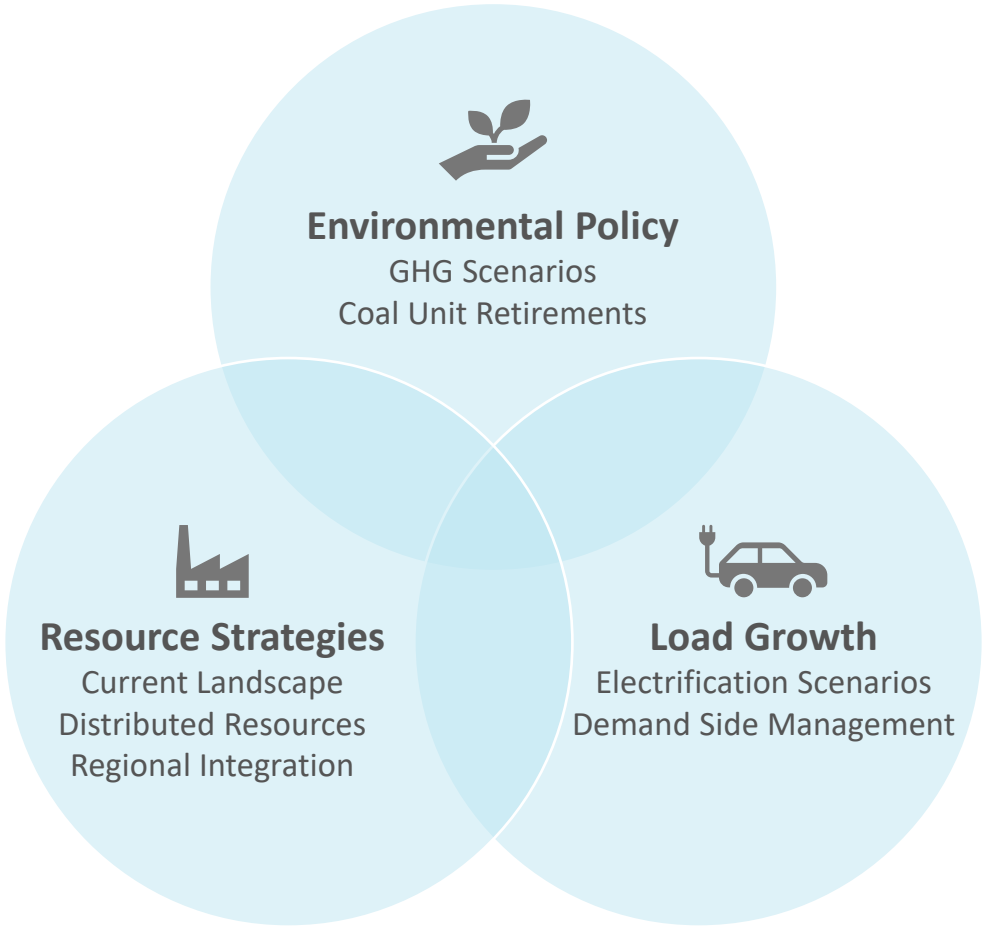
PROCESS UPDATE & WORK COMPLETED

- Recap: Since the Summer/Fall of 2019, NSP has finalized the Terms of Reference, Scenarios & Modeling Plan, and Assumptions and has begun modeling work
- Stakeholder consultation and engagement continues to be a priority for the IRP team



KEY ASSUMPTIONS & POLICY DRIVERS



- NS Power has developed assumptions for all major inputs to the IRP model:
  - Financial
  - Load
  - Demand Side Management
  - Supply Options
  - Distributed Energy Resources
  - Planning Reserve Margin
  - Environmental
  - Demand Response
  - Imports & Transmission
  - Fuel Pricing
  - Sustaining Capital
  - Renewable Integration
- The comprehensive assumption set will allow the IRP to analyze the sensitivity of the resource plans to changes in assumptions, and build a series of key insights and signposts to monitor
- Stakeholder input incorporated into the development of the assumptions, scenarios, and modeling plan
- Written responses to over 160 individual questions and comments on these topics

