Nova Scotia Utility and Review Board

IN THE MATTER OF *The Public Utilities Act*, R.S.N.S. 1989, c.380, as amended

2014 Integrated Resource Plan

NS Power Final Report

October 15, 2014

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1.0 EXECUTIVE SUMMARY

The 2014 Integrated Resource Plan (IRP) process represents a continuation of Nova Scotia Power's (NS Power, the Company) previous 2007 and 2009 IRP work. The process has built on learnings and actions from the previous IRPs to further shape the future of the Nova Scotia electrical system in a collaborative, consultative and planned manner. The IRP Terms of Reference (TOR) highlight this objective:

> To develop a long-term Preferred Resource Plan that establishes the direction for NS Power to meet customer demand and energy requirements, and environmental obligations in a cost-effective, safe and reliable manner across a reasonable range of foreseeable futures; and to develop an Action Plan describing the major tasks required to implement a no regrets strategy that aligns with the Preferred Resource Plan during the first five years of the planning horizon.

Since the initiation of the 2014 IRP through the Nova Scotia Utility and Review Board's (NSUARB, UARB, the Board) letter of December 18, 2013, the Company has worked in collaboration with Synapse Energy Economics, Multeese Consulting, and The Liberty Consulting Group (the UARB's Consultants), UARB Staff, and in consultation with stakeholders. The process was similar to previous IRPs in that a Terms of Reference was jointly developed and submitted to stakeholders, assumptions were submitted for comment and an Analysis Plan was sent out for consideration. This collaborative and consultative process allowed NS Power to use its long term and detailed modeling tools (Strategist and Plexos) to consider a broad range of potential Candidate Resource Plans (CRPs) with a focus on four key variables:

- Plant retirement dates
- Level of Demand Side Management
- Level of Renewable Generation
- Potential for a large PPA

These variables were considered under a Reference World that assumed base load, current and currently proposed environmental regulations, and energy generated at Muskrat Falls and delivered to NS Power through the Maritime Link including economic market purchase opportunities. Worlds where load was flat or growing, or where DSM did not achieve its potential, were also contemplated.

NS Power then tested the sensitivity of the plans to potential changes in market dynamics including the following:

- More stringent air emissions regulations
- No further reductions in air emissions regulations
- High natural gas, high import power pricing
- Low natural gas, low import power price
- No Demand Response Programs
- Low international price for high sulphur coal
- High international price for high sulphur coal
- Low cost, high output wind

A number of key conclusions can be derived from the data and ensuing analysis performed by the Company and the feedback garnered from both collaboration with UARB Staff and consultants and consultation with the stakeholder group:

- Investment in renewables and DSM has allowed NS Power to meet its current environmental obligations and well-positioned the Company to meet pending environmental requirements.

- There is now a near-term window where limited incremental capital spending is required. This window provides an opportunity to ensure we optimize our near-term demand and supply-side resources in order to minimize near-term rate

pressures without compromising longer term environmental and economic objectives.

- An Action Plan focused on developing the optimal balance between near-term electricity service affordability and ensuring the long-term benefits of DSM and capital spending are maintained is required. This includes:
  - determining the optimal near-term DSM spending profile;
  - assessing the appropriate near and medium term sustaining capital spend on NS Power generation assets;
  - exploring opportunities for enhanced regional integration and cooperation;
  - examining additional opportunities to enhance renewable energy integration and performance;
  - calculating the avoided cost of DSM and reporting to stakeholders and ENSC;
  - studying the potential cost and benefit of a flue gas desulphurization unit at Lingan; and,
  - refurbishing the Mersey Hydro System and studying the cost and benefit of increasing the capacity of that system.

The IRP has confirmed that with DSM programing within the range tested, adequate demand and supply resources are available to NS Power to economically meet its planning constraints to 2020, without significant capacity additions. Capacity additions are required across a number of CRPs to meet either Renewable Electricity Standard

(RES) requirements or system requirements over the planning period, specifically in the 2030s, for the most economic plans (please note that there will be additional IRPs before decision points are reached for the 2030s). The current IRP process has served to identify a number of resource plans which provide comparable costs and benefits to customers over the long term, but differ significantly in the near term with respect to upward pressure on power rates.

Nova Scotia Power believes that reducing rate pressure in the near term is in the interest of our customers. In parallel to the technical IRP, Nova Scotia Power has conducted – and continues to conduct – direct consultation with residential, business, and institutional customers, as well as elected officials. More than 300 customers have attended NS Power's consultation sessions as of the writing of this report. The overwhelming feedback from customers has been that price is their top priority on electricity: customers want power rates that are affordable, predictable and stable.

Evaluating on a five-year net present value (NPV) basis, the IRP has shown that the near-term spending level for demand side management is the primary driver of increased customer costs among the most economic plans. Some IRP participants object to evaluating on a five-year NPV basis, but NS Power maintains that such evaluation is essential to assessing near-term rate impacts on customers, and thus is critical to the planning process. NS Power's position is further supported by the Terms of Reference, which recommend "a no regrets strategy that aligns with the Preferred Resource Plan during the first five years of the planning horizon."

NS Power acknowledges that some parties would prefer that this report include a choice of a specific Preferred Resource Plan and accompanying level of notional DSM spending for planning purposes. ~~However, pre-determining a level of DSM, even if only for planning purposes, would limit the ability of Nova Scotia Power, Efficiency Nova Scotia, and ultimately the UARB to finalize an operational level of cost-effective, affordable DSM to be procured by the utility from the DSM provider, in accordance with the~~

~~Electricity Efficiency and Conservation Restructuring (2014) Act. In the interest of customers, the process established by the Act must take precedence.~~

~~The~~Given the results of the IRP process (primarily the lack of a requirement for any material near-term capital investment), that DSM is the primary variable between the most attractive resource plans and the fact that DSM was not subject to any meaningful review during the IRP, NS Power believes that choosing one Preferred Resource Plan at this time could actually provide a disservice – especially given the pending DSM review process. Furthermore, it is important to note that choosing one Preferred Resource Plan will not change any of the analysis conducted pursuant to the IRP process nor will it add to the information available to participants in the IRP process to inform future discussions. However, pre-determining a level of DSM, even if only for planning purposes, could inappropriately influence the legislated process to finalize an operational level of cost-effective, affordable DSM to be procured by the utility from the DSM provider in accordance with the Electricity Efficiency and Conservation Restructuring (2014) Act.

After taking into consideration Intervenor submissions on the Draft Report, the Company maintains its conclusion that the results of this Integrated Resource Plan have demonstrated that there is a common, no regrets path forward for the Action Plan period and several years thereafter. There are divergent views on key issues such as DSM, rate effects, selection of a Preferred Resource Plan, sustaining capital and how the results for the IRP will be used to continuously inform the system planning process. However, the information that has emerged from the IRP has created the platform necessary for continued dialogue and engagement in the regulatory processes that will effectively, in conjunction with the Action Plan, extend the planning exercise until the next IRP. In fact, though there are areas where consensus has not been reached in the feedback on the Draft Report, Synapse recognizes different conclusions can be drawn from the information, but that there has been significant effort to adequately inform the IRP

process.[1] NS Power agrees and would highlight that consensus on areas where more work is needed form the backbone of the Action Plan path forward. This path requires minimal incremental capital spending for new capacity, while maximizing the lifespan of existing generation assets and selecting ~~an optimal~~a preferred level of DSM. ~~While the~~

The detailed Action Plan will resolve ~~some~~ key areas requiring additional study~~,~~ that reflect the feedback the Company has received on the Draft Report. A detailed review and response to this feedback is included in Section 2.4.3 of this report. This collaborative and consultative IRP process has provided clear direction for the future of the power system that will benefit Nova Scotia Power customers.

[1] Please refer to Appendix R – Synapse and Facilitator Comments on the 2014 IRP.

2.0 INTRODUCTION

An Integrated Resource Plan (IRP) is a comprehensive and public utility planning exercise that integrates supply and demand-side options to develop a long-term resource plan for the utility. NS Power filed an Integrated Resource Plan in 2007 and an Integrated Resource Plan Update in 2009 with the Nova Scotia Utility and Review Board. In its letter of December 18, 2013 the Board directed NS Power to undertake development of the full-scale analysis and preparation of a 2014 Integrated Resource Plan.

The 2014 IRP Terms of Reference, as approved by the Board, contains the following objective:

> To develop a long-term Preferred Resource Plan that establishes the direction for NS Power to meet customer demand and energy requirements, and environmental obligations in a cost-effective, safe and reliable manner across a reasonable range of foreseeable futures; and to develop an Action Plan describing the major tasks required to implement a no regrets strategy that aligns with the Preferred Resource Plan during the first five years of the planning horizon.[2]

The policy judgments and decisions concerning the IRP are made by NS Power in light of its obligations to its customers and regulator. The resultant Action Plan is a road-map to guide the utility's strategy for meeting its resource needs over the planning horizon. It is directional, not prescriptive, in nature, and is meant to provide the utility with sufficient flexibility to effectively accommodate a range of future uncertainties.

This IRP fulfills the Company's obligation to develop a long-term resource plan that establishes the direction for NS Power which considers customer demand and energy requirements as well as environmental obligations, cost-effectiveness, safety and reliability. NS Power has applied the IRP process described in Section 4 of this report in

[2] Nova Scotia Power Integrated Resource Plan – 2014 Terms of Reference, Appendix A, page 1.

collaboration with UARB staff and its consultants, and in consultation with customer representatives and interested parties.

This chapter outlines the primary steps of the IRP process, summarizes advancements in the Company's Integrated Resource Planning approach, and provides an overview of the public process.

2.1 2014 Integrated Resource Plan Process

The primary steps of the Integrated Resource Planning process, and where they are addressed in this report, are outlined below:

- Develop the Terms of Reference and timeline for the IRP – Section 4.1
- Establish the criteria for evaluation of various plans and selection of the Preferred Resource Plan(s) – Section 4.2, 4.3, 4.5
- Develop input assumptions reflecting projections of the most likely values for variables representing the planning environment and resource options – Section 4.2
- Evaluate potential resource plans using screening methods, modeling, and sensitivity analysis – Section 5
- Select the Preferred Resource Plan based on analysis results – Section 5.7
- Develop an Action Plan describing major tasks required to implement a no-regrets strategy that aligns with the Preferred Resource Plan during the first five years of the planning horizon – Section 6

- Engage with Stakeholders throughout the IRP process – Section 2.4

Section 4 of the TOR requires the IRP report to address 11 specific areas. Those 11 areas, and the section where NS Power addresses them in this document, are as follows:

1. Background/Process Overview – Sections 2 and 4
2. Stakeholder engagement process – Section 2.4
3. Criteria for evaluation of the various plans – Section 4
4. Load forecast of future supply requirements – Appendix B (Final Assumptions), slides 77-94
5. Sets of alternative supply-side and DSM alternatives to meet future system requirements – Appendix B (Final Assumptions), slides 35-38 and slides 94-111, respectively
6. Screening analysis used to determine which alternatives were evaluated – Section 4
7. Evaluation of alternative plans in order to determine the least cost plans and rates impact – Section 5
8. Sensitivity analysis on the least cost plans and other selected plans to determine the robustness of the plans to variations in input assumptions – Section 5
9. Preferred Resource Plan – Section 5
10. Avoided cost of DSM methodology method utilized and results – Section 6
11. Action Plan. Actions required over the next 5 years to meet load projections and other regulatory and environmental requirements through implementation of a no regrets strategy that follows the Preferred Resource Plan – Section 6

2.2 Advancements in the IRP Approach

This IRP builds on NS Power's prior resource planning efforts and reflects continued advancements in resource plan modeling and methodology. These advancements are described in Sections 2.2.1 – 2.2.3.

2.2.1 Candidate Resource Plan (CRP) Approach

In previous IRPs, the resource plans were produced by the output of Strategist. The Base World assumptions were run through the model and from the numerous output resource plans developed, candidate plans to be considered for the Preferred Plan were selected. For the 2014 IRP, UARB staff and consultants recommended the Candidate Resource Plan approach and the Company agreed to employ this methodology. Advantages of the Candidate Resource Plan approach (a full description of the CRP approach is included in Section 4.2 of this report) are the ability to test a wide range of possible outcomes while minimizing the required computing time. While providing advantages within the relatively short timeframe allotted for the execution of the IRP, one of the challenges with the Candidate Resource Plan approach was the development of a fully optimized resource plan. Major components of resource plans, such as level of DSM, steam unit retirements and wind generation additions, are pre-determined rather than optimized,[3] so the optimal path forward may prove to be a combination of the most favorable aspects of the top performing Candidate Resource Plans. While it is possible to select the best of the Candidate Resource Plans, it is clear that many of the plans could be further optimized.

A table describing the CRPs can be found in Section 4.3, page 39 of this report.

2.2.2 Evaluation with Plexos

Operational viability of a select set of Candidate Resource Plans was tested in chronological hourly dispatch optimization software examining CRP performance within unit commitment, system security and other system dispatch constraints.

[3] While Strategist can optimize various levels of DSM year to year, due to the problem size, this process is time consuming and it could not have been completed in the IRP time frame.

NS Power described the basis for using Plexos in its July 30 Memo to stakeholders:

> The Company proposes to use Plexos to examine certain CRPs (i.e. high wind, high DSM, Scenario "C" emissions) to evaluate key system operational attributes that Strategist does not evaluate, such as dispatch within generating unit commitment constraints, transmission system constraints, dynamic reactive reserve requirements, wind generation curtailment, and other chronological system constraints. The analysis may show that the system needs reinforcement or that, although Strategist has indicated that a given CRP meets the system's annual capacity, generation and emissions needs, the CRP does not satisfy the system's hourly operational needs. NS Power will use its engineering judgment, in collaboration with Synapse, to determine which CRPs require Plexos analysis. NS Power will document its rationale for choosing to apply Plexos to specific CRPs. It will also identify any CRP that it excludes from further consideration based upon the Plexos assessment and the reasons for that exclusion.[4]

Chronological dispatch analysis offers several indicators of system stress under certain CRPs' system configurations and these are wind energy curtailment, uneconomic exports, system constraint violations, steam unit start-stops, heat rate impact, barriers to purchasing otherwise economic Maritime Link surplus energy, etc. The use of Plexos in conjunction with Strategist is an adaptation of the NS Power IRP process reflecting the complexity of the power system as it transitions away from base loaded coal generation.

2.2.3 Sustaining Capital Investments

Sustaining capital investments for existing and new thermal units were included in the cost comparison among Candidate Resource Plans. Sustaining ~~Capital~~capital investments are investments to maintain NS Power's generation fleet. This is the first IRP where sustaining capital was added to the modeling exercise due to the variety of retirement options. Sustaining capital costs for the Minimum (early~~, base~~), Medium and ~~max~~Maximum coal use retirement assumptions are calculated outside of Strategist and added as an input to the model. Steam unit retirements have not been a feature of

[4] Appendix J – NS Power July 30, 2014 memo to stakeholders.

previous NS Power IRPs. NS Power modeled a 60-year life for steam resources, and this assumption was modified following stakeholder consultation to reflect two additional (shorter life) steam resource retirement strategies. To allow for the side-by-side comparison of CRPs with differing retirement strategies in the planning period, it became necessary to include sustaining capital investments for these assets.

2.3 Role of Board Staff and Consultants

NS Power's 2014 Integrated Resource Plan has been developed as a joint effort between the Company and Board staff and consultants. This collaboration has included: establishing the Terms of Reference and key evaluation criteria; identifying key input assumptions; designing the analysis framework; screening, selecting and assessing resource plans and analyzing model results. In addition, Board consultants provided comments on draft versions of this report.

The knowledge brought to this project by Board staff and consultants, Synapse Energy Economics, Inc., Multeese Consulting Inc., and The Liberty Consulting Group, along with NS Power technical and analytical expertise, has produced a comprehensive IRP. The key outcomes confirm the direction indicated by the 2009 IRP Update and have resulted in an Action Plan which the Company believes will enable it to meet future customer needs as well as environmental, safety, and reliability obligations.

