# PRE-IRP DELIVERABLES STAKEHOLDER DISCUSSION

AUGUST 7, 2019

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# TODAY'S AGENDA

1. Introduction to Pre-IRP Deliverables

2. Overview & Discussion of each Deliverable:

    I. **CAPACITY STUDY**
    II. **SUPPLY OPTIONS STUDY**
    III. **RENEWABLES STABILITY STUDY**
    IV. **DR PROGRAM ASSUMPTIONS DEVELOPMENT**

3. Discuss Next Steps

# INTRODUCTION TO PRE-IRP DELIVERABLES

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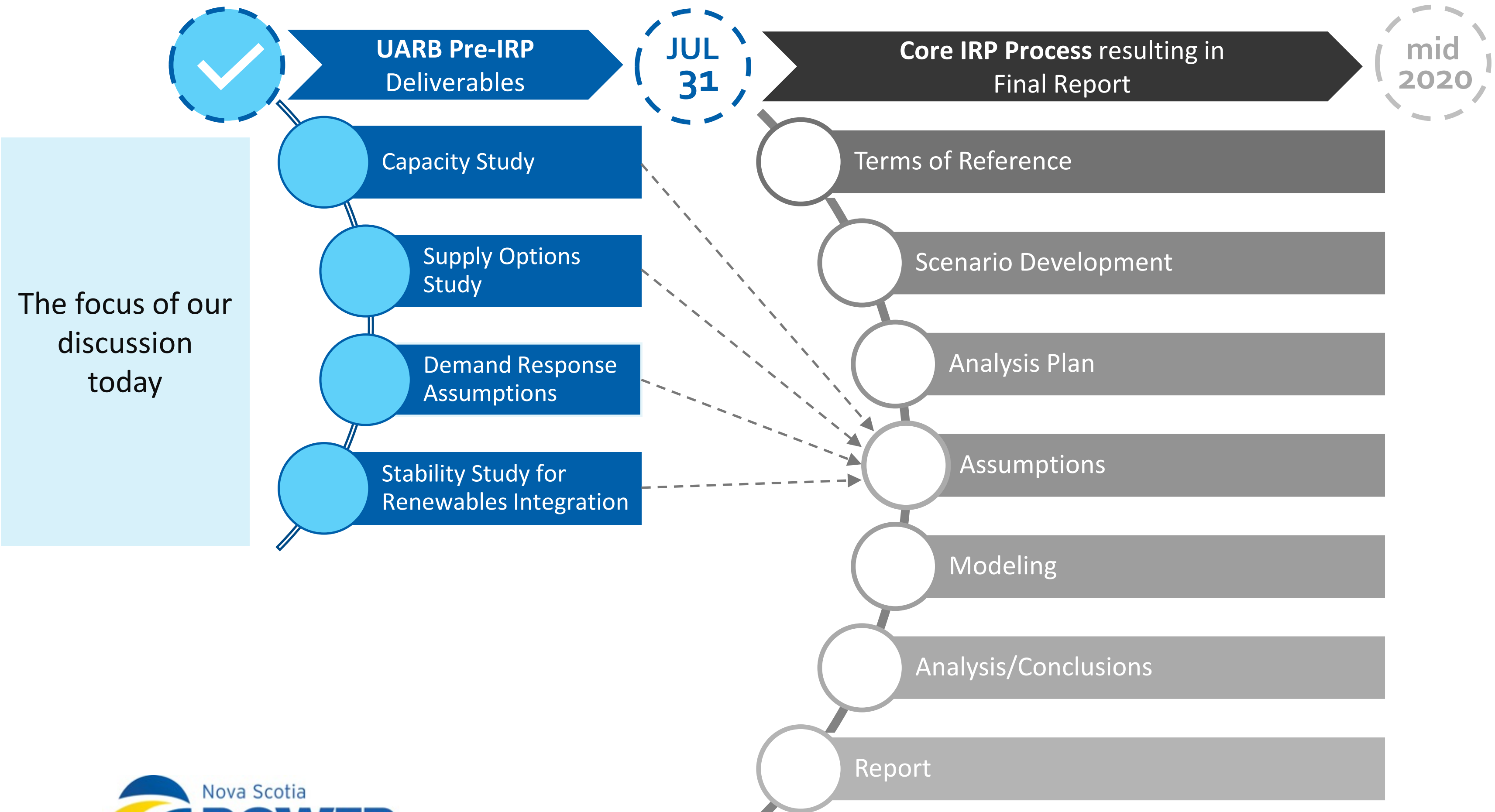
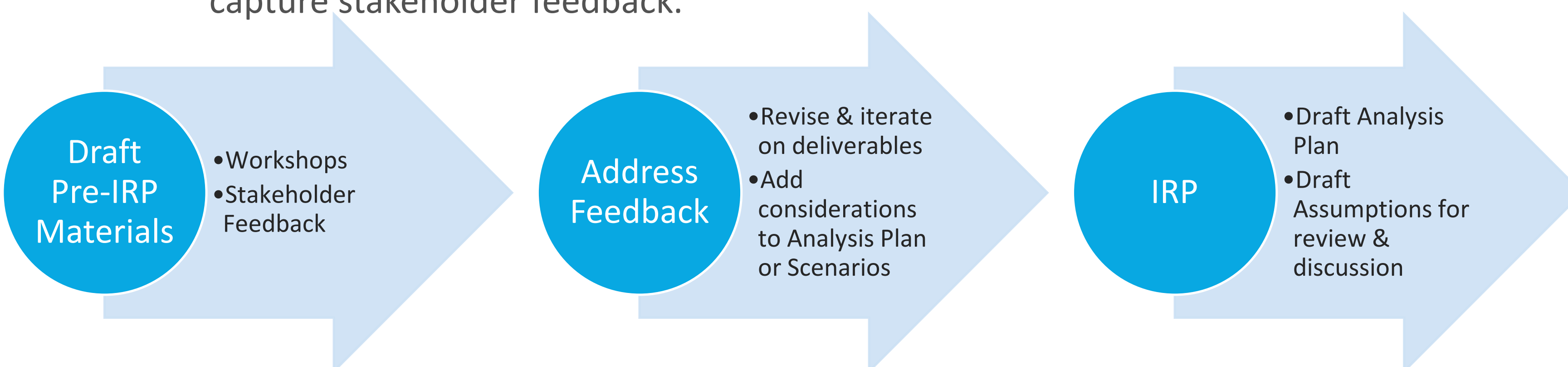
# IRP PROCESS OVERVIEW