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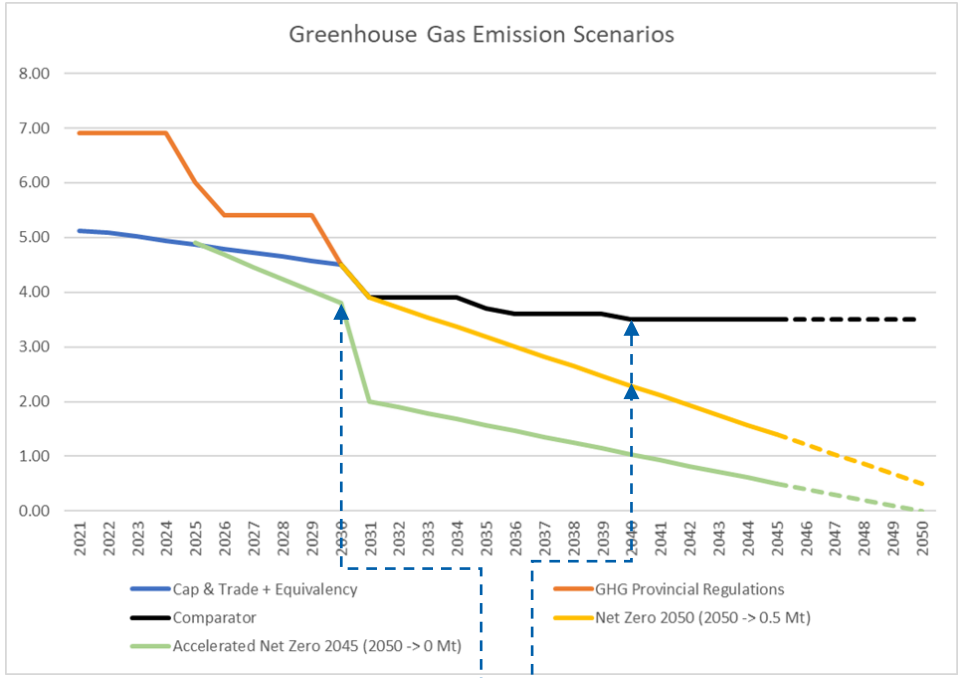
ENVIRONMENTAL ASSUMPTIONS



Coal Generation retired by 2030

Coal Generation retired by 2040

- NS Power has developed three Greenhouse Gas scenarios which reflect potential future federal and provincial carbon policies
- The *Net Zero 2050* and *Accelerated Net Zero 2045* scenarios are both SDGA* compliant and represent different possible rates of decarbonization of the electricity sector
- Each scenario incorporates mandatory coal unit retirements by no later than 2030 or 2040; earlier retirement is possible if economic

**Sustainable Development Goals Act (Nova Scotia)*

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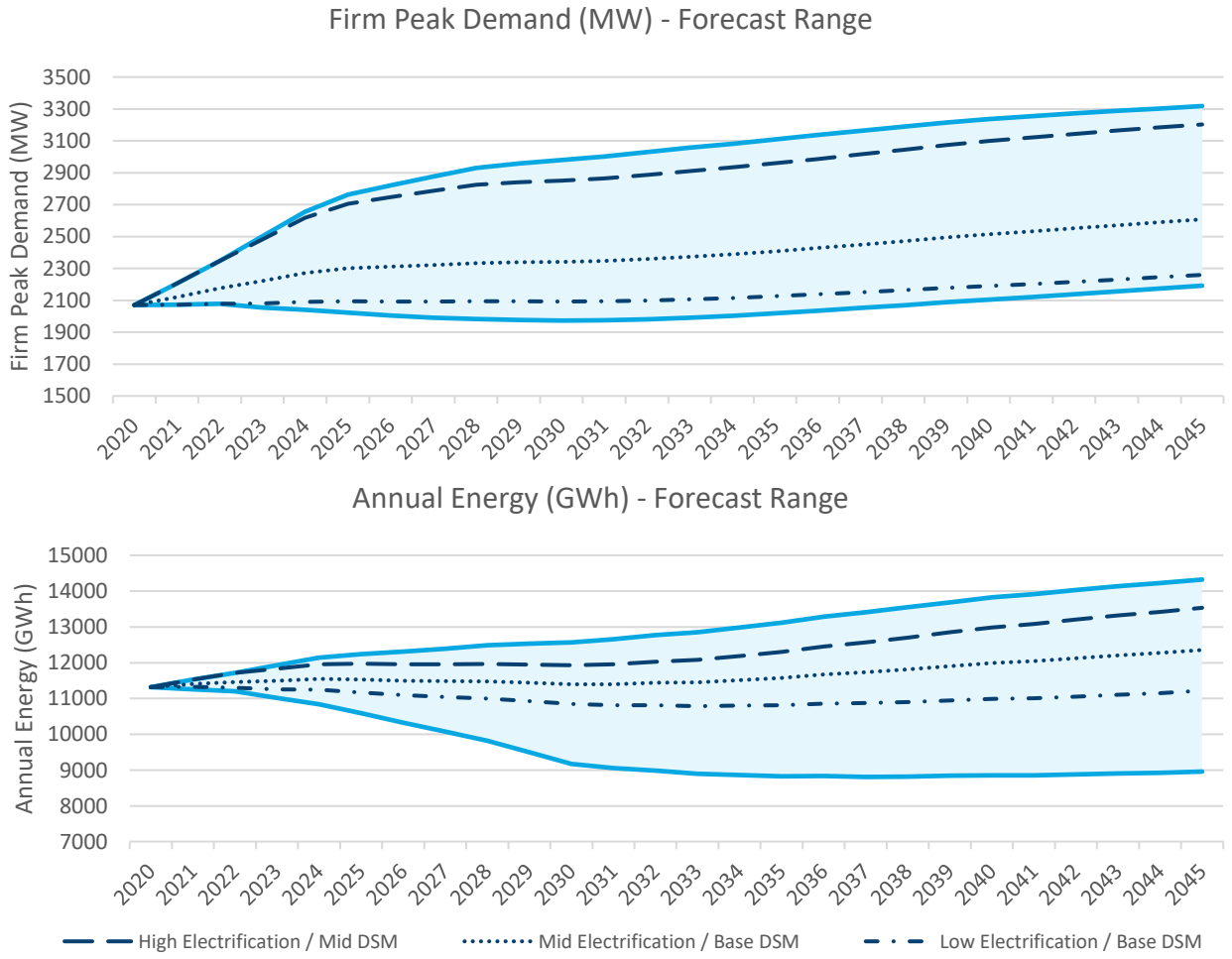
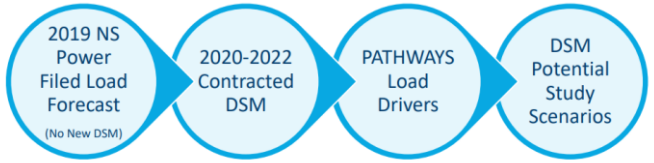
ELECTRIFICATION & LOAD GROWTH