2.4 Stakeholder Consultation & Public Process

2.4.1 Stakeholder Consultation

Stakeholder input is an integral part of the IRP process**.** In accordance with the 2014 IRP Terms of Reference, NS Power consulted with stakeholders throughout the planning process.

Technical Conferences were conducted with regulatory stakeholders on March 7, June 25, and September 12, 2014. Stakeholder update memos were also distributed on April 11, June 5 and July 30. Comments were accepted and considered by the Company from stakeholders throughout the 2014 IRP process, including comments on the Company's analysis results presented on September 12. Appendix N contains all comments and written feedback received by the Company from stakeholders throughout the 2014 IRP process. NS Power has responded to feedback it received from stakeholders (Appendices F, G and H) and offers the following for consideration based on the September 12 feedback.

2.4.2 September 12 Technical Conference Feedback

Generally speaking, the Company has identified 4 main areas that are of concern to the stakeholder group. These are listed below followed by NS Power's response to each.

- The Role of a Preferred Resource Plan
- The Role of the Action Plan
- DSM
- IRP Timelines and Content

The Role of a Preferred Resource Plan

Often in advance of initiation of an IRP, the need for specific capacity additions or potential changes to the planning environment are identified in the near-term and these additions or changes are the basis for initiating the planning exercise. This was the case in 2007 and 2009 for NS Power's previous IRPs. Changes to emissions and renewable regulations required the Company and stakeholders to examine what was the most cost-effective means to manage existing capacity as new capacity came online. ~~The 2014 IRP, however, is quite different.~~The 2014 IRPis quite different; loss of industrial load, certainty around emissions targets and the addition of the Maritime Link are key

considerations for the future resource mix. Through the course of this process, the analysis has shown that with the addition of the Maritime Link, maximized life of current assets and a level of DSM to be determined by a subsequent regulatory process, the Company can meet its near-term[5] capacity and energy needs.

Several plans have emerged that produce similar~~, "no regrets"~~ paths for the first five years of the Action Plan. In CRPs 1, 2 and 5, there is minimal incremental capital investment required to meet emissions and renewable energy requirements out to 2020. The main variable between these plans is the level of DSM investment required. There are other plans that are less economic over various time horizons that the Company can implement if there are significant changes to load or environmental regulations.

NS Power has planning flexibility over the next 5 years because the least cost alternatives emerging from the IRP do not call for new capacity additions in that window. The Company proposes to take advantage of this flexibility by implementing the items identified in the Action Plan.

The Role of the Action Plan

NS Power has developed a robust Action Plan to address its findings from the IRP analysis. The Company proposes to examine further elements raised by stakeholders as items for further study and areas where the Company has firm deliverables. This type of detailed Action Plan, with input from the Board's consultants and in consultation with stakeholders, requires the Company to perform the work per the established timelines. The resulting required information will be available to inform the next long-term planning exercise.

The Action Plan contains a number of items that emerged from the IRP and are critical elements for planning the future of the power system. The Action Plan will significantly

[5] "near-term" is out to 2020.

bolster the content of the 10 Year System Outlook Report, filed annually. The 10 Year System Outlook is a report to the UARB which describes NS Power's system for the next 10 years, from a system operations perspective. The report will inform stakeholders of key items raised in the IRP, for example: plant retirement ~~schedules~~forecasts, regional integration and the requirement for flexible generation assets. There are also significant standalone studies that will be completed as part of the Action Plan raised by the stakeholder group, including: an Energy Resource Interconnection Resource/Network Energy Resource Interconnection Request (ERIS/NRIS) capacity value study, a study to determine the viability and potential economic benefit of adding a flue gas desulphurizer and a detailed examination of the Company's sustaining capital spend for its generation fleet.

The Action Plan provides the means to conduct further analyses of areas that were not fully examined during the IRP or emerged from the analysis of this IRP.

DSM

Stakeholders have varying views on DSM; some advocate for higher or lower DSM levels, while recognizing that there should be a separate process to determine the level of DSM that will be implemented. Feedback from the Industrial Group, the Consumer Advocate and the Small Business Advocate, representatives for the vast majority of NS Power's customers, acknowledges that DSM has its own regulatory process outside of the IRP. Efficiency NS (ENSC) also acknowledges this in their submission following the September 12 Technical Conference. This is aligned with NS Power's position in its Action Plan. The Company proposes to engage ENSC to bring a filing to the UARB for approval. This aligns with what is called for under the provisions of the recently amended Public Utilities Act for electricity efficiency and conservation activities.

Given the direction provided within the ~~new~~amended Public Utilities Act, NS Power believes that the IRP is not the appropriate forum to derive an optimal level of DSM.

Instead ~~NS Power believes~~ the ~~new~~amended Act requires~~ the formal process to approve the level of DSM to be~~ a separate regulatory proceeding to determine the cost-effective, affordable level of DSM.

The IRP process has informed NS Power and stakeholders that different levels of DSM investment will produce different cost profiles over time. In ~~conjunction~~consultation with stakeholders, NS Power will ~~also~~ produce an avoided cost analysis of DSM as part of the Action Plan. The Company can also use the IRP modeling tools to determine how best to balance cost effectiveness and affordability ~~during the establishment~~as part of ~~an~~the application with ENSC to be made to the UARB to approve the 2016-2018 DSM investment profile.

As part of its Action Plan, the Company will produce the additional modeling requested by the Industrial Group:

> The Industrial Group requests that NSPI model an optimum DSM spending profile on a variable basis, having regard to any operational constraints (on the part of NSPI and ENS). It is understood that NSPI and ENS will be negotiating an agreement for the delivery of efficiency programs on three year terms so the ultimate level of DSM will be determined in that process and approved by the Board; nonetheless, for planning purposes, it would be helpful to understand the implications of an optimum variable DSM spend…
>
> The Industrial Group requests that NSPI run a sensitivity of both higher and lower costs of DSM per MWh and also higher and lower achievable energy and demand savings for the same DSM dollar investment (Base, Half Low).

IRP Timelines and Content

The IRP timeline has been challenging. The Company endeavoured to provide stakeholders with ~~a meaningful~~an opportunity to comment on the process at critical stages. NS Power sees the Action Plan period as an important vehicle for resolving key resource matters and to shape the next IRP. ~~The Company does not consider the end of~~

~~the analysis phase to be the conclusion of the IRP.~~ There is significant work ahead and NS Power would like to continue to engage the stakeholder group as part of that process. Having a robust Action Plan and several low-cost resource plans with similar no-regrets paths will allow the Company to maintain a broad perspective on near to longer-term resource options and ensure stakeholders have the opportunity to remain fully engaged in resource planning matters leading to the next IRP.

2.4.3 Draft Report Feedback

The Terms of Reference provides for stakeholder comment on the Draft Report and Action Plan prior to the Final Report being submitted to the UARB. The Company thanks the Board's consultants and stakeholders for the detailed and valuable feedback it has received. Appendices N and R include all feedback received on the Draft Report. This Final Report reflects changes suggested by the stakeholders where appropriate and additional comments are included below based on common themes that have emerged from the stakeholder comments. Generally the comments can be organized based on the following themes:

- Responsiveness, IRP timeline, Next Steps
- Selection of a Preferred Resource Plan and Plan Evaluation
- DSM
- Sustaining Capital
- Maritime Link
- Wind Capacity Value
- Affordability and Rate Effects

Responsiveness, IRP timeline and Next Steps

Through the IRP process there has been feedback suggesting that the timeline and level of engagement was not sufficient to come to a final report and close out the IRP. Customer representatives, including the Consumer Advocate, Small Business Advocate and

Industrial Group, have identified concerns with their ability to participate within the IRP timelines. The Company recognizes these concerns along with its need to comply with the UARB-established timeline. The Company has worked with Synapse to create a detailed Action Plan that commits to engage stakeholders beyond the close of the modeling and reporting phases of the IRP through the Action Plan Period.

The information from the IRP modeling and reporting phases remains useful for the duration of the planning period and serves to inform future regulatory processes. These phases of the IRP have been successful at providing the underlying data that will inform the planning decisions that need to be made over the Action Period. The UARB and stakeholders can be confident that where required, such as for decisions relating to DSM, sustaining capital or capacity additions, the information from the IRP will be utilized to provide value to customers. This is consistent with previous IRPs in that the Integrated Resource Plan is not an approval of discrete projects or a prescribed path, as expressed in the TOR:

> The IRP is a comprehensive and public utility planning exercise that integrates supply and demand-side options to develop a long-term Preferred Resource Plan for the utility. The resultant Preferred Resource Plan is a road-map to guide the utility's strategy for meeting its resource needs over the planning horizon. It is directional, not prescriptive in nature. The Preferred Resource Plan does not commit the utility to certain courses of action or foreclose options determined to be in the interests of our customers subsequent to completion of the IRP process. Instead, the Preferred Resource Plan is meant to provide the utility with sufficient flexibility to effectively accommodate a range of future uncertainties.

The Action Plan phase of the IRP begins with the submission of this Final Report and NS Power commits to ongoing reporting to the UARB and interested parties on its progress against the Action Plan.

Selection of a Preferred Resource Plan and Plan Evaluation

The stakeholder group has expressed contrasting views regarding both the need to select a specific resource plan based on a CRP (including a DSM level) and the time horizon that should be the primary consideration to evaluate plans. Several stakeholders (NS Department of Energy, SBA and Industrial Group) have asked NS Power to be especially mindful of potential rate impacts over the next 5 years provided that long term affordability is not compromised. Others (PHP, Synapse, ENSC) believe that plan evaluation should primarily consider the planning and study period costs even if this could cause rate pressures in the short term. However, all parties recognize that there is a convergence of the most economic plans over the planning horizon. Several plans fall within 5 percent of the plan with the lowest planning period NPV. NS Power has focused on short and medium term affordability as a means to distinguish between plans in the interest of customers, knowing that the next IRP will better inform the longer term capacity addition decisions which separate the plans. The early-year convergence of the mix of plans that are most economic over the short, medium and long terms respectively (CRP 1, 2-17 and 5) also diminishes the need to pick from among plans that are not fully optimized. Rather, the Company selected the direction (wind levels, plant retirement dates, etc.) that are common to the most economic plans and has used that direction as the basis for its Action Plan.

The TOR does not require the Company to choose a Preferred Resource Plan based on all attributes of a single CRP. By combining common attributes from CRPs that perform the best over a variety of timeframes, the Company is in fact moving closer to an optimal system plan. Synapse, by submitting a new and previously undiscussed CRP, also recognizes that the CRP process has not produced a fully optimized plan and that there is opportunity to further optimize elements (i.e. DSM, planning reserve, sustaining capital) of the CRPs on a go-forward basis to ensure customers have the most economic and affordable system. Additional support for this position stems from requests from the Industrial Group and Government for additional analysis around DSM spend levels.

DSM

Both the CA and the Department of Energy highlight in their submissions that there has been no consensus reached in the IRP on the appropriate level of DSM. This is not surprising since, at its outset, the IRP did not intend to optimize for DSM. Rather the CRP process was designed to test the effect of 3 DSM levels; Low, Base and High. The High, Base and Low assumptions for DSM were developed in collaboration with the Board's consultants and vetted by the stakeholder group, as was their incorporation in the various CRPs during the assumptions and analysis phases of the IRP. At the outset of the IRP it was communicated that while DSM would be modelled in the IRP, NS Power anticipated that the optimal level of DSM would result from a separate regulatory process (please refer to quote at page 35).

However, there does seem to be consensus that establishing an optimal DSM level is critical to the IRP process. The Department of Energy and the Industrial Group have requested, based on near-term affordability concerns, that additional analysis should be conducted on the Base and Low DSM values used in the IRP. Synapse, the Ecology Action Centre and Port Hawkesbury Paper have requested that additional analysis be conducted on the Base and High levels of DSM, based on concerns for long term NPV. It bears noting that the cost of DSM programs is not currently recovered from PHP nor does it participate in DSM programs; however, PHP is on a fixed, marginal cost based rate until 2019 and incremental DSM is likely to cause marginal costs to decrease or remain stable. NS Power's approach accommodates the requests for an optimal level of DSM as part of the Action Plan and will use the learnings from the new DSM structure to inform future IRP updates. NS Power has also committed to consulting with interested parties on the development of the avoided costs of DSM as part of the Action Plan.

The optimal level of DSM should be something that can be flexible through time to meet the needs of the power system. The IRP has supplied the information necessary to determine the range of resource needs over the short, medium and long term. The optimization process can be ongoing with appropriate lead time and determined based on

the system needs at the time of DSM procurement, much like capacity additions. The Company intends to engage stakeholders in assessing and proposing the appropriate DSM level for approval but agrees with the Industrial Group that this should not be part of the formal negotiations nor should it preclude the Intervenors' right to question the validity of the DSM supply arrangement.

Sustaining Capital

The Company notes the comments of Synapse, the Industrial Group and the Small Business Advocate regarding sustaining capital. Items in the Action Plan are intended to give stakeholders enhanced visibility into the Company's asset management plan and the resulting sustaining capital. This should allow future ACE Plan proceedings, which propose for approval sustaining capital spend, to be adequately informed.

Maritime Link

The Industrial Group has questioned why the IRP did not examine a variety of sensitivities for the Maritime Link, citing NS Power's Plexos analysis that High DSM and High wind penetration levels erode the ability of the system to maximize purchases of economic energy off of the Maritime Link. Contrary to this assertion, this analysis demonstrated the economics of the Maritime Link rather than calling them into question: the High DSM, High/Base wind scenarios that were tested for system operability in Plexos (CRP 6, CRP 8) ranked 13th and 11th respectively for planning period NPV. In comparison, the top ranked plans on an NPV basis allowed for more use of economic energy off of the Maritime Link.

Wind Capacity Value

The CA has provided detailed comments on the capacity value of wind that should be assumed on a go-forward basis. The Company concluded in consultation with Synapse

that for the purpose of the IRP analysis 17 percent was used for the capacity value of NRIS connected wind. NS Power has committed to examining this value as part of the Action Plan and would welcome further input from the CA as part of this Action Plan item. NS Power's review of this issue reveals that the industry continues to refine the tools used to determine the capacity value of wind generation, and annually adjusted approaches are emerging in some jurisdictions which reflect both the ongoing additions of installed wind generation and the variability of this resource.

Affordability and Rate Effects

As stated previously, many of the most economic plans share similar directions and are close in NPV for much of the planning period. NS Power therefore considered rate effects as a key criterion for CRP evaluation. Additional weight was given to plans that had the ability to mitigate rate pressure in the near term, as assumptions are usually more accurate over the near term and uncertainty increases as the planning period lengthens and the operational aspects of the Maritime Link are optimized. The Department of Energy, SBA and Industrial Group agree that affordability and rate effects are an important consideration for the planning period and that NS Power should consider near-term rate effects, provided it does not sacrifice long term economic value. PHP recognizes that there is merit to considering near-term rate effects as well. PHP, however, raises an important point: an IRP is not a rate setting exercise. NS Power agrees. The goal of the IRP was not to compare and contrast absolute power rates over the planning period amongst various CRPs. The SBA and Synapse are critical of NS Power's use of NPVs over various periods (5, 15 and 25 years) and the partial revenue requirements as a proxy for rate effects and affordability. The Company recognizes, as does the SBA in its submission, that there are rate treatments that are possible under the Nova Scotia regulatory framework to potentially mitigate rate pressures, to an extent, from an operational vs. planning perspective. Therefore, notional rate effect and affordability concerns are best expressed using the relative comparators used by NS Power to contrast plans against the lowest partial revenue requirement plan and lowest

NPV plans across various time horizons. To do otherwise, by producing an absolute rate in cents per kWh, is to portend a level of operational rate setting potential that the IRP planning exercise was never intended to have.

The Company has used the analytical tools that are common to all plans in the IRP – NPV and partial revenue requirements from Strategist – as a proxy to evaluate potential rate effects and affordability. However, there is a difference between the operational reality of rate setting and the use of proxy comparators for planning purposes. NS Power will strive to find operational rate solutions that keep affordability front and centre, but will allow for transparency and comparability across plans by using the planning exercise proxies of NPV and partial revenue requirements to represent affordability and rate effects.