# INTRODUCTION TO MATERIALS

- All Pre-IRP deliverables are provided as drafts for discussion and feedback. These deliverables will form the primary basis for many of the key IRP Assumptions.
- Our plan is to address feedback either via revision/iteration on these deliverables (in time to be finalized by the Assumptions Development phase), or to design appropriate Scenarios and/or Sensitivities in the Analysis Plan to capture stakeholder feedback.

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# KEY CONSIDERATIONS FOR THIS IRP

As discussed in the workshop on June 28, 2019, there are many additional factors in the planning environment at this time to consider for this IRP; in particular there is uncertainty around:

- Environmental Policy
- Provision of Essential Grid/Reliability Services
- Distributed Energy Resources
- Cost and capability of new technologies
- Customer behaviour and trends (e.g. electric vehicles, rooftop solar)
- Firm fuel supply sources

Our objective is to develop an Analysis Plan that captures consideration of the above and to facilitate further discussion with stakeholders on these issues to form conclusions/recommendations as appropriate in the IRP.

# IRP OBJECTIVES IN A DYNAMIC PLANNING ENVIRONMENT

- Terms of Reference
- Scenario Development
- Analysis Plan
- Assumptions
- Modeling
- Analysis/Conclusions
- Report

Consideration of objectives and process changes will be part of further discussion through development of the TOR and Analysis plan.