- A key driver for the IRP is the interplay of de-carbonization and electrification in the Nova Scotia economy
- NS Power has developed a series of IRP load forecasts by combining four components:



- The E3 PATHWAYS study produced various electrification scenarios based on decarbonization of building and transportation energy use
- EfficiencyOne produced a series of DSM* scenarios via their 2019 DSM Potential Study
- The various combinations of these inputs produce the wide range of outcomes of Firm Peak Demand (MW) and Annual Energy (GWh) by the end of the IRP planning horizon:
  - Annual Energy: 9,000 – 14,300 GWh
  - Firm Peak Demand: 2,200 – 3,300 MW

**Demand Side Management*

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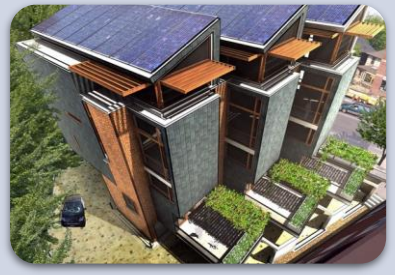
RESOURCE STRATEGIES

- Three resource strategies will be modeled to ensure the IRP examines a broad range of supply and demand side options; this will enable analyses of the value and cost deltas inherent in each of these approaches including sensitivities and interplay among the strategies

Current Landscape

Serve customer load and meet environmental requirements via in-province supply and demand resources



Distributed Resources

Promote the uptake of Distributed Energy Resources (e.g. rooftop solar)

Regional Integration

New Transmission Interconnections enable access to energy and firm capacity resources outside of Nova Scotia

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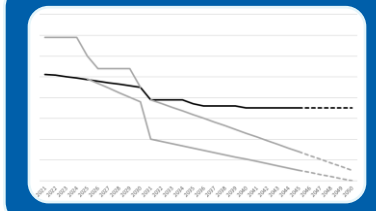
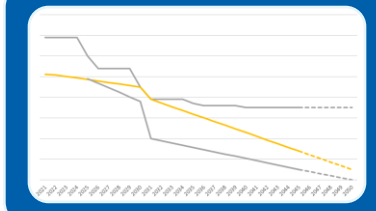
KEY MODELING SCENARIOS

- NS Power has identified key combinations of assumptions, policy drivers, and resource strategies to examine
- The first runs from these key scenarios are being run now as part of the Initial Portfolio Study



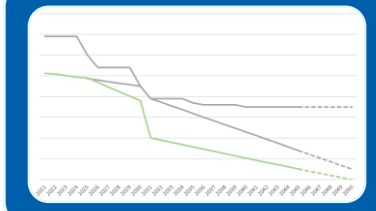
Comparator

- Not SDGA* compliant; Federal equivalency maintained & minimal CO_2 reductions post-2030
- Provides a basis for comparison of CO_2 policy options & enables model validation against previous studies (e.g. 2018 Generation Utilization & Optimization)



Net Zero 2050

- SDGA compliant; will test key combinations of electrification and DSM scenarios against all three resource strategies
- Base case for sensitivity analysis in the IRP (e.g. fuel prices, capital costs, etc.)



Accelerated Net Zero 2045

- SDGA compliant; allows testing of more aggressive assumptions for GHG reductions and coal generation retirements; potential for absolute zero CO_2 emissions by 2050
- Represents feedback from several stakeholder groups

Sustainable Development Goals Act (Nova Scotia)