~~2.4.3~~2.4.4 Public Consultation Process

Nova Scotians have a great deal of interest in electricity issues. The Company continually engages customers through tools like the NS Power website, TomorrowsPower.ca, and regional meetings to have a dialogue on the different aspects of the electrical system. The 2014 Integrated Resource Planning process presented a significant opportunity for NS Power to engage customers in a dialogue about long term electricity planning and to discuss the various challenges and opportunities with customers.

Customer Engagement Sessions

The Company held ~~thirteen~~fifteen customer engagement sessions in regions across Nova Scotia. Invitations to the events were extended by NS Power to a broad representation of stakeholders. Stakeholders were encouraged to forward the invites to their own networks. An electricity primer with information on key aspects of Nova Scotia's

electricity system and issues related to the IRP process was shared with participants to help them prepare.

The sessions included an overview by NS Power's Vice President, Generation and Delivery, of the key IRP issues and how customer input will guide long term plans. For the purposes of the discussion, the content for the sessions was crafted based on four themes that align closely with the various aspects of the overall IRP process: cost, innovation, energy sources and reliability. Each session was broken into four groups based on the above four topic areas. For each of the topic areas, participants were asked the following questions:

1) What are your thoughts on this topic?
2) What outcomes do you care most about?

Information boards about the four topics were used to trigger conversations. Facilitators recorded responses, which were later used towards reports shared with the participants and posted on our TomorrowsPower.ca website. The Company finished the session with an open question and answer period.

In November, NS Power intends to hold a second round of sessions throughout the province to report back to the stakeholders on the outcome of the IRP.

NS Power met with approximately 300 customers about the IRP through these sessions. The Company provided an exit survey to each participant to collect their feedback on the sessions as well as their overall perspective on NS Power. Customers who attended the engagement sessions provided a positive rating of the session (94 percent). In addition, a large majority of participants found the sessions to be informative (82 percent) and useful (87 percent). Overall, a vast majority of the participants found the events to be an effective platform to share feedback and learn about electricity planning.

Online Engagement and Other Activities

NS Power also provided an online customer engagement platform called TomorrowsPower.ca. On this website, we encouraged customers to "ask us anything", read information on the IRP (based on the four topic areas mentioned above) and answer poll questions developed on key themes that arose during the deliberative polling stakeholder sessions. The Company created awareness about the process through some paid advertising, NS Power's customer newsletter "Connections" and social media.

NS Power provided a dedicated email address for customers to get in touch directly with the IRP Team, electricityplanning@tomorrowspower.ca, and responded to follow-up phone calls. At various public events, NS Power used a board, and an opportunity for customers to provide input on their priorities and thoughts for our electricity future.

From April 2014 to the present, nearly 300 questions were submitted through TomorrowsPower.ca for which we have provided answers with the help of NS Power's technical experts, with close to 21,000 unique visits to the website during the same period. This includes collecting brief written comments on the future of electricity.

Conclusions

As stated above, the objective of using a variety of tools was to ensure the process would be relevant for as many customers as possible. Here are the key insights we heard in order of priority:

- Affordability[6] is a key concern for residential and business customers and the importance of striking a reasonable balance between cost and moving to a greener grid.

[6] Affordability was defined as having the minimum revenue requirement increase possible over the near term.

- In almost all cases, the outcomes identified as most important to customers had strong financial and/or environmental considerations.

- Customers would like to see Nova Scotia Power provide more information about the business, and education on existing programs that will help them manage usage and reduce their costs.

- On the topic of reliability, customers emphasized the importance of improved outage and restoration communications as well as continuous investment in preventative maintenance.

- On the topic of energy sources, the majority of participants validated NS Power's focus on a diversified portfolio, with an emphasis on the best utilization of local sources.

- On the topic of innovation, we heard customers' overwhelming desire for more awareness on innovation programs that we already offer, such as the heat pump program and Time-of-day rates. There was a strong interest in technologies that allow customers to see real time information on and control over their electrical use.

The Company will be reporting back detailed results to stakeholders both online as well as through a second round of sessions throughout the province in November. NS Power will also take the opportunity to inform customers about the technical IRP submission with the Board.

NS Power has been encouraged by the positive response and the level of engagement the process has generated. The Company intends to continue the dialogue with customers going forward.

3.0 PLANNING ENVIRONMENT

3.1 NS Power System Overview

NS Power is a vertically integrated electric utility, regulated by the Nova Scotia Utility and Review Board. The Company serves approximately 501,000 residential, commercial, industrial and municipal customers across Nova Scotia. In 2013 system peak load was 2,033 megawatts; net system requirement was 11,193 gigawatt hours.

Nova Scotia's generation portfolio is comprised of a mix of fuel types that includes coal, petroleum coke, diesel and heavy fuel oil, natural gas, biomass, wind and hydro. In addition, NS Power purchases renewable energy from Independent Power Producers located in the Province resulting in total firm capacity of 2,341 MW. The table below summarizes the resource mix of the Company's generation fleet.

Generation Type	Capacity (Firm MW)
Coal/Petcoke	1,247
Natural Gas/Heavy Fuel Oil	321
Natural Gas Combined Cycle	147
Diesel Combustion Turbine	194
Hydro	376
NS Power Wind (firm)	5
Independent Power Producers Renewable (firm)	51
Total Existing Firm Capacity	**2,341**

3.2 Air Emissions Legislation and Regulation

Nova Scotia Greenhouse Gas Emission Regulations outline hard caps for 2010 to 2030.[7] Nova Scotia was the first jurisdiction in North America to place a "hard cap" on greenhouse gas (GHG) emissions from the electricity sector.

In September 2012, the Federal Government released its regulations for coal-fired electricity generators to come into force in 2015. The regulations would require coal-fired units to meet a GHG emissions standard of 420 t CO_2/GWh or to be retired at the end of their useful life, approximately 50 years from commissioning.[8] In September 2012, the Federal and Provincial governments released a draft equivalency agreement.[9] In June 2014, Environment Canada posted the draft Order authorizing the GHG Equivalency in the federal Gazette Part 1. Once finalized, likely in early 2015, the agreement will ensure provincial regulations will apply in Nova Scotia and electricity customers will receive the full value of the coal-fired generating facilities.

Nova Scotia Air Quality Regulations outline hard targets for SO_2, NO_x, and Hg until 2020. In June 2013, Nova Scotia Environment released a discussion paper[10] outlining emission limits for SO_2, NO_x, and Hg until 2030. The general intent for emissions reductions targets described in the discussion paper is consistent with the Department's goal of long term reductions.

[7] An Agreement on the Equivalency of Federal and Nova Scotia Regulations for the Control of Greenhouse Gas Emissions from Electricity Producers in Nova Scotia (September 2012).
[8] Canadian Environmental Protection Act, 1999, Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations.
[9] An Agreement on the Equivalency of Federal and Nova Scotia Regulations for the Control of Greenhouse Gas Emissions from Electricity Producers in Nova Scotia (September 2012).
[10] Amendments to Greenhouse Gas & Air Quality Emissions Regulations Discussion Paper (NSE, June 2013).

3.3 Renewable Electricity Standards

Nova Scotia Renewable Electricity Regulations outline the Renewable Electricity Standards. The Renewable Electricity Standards are summarized below:

- As of 2014, at least 10 percent of net sales must be generated by renewable electricity, of which 5 percent can be owned by NS Power (not including NS Power owned renewables built prior to 2001).

- As of 2015, at least 25 percent of net sales must be generated by renewable electricity, of which at least 5 percent plus an additional 300 GWh must be supplied by IPPs. The additional generation may be supplied by the feed-in-tariff program, facilities owned by NS Power, or other sources of renewables. NS Power can only supply 150 GWh or less from co-firing biomass.

- As of 2020, at least 40 percent of net sales must be generated by renewable electricity, of which at least 5 percent plus an additional 300 GWh must be supplied by IPPs. The additional generation may be supplied by the feed-in-tariff program, distribution connected generators, up to 150 GWh of biomass co-firing, other NS Power-owned facilities, or other sources of renewables, as well as 20 percent of the generation produced at the Muskrat Falls facility currently under construction.

- In addition, there is also a requirement to procure or generate 260 GWh of firm renewable electricity in 2013 and 350 GWh of firm renewables in 2014 and subsequent years. The regulatory definition of firm indicates this generation must be from sources commissioned after December 31, 2001, of which the Port Hawkesbury Biomass facility would apply.

3.4 The Maritime Link

On July 22, 2013, the UARB concluded that the Maritime Link was the lowest long term cost alternative for electricity supply for Nova Scotia in accordance with section 5.1 of the Maritime Link Regulations. However, the UARB concluded that this was only the case if customers had access to market-priced energy.[11] Subsequently, NSP Maritime Link (NSPML) negotiated an Energy Access Agreement with Nalcor to ensure that Nova Scotians have access to market priced energy flowing through the province from the Maritime Link. NSPML then submitted a Compliance Filing to the UARB and final approval was given to the Maritime Link on November 29, 2013.

The Maritime Link is a 500 MW high voltage direct current (HVDC) cable that will bring energy from the Muskrat Falls Hydro project in Newfoundland and Labrador through Nova Scotia. There are several different components to the energy available from the Link. First is the Nova Scotia Block of approximately 0.9 TWh annually (153MW firm capacity 16 hours/day), which is essentially 20 percent of the Muskrat Falls output adjusted for line losses over a 35 year period. NS Power also receives a Supplemental Energy Block of approximately 0.24 TWh annually for the first five years of operation delivered in the overnight hours of November through March. Nova Scotians will also have access to an average of 1.2 TWh of market priced energy annually under this agreement and Nalcor has agreed to bid its forecast of up to 1.8 TWh of energy annually, meaning that Nova Scotians will have the opportunity to bid on the full forecast.

When combined with the Nova Scotia Block, the Maritime Link has the potential to provide 2.6 TWh of Nova Scotia's annual energy requirement for beyond the length of the IRP planning period. The Link is currently scheduled to come online in late 2017 and is a crucial tool for NS Power to meet its 2020 environmental obligations. In addition to

[11] Market priced energy is energy priced off of the New England Market at Mass Hub plus applicable transmission, if any, as outlined in slides 60-62 of the Final Assumptions – Appendix B.

providing energy, the Maritime Link also provides enhanced interconnection and opportunities for better regional system cooperation.

3.5 Demand Side Management

~~Changes to electricity efficiency legislation in Nova Scotia have impacted the analysis of DSM in the 2014 IRP.~~ In order to better integrate DSM within the Candidate Resource Plan model NS Power used various pre-determined levels of DSM which will inform the process of contracting with the DSM franchisee contemplated in the revised regulations. Efficiency Nova Scotia Corp (ENSC) provided the DSM profiles utilized in this planning exercise through a Potential Study undertaken on their behalf by Navigant Consulting, Inc. The Company communicated this approach in its April 11 memo to stakeholders[12] that accompanied the final assumptions:

> On April 7, 2014, the Province of Nova Scotia introduced Bill No. 41, Electricity Efficiency and Conservation Restructuring (2014) Act.[13] The Act, when passed, and the Regulations to be made thereunder, represent a significant shift in the approach to DSM in the Province. Just as the IRP is not a regulatory process that determines NS Power's capital spend or revenue requirements, the IRP is not a regulatory process to determine a DSM supplier's level, programs or evaluation tests. The proposed legislation requires NS Power to undertake cost-effective electricity efficiency and conservation activities that are reasonably available in an effort to reduce costs for its customers.[14] It provides that in order to meet this obligation NS Power must contract with the government's approved franchise holder for the supply of efficiency and conservation programs, and that such agreement must be approved by the UARB.[15] The Board shall approve NS Power's agreement with the franchise holder if it is satisfied that the conservation and efficiency activities that are the subject of the agreement are in the best interests of customers.[16] The Board's assessment of the proposed electricity efficiency and conservation

[12] Please refer to Appendix F.
[13] Bill 41, *Electricity Efficiency and Conservation Restructuring (2014) Act*, 1st Sess., 62nd General Assembly, Nova Scotia, 2014 (First Reading: April 7, 2014).
[14] Ibid, s. 79(I)(1).
[15] Ibid, s. 79(I)(2)(a).
[16] Ibid, s. 79(L)(8).

> activities for the purpose of the approval must take into account their affordability to Nova Scotia Power Incorporated's customers, along with any other matters considered appropriate by the Board or as may be prescribed.[17]

Given the above, NS Power anticipates that the assessment of cost effective DSM potential will require evaluation as part of a regulatory process ~~as part of or in anticipation of the proceedings~~ to approve NS Power's agreements with the efficiency and conservation franchise holder in the future.

3.6 Wind Energy

Wind energy variability is reflected in the Strategist model by one representative week per month compression of observed wind generation shapes. Two other assumptions regarding wind generation which need to be specified in the model are:

1. Capacity value of wind
2. Integration costs of wind

With significant quantity of wind generation on the system, capacity value or Effective Load Carrying Capacity (ELCC) of wind generation is a crucial assumption. If ELCC is assumed to be too high, it can erode system reliability by having too high a contribution of wind generation to the planning reserve margin. If ELCC is assumed to be too low, the assumption may drive unnecessary investment in firm capacity in order to meet planning reserve margin.

ELCC of wind was calculated by GE Energy in the Renewable Energy Integration study commissioned by NS Power and published in June 2013. GE Energy used the Loss of Load Expectation (LOLE) methodology to calculate the capacity value of wind, based on a 2006 year wind-load data set which was developed by AWS Truepower from location

[17] Ibid, s. 79(L)(9).

specific wind speed measurements. GE Energy calculated ELCC of wind to be 27 percent at approximately 585 MW of wind generation on the system, representing the presently built and committed wind generation in Nova Scotia.

Subsequent to publishing the NS Renewable Energy Integration study, GE Energy identified shortcomings with the LOLE methodology based on a single year's wind-load data pair. When used on a single year load-wind data set, the LOLE methodology can yield unreliable conclusions due to widely varying ELCC figures from year to year.

GE Energy's subsequent March 2014 analysis of PJM ELCC of wind calculation based on three years of data, showed widely ranging results of between 8 percent and 44 percent. Please refer to Appendix O (PJM Renewable Integration Study), page 22, figure 1-11.

Another example of the same concern with LOLE methodology is the MISO 2014 Wind Capacity Credit Report which shows ELCC of wind based on 9 years of wind-load data, ranging from 3 percent to 18 percent. Please refer to Appendix P (MISO 2014 Wind Capacity Credit Report), page 8, figure 2-3.

The graph from MISO report, containing 8 years of wind-load data, was also used by Synapse in their Technical Training document Session 2: Best and Worst Practices in IRP and CPCN, in August 2013. Please refer to Appendix Q, page 40.

As the industry continues to address the planning questions raised by the integration of variable generation, some approaches like the single wind-load data set ELCC calculation employed by GE Energy in the NS Renewable Energy Integration Study are refined to improve the information provided to system planners and operators.

Due to time constraints, the Company was unable to complete a multi-year LOLE study in order to assess the reliability of LOLE methodology and inform a conclusive selection of ELCC of wind based on LOLE methodology.

NS Power conducted a single year LOLE study in order to validate GE Energy results and a Cumulative Frequency Analysis study which showed ELCC of wind generation ranging from four to sixteen percent, depending on the level of confidence.[18] Based on the referenced studies, NS Power chose ELCC of wind generation to be 12 percent. In subsequent discussions with Synapse, the Company and Synapse agreed to use 17 percent ELCC of wind for the purpose of this IRP exercise.

3.6.1 NRIS vs. ERIS Interconnected Wind Generation Resources

For the 2014 IRP study simulations, wind generators connected under Network Resource Interconnection Service (NRIS) were assumed to have a firm capacity value of 17 percent, while the wind generators connected under Energy Resource Interconnection Service (ERIS): Nuttby Mountain, Dalhousie Mountain and Glen Dhu, were assumed to have no firm capacity, until further studies can be conducted by the System Operator. All future wind generation additions up to the contracted 582 MW were assumed to be connected under NRIS and thus have firm capacity value of 17 percent. The decision to treat wind generating resources connected under ERIS as having no firm capacity was consistent with NS Power's planning approach.