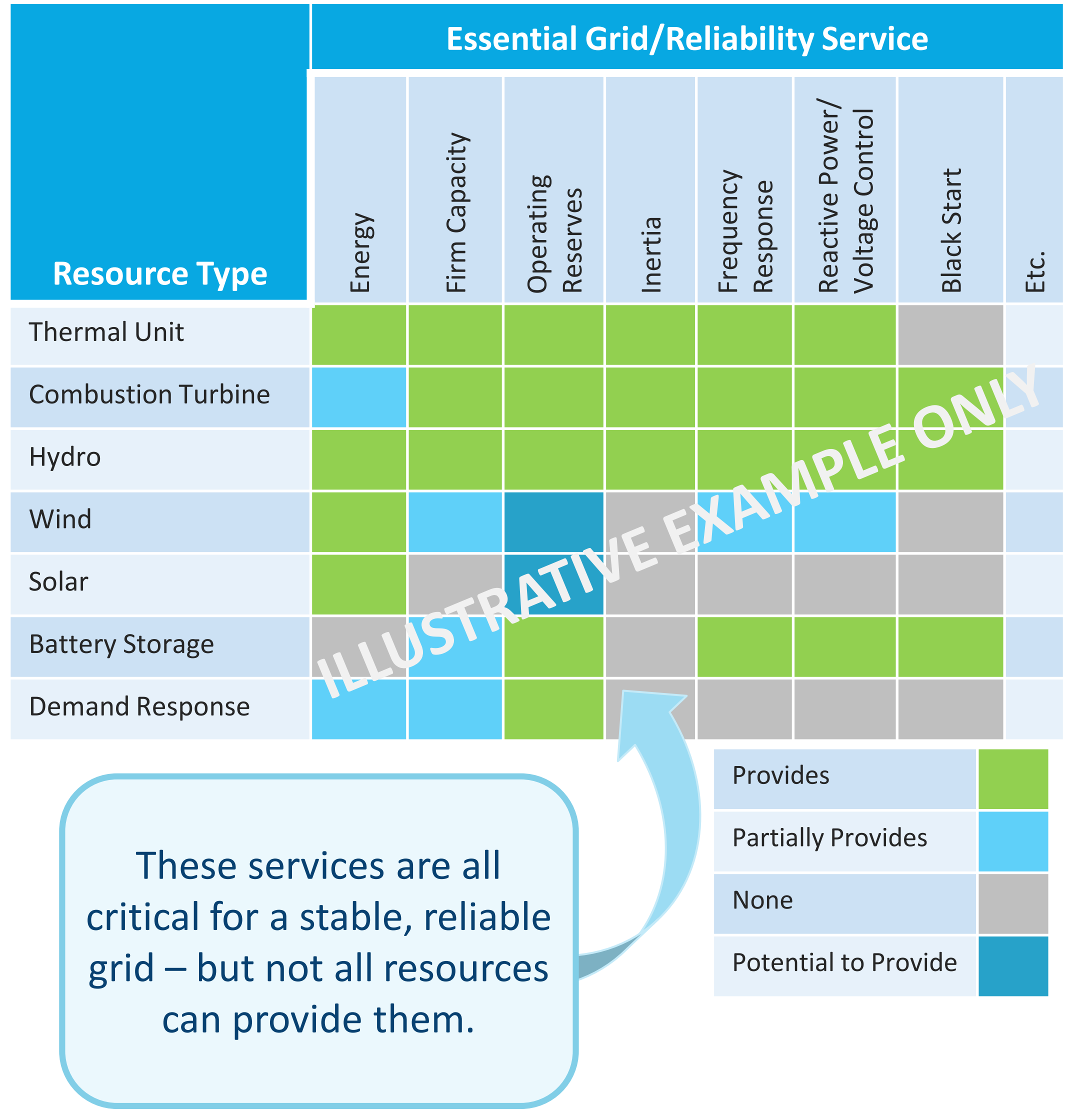
For example:

- Should IRP objectives move beyond "least cost NPV Revenue Requirement"?
- How do we consider decarbonization?
- How do we ensure "no regrets" given the significant uncertainty we face?