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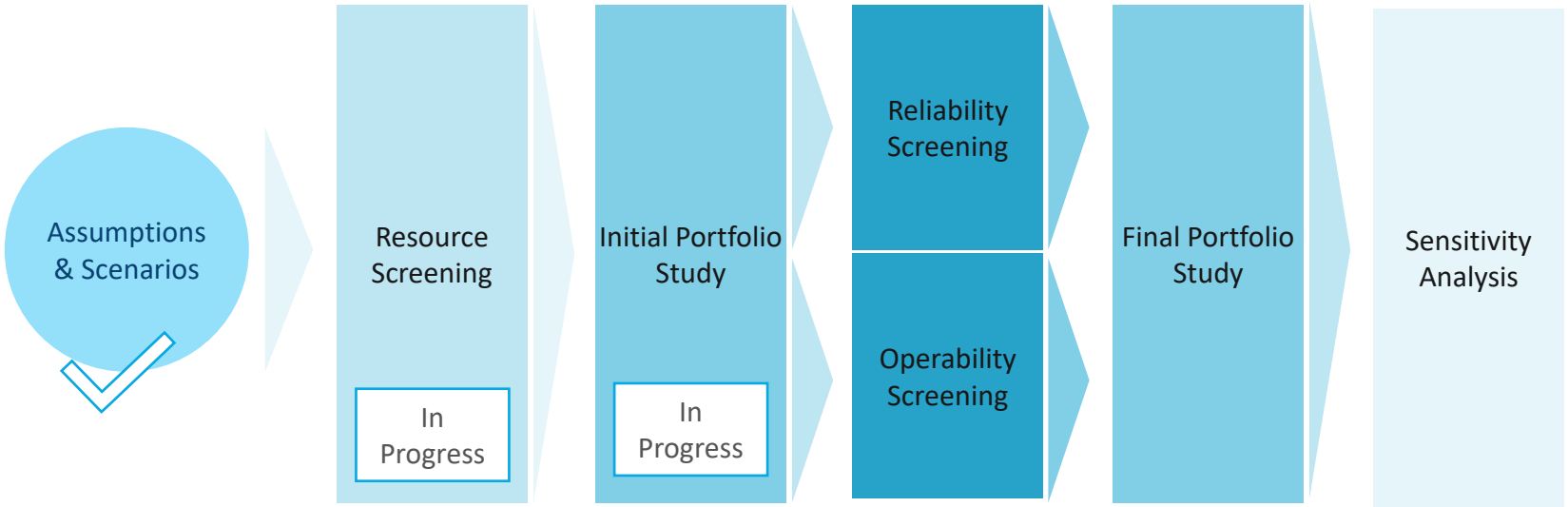
KEY MODELING SCENARIOS

Scenario	Features	Load Drivers	Coal Retires	Resource Strategies Tested	Key Sensitivities
1.0 **Comparator**	Equivalency GHG	Low Elec. Base DSM	2040	A - Current Landscape	
2.0 **Net Zero 2050** **Low Electrification**	GHG targets decline linearly from 2030 to 0.5Mt in 2050	Low Elec. Base DSM	2040	A - Current Landscape C - Regional Integration	• DSM Levels
2.1 **Net Zero 2050** **Mid Electrification**	GHG targets decline linearly from 2030 to 0.5Mt in 2050	Mid Elec. Base DSM	2040	A - Current Landscape B - Distributed Resources C - Regional Integration	• DSM Levels • No New Emitting • Target Case for Sensitivity Evaluation
2.2 **Net Zero 2050** **High Electrification**	GHG targets decline linearly from 2030 to 0.5Mt in 2050	High Elec. Max DSM	2040	A - Current Landscape C - Regional Integration	• DSM Levels • No New Emitting
3.1 **Accelerated Net Zero 2045 Mid Electrification**	GHG targets decline from 2025 to 0.5Mt in 2045; path to Absolute Zero 2050	Mid Elec. Base DSM	2030	B - Distributed Resources C - Regional Integration	• DSM Levels • No New Emitting • Target Case for Sensitivity Evaluation
3.2 **Accelerated Net Zero 2045 High Electrification**	GHG targets decline from 2025 to 0.5Mt in 2045; path to Absolute Zero 2050	High Elec. Max DSM	2030	B - Distributed Resources C - Regional Integration	• DSM Levels

IRP MODELING PLAN

MODELING



POST-MODELING

Extract findings (observations and conclusions) in order to develop:

- Long-term Strategy
- Roadmap
- Near-term Action Plan

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MODEL STATUS UPDATES

WORK COMPLETED TO DATE

- Final Assumptions have been entered into both RESOLVE and PLEXOS models
- Significant volume of test runs undertaking to confirm model functionality and optimize execution parameters
- Comparison of results between PLEXOS and RESOLVE has enabled detailed testing of both models – benefit of our parallel approach
- Focus of initial modeling has been on two key scenarios:
  - 1.0A Comparator – Current Landscape
  - 2.1C Net Zero 2050 – Regional Integration

INITIAL MODELING NOTES

- The quality of the PLEXOS LT model is sensitive to execution time; we are factoring this into our modeling plan
- Initial Portfolio Study runs (PLEXOS) and Resource Screening runs (RESOLVE) are now in progress

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RESOURCE SCREENING UPDATE

The Resource Screening phase is designed to support key assumptions in the Initial Portfolio Study by testing key model assumptions.