In order to avoid undue influence of the capacity value of wind selection on the IRP results, an optimistic capacity value of wind was studied under:

- A separate CRP dedicated to optimistic capacity value of wind: CRP-9 WIND CAP
- An optimistic Wind Cost/Output sensitivity across all CRPs

[18] Please refer to Appendix C.

The subject of capacity value of ERIS resources is further discussed in Section 6.4.6.

3.6.2 Medium and High Wind ELCC Assumptions

The capacity value of incremental wind additions were taken from the 2013 GE Energy Renewable Energy Integration Study report and were also tested with the Optimistic Wind Cost/Output sensitivity.

3.6.3 Wind Integration Costs

Integration costs of a significant quantity of wind generation show up in four major system assumptions:

1. Effect on generating fleet efficiency

The costs of wind energy integration reflected in suboptimal hydro fleet dispatch and deterioration of thermal system heat rates were modeled implicitly in Strategist. Additional generating unit start and stops and associated wear and tear were not reflected in the model.

2. Wind generation curtailment and uneconomic exports

Strategist does not model wind curtailment. Rather than expressing the costs associated with wind curtailment explicitly and providing it to the Strategist model as an assumption, wind curtailment costs were not modeled, due to the possibility of unduly penalizing wind generation.

3. Additional system reserve requirement

Additional reserve requirement associated with incremental additions of wind generation is not yet known to a sufficient degree for the assumption to be included in the IRP. No additional reserve was assumed for incremental wind additions.

4. Additional system upgrades to maintain system stability and security

Wind integration costs of incremental wind additions beyond the presently-installed and committed wind generation associated with system upgrades required to securely integrate further quantities of wind were modeled as an explicit cost associated with each incremental 150 MW wind generation block. Please refer to Appendix D for details.

4.0 ASSUMPTIONS & ANALYSIS PLAN DEVELOPMENT

4.1 Introduction

In its Terms of Reference, the Company put forward a timeline for the IRP to meet the directive of the UARB to submit a draft final report for September 30, 2014. That timeline included the following steps for the development of assumptions and the Analysis Plan:

1. Develop criteria for evaluation of various plans and selection of a Preferred Resource Plan.

2. Identify the major input assumptions which will drive evaluation and selection of the Preferred Resource Plan.

3. Evaluation of potential resource plans.

4. Select Preferred Resource plan and Develop Action Plan.

5. Prepare final report and Action Plan. File with UARB.

On March 7, 2014, NS Power hosted a Technical Conference for participants at which it reviewed initial draft assumptions and discussed its preliminary thoughts on the Analysis Plan for the 2014 Integrated Resource Plan (IRP) to obtain feedback from participants. Final assumptions were developed based on stakeholder feedback and circulated on April 11, with additional final assumptions for wind capacity value and variable generation integration costs circulated on April 23 and May 1 respectively. Please refer to Appendices B, C and D for the detailed slide decks of final assumptions.

4.2 Assumptions & Analysis Plan

On March 14, 2014, NS Power circulated draft basic assumptions for feedback. The Company also circulated additional assumptions details in response to requests from Larry Hughes, PhD., the Industrial Group and the Nova Scotia Department of Energy. The March 14 material included a memo[19] describing the 5 steps listed above that NS Power suggested for the Analysis Plan. That memo contained the following description of the Analysis Plan:

> The Analysis Plan strives to;
>
> i. identify candidate resource plans, including the least cost plan under the Reference World
> ii. identify a reasonable range of foreseeable futures,
> iii. evaluate the candidate plans including least cost plans across that range of futures and
> iv. select the Preferred Resource Plan.
>
> NS Power has developed the following analysis plan in line with IRP best practices and will continue to refine its plan based on feedback from Synapse and Stakeholders. The Company suggests the 5 following steps:
>
> **1. Candidate Resource Plans**
>
> a. Develop a set of candidate resource plans under the Reference World. Begin with a broad range of draft resource plans, each developed based on existing resources and high-level screening of possible resource options.
> b. Optimize each draft resource plan under the Reference World using Strategist. The optimizations would include the resource options that pass the high level screening. The results from Strategist will be candidate resource plans. The results will indicate the relative cost of each resource plan.
>
> **2. Candidate Resource Plan Evaluation**
>
> a. Run sensitivity tests under the Reference World on each candidate resource plan from step 1. Strategist may need to re-optimize certain of the resource plans under certain of

[19] Please refer to Appendix E – NS Power memo to stakeholders re: Analysis Plan.

the sensitivity tests in order for those plans to meet all reliability and regulatory constraints.

3. Scenario Testing ("Worlds" Development)

a. Develop additional "Worlds" and sensitivities for further evaluation of the candidate resource plans (a World is a combination of key assumptions and constraints). This step includes Worlds of interest to NSPI, Synapse and Stakeholders.

4. Evaluation and Optimization

a. Evaluate the candidate resource plans from step 1 under the different Worlds and sensitivities. Strategist may need to re-optimize certain of the resource plans under certain of the different Worlds in order for those plans to meet all reliability and regulatory constraints.

b. The results will indicate the expected relative cost of each resource plan.

5. Preferred Resource Plan Development

a. Evaluate performance of resource plans across Worlds and select Preferred Resource Plan.

At this point NS Power will have tested and optimized a number of candidate resource plans across a range of foreseeable futures, i.e. "Worlds" based on stakeholder feedback and consultation with Synapse. NS Power would select its Preferred Resource Plan from among those candidate plans. The Preferred Resource Plan should have the flexibility to enable NS Power to meet customer demand and energy requirements, and environmental obligations in a cost-effective, safe and reliable manner across a reasonable range of foreseeable futures. This should enable development of an Action plan for the next 5 years that reflects the type of "course corrections" that may be required depending on how the world (e.g., net load, emissions targets, RES requirements) unfolds.[20]

On April 11, 2014, based on stakeholder feedback on the draft assumptions, NS Power supplied Intervenors with the final assumptions for the 2014 IRP developed in collaboration with UARB Staff and their consultants.[21] In addition, the Company provided detailed feedback on Intervenor comments on the assumptions with its April 11

[20] Appendix E - NS Power Memo to Stakeholders, March 14, 2014.
[21] Please refer to Appendix B.

submission. Please refer to Appendices F and G for NS Power's response to stakeholder feedback. Intervenors were also given the opportunity to comment on final assumptions not provided with the April 11 package (capacity value of wind and variable generation integration costs). The April 11 memo[22] included a brief discussion of NS Power's proposed approach to completing the Analysis Plan, specifically to model a limited number of Candidate Resource Plans, sensitivities and Worlds that bound the wide range of possible permutations and combinations that have been suggested. The Company committed to meeting to discuss the Analysis Plan with stakeholders throughout the modeling phase of the IRP. NS Power held a meeting for customer representatives at its offices on June 4, 2014 and ENSC on June 20, 2014 to discuss progress on the Analysis Plan in advance of the scheduled June 25 Technical Conference. The Company provided an Analysis Plan status update in its memo of June 5, 2014.[23] The Company also made all IRP information publically available on its website at the following address:

http://www.nspower.ca/en/home/about-us/electricity-rates-and-regulations/regulatory-initiatives/IRP.aspx

On June 25, 2014 the Company hosted its second Technical Conference[24] with stakeholders. The goal of the consultation was to discuss the Analysis Plan as well as preliminary results.

4.3 Candidate Resource Plans

The Candidate Resource Plan component of the 2014 IRP was a change from previous IRP practices. NS Power discussed how CRPs were selected in its update memo to stakeholders on July 30, 2014.[25] Candidate Resource Plans are potential IRP plans for further examination through Strategist modeling and sensitivity analysis. Key

[22] Please refer to Appendix F.
[23] Please refer to Appendix H.
[24] Please refer to Appendix I for the presentation materials from the Technical Conference.
[25] Please refer to Appendix J.

assumptions are modified to establish different Candidate Resource Plans modifications. The following excerpt from the July 30, 2014 memo elaborates on how CRPs were selected:

> ***Basis for selection of initial Candidate Resource Plans (CRPs) from 30 draft resource plans***
>
> The initial Candidate Resource Plans were selected from the 30 draft resource plans based on the goal of developing a set of CRPs that span a reasonable range of plausible resource choices (the IRP Terms of Reference at page 3 specify that NS Power is to assess "a reasonable, but not unlimited, number of alternative plans"). The sequence in which NS Power made this selection, and the criteria it considered at each stage of the sequence, is summarized below:
>
> - NS Power, in collaboration with UARB staff and consultants, began by identifying 30 draft resource plans (see Attachment 1 to June 5, 2014 memo to stakeholders). Each draft resource plan began with the existing resources and resource commitments in effect as of 2015. Those draft resource plans differed in terms of four major input variables/components that were expected to have the potential to significantly change the results of the plan (e.g. revenue requirements, robustness). Those four key input variables/components were: DSM level, variable generation level (e.g. wind), fossil unit retirement dates (coal, Tufts Cove) and potential for a large Power Purchase Agreement (PPA) – please refer to the June 5th memo to stakeholders and its Attachment 2, slide 12.
>
> - NS Power then identified five of the 30 draft resource plans to model in Strategist as initial CRPs under the Reference World. The initial CRPs were selected to begin developing a set of CRPs that spanned a reasonable range of plausible, and materially different, resource choices. They were selected to reflect three different levels of DSM, two levels of variable generation (e.g. wind), and two levels of coal retirements. NS Power expected that the results from modelling these five initial CRPs would help it determine which of the remaining draft resource plans it would need to model in order to evaluate a reasonable range of plausible, and materially different, CRPs and which it would not need to model because they would not produce materially different results.

- Based upon the results of modelling the initial five CRPs and upon further examination of the components that can most affect the results of CRPs, NS Power has identified an additional 11 initial CRPs to model under the Reference World. These 11 additional CRPS are included in the list of CRPs described earlier in this memo. These additional initial CRPs were again selected as part of the process to develop a set of CRPs that span a reasonable range of plausible, and materially different, resource choices. The additional 11 CRPs reflect higher levels of wind, earlier coal plant retirement and different DSM levels. They complement the initial five CRPs by representing a further range of differences in levels of DSM, variable generation, levels of coal retirements, Demand response levels, Tufts Cove unit retirements and repowering and PPAs. The Company has also identified two additional CRPs to be modelled under the High Load World.[26]

In total the Company used Strategist to optimize the following 16 resource plans:

CRP	DSM	WIND	COAL
World 1 - REFERENCE			
CRP1-1-FGD	50% of LOW	BASE	MAX
CRP2-1	BASE	BASE	MAX
CRP2-17-FGD	BASE	BASE	MAX
CRP3-1	BASE	MED	MAX
CRP4-1	BASE	BASE	MED
CRP4-1-FGD	BASE	BASE	MED
CRP5-1	HIGH	BASE	MAX
CRP6-1	HIGH	HIGH	MIN
CRP7-1	HIGH	MED	MIN
CRP8-1	BASE	HIGH	MIN
CRP9-1	BASE	MED	MIN
CRP9WC	BASE	MED (Optimistic Capacity Credit)	MIN
CRP10-1	BASE	MED	MED
CRP31-1	BASE - 50% Peak 100% Energy	MED	MAX
World 2- HIGH LOAD			
CRP21-1 (FGD WIND)	BASE	MED (Optimize)	MAX
CRP32-1 (FGD PPA)	BASE -50% Peak 100% Energy	MED (Optimize)	MAX

Max Retirement Strategy
Med Retirement Strategy
Min Retirement Strategy
Max Retirement Strategy - High Load

[26] Appendix J - NS Power Memo to IRP Stakeholders, July 30, 2014.

Note: Maximum retirement strategy indicates the Company plans to maximize utilization of the units to a 60 year life span. Medium is between 50 and 55 years and Minimum is around a 40 year life before retirement. Please refer to Appendix J, pages 15 to 16 for details on the retirement strategies assumptions.

4.4 Sensitivity Analysis

In addition to a broad range of initial resource plans NS Power ran a significant number of sensitivity analyses leading to 76 re-dispatch simulations of the various CRPs:

- Scenario B emissions – hold emissions at currently legislated levels
- Scenario C emissions – Reduce CO_2 emissions to 2.25 MT by 2040 and associated co-benefits
- High Natural Gas and High Import Power pricing
- Low Natural Gas and Low Import Power pricing
- Low International Price of High Sulphur Coal
- High International Price of High Sulphur Coal
- Optimistic Wind – low cost, high output wind

4.5 Plan Evaluation

Based on the output from the Strategist modeling, NS Power in collaboration with Synapse and consultation with stakeholders analyzed the results against the following criterion:

- *NPV*: Cross-section of near and long term NPVs including end effects NPVs
- *Rate Effects*: Relative time-series revenue requirements
- *Future Regulatory emissions outlook*: Results of sensitivity tests
- *Risk*: Relative complexity and risks inherent in CRPs
- *Flexibility*: Diversity of technological solutions

- *Robustness*: Results of sensitivity tests

These metrics include both qualitative and quantitative measures.

- *NPV and Rate Effects* – For the NPV and Rate Effects metrics, NS Power evaluated the NPV of the partial revenue requirements for the planning period (2015 - 2039) and the shorter term NPV (2015 - 2020) from the Strategist modeling results. This provides an indication of the performance of the plans based on the ability to deliver long-term value while giving consideration to near-term affordability.

- *Future Regulatory Emissions Outlook* – For the Future Regulatory Emissions Outlook metric, the Company looked at a range of emissions constraints. For its base case (Scenario A) NS Power selected the currently proposed emissions level over the planning period; sensitivities were run comparing the impact of changing emissions to lower or higher levels and the impact on the NPVs was analyzed. As discussed in Section 5, the plan reordering based on emissions scenarios was not significant.

In terms of its assessment of the qualitative metrics listed above – Risk, Flexibility and Robustness – the Company took a higher level approach. NS Power sought to analyze the plans to ensure that, while effective from a quantitative perspective, no plan introduced imbalance from a qualitative perspective. Generally speaking, the plans performed well qualitatively; this can be seen through the sensitivity analysis discussed in the next section. The fact that there are no major outliers across the range of sensitivities speaks to the relative low-risk, robust and flexible nature of the plans.

- *Risk* – Risk takes on two dimensions in utility planning; financial risk and operational risk. Financial risks could be considered the risk that utility spending to serve forecasted customer needs proves with time to be off target, leaving the

utility and its customers exposed to greater-than-anticipated costs. In the window of the Action Plan, most CRPs have no need for investments in new capital expansion. DSM programing levels are the largest discretionary consideration faced in most of the CRPs. One perspective is that choosing not to maximize DSM spending leaves an opportunity for load reduction unattained. Conversely, DSM programming has some level of scalability, allowing for a balancing of near term cost pressure with longer-term efficiency objectives. NS Power proposes that seeking to find this balance through upcoming contracting discussions with ENSC mitigates some of the near-term financial risks. Operational risk reflects the need for the utility to have the proper mix of reliable assets to meet customer needs for capacity and energy. The NS Power system is in the midst of a major transformation away from base loaded coal to a broader mix of generation including renewables. All CRPs share much of the same operational risks in the near years. Plexos modeling indicates greater operational challenges are faced by CRPs with higher wind and lighter system load. Certain CRPs presented more complex (higher risk) solutions than others. Risk across the plans was measured relative to the plans that had the simplest and most proven solutions implemented in the near-term period. The Company considered risk over the planning period to a lesser extent, as future technology changes over the longer period create less certainty. As a result, plans demonstrating minimal incremental investment over the short term and a reliance on established technology in the longer term pass the bar.