# ESSENTIAL GRID/RELIABILITY SERVICES

Of particular importance in modeling scenarios with high penetration of renewables and/or significant thermal generation retirements is the provision of essential grid/reliability services (and the associated costs of obtaining them).

NS Power will work with stakeholders through the Assumptions Development and Modeling Phases to better understand these opportunities and challenges.

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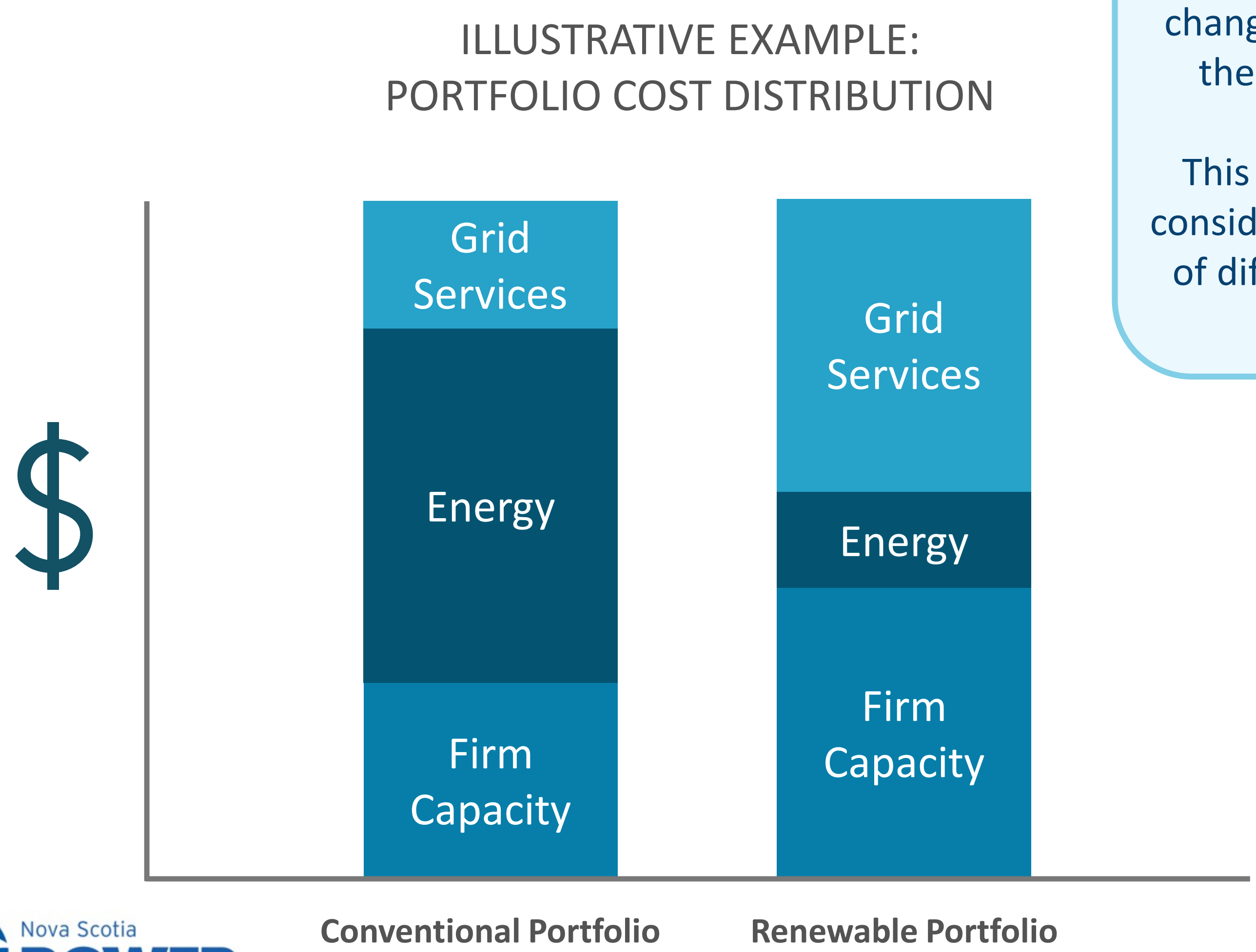
# WHY DO ESSENTIAL GRID SERVICES MATTER?