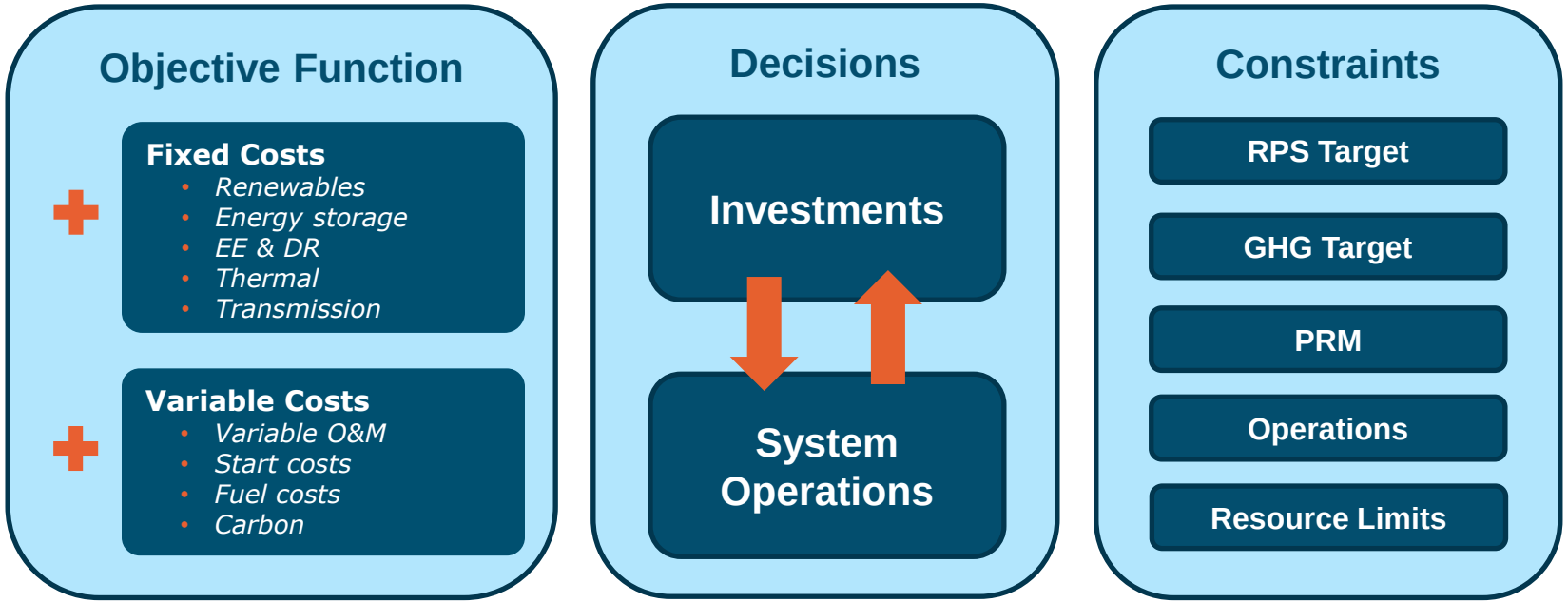
- Using E3's RESOLVE model allows a sets of runs to be executed quickly due to the faster execution time of the model
- The methodology for screening is to do an "in-and-out" analysis of the resource being tested, and then to compare NPV RR across key scenarios
- Resources that screen "in" can be fixed in the PLEXOS model for the Initial Portfolio Study; this reduces the number of variables and improves execution time and solution quality for those runs

As part of the IRP, NS Power is undertaking 3 screening analyses:

- Diesel CT Screening
- Hydro Screening
- Carbon Price Screening

RESOLVE MODEL STRUCTURE

- **RESOLVE co-optimizes investments and operations to minimize total NPV of electric system cost**
  - Investments and operations optimized in a single stage
  - Single-stage optimization directly captures linkages between investment decisions and system operations
  - Relies on hourly dispatch for a subset of representative days, with a parameterization of sub-hourly impacts