- *Flexibility* – Nova Scotia Power's generation assets are very diverse with a capacity mix that includes: coal, petcoke, natural gas, HFO, LFO, hydro and wind. This diversity will be enhanced by the Maritime Link which brings augmented market connection. As the system evolves, modeling from this study suggests that a key focus should be to ensure that it does not become too reliant on any one supply side or demand side resource to meet its energy and capacity needs. So, plans that maintained a more diversified portfolio across the planning

period were judged favorably to plans that had a heavier reliance on one or two specific technologies. Plexos modeling indicates the interplay between some of the resource options. For example in times of heavy wind generation, system load can be a valuable tool held by a system operator to integrate variable generation. When wind becomes a large proportion of the instantaneous online generation, system operators must give consideration to power system inertia, frequency response and general stability. The ratio of wind generation to load increases through the development of new wind generation resources, but it also increases with the reduction of system load through DSM or customer load loss. Put another way, a barrier to system flexibility could be the reduction of power system load. Other flexibility considerations come from fuel options. Retiring coal generation reduces the opportunity to take advantage of possible lower coal pricing relative to natural gas in this region. Equally true are the inherent challenges in utilizing conventional steam units in variable generation integration efforts. The industry is facing the need to repurpose these units on power systems seeking to integrate greater amounts of non-dispatchable assets. Flue Gas Desulphurization opens opportunities for higher sulphur domestic fuels with security of supply, price and economic development advantages, but aggressive and early DSM spending could be seen as a flexibility measure opening up opportunities for lower load futures. However, overspending in DSM might constrain system flexibility by compounding bulk power system operational challenges that could be introduced by customer self-generation or other load loss in the future.

- *Robustness* – NS Power tested a range of sensitivities including pricing and modified emissions constraints. The results of the sensitivity runs are reflected in Section 5.5, they show that the plans move relatively uniformly across the sensitivities. For example the lower cost plans in the base case remain the lower cost plans across sensitivities and the higher cost plans in the base case remain the higher cost plans in the sensitivities. Had there been significant swings in the

plans across sensitivities, the Company would have had to further examine plan robustness.

Further discussion with stakeholders on evaluation criteria and metrics for choosing a Preferred Plan took place at the September 12 Technical Conference. The Company concluded that there are a number of plans with common attributes in the Action Plan period that should be considered as the Preferred Plan. CPR 2-1 and CRP 5-1 share a similar resource addition profile out to 2030. The level of DSM spend is the significant difference in the two plans, but modeling forecasts that neither of the CRPs have capacity additions during the proposed Action Plan period. These CRPs are robust and flexible as well as cost effective over both the planning and study periods. NS Power is proposing that the resource addition profiles from these CRPs represent the most reasonable planning path until the next IRP. DSM programming levels are to be determined in a separate regulatory process as per the legislation.

5.0 MODELING RESULTS & PREFERRED RESOURCE PLAN SELECTION

5.1 Introduction

NS Power started the Candidate Resource Plan screening process with over 30 plans under consideration. In collaboration with Synapse those plans were screened down to 16 CRPs. The selected plans represent a broad array of considerations and can reasonably be expected to represent the range of futures that should be considered to plan for the future electricity system. The main variables in planning the power system for the next 25 years were considered in the IRP; they include:

- Load
- DSM
- Unit retirements
- Fuel prices
- Wind levels

By changing these assumptions through the various CRPs and sensitivities, the Company has produced resource plans that can withstand a variety of futures at various costs. For example, if there are additional renewable requirements, the Company could choose a high wind CRP; if more DSM is needed, the Company could pick a plan with a higher DSM investment level.

Please refer to Appendix K for a summary of the CRP analysis results. The detailed modeling results are available in Appendix L. The CRP results generally shared a couple of common themes; major capacity additions before 2020 were not necessary in the most economic plans and most plans were similar in NPV over the planning period – most were within 5 percent of the lowest NPV plan. The Company examined various levels of wind additions, DSM and coal retirement dates as well as several sensitivities and High Load World CRPs. The Company's analysis of the similarity in the planning period NPV

across a number of plans is that previous resource planning has proven robust and should allow the electricity system in Nova Scotia to meet its environmental and service requirements in a cost effective manner.

Since the 2007 and 2009 IRPs, renewable integration and DSM have been successful tools to manage load and green the power system. The following table shows the significant changes to the system since the last IRP Update:

Regulatory and legislative initiatives:		
RES target set at 40% in 2020		
Legislation limiting biomass consumption in the province		
Air emissions equivalency agreement		
Demand and supply side investment:		
DSM Administrator (2008/9 – 2013)	$165 million	128 MW – 632 GWh
Tufts Cove 6 (HR with duct firing)	$93 million	49 MW
Port Hawkesbury Biomass	$209 million	45 MW – 350 GWh
Wind Energy	$308 million (NSPI)	81 MW – 256 GWh (NSPI) 447 MW – 964 GWh (IPP)
Maritime Link	$1,500 million	153 MW – 1,000 GWh
System load:		
Loss of industrial load	~165MW – 1,100 GWh	
Industrial load on load retention tariff	~185 MW – 1,050 GWh	
Fuel expense recovery:		
FAM Process instated	Deferred fuel expense: $89 million	

The modeling results from this IRP reflect the major changes to the power system since 2009. With the addition of the Maritime Link, slated to be online in late 2017, the Company is well positioned to meet its environmental targets. Results from Strategist showed compliance with RES and emissions requirements across all CRPs for the 2020 period and beyond. The plans with the lowest NPVs over the planning and study periods, CRP 2 and CRP 5, did not require capacity additions beyond the Maritime Link pre-2020 to meet emissions and RES requirements. The following table shows resource additions for all plans in the pre-2020 and post-2020 periods.

Candidate Resource Plans - Schedule of Changes to Supply-side and Demand-side Resources (Firm MWs)

	CRP1-1 FGD	CRP2-1	CRP2-17 FGD	CRP3-1	CRP4-1	CRP4-1 FGD	CRP5-1	CRP6-1	CRP7-1	CRP8-1	CRP9-1	CRP9WC*	CRP10-1	CRP31-1	CRP21-1 (FGD WIND)	CRP32-1 (FGD PPA)
Load	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	High	High
DSM Profile	Half Low	Base	Base	Base	Base	Base	High	High	High	Base	Base	Base	Base	Base 50% Peak 100% Energy	Base	Base 50% Peak 100% Energy
Wind	Base	Base	Base	Med	Base	Base	Base	High	Med	High	Med	Med	Med	Med	Med	Base
Retirement Strategy	Max	Max	Max	Max	Med	Med	Max	Min	Min	Min	Min	Min	Med	Max	Max	Max
New Resources 2015-2020																
DSM	62	156	156	156	156	156	241	241	241	156	156	156	156	80	156	80
Maritime Link	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153
DR	0	0	0	0	19	19	0	0	19	10	19	19	19	0	0	10
Mersey	15	0	0	0	0	0	0	0	0	15	15	15	15	0	15	0
Wind	0	0	0	0	0	0	0	0	0	0	0	70	0	0	18	0
PPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
PHBM	0	0	0	0	0	0	0	52	52	52	52	52	0	0	0	0
NG CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	0
NG CC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FGD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8	-8
Retirements																
Coal	-153	-153	-153	-153	-153	-153	-153	-306	-306	-306	-306	-306	-153	-153	-153	-153
NG/Oil	0	0	0	0	-81	-81	0	0	0	0	0	0	0	0	0	0
Subtotal	**77**	**156**	**156**	**156**	**94**	**94**	**241**	**140**	**159**	**80**	**89**	**158**	**190**	**80**	**280**	**182**
New Resources 2021-2039																
DSM	202	510	510	510	510	510	643	643	643	510	510	510	510	254	510	254
DR	0	0	0	0	67	67	0	0	67	52	67	67	67	0	0	52
Mersey	15	0	0	0	0	0	0	0	0	15	15	15	15	0	15	0
Wind	0	0	0	18	0	0	0	36	18	36	18	36	18	18	0	0
PPA	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHBM	52	52	52	52	0	0	52	0	0	0	0	0	52	52	45	45
NG CT	315	99	149	99	216	99	0	296	197	444	296	364	265	330	148	397
NG CC	145	0	0	0	290	145	0	0	0	0	145	0	0	145	0	145
FGD	-8	0	-8	0	0	-8	0	0	0	0	0	0	0	0	0	0
Retirements																
Coal	-303	-303	-303	-303	-614	-303	-303	-613	-613	-613	-613	-613	-614	-303	-303	-303
NG/Oil	-174	-174	-174	-174	-240	-240	-174	-174	-174	-174	-174	-174	-174	-174	-174	-174
Subtotal	**344**	**183**	**226**	**201**	**229**	**270**	**218**	**188**	**138**	**270**	**264**	**205**	**139**	**322**	**242**	**417**
Total Additional Firm Supply & Demand MW's Over Planning Period																
Total	**421**	**340**	**382**	**358**	**323**	**364**	**459**	**328**	**297**	**350**	**353**	**364**	**329**	**402**	**521**	**599**

Notes for Schedule of Changes to Supply-side and Demand-side Resources (Firm MWs):

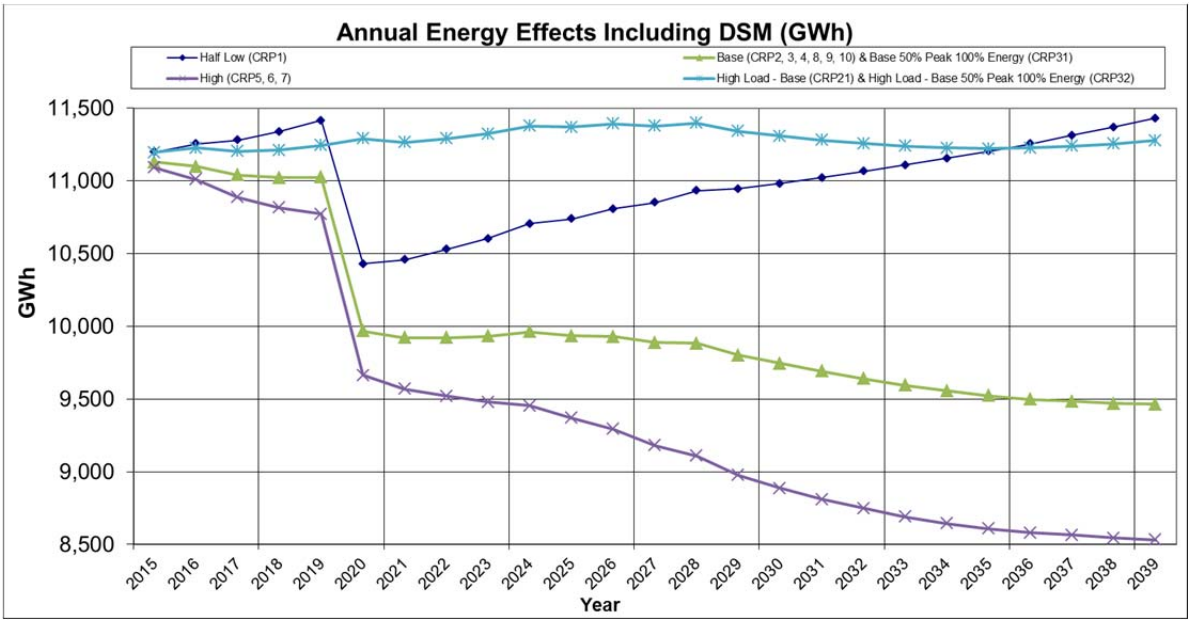
- DSM - capacity refers to reduction in firm demand (net of interruptible industrial portion)
- DR (Demand Response) - capacity refers to reduction in firm demand
- Mersey - incremental capacity upgrade
- Wind - firm contribution of incremental wind above planned and committed wind of 582 MW
  - * for CRP 9 WC the firm contribution of planned /committed wind and incremental wind was increased to 24.1 percent.
- PPA - Large non-emitting, RES compliant Purchased Power Agreement
- PHBM - PH Biomass unit is assumed to transition to a firm capacity resource upon the retirement of a second Lingan unit
- NG CT - Natural Gas Combustion Turbine
- NG CC - Natural Gas Combined Cycle
- FGD - coal retrofit with an FGD (scrubber) results in reduced capacity due to parasitic power

As indicated in the table above, apart from investment in Demand Response, incremental Mersey capacity and a change to the Port Hawkesbury biomass facility from Energy Resource Interconnection Service to Network Resource Interconnection Service, there is no call for new capacity in the next 5 years under any of the 14 CRPs for the Reference World. The resources the system needs to serve load over the near term period are in

place and available. The key variable, from a planning perspective, for the Reference World over the near term period is the level of DSM.

5.2 DSM

The range of DSM levels modeled was derived from the most recent Efficiency Nova Scotia Corporation DSM Potential Study and was intended to reflect a wide range of potential DSM outcomes. The graph below shows the various DSM impacts assumed across the CRPs. Base DSM is the base amount from the ENSC potential study, High is the amount assumed in the high case of that same study and Half Low is 50 percent of the low range of the study. Current energy savings and investment in DSM was set at $35 million for 2015, producing an energy savings of 121 GWh. This level was established by the government of Nova Scotia in the Electricity Efficiency and Conservation Restructuring (2014) Act. The investment levels for the High, Base and Half Low cases are roughly $100 million, $50 million and $25 million respectively and are reflected in the graph labelled "DSM Program Administrator Costs" on page 56.



5.3 Thermal Fleet

The CRPs with the lowest planning period NPVs (CRP 2 and CRP 2-17 FGD) both had coal retirements occurring at 60 years, demonstrating that delaying retirement of existing coal assets is the lowest cost option for customers. This is the case across all sensitivities, as can be seen from the table below, CRP 2 and CRP 2-17 consistently rank 1 and 2 in planning period NPV across the scenarios considered. 60 year retirements represent the optimal economic life of the units from the analysis of the Company's asset management team. Apart from Lingan 2 which retires when the Maritime Link comes in service, there are no scheduled coal plant retirements in the lowest NPV plans until post 2020. Such a strategy will require ongoing asset management efforts to mitigate the risks associated with the transition away from base loaded operation to more of a load-following dispatch.