The proportions of the costs to serve the needs of customers can change depending on the resource mix.

This is important to consider in the full cost of different portfolio options.

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# CAPACITY STUDY:
# OVERVIEW & DISCUSSION

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{E3 SLIDES (FILE 02)}

# SUPPLY OPTIONS STUDY:
## OVERVIEW & DISCUSSION

# {E3 SLIDES (FILE 03)}

# RENEWABLES STABILITY STUDY:
## OVERVIEW & DISCUSSION

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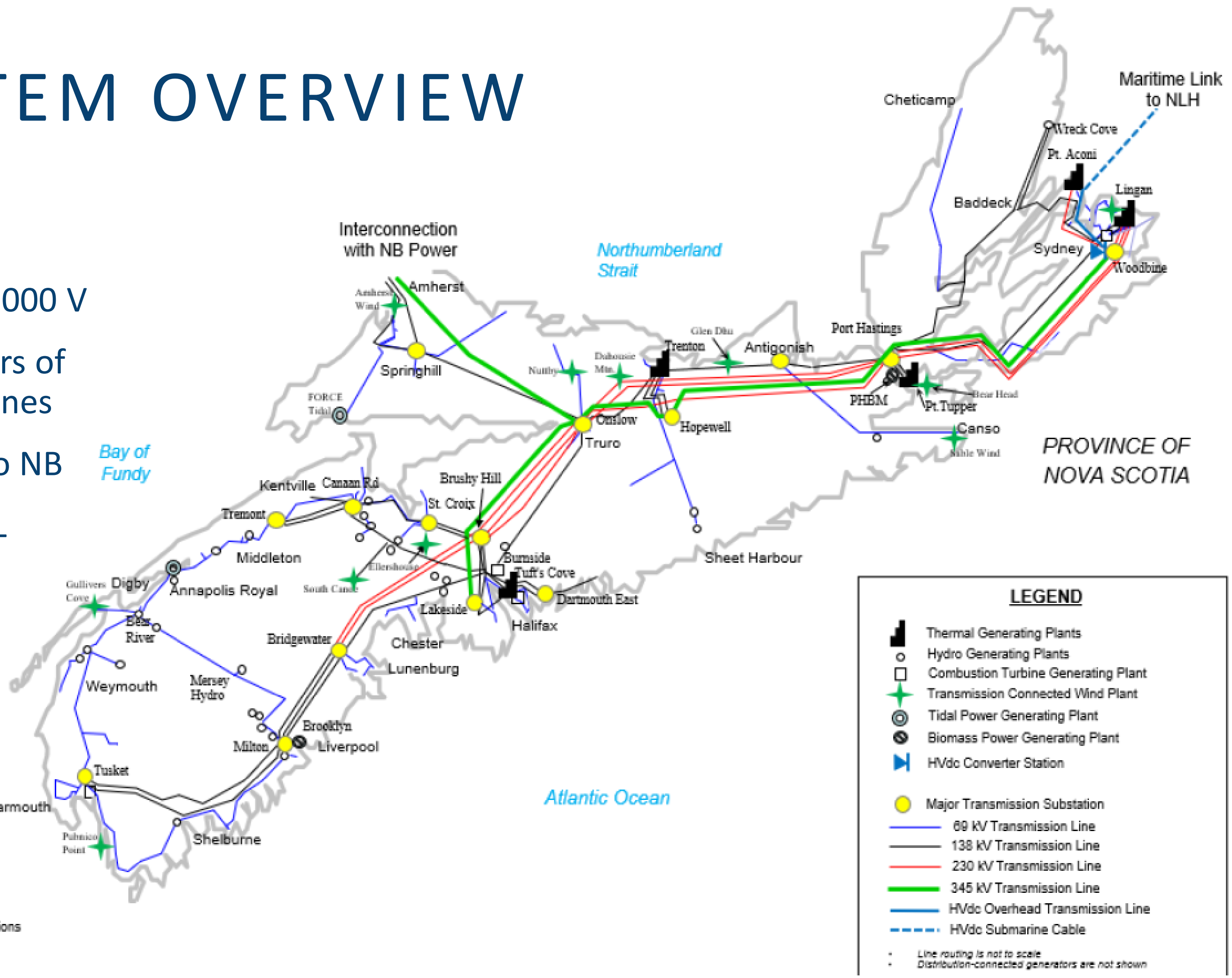
# SYSTEM OVERVIEW