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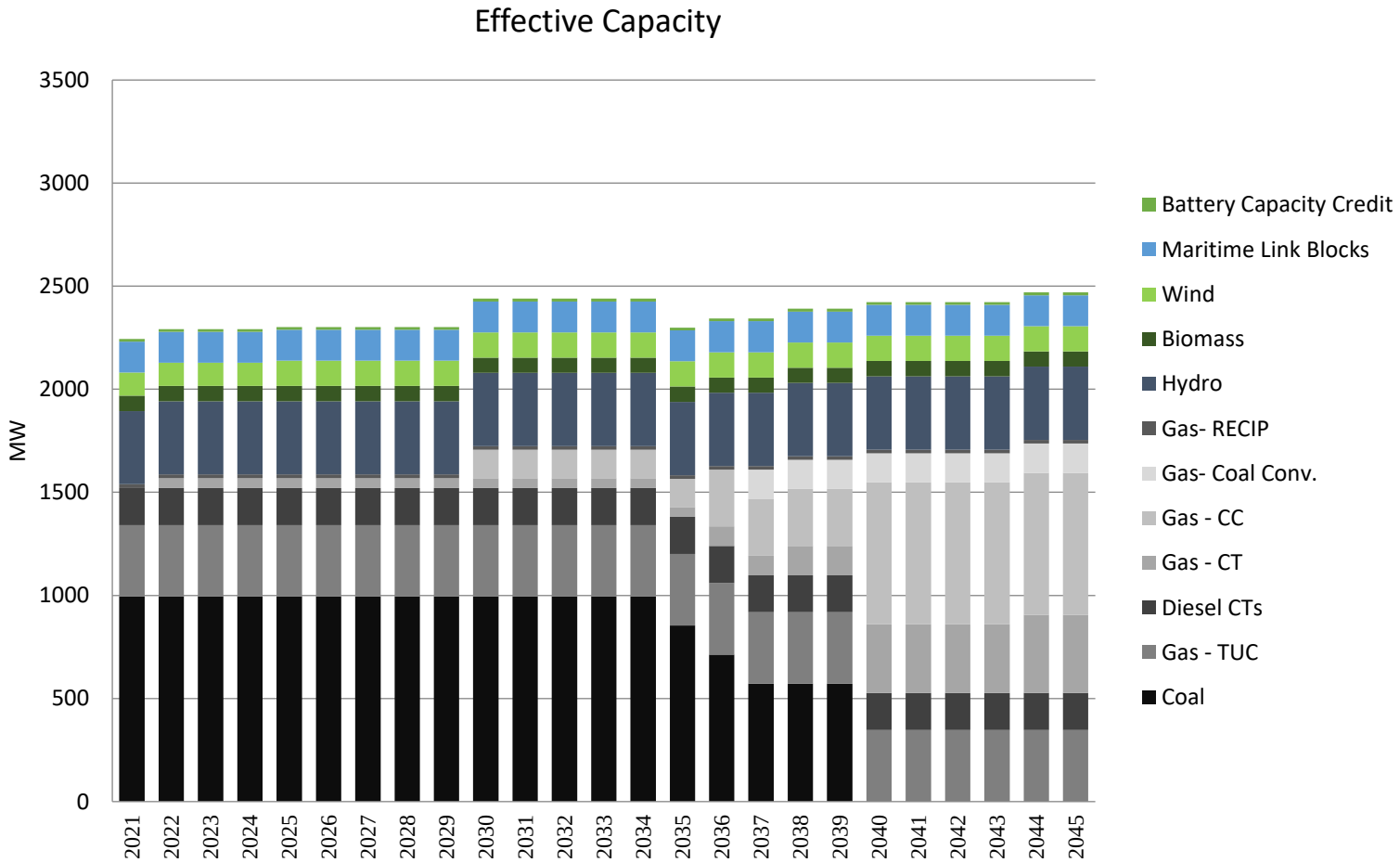
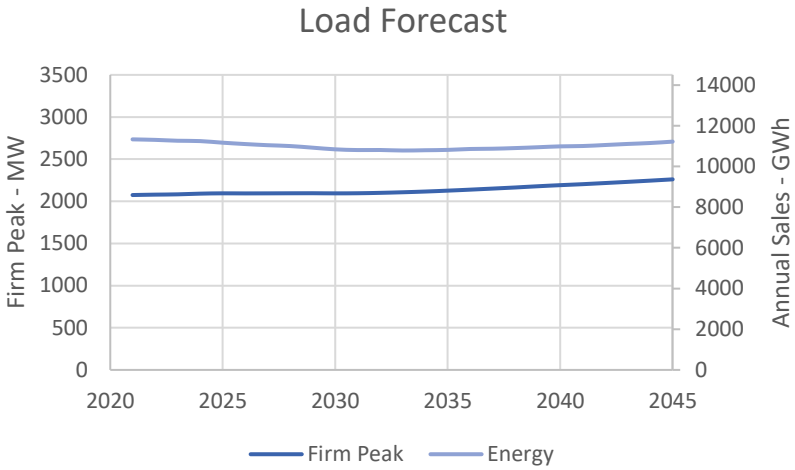
INITIAL PORTFOLIO STUDY UPDATE

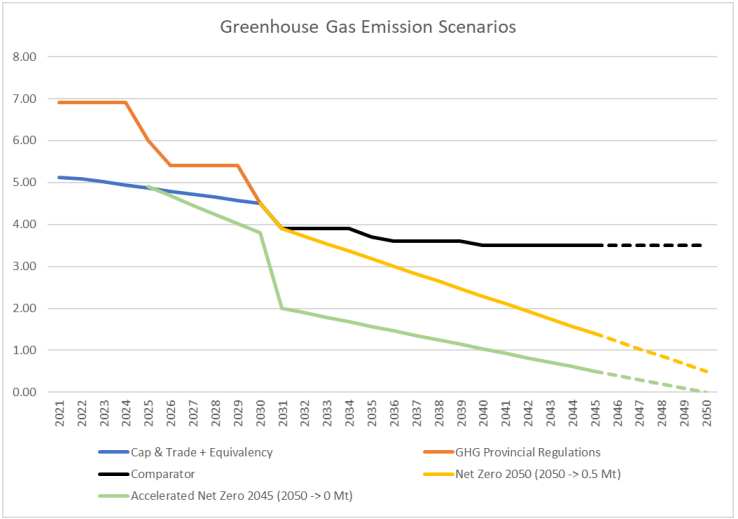
- Initial Portfolio Study runs are currently underway
- To begin, focus has been on the 1.0A Comparator – Current Landscape scenario