These results include the NPV adders for Sustaining Capital
Study period NPV's can only be compared within the same unit retirement strategies (e.g. all maximum coal)

50% Low DSM | High DSM | Base DSM | Base DSM- 50% PEAK, 100% ENERGY | Cost unchanged from Original Case

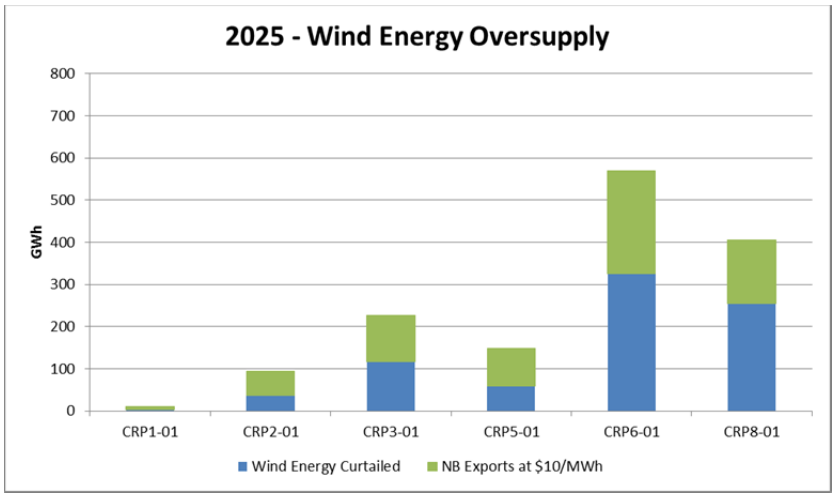
All Values in $M	Original Data		S1 - Emissions B		S2 - Emissions C		S3 - High NG & IMPORT Prices		S4 - Low NG & IMPORT Prices		S6 -Low Price High S Coal		S7- High Price High S Coal		S9- Optimistic Wind - cost -output	
CRP	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost	Planning Period Cost	Study Period Cost
World 1 - REFERENCE																
CRP1-1-FGD	$12,449	$19,774	$12,370	$19,617			$13,166	$21,288	$11,899	$18,331	$12,372	$19,600	$12,619	$20,203	$12,449	$19,774
CRP2-1	$11,544	$17,103	$11,405	$16,802	$11,551	$17,192	$12,097	$18,216	$11,090	$15,993	$11,544	$17,103	$11,544	$17,103	$11,544	$17,103
CRP2-17-FGD	$11,530	$17,200	$11,489	$17,102	$11,580	$17,391	$11,996	$18,280	$11,157	$16,259	$11,460	$17,093	$11,704	$17,484	$11,530	$17,200
CRP3-1	$11,825	$17,419	$11,704	$17,150			$12,308	$18,392	$11,406	$16,412	$11,825	$17,419	$11,825	$17,419	$11,742	$17,199
CRP4-1	$11,736	$17,643	$11,609	$17,436	$11,743	$17,686	$12,309	$18,807	$11,253	$16,258	$11,736	$17,643	$11,736	$17,643	$11,736	$17,643
CRP4-1-FGD	$11,692	$17,469	$11,654	$17,343	$11,734	$17,594	$12,156	$18,563	$11,305	$16,401	$11,622	$17,326	$11,863	$17,713	$11,692	$17,469
CRP5-1	$12,125	$17,076	$12,027	$16,849			$12,548	$17,900	$11,746	$16,185	$12,125	$17,076	$12,125	$17,076	$12,125	$17,076
CRP6-1	$12,638	$17,829	$12,617	$17,808	$12,638	$17,829	$13,110	$18,735	$12,264	$16,965	$12,638	$17,829	$12,638	$17,829	$12,478	$17,405
CRP7-1	$12,512	$17,666	$12,479	$17,633			$13,016	$18,653	$12,108	$16,727	$12,512	$17,666	$12,512	$17,666	$12,430	$17,452
CRP8-1	$12,240	$18,095	$12,205	$18,059	$12,240	$18,095	$12,811	$19,263	$11,784	$16,991	$12,240	$18,095	$12,240	$18,095	$12,075	$17,651
CRP9-1	$12,200	$18,091	$12,158	$18,049	$12,200	$18,091	$12,824	$19,396	$11,680	$16,770	$12,200	$18,091	$12,200	$18,091	$12,117	$17,870
CRP9WC	$12,101	$17,968	$12,059	$17,926	$12,101	$17,968	$12,718	$19,281	$11,600	$16,736	$12,101	$17,968	$12,101	$17,968	$12,017	$17,742
CRP10-1	$12,000	$17,731	$11,904	$17,566			$12,490	$18,733	$11,576	$16,694	$12,000	$17,731	$12,000	$17,731	$11,919	$17,515
CRP31-1	$11,934	$17,831	$11,815	$17,563			$12,424	$18,822	$11,505	$16,690	$11,934	$17,831	$11,934	$17,831	$11,856	$17,620
World 2- HIGH LOAD																
CRP21-1 (FGD	$13,071	$19,852	$12,990	$19,712	$13,157	$20,289	$13,706	$21,267	$12,593	$18,690	$12,962	$19,685	$13,322	$20,246	$12,979	$19,624
CRP32-1 (FGD PPA)	$13,256	$20,585	$13,166	$20,389			$14,056	$22,161	$12,697	$19,067	$13,143	$20,371	$13,508	$21,084	$13,256	$20,585

What can also be seen from the table above is that in several cases, and in the High Load World, flue gas desulphurization (FGD) technology appears to be an economic investment. FGD is an emission control technology fitted to the coal fired generating units to remove most of the sulphur dioxide from boiler flue gases prior to release to the atmosphere. Utilization of FGD technology allows for the combustion of generally high sulphur, lower cost fuels (coal and petcoke). This could introduce the opportunity of

domestic high sulphur coals, provided that the source presented a cost effective option. The Company is proposing to study this further in the context of solid fuel pricing as part of its Action Plan. As can be seen in the schedule of changes to supply, there are capacity additions in the high load scenarios before 2020 and the Company anticipates that if energy demand or peak demand exceed the base levels forecast or DSM does not perform then capacity additions either via a PPA or natural gas combustion turbines may be necessary.

5.4 Renewables

Several different levels of renewable generation were assumed in the IRP: existing and committed wind generation of 582 MW (Base), and two incremental levels of wind addition bring the installed total to 750 MW (Medium) and 900 MW (High). Assumptions included incremental capital investments for system reliability to manage wind cases of 750 MW and 900 MW. Plexos modeling was used to evaluate dispatch and operating challenges associated with some of the selected CRPs. This work revealed that wind generation above base levels[27] when combined with significant DSM programing could result in significant uneconomic exports and wind curtailments.



[27] Base levels are the 582 MW currently planned or under development and included in slide 34 of the presentation given at the June 25, 2014 Technical Conference.

The Company continues to gain firsthand experience with the integration of wind generation on the power system. Accordingly, the Company proposes to report on the ongoing integration experience of variable renewable generation as part of its Action Plan.

The basic assumptions also called for the Mersey system redevelopment as a feature that was included across all plans. Strategist was then given the option to select 2 blocks of 15 MW capacity additions associated with the Mersey system upgrades, as when the refurbishment occurs it has been estimated that there could be a capacity increase of 30 MW.

The Maritime Link is scheduled to come online in the first 5 years of the IRP. The Company has a number of transmission projects related to the Maritime Link that will be implemented prior to the completion of the Link. NS Power also expects that the Link will bring opportunities for enhanced regional coordination and integration. This enhanced interconnection will also enable better access to markets for imports and exports.

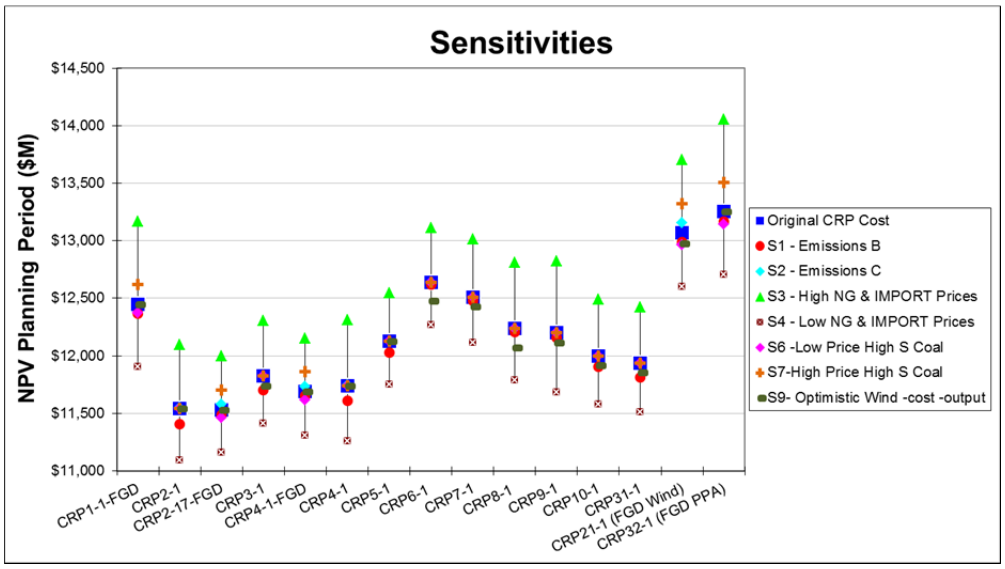
5.5 Sensitivities and Worlds

Nova Scotia Power ran the following sensitivities:

- Deeper emissions cuts
- Less emissions cuts
- High natural gas, high import power pricing
- Low natural gas, low import power price
- No Demand Response Programs
- Low international price for high sulphur coal
- High international price for high sulphur coal

- Low cost, high output wind

The whisker graph below shows that CRPs performed similarly across the various sensitivities. This shows that the resource mix for supplying the Nova Scotia system is robust. The diversified portfolio of options includes; coal, natural gas, oil, biomass, hydro, wind, Maritime Link and DSM. Having such a diversified system provides a natural hedge so if one commodity spikes there isn't necessarily a system wide impact.



5.6 Evaluation of Alternative CRPs

NS Power evaluated the suite of CRPs using planning period NPV and rate impact as the primary criteria to judge the various plans. However the Company also considered Risk, Flexibility, Robustness and Future Regulatory Emissions Outlook as qualitative screens to ensure that the chosen path could maintain the characteristics of previous IRPs and be a "no regrets" solution.

The various DSM profiles result in a range of nearly 3,000 GWh by the end of the study period, roughly 25 percent of the annual energy in the high load case. There is also a significant difference in the NPVs, and therefore potentially the revenue requirements, of

the various DSM profiles over the short, medium and long terms respectively. The following table shows the NPVs of all plans across 4 periods.

- to 2020 (5 years)
- to 2030 (15 years)
- to 2039 (Planning Period)
- beyond 2039 (Study Period)

	CRP1-1 FGD	CRP2-1	CRP2-17 FGD	CRP3-1	CRP4-1	CRP4-1 FGD	CRP5-1	CRP6-1	CRP7-1	CRP8-1	CRP9-1	CRP9WC	CRP10-1	CRP31-1	* CRP21-1 (FGD WIND)	* CRP32-1 (FGD PPA)
Load	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	High	High
DSM Profile	Half Low	Base	Base	Base	Base	Base	High	High	High	Base	Base	Base	Base	Base 50% Peak 100% Energy	Base	Base 50% Peak 100% Energy
Wind	Base	Base	Base	Med	Base	Base	Base	High	Med	High	Med	Med	Med	Med	Med	Base
Retirement Strategy	Max	Max	Max	Max	Med	Med	Max	Min	Min	Min	Min	Min	Med	Max	Max	Max
TRC $ M																
NPV 2020	$3,907	$4,049	$4,049	$4,049	$4,065	$4,065	$4,491	$4,489	$4,507	$4,062	$4,072	$4,072	$4,075	$4,050	$4,194	$4,195
NPV 2030	$9,025	$8,777	$8,780	$8,959	$8,836	$8,838	$9,547	$9,864	$9,790	$9,203	$9,182	$9,113	$9,063	$8,963	$9,764	$9,761
Planning Period	$12,449	$11,544	$11,530	$11,825	$11,737	$11,693	$12,125	$12,638	$12,512	$12,240	$12,200	$12,101	$12,000	$11,933	$13,070	$13,256
**** Study Period**	$19,775	$17,103	$17,201	$17,419	$17,643	$17,469	$17,076	$17,829	$17,666	$18,095	$18,091	$17,968	$17,731	$17,831	$19,851	$20,585
TRC Rank																
NPV 2020	1	3	2	3	7	7	13	12	14	6	9	9	11	5	1	2
NPV 2030	7	1	2	5	3	4	12	14	13	11	10	9	8	6	2	1
Planning Period	12	2	1	5	4	3	9	14	13	11	10	8	7	6	1	2
Avg. Rank	*6.7*	*2.0*	*1.7*	*4.3*	*4.7*	*4.7*	*11.3*	*13.3*	*13.3*	*9.3*	*9.7*	*8.7*	*8.7*	*5.7*	*1.25*	*1.75*
**** Study Period**	6	2	3	4	2	1	1	2	1	5	4	3	3	5	1	2
Utility Cost $ M																
NPV 2020	$3,784	$3,858	$3,857	$3,858	$3,874	$3,874	$4,054	$4,051	$4,069	$3,871	$3,880	$3,880	$3,883	$3,859	$4,002	$4,003
NPV 2030	$8,762	$8,416	$8,420	$8,599	$8,475	$8,478	$8,672	$8,989	$8,915	$8,843	$8,822	$8,753	$8,703	$8,603	$9,403	$9,401
Planning Period	$12,086	$11,069	$11,055	$11,350	$11,262	$11,218	$11,087	$11,601	$11,475	$11,765	$11,725	$11,626	$11,525	$11,458	$12,595	$12,781
**** Study Period**	$19,270	$16,471	$16,568	$16,786	$17,010	$16,836	$15,846	$16,599	$16,436	$17,462	$17,458	$17,336	$17,098	$17,198	$19,219	$19,953
Utility Cost Rank																
NPV 2020	1	3	2	3	7	7	13	12	14	6	9	9	11	5	1	2
NPV 2030	10	1	2	5	3	4	7	14	13	12	11	9	8	6	2	1
Planning Period	14	2	1	6	5	4	3	10	8	13	12	11	9	7	1	2
Avg. Rank	*8.3*	*2.0*	*1.7*	*4.7*	*5.0*	*5.0*	*7.7*	*12.0*	*11.7*	*10.3*	*10.7*	*9.7*	*9.3*	*6.0*	*1.25*	*1.75*
**** Study Period**	6	2	3	4	2	1	1	2	1	5	4	3	3	5	1	2

Max Retirement Strategy Med Retirement Strategy Min Retirement Strategy

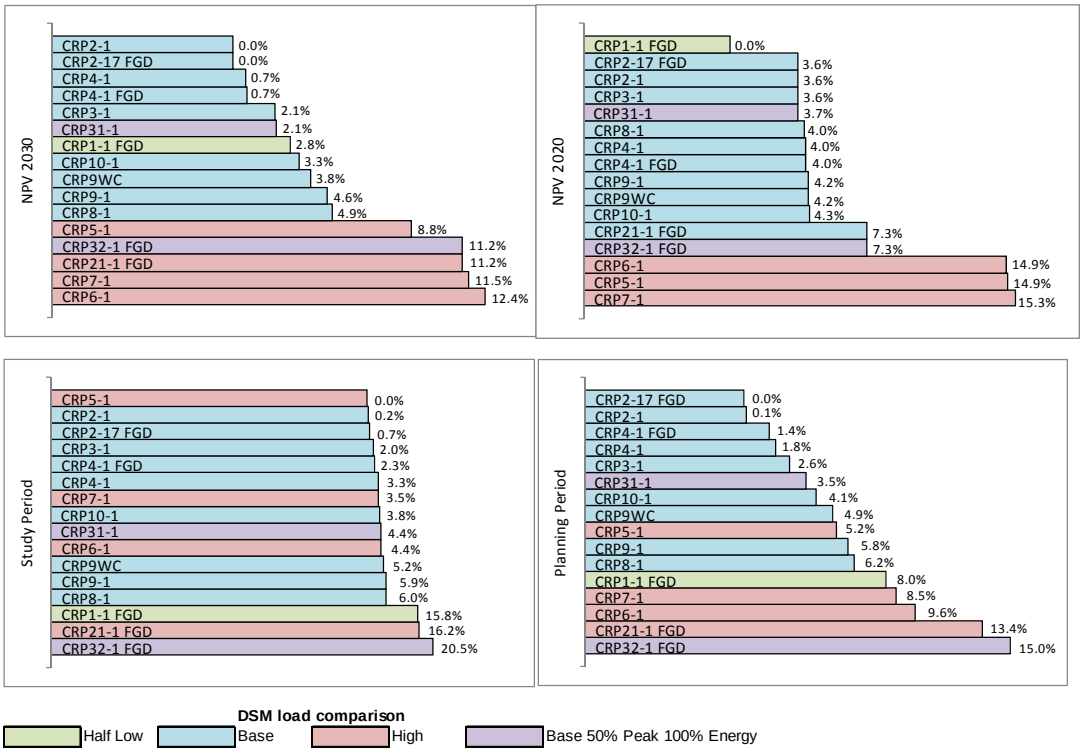
This table shows that from an NPV perspective, 4 plans with 3 different DSM profiles emerge as the low-cost plan depending on the timeframe:

- to 2020 (5 years) – CRP 1-1 FGD
- to 2030 (15 years) – CRP 2-1
- to 2039 (Planning Period) – CRP 2-17 FGD
- beyond 2039 (Study Period) – CRP 5-1

These plans share common assumptions for wind levels and retirement strategies – base wind levels and maximizing the life of NS Power's coal fleet. However, these plans vary in their DSM investment:

- CRP 1-1 FGD – 50% of low
- CRP 2-1 – Base
- CRP 2-17 FGD – Base
- CRP 5-1 – High

The following graphs show the variation in NPVs based on DSM profiles across the periods:



The percentages on the charts represent what percentage the plans' respective NPV is higher than the plan with the lowest NPV in that period. While the IRP is a long-term planning exercise, it can provide an indication of potential rate pressures for the near term