- 69,000 to 345,000 V
- 5200 kilometers of transmission lines
- Single AC tie to NB
- HVDC tie to NL

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# STUDY BACKGROUND & OBJECTIVES

## Stability Study for Renewables Integration (SSRI)

Power System Consultants (PSC) were contracted by NS Power to complete a System Stability Study associated with additional levels of Renewable Energy Integration.

The primary objective, to assess the integration of increased levels of renewable generation, was achieved by:

- ✓ Determining if 600MW is the limit with the existing Nova Scotia system
- ✓ Determining how much additional renewable energy can be accommodated with a second 345kv transmission tie to New Brunswick
- ✓ Recommending alternative system upgrades (i.e. synchronous generators, large scale batteries, etc.) that could allow increased levels of renewables
- ✓ Comparing experiences from other jurisdictions, such as Southern Australia and Ireland, for possible learnings for Nova Scotia

# STUDY APPROACH

| | |
|---|---|
| SCENARIOS | Scenarios chosen for the study represent the system stability boundaries of the most potentially stressed conditions and the most significant contingencies. |
| MODELING | Transient stability simulations were executed to:<br>• Assess each set of contingencies with 600MW of inverter based generation with the existing NS system configuration<br>• Confirm additional levels of inverter based generation that could be installed with a second tie to New Brunswick in service<br>• Calculate short circuit ratios<br>• Assess potential renewable enabling solutions using large scale batteries and synchronous generators |
| ANALYSIS | PSC's international experience with South Australia and Ireland was reviewed for similarities and potential opportunities for Nova Scotia future planning. Regulation reserve using historical wind generation profiles was calculated for additional levels of renewable generation. |

# LEARNINGS FROM OTHER JURISDICTIONS

South Australia experienced rapid growth in renewable generation. Low short circuit levels (system inertia) is a significant problem due to a large geographic area with long transmission lines between wind generation clustered remotely from synchronous machines.

- In 2016, South Australia experienced a state-wide blackout due to unforeseen sustained reduction of wind generators caused by transmission interconnector interruptions during an extreme weather event
- 850,000 customers lost supply; 90% restored in 8 hours, remainder within approximately 2 weeks

Load shedding is used in both the South Australia and Irish systems but not relied upon for mitigating the effects of planning contingencies.

Both South Australia and Ireland have introduced grid code changes, enhanced protection changes, and additional transmission infrastructure and dynamic compensation to accommodate increased levels of renewable generation.

# PRIMARY OBSERVATIONS & CONCLUSIONS

KEY FINDINGS FOR IRP SCENARIOS

- The existing NS system can remain stable with 600MW of inverter based renewable generation as long as NS maintains a minimum of three thermal units (or an equivalent short circuit level) on line.

- Up to 1000MW of inverter based renewable generation may be installed in NS with a second tie to New Brunswick in place.
  - The loss of the tie to New Brunswick is the most significant contingency impacting system stability and associated planning and operational actions.