- The results on the following slides are preliminary and intended to provide a view of the modeling work completed to date to IRP participants
  - They are not considered final and are subject to be updated through the remainder of the IRP modeling phase

PRELIMINARY RESULTS PREVIEW: 1.0A COMPARATOR (CURRENT LANDSCAPE)







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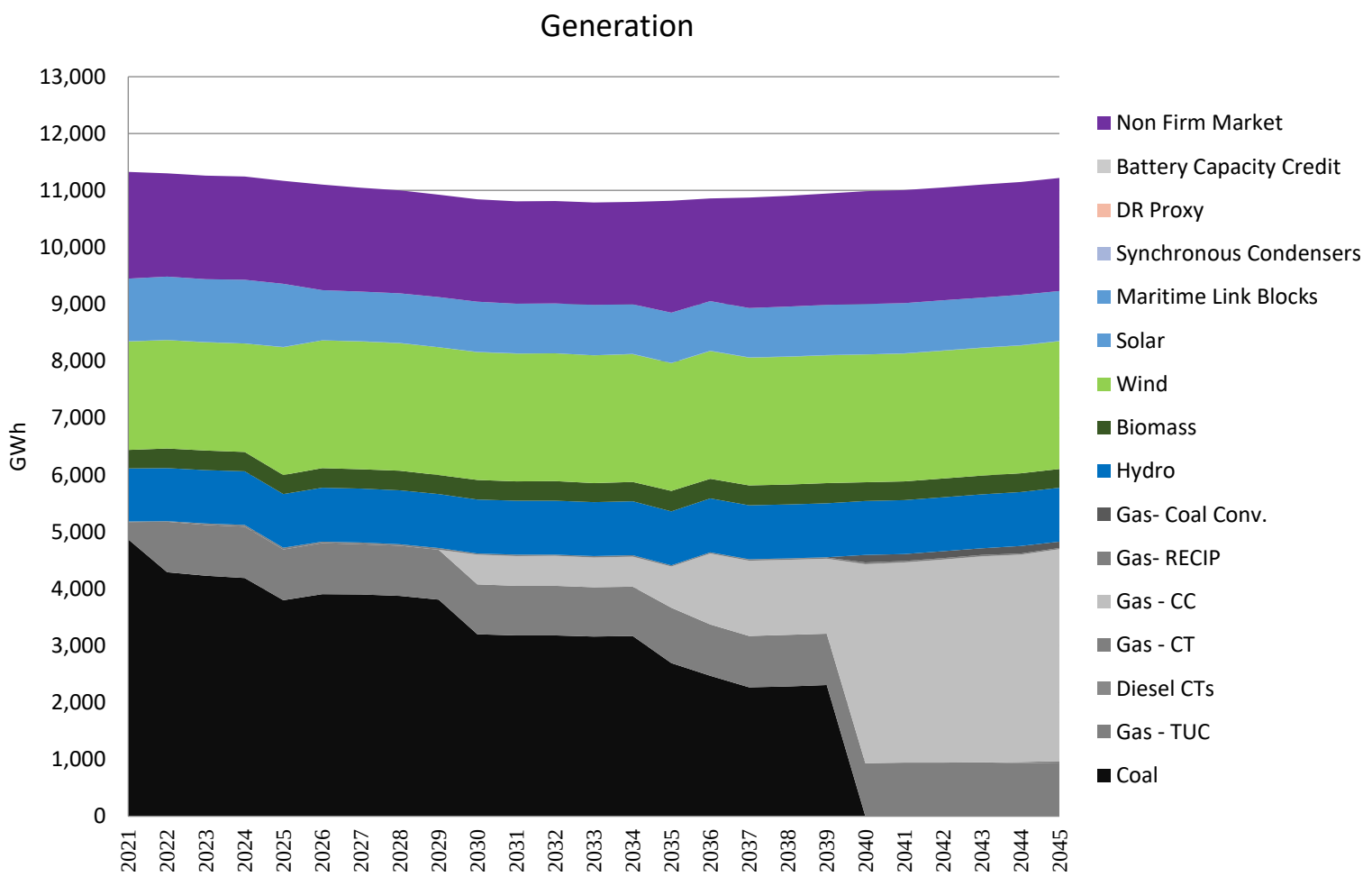
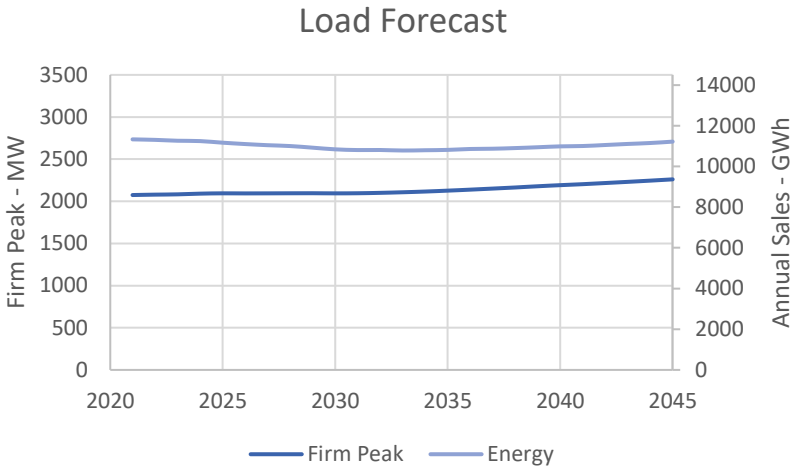
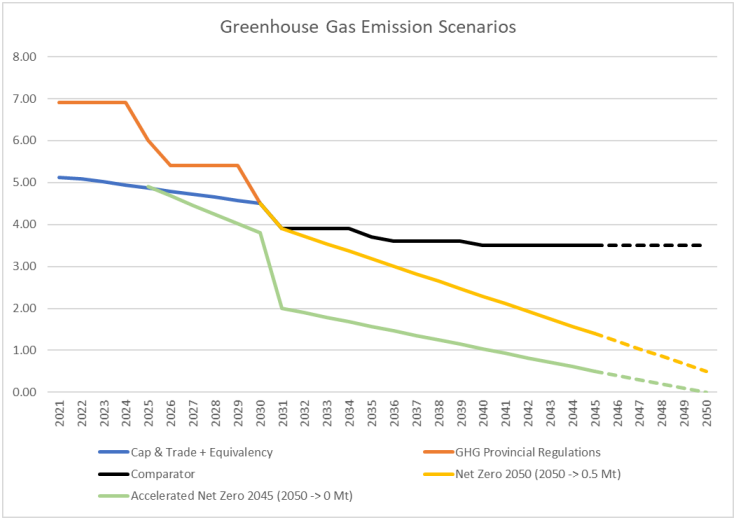
PRELIMINARY RESULTS PREVIEW: 1.0A COMPARATOR (CURRENT LANDSCAPE)