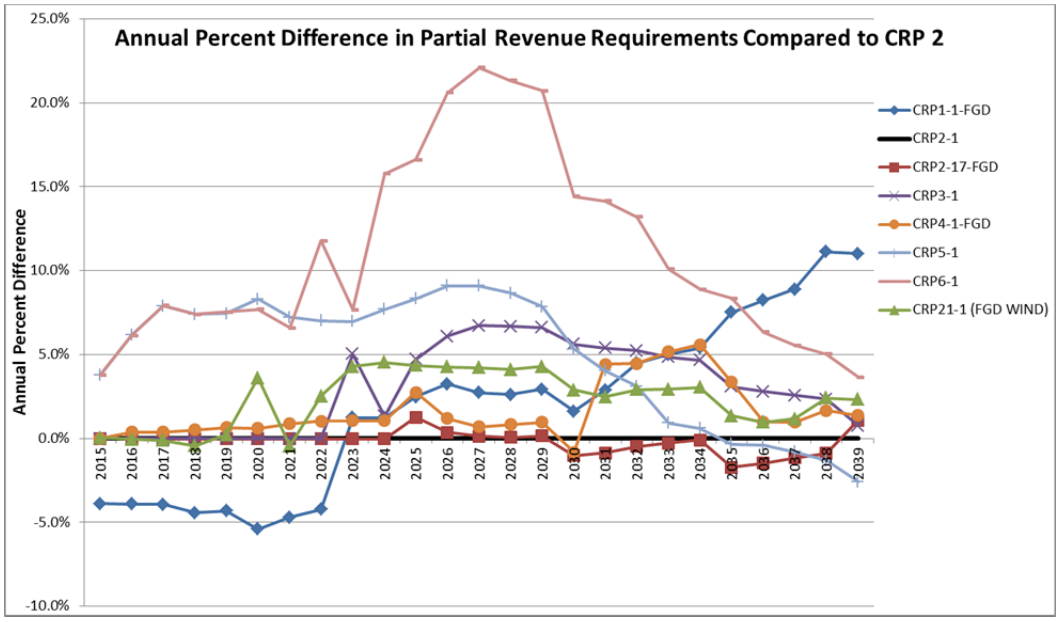
through partial revenue requirements produced by the modeling. Partial revenue requirements include the following:

- fuel and purchased power
- thermal and hydro unit O&M
- capital costs for new resources added in the CRP
- DSM program administrator costs
- sustaining capital costs for existing and new generation added in the CRP

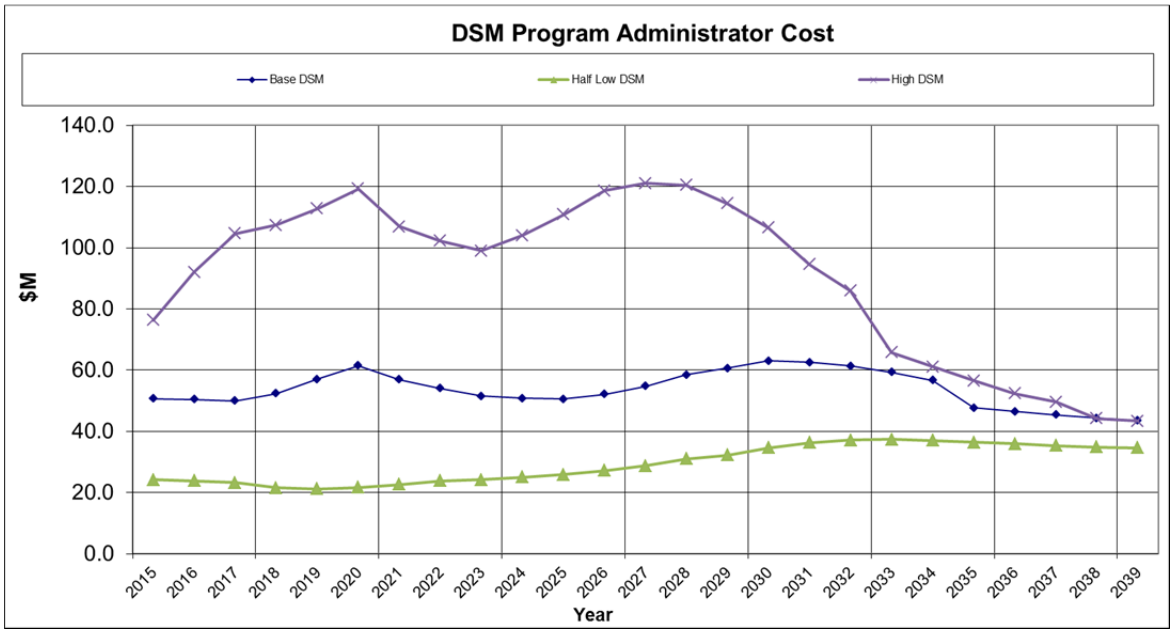
Strategist revenue requirements do not include the following:

- remaining O&M
- regulatory adjustments/amortizations,
- depreciation, interest and tax impacts for existing assets
- T&D sustaining capital cost

The following graph illustrates the revenue requirements compared against CRP 2, the lowest cost plan over the planning period:



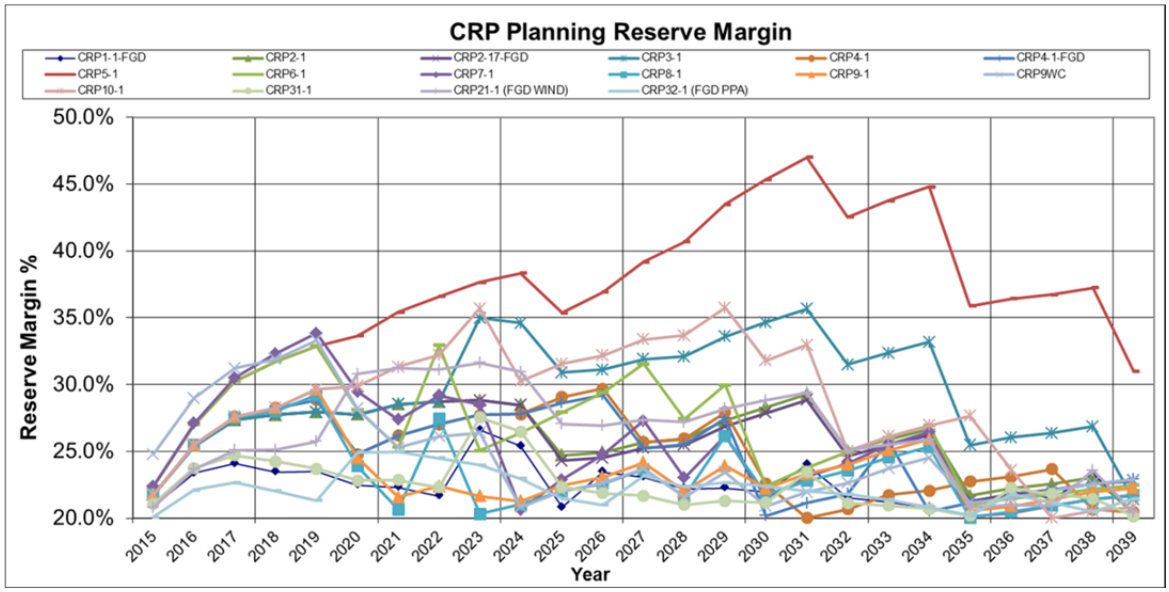
In the near-term, low DSM investment produces the lowest revenue requirement and potentially the least rate pressure. Alternatively, High DSM produces the highest revenue requirement in the near-term but the lowest in the final years of the planning period. This should be expected as the graph below shows the difference in investment in DSM between the various cases, close to $100 million in revenue requirement in some years.



As part of its Action Plan, NS Power will work with ENSC and stakeholders to determine the optimal level of DSM spend that balances short term affordability[28] with long term performance.

DSM levels in the planning period also have a significant impact on planning reserve margin. The graph below demonstrates that some CRPs have much higher levels of planning reserve margin than the 20 percent reserve margin requirement.

[28] Affordability as referenced in Bill 41, Electricity Efficiency and Conservation Restructuring (2014) Act, 1st Sess., 62nd General Assembly, Nova Scotia, 2014 (First Reading: April 7, 2014).



The Company has committed to studying levels of sustaining capital that could, if necessary, reduce the level of surplus planning reserve margin in the event of lower firm peak load. ~~NS Power will also produce a report on industry best practices regarding sustaining capital.~~ Sustaining capital as discussed in the IRP is the investment the Company makes on an annual basis to maintain over 1500 MW of firm thermal generating capacity. The estimates of sustaining capital required for the planning period were derived for the different fleet utilization strategies and expressed as a net present value of approximately $300 million dollars. Having excess planning reserve margin could mean that capacity could be retired therefore reducing the amount of sustaining capital required. But like DSM investment, discrete retirement strategies were selected for modeling and were not optimized in the CRP process. Further work will be undertaken within the Action Plan to refine and report on unit retirement forecasts.

5.7 Preferred Plan

As indicated, the IRP is a 25 year planning exercise but the various plans perform differently at different time intervals within and beyond that period. The top performing plans from a planning period NPV perspective have similar attributes – they utilize

existing coal units to their maximum lifespans, there is no incremental variable generation added and new thermal generation, if any, is natural gas combustion turbines.

The Company believes that maximizing coal plant life, not adding incremental variable generation, and a focus on affordability to be a no regrets path and has tried to reflect that in the Action Plan. So while in past IRPs the Company would have selected a certain plan to base its Action Plan on, the range of reasonable futures and therefore plans seems to have converged significantly around a strategy of minimal incremental capital expenditure, especially in the near term.

The notable exception to this trend of convergence and minimal investment is DSM. The low DSM plan has the best NPV in the near term, the base DSM plan has the best NPV in the 25 years of the planning period, and high levels of spending on DSM show the best NPV in the long term period, while exerting the highest rate pressure in the near term. The Company feels that the IRP process has identified the appropriate range of DSM to acquire over the planning period from a planning perspective. Given the Electricity Efficiency and Conservation Restructuring Act, which received Royal Assent on May 1, 2014, NS Power expects to establish the specific level of DSM to acquire during the Action Plan period in a separate proceeding. The Act calls for NS Power to contract with the electricity efficiency and conservation franchise holder over the next ten years in three year terms, the first term beginning in 2016. This will enable NS Power to work with ENSC and stakeholders to establish a proposal for the level of DSM that considers the long term benefits of DSM in conjunction with affordability considerations as outlined in its Action Plan.

6.0 ACTION PLAN

6.1 Action Plan Introduction

The intent of the Action Plan is to provide the UARB, NS Power and stakeholders with a guideline for system planning over the next five years. The Action Plan also serves to inform the next IRP by studying key findings from the analysis phase of this IRP. There are action items pertaining to DSM, renewables, regional integration, sustaining capital, transmission and capacity reserve margin.

6.2 2014 IRP Action Items

The 2014 IRP Action Plan identifies specific actions the Company will take over the next five years. Action items are based on the type and timing of resources identified in the least cost plans from analysis completed over the course of the IRP modeling, and feedback received from stakeholders throughout the IRP process. The directed actions also recognize the limitations of the modeling processes used, and reflect NS Power's understanding of additional analytical efforts required to sufficiently address certain areas of inquiry.

6.2.1 Demand Side Management

Changes to electricity efficiency legislation in Nova Scotia have impacted the analysis of DSM in the 2014 IRP. In order to evaluate DSM programming within the Candidate Resource Plan model, various pre-determined levels of DSM were used. These levels will inform the process of contracting with the DSM franchisee contemplated in the revised legislation. NS Power therefore proposes to work with ENSC and stakeholders to obtain a cost-effective and affordable level of DSM consistent with the IRP findings, to be submitted to the UARB for approval in accordance with the revised DSM legislation.

Demand Side Management Actions:

- Engage with ENSC and stakeholders to develop a three year plan and file for UARB approval: first half of 2015.

- Obtain DSM resource commitments (annual system energy and peak period capacity reductions) for the 2016-2018 period that are consistent with the IRP analysis.

- Engage with stakeholders and ENSC to monitor DSM performance and options: Q4, 2014, Q1, 2015.

- During 2015, determine whether evaluation, monitoring and verification will be sufficient to establish the savings impacts of DSM resources going forward, including commitments for the period 2016-2018.

- Pursue cost-effective Demand Response opportunities: ongoing.

6.2.2 Renewable Resources

Several different levels of renewable generation were assumed in the IRP: 582 MW (Base), 750 MW (Medium), and 900 MW (High). Wind levels above currently planned capacity additions when combined with medium and early coal retirement dates could result in uneconomic exports and additional wind curtailments. However, the IRP studies do not explicitly account for the potential of mitigating factors (such as infrastructure investment, and increased regional cooperation) to manage such concerns. Action Plan items will address this.

The Maritime Link is scheduled to come online in the first five years of the IRP. The Company has a number of transmission projects related to the Maritime Link that will be

implemented prior to the completion of the Link. NS Power also expects that the Link will bring opportunities for enhanced regional coordination and integration. This enhanced interconnection will also enable better access to markets for imports and potentially exports.

The basic assumptions also called for the Mersey system redevelopment as a feature that was included across all plans. Strategist was then given the option to select 2 blocks of 15 MW capacity additions associated with the Mersey system upgrades as when the refurbishment occurs it has been estimated that there could be a capacity increase of 30MW. As noted elsewhere, since the Strategist modeling process did not economically optimize capacity contributions from different resources, the extent to which the Mersey system increment could be a cost-effective capacity contribution to NS Power's system is still to be determined through a UARB process if the Company makes application for the upgrades.

NS Power recognizes there are challenges and opportunities over the course of the Action Plan period concerning the integration of renewable energy and proposes the following action items.

Renewable Resource Actions:

- During 2015-2016, continue to evaluate the coincidence of wind generation with peak load to better understand the capacity value of wind assets on the NS Power system.

- Monitor ongoing developments of tidal energy and report to the UARB as part of the 10 Year System Outlook Report filed annually in June.

- Complete the integration of the Maritime Link.

- Evaluate the options for Mersey Hydro System redevelopment and file an Application with the UARB, inclusive of both existing capacity and potential capacity expansions. Conduct further analysis to understand the value of incremental capacity associated with the Mersey redevelopment, accounting for the value of small-scale capacity additions, possible different thermal plant retirement paths (thus affecting the need for a Mersey increment), the flexibly dispatchable nature of a Mersey hydro increment, and the lack of emissions associated with any increase in hydro development.

- Continue to develop an understanding of the operational challenges associated with the planned increasing levels of variable generation integration and report to the UARB as part of the 10 Year System Outlook Report.

- File Renewable to Retail Tariff Application by September 1, 2015.

- Report to the UARB on the status of the need for flexible resources to integrate additional variable generation in the 10 Year System Outlook Report.

6.2.3 Regional Opportunities

The Maritime Link is scheduled to come online in 2017 and is a crucial tool for NS Power to meet its 2020 environmental obligations. In addition to providing energy, the Maritime Link also provides enhanced interconnection and opportunities for better regional system cooperation. There is also greater interconnection and cooperation possibilities with New Brunswick, the Company would like to further consider these opportunities through the Action Plan period.

The IRP modeling process did not include explicit modeling of the potential benefits of greater levels of regional cooperation, as the work focused primarily on in-province actions.

Regional Opportunities Actions:

- Monitor cost-effective market opportunities (imports and exports) as well as enhancements in regional balancing and interconnection and report on developments in the 10 Year System Outlook Report.

- During 2015, continue discussions with Newfoundland (NALCOR) and New Brunswick (New Brunswick Power) on greater regional electric system coordination.

    - Provide an annual update to the UARB.

    - Discuss need, impacts, and cost allocation associated with a second 345 kV line to New Brunswick.

    - Explore mechanisms to advance efficient regional unit commitment, dispatch, and operating reserve sharing policies.

    - Examine the effects of the operation of the Maritime Link on these issues.