  - Other renewable enabling technologies such as large scale batteries combined with synchronous condensers can provide a technical solution to increasing levels of inverter based generation but do not eliminate the reliability implications associated with loss of the existing AC tie.

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# PRIMARY OBSERVATIONS & CONCLUSIONS

KEY FINDINGS FOR FURTHER STUDY & OPERATIONS

- The second tie likely eliminates the primary rationale for the minimum online thermal units but consideration must be given to other services provided by online thermal units such as tie balancing, load following, and local short circuit current and voltage control.
- Revision of grid codes (interconnection requirements) has been heavily relied upon in other jurisdictions to assist with system stability challenges.
- Total aggregate online inertia may provide a more general way of quantifying the minimum number of on line thermal unit requirement, however, expanded study would be required to further define this for Nova Scotia.
- Increased levels of inverter based generation is known to introduce potential power quality issues not within the scope of this study. Further study is required to fully understand the operational impact on the NS system.

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# STUDY RECOMMENDATIONS

- Further study is required to establish system security levels, with expanded system conditions and scenarios, to confirm an operable renewable generation limit beyond 600MW.
  - The defined topology should include the second tie as a starting position to establish maximum renewable generation with minimum system reinforcement.
- Expand the existing study with broader system dispatch scenarios and establish requirements in terms of operational and reliability support.
- Perform enhanced studies in PSCAD software to refine technical requirements.
- Establish how the requirements could be met via service provision or grid code changes.
- Commission parallel studies to investigate other potential technical and operational limitations such as power quality.

# PRELIMINARY DR PROGRAM ASSUMPTIONS

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# DR PROGRAM ASSUMPTIONS: INTRODUCTION

- NS Power has developed draft assumptions for three specific DR programs for discussion.
- Efficiency One (E1) has developed information on DR programs as part of its DSM Potential Study.
- The DR program assumptions are meant to be viewed as potential details of a few specific programs within the larger scope of DR considered by E1.
- NSP will  continue to discuss with E1 and stakeholders to define the DR programs to be assessed in the Assumptions Development and Modeling phases of the IRP.

# SUMMARY OF PROPOSED DR PROGRAM ASSUMPTIONS

| Device | Program | Peak shaving potential (kW/device) | Customer Incentive[1] | Participation Scenario (in year 25) | NSP Total Program Costs (25 year) |
|---|---|---|---|---|---|
| **Water Heater** | Controller installed on customer WH and used during peak shifting events | 0.5 | $25 enrollment, $25/yr when compliant to program criteria | Cumulative 50,779 participants (10% of market), 27 MW peak shaving potential | $1.49M/MW |
| **EV Supply Equipment** | Customer owned and installed EVSE with peak shifting participation incentives | 0.7 | $150 enrollment, $50/yr when compliant to program criteria | Cumulative 89,704 participants (70% of market), 63 MW peak shaving potential | $1.19M/MW |
| **Residential Battery** | Customer contribution comparable to diesel generator installation, utility control for up to defined number of system peak events | 2.5 | $2500 customer contribution, Balance of battery cost covered by NSP and funding where available | Cumulative 4,000 participants, 6.25 MW peak shaving potential | $8M/MW |

[1] Customer behaviour-based peak shifting also through residential time of use, commercial time of use, and critical peak pricing rates.

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# NEXT STEPS

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# NEXT STEPS

- We are soliciting feedback on the Pre-IRP Deliverables now, to allow time for revision and iteration prior to Assumptions Development phase.
- Next step will be formal kick-off of IRP with draft Terms of Reference
- Discussion/Addressing Questions: One-on-one or broader meetings to address further questions/feedback are available by request.
- Stakeholder Feedback:
  - While IRP kickoff begins, NSP welcomes written feedback on these materials for consideration.
  - We will use feedback to inform any revision/iteration on this work for Assumptions Development (or to influence Scenario Development that may capture input).