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T&D AVOIDED COST METHODOLOGY UPDATE

NS Power's T&D Avoided Cost methodology will be reviewed during the 2020 IRP Process

BACKGROUND

- NS Power has calculated and provided Avoided T&D Costs as part of DSM Rate and Bill Impact Analysis (RBIA) processes since 2015. In order to develop Avoided T&D Costs, the Annual Capital Expenditure (ACE) Plans from 2007 onward were used as the primary data source
  - Each ACE Plan was reviewed to break out the T&D capital investments by category (load growth, non-load growth, etc.)
  - Load growth investments were deemed to include any investment that enables additional load to be served by the transmission or distribution system (i.e. line rebuilds, feeder reconfigurations, reconductoring projects)
  - These investments provide additional T&D system capacity, often due to new construction standards and equipment capabilities, whether or not that incremental capacity is currently required based on the load forecast for that system
  - The costs of projects determined to be load growth-related (including carry-over) were then summed and used to create a ratio for total spend; this ratio was then applied to forecast future projected ACE Plan investments to calculate a forecast of future load growth-related investment on an annual basis going forward
  - This value was divided by the anticipated generation load forecast (firm peak) and the weighted investment/firm peak was then averaged to determine the values used in the RBIA calculations

T&D AVOIDED COST METHODOLOGY UPDATE

CONSIDERATIONS

- There is no universally accepted methodology for calculating Avoided T&D Costs

- A methodology which examines capital investments justified based on identified or forecast load growth (rather than capacity growth) could be appropriate when paired with forecast incremental firm peak load growth
- A new approach should also consider non-linear nature of T&D investments and fluctuations in load in a given year by considering averages over time
  - NS Power proposes to consider transmission-related investments against system-wide load growth
  - Where possible, NS Power proposes to consider distribution-related investments against local (i.e. substation level) load growth where the data is available and useable.
- It may be more accurate to consider the savings achieved via potential project deferrals, rather than avoided project costs, as the identified T&D investments will likely still be required at some point in the future
  - If Demand Side Management or other technologies can defer such investments forward to future years and achieve a net present value savings, value is achieved for NS Power customers

NEXT STEPS

- Further discussion will occur in parallel with IRP timeline, with the revision concluded by Sept. 15, 2020

NEXT STEPS

UPCOMING TERMS OF REFERENCE MILESTONES

• Modeling Results circulated	June 5	*(workshop and stakeholder feedback cycle follows)*
• Draft Findings, Roadmap & Action Plan circulated	July 9	*(workshop and stakeholder feedback cycle follows)*
• Draft IRP Report circulated for comment	August 20	
• Final IRP Report filed	September 30	

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