6.2.4 Existing Thermal Resources

CRPs with lower planning period NPVs generally reflect "maximum coal" utilization inputs to Strategist, indicating the potential value of extending coal plant asset life in order to meet planning reserve requirements. However, since Strategist does not optimize plant retirement, the modeling results do not provide absolute clarity on the most economic retirement or plant life extension path for the thermal units.

In several cases, and in the High Load World CRPs, flue gas desulphurization appears to be an economic investment. The Company is proposing to study this further in the context of solid fuel pricing.

Over the study period CRP 5-1 had the lowest NPV; it was also competitive over the planning period. CRP 5-1 and other CRPs had excess capacity margin, as a result of the modeling technique, indicating that there may be opportunity to optimize asset management over the planning period to reduce spare capacity reserve. NS Power proposes to further study its asset management practices and sustaining capital spend within the context of the Action Plan.

Existing Thermal Resources Actions:

- Continue the thermal generation asset analysis work from the IRP process. By the end of June 2015, file an initial thermal asset management plan striving to optimize the level of sustaining capital expenditures required for the fleet of coal/oil/gas plant. Update this plan each year in the 10 Year System Outlook Report. The plan will include the following:
    - Recognition of uncertainty of many elements involved in this form of analysis.
    - Recognition of/adherence to planning reserve margin requirement and level of planning reserve surplus associated with different net firm peak load trajectories based on then-anticipated DSM peak reductions and associated net firm peak load forecast.
    - Projections of possible retirement paths for the thermal fleet.
    - Prioritization of units or plans for retention given system constraints.

- Consideration of locational value of Tufts Cove plant, and flexible operating characteristics of gas and oil-fired steam units compared to coal-fired units. There may be locational or system considerations that could give preference to sustaining capital or life extension expenditures at the Tufts Cove location compared to other plants.

- Consideration of location of other system resources, either NS Power-owned or IPP-owned, and their capacity value.

- Consideration of unit utilization forecasts and the significant driver that operating hours is for maintenance investment.

Ultimately, this Action Plan item will result in an analysis of investment plans for the existing thermal fleet given forecasted system peak and unit utilization. Based on the modeling results, high DSM plans can lead to excess planning reserve margin if no changes are made to the coal utilization path modeled; this may also be the case with base-level DSM resource commitments.

- Provide an outlook of sustaining capital expenditures for thermal assets for a five year period in the Annual Capital Expenditure Plan.

- Study the economic potential of an FGD in combination with opportunities to optimize solid fuel use.

6.2.5 Transmission and System Studies

NS Power expects regional transmission opportunities to result from the integration of the Maritime Link and subsequent improvements to the Nova Scotia transmission system. The Company will monitor and report on these opportunities during the Action Plan

period. Additional system level studies will continue to be required to assess how NS Power's changing generation asset mix, and potential regional coordination actions, will affect the need for new transmission system resources.

Transmission and System Studies Actions:

- Execute the Maritime Link transmission investments.

- During 2015 - 2020, conduct additional system studies to evaluate operations with increased levels of renewable resources that are expected over the next few years. Include investigation of system requirements with fewer steam units providing real power operations.

    - Report on the status of such efforts each year in the 10 Year System Outlook Report.

    - Use Plexos to continue to assess hourly patterns of system need and resources with respect to operation under higher levels of wind resources expected over the next few years.

    - Conduct system studies to estimate requirements to ensure reliability with levels of wind similar to those seen in CRP 7 (medium wind, ~750 MW installed capacity) and CRP 6 (high wind, ~900 MW of installed capacity).

    - Consider the effect of the presence of the Maritime Link on system operations with higher levels of wind, and/or lower levels of connected coal-fired capacity.

- Conduct system studies that evaluate the economics, stability and reliability of the system with accelerated coal unit retirements.

- Assess the type, level, cost, sequencing, and integration of transmission system reinforcement requirements that could accompany various coal plant retirement schedules. This includes the presence of additional transmission line assets or reinforcement of existing assets; the presence of dynamic and static reactive power devices including synchronous condensers (new, or conversions of existing power generators to operate in this mode); regional coordination opportunities; improved forecasting techniques; greater use of advanced wind turbine technologies with new wind; demand response resources; and any other technical innovations that would affect operations.

6.2.6 Ongoing Analysis of Value of Capacity Contribution towards Resource Adequacy Requirements

Strategist used coal plant retirement schedules as an input assumption to the modeling; it did not determine an economic optimum retirement path as this was not contemplated in the Candidate Resource Plan process. Sustaining capital needs were also evaluated outside of the Strategist environment; therefore, additional efforts are required to determine whether or not certain non-thermal capacity additions can be considered cost-effective for customers as a contribution towards resource adequacy requirements. The Candidate Resource Plan method tests characteristics but leaves some optimizations as actions. This Action Plan element summarizes the actions required to address this issue.

Capacity Contribution Actions:

- ERIS connected wind resources will be evaluated for firm capacity contribution. During 2015, NS Power will determine the extent to which ERIS resources can count as capacity towards resource adequacy during winter peak.

- As part of DSM programming, evaluate the DR resource contributions to capacity. During 2015-2020, NS Power will continue to assess the availability and potential for cost-effective Demand Response.

6.2.7 Planning Reserve Margin

NS Power maintains a planning reserve margin for system reliability purposes. NS Power's current planning reserve margin, in compliance with Northeast Power Coordinating Council (NPCC) criteria, is equal to 20 percent of firm system peak demand. Enhanced regional cooperation and variable generation integration may impact planning reserve margin over the Action Plan period. NS Power proposes to keep the Board and stakeholders advised of any such changes.

Planning Reserve Margin Actions:

- Report on the ongoing evaluation of the planning reserve margin for the power system in the 10 Year System Outlook Report.

6.2.8 Regulatory

Since the last IRP, there have been numerous regulatory and environmental changes. The Company does not expect significant additional regulatory changes; however, this remains a possibility and NS Power wants to ensure the UARB and stakeholders are informed of the impact of such changes to the IRP planning process.

Regulatory Actions:

- Monitor renewable and emissions related legislative/regulatory developments.

- Report to the UARB on legislative/regulatory changes that may have a material impact on the Action Plan – one update to be sent in Q3 2016.

6.2.9 IRP Planning and Modeling Process Improvement

IRP and Planning Process Actions:

- During 2015, create a plan for an update to the IRP process during the 2016-2018 ENSC performance period to reflect then-current performance and then-current net load forecasts for firm peak and annual energy. Report to the UARB by the end of 2015 on this.

- Review model use for the next IRP. Consider how Strategist, Plexos, and power flow modeling tools can be best utilized for the next round of integrated resource planning.

    - Strategist – analyze strengths and weaknesses.

    - Plexos – analyze strengths and weaknesses.

    - Power flow modeling tools – analyze their role in assessing capital requirements for system stability and related transmission reinforcement.

6.3 Strategic Resource Plan Decision Paths

As with all long-term planning exercises or forecasts in general, there are considerable uncertainties within the planning period. One of the goals of the IRP is to produce a path that maintains enough flexibility to allow for such uncertainty. As part of its Analysis Plan, the Company considered a number of possible deviations from the basic assumptions to enable it optionality in the event of a different planning horizon. The table below references potential triggers that could cause the Company to alter its planning path and identifies the CRPs which it would consider under such circumstances.

Trigger	2014 IRP World	Resource Plan to Consider
Higher sustained load growth	High Load World	CRP 21
High DSM performance	Reference World	CRP 5
Low DSM performance	Reference World	CRP 1
More stringent environmental requirements introduced	Reference World High Load World	CRP 2 CRP 21
Additional RES requirement	Reference World	CRP 3 (medium wind) CRP 8 (high wind)

6.4 Risk and Opportunity Analysis

The following sections outline the potential risks and opportunities that the Company envisions over the planning horizon. These are items that NS Power will continue to evaluate over the Action Plan Period and consider as part of subsequent IRPs.

6.4.1 Retirements

Early steam fleet retirement did not show significant benefit when compared to maximum steam fleet utilization. The risk associated with early steam fleet retirement is the reduced system flexibility while attempting to integrate approximately 600 MW of variable generation and significant quantity of DSM. If DSM programs do not deliver energy and peak reductions as forecasted, early steam fleet retirement scenarios will call for new capacity to be built in order to maintain system reliability.

~~We acknowledge~~NS Power acknowledges that the load-following service envisioned for many of NS Power's conventional steam units will introduce new maintenance risks that will be addressed through asset management strategies.

6.4.2 DSM

High investment in DSM in the early years poses a risk of increasing pressure on power rates in the near term, while the risk of underperformance associated with unprecedented levels of DSM may require additional investment in firm capacity, exerting further pressure on power rates.

Low investment in DSM in the early years carries the risk of missed opportunity to reduce demand and provide immediate fuel cost savings in the near term, while providing extended benefits for the life of the program.

Suboptimal investment in DSM coupled with the potential loss of industrial load poses a challenge with taking advantage of Maritime Link surplus energy and is showing higher amounts of wind energy curtailment and uneconomic exports.

6.4.3 Environmental regulations

There are no legislated environmental regulations past year 2030. In the IRP simulations, the Company extrapolated the most likely set of emissions limits based on the existing regulations, and tested two sensitivities around the base line. The risk associated with uncertain environmental regulations in the long term stresses the importance of maintaining the flexibility of the existing diverse generation fleet and planning additional supply and demand side resources as required.

While different emission sensitivities were tested this analysis was conducted with only base case fuel and energy prices and the impact of variable fuel and energy pricing on emission compliance costs was not evaluated in this IRP.

6.4.4 Flu Gas Desulphurization

More so than in the previous IRPs, FGD emerged as optimal even with the assumed relatively high price of high sulfur coal. With decreasing SO_2 emissions caps, an FGD could provide an opportunity to take advantage of low priced high sulfur coal which can help stabilize power rates and provide an attractive incentive for retention of present industrial load and even attracting new industrial customers. Due the single stack shared by two generating units configuration, Lingan power station is an ideal site for an FGD providing most value for a single installation.

The risk associated with building an FGD lies partly in the availability of sufficient quantity of relatively inexpensive high sulfur coal product, and partly in the uncertainty with CO_2 air emissions regulations in the future.

6.4.5 Resource Incompatibility and Unintended Competition

Nova Scotia climate causes the phenomenon of low overnight system demand, followed by relatively high morning demand, with significant seasonal variations. Due to system stability and security issues, minimum amount of high inertia steam generation is required to be online, which in low load periods causes wind curtailment and sub optimal utilization of Maritime Link off-peak surplus energy. Chronological hourly system simulations have shown high levels of wind curtailment and uneconomic energy exports, coupled with low utilization of Maritime Link available off-peak surplus energy, in resource plans containing additional wind generation and high levels of DSM. Investment in wind resources and DSM programs will have to be designed not to exert further downward pressure on low load periods and not to compete with Maritime Link surplus energy utilization and with each other. DSM programs may have to include demand response in order to be optimal.

6.4.6 Firm Capacity and ERIS Wind Generation

Arising from the Cost of Service proceedings was an action for NS Power to evaluate the contribution to firm capacity which is available from Energy Resource Interconnection Service (ERIS) wind projects. The concept around ERIS is that the generation interconnection customer can operate up to its full rated output only if transmission capacity is available. Under peak conditions, many transmission corridors are operating at rated transfer capacity, leaving no transmission capability available for ERIS generator and requiring a down dispatch or curtailment of that generator. Network Resource Interconnection Service generation projects are considered firm assets as transmission capacity is available at all times for the facility to deliver its full rated capacity to the power system.

On the NS Power electric power system, at the present level of wind integration, curtailment of ERIS wind projects is not frequently observed leaving the impression that

there is adequate transmission capacity to accommodate both NRIS and ERIS projects even during peak operating conditions. As most ERIS projects on the NS Power system are recently added renewable electricity generators they receive priority environmental dispatch to assist NS Power in meeting the requirements of the Nova Scotia Renewable Electricity Regulations. What often goes unnoticed is the down dispatch or the bottling of NRIS generating capacity to allow the renewable projects to operate and meet production targets. In other words, firm generation is being dispatched down in order to allow ERIS wind generation on the system, at times when all firm generation capacity is not required. On most occasions the down dispatch of firm resources has no bearing on the power system, but this does become a consideration in the planning of the contribution of these ERIS projects to firm system capacity. If ERIS projects operate on peak system conditions only when NRIS generation is restricted to accommodate the renewables, then the full capacity of the NRIS resources and the ERIS resources cannot be counted towards the system's firm capacity.

ERIS generation is considered non-firm energy under the Open Access Transmission Tariff (OATT) and an ERIS generation unit cannot be assigned as a Network Resource by a Network Service Customer as per Section III of the Tariff. Despite this, the NS Power was requested to evaluate the possible contribution to firm capacity that could be counted from ERIS wind projects.

The Nova Scotia Power System Operator (NSPSO) examined the following wind powered generation facilities which are designated ERIS on the NS Power transmission System:

- 89N-Nuttby Mountain 49.5 MW
- 91N-Dalhousie Mountain 50.0 MW
- 93N-Glen Dhu 62.0 MW

Any such evaluation is subject to power system configuration and the NSPSO examined conditions anticipated after the integration of the Maritime Link. The particulars of these system modeling assumptions are summarized in Appendix M. All design contingencies as described by NPCC and the North American Electricity Reliability Corporation (NERC) criteria were tested for the assumed system configuration. No violations of voltage, stability, or thermal overloads were found under these tested conditions for the wind projects noted above.

Accordingly it can be concluded that, given the study assumptions**,** the transmission connected ERIS wind projects considered in this study would not likely be curtailed if they are operating at 17 percent of their nameplate capacity. It is important to note that this is not a derivation of the Capacity Value of the wind which is a consideration discussed in Section 3.6 of this report. It should also be noted that this evaluation is limited to the projects studied and is not applicable to all future ERIS projects. It is also possible that if system development deviates from the conditions assumed in Appendix M that these study outcomes could change.

This analysis does not constitute the System Impact Study necessary to change the designation of any wind project from ERIS to NRIS. For these installations to be designated as Network Resource Interconnection Service (NRIS), and therefore be eligible to be counted as Network Resources, an application for NRIS would be required via the Generator Interconnection Procedures (GIP) and the appropriate procedures would be followed. This work suggests that a portion of the installed projects could be counted towards the firm system generating capacity, but it isn't clear how this could be handled within the provisions of the Tariff. NS Power is proposing an Action Plan item to determine how to work through these Tariff and GIP related issues.

7.0 GLOSSARY OF TERMS

ACI	Activated Carbon Injection
BSD	Burnside
CAES	Compressed Air Energy Storage
CC	Combined Cycle
CCS	Carbon Capture and Storage
CO_2	Carbon Dioxide
COMFIT	Community Feed-In Tariff
CRP	Candidate Resource Plan
CT	Combustion Turbine
CV	Capacity Value
DR	Demand Response
DSM	Demand Side Management
ERIS	Energy Resource Interconnection Service
FGD	Flue Gas Desulfurization
GHG	Greenhouse Gas
HFO	Heavy Fuel Oil
Hg	Mercury
HRSG	Heat Recovery Steam Generator
HS	High Sulfur
IGCC	Integrated Gasification Combined Cycle
IPP	Independent Power Producer
IRP	Integrated Resource Plan
LFO	Light Fuel Oil
LIN	Lingan
LS	Low Sulfur
ML	Maritime Link
MS	Medium Sulfur
NB	New Brunswick
NG	Natural Gas
NO_x	Oxides of Nitrogen (NO and NO_2)

NPV	Net Present Value
NRIS	Network Resource Interconnection Service
NS	Nova Scotia
NSPI	Nova Scotia Power Incorporated
PAC	Powder Activated Carbon
PC	Pulverized Coal
PHP	Port Hawkesbury Paper
POA	Point Aconi
POT	Point Tupper
PPA	Power Purchase Agreement
RES	Renewable Electricity Standard
RM	Reserve Margin
SO_2	Sulfur Dioxide
TRE	Trenton
TRL	Technology Readiness Level
TUC	Tuft's Cove
WRC	Wreck Cove

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