Updated Assessment of the Need for the East-West Tie Expansion

Submitted to the Ministry of Energy

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1.0 KEY FINDINGS/RECOMMENDATIONS

This report has been prepared in response to the August 4, 2017 direction from the Minister of Energy ("Minister") requesting the IESO to prepare an updated need assessment, similar in scope to the previous update reports prepared for the Ontario Energy Board ("OEB"). This report confirms the rationale for the East-West Tie ("E-W Tie") Expansion project based on updated information and study results. This project continues to be the IESO's recommended option to maintain a reliable and cost-effective supply of electricity to the Northwest for the long term.

The E-W Tie Expansion project provides approximately $200 million in net cost savings compared to the least-cost local generation alternative. The IESO also considered high and low sensitivities on a number of key parameters, such the assumed cost of the generation alternative. Based on the sensitivities tested for the Reference outlook, the E-W Tie Expansion project, compared to the least-cost local generation option, ranges from a net cost savings of approximately $500 million to a net cost of just under $100 million.

The IESO continues to recommend an in-service date of 2020 for the E-W Tie Expansion project. Discussions with the transmitters confirmed their ability to meet this date, dependent on timely regulatory approvals. The IESO will continue to support the implementation of the project and monitor electricity supply and demand in the Northwest until the E-W Tie Expansion project comes into service.

2.0 INTRODUCTION

The Ontario Government's 2010[1] and 2013[2] Long-Term Energy Plans ("LTEP") have both identified the expansion of the E-W Tie transmission line as a priority project. The E-W Tie Expansion project is intended to increase the transfer capability into the Northwest by adding a new transmission line roughly parallel to the existing E-W Tie transmission line, which extends between Wawa and Thunder Bay.[3]

The Minister's letter to the OEB of March 29, 2011 was the impetus for the OEB undertaking a designation process to select the most qualified and cost-effective transmitter to undertake development work for the E-W Tie project. Early in that proceeding (EB-2011-0140), the OEB

[1] Ontario's 2010 Long-Term Energy Plan: Building Our Clean Energy Future, Figure 12, page 47.

[2] Ontario's 2013 Long-Term Energy Plan: Achieving Balance, page 52.

[3] The route deviates from that of the existing E-W Tie by travelling around Pukaskwa National Park rather than through, and travelling north of Loon Lake and west of Ouimet Canyon Provincial Park.

requested that the former Ontario Power Authority ("OPA")[4] – now the Independent Electricity System Operator ("IESO") and hereinafter referred to as the IESO – provide a report documenting the preliminary assessment of the need for the E-W Tie Expansion. In response, the IESO filed its original report in June 2011, titled "Long Term Electricity Outlook for the Northwest and Context for the East-West Tie Expansion" ("June 2011 Report"). As a result of the designation proceeding, Upper Canada Transmission, Inc. (o/a "NextBridge Infrastructure") was selected as the proponent to develop the E-W Tie.

The OEB's Phase 2 Decision and Order Regarding Reporting by Designated Transmitter, and the subsequent update due to the deferral of the in-service date from 2018 to 2020, dated September 26, 2013 and January 22, 2015[5] respectively, required the IESO to provide updates to the OEB on the need for the E-W Tie Expansion. In response, three previous E-W Tie reports were prepared by the IESO for the OEB: i) the first update report, was filed in October 2013, titled "Updated Assessment of the Rationale for the East-West Tie Expansion" ("October 2013 Report"); ii) the second update report titled "Assessment of the Rationale for the East-West Tie Expansion" was filed with the OEB on May 5, 2014 ("May 2014 Report"); and iii) the third update report titled "Assessment of the Rationale for the East-West Tie Expansion" was filed on December 15, 2015 ("December 2015 Report").

Following the December 2015 Report, the former Ontario Minister of Energy, Bob Chiarelli, issued a letter to the OEB stating that the E-W Tie Expansion continues to be the IESO's recommended alternative to maintaining a reliable and cost-effective supply of electricity in Northwestern Ontario for the long term and that the government had accordingly issued an Order in Council ("OIC") on March 10, 2016 declaring that the E-W Tie Expansion was needed as a priority project. Consequently, on December 6, 2016, the OEB issued an additional revision to their Phase 2 Decision and Order Regarding Reporting by Designated Transmitter relieving the IESO of the obligation of completing a 2016 need update report.

On July 31, 2017, NextBridge and Hydro One Networks Inc. ("Hydro One") filed Leave to Construct ("LTC") applications[6] with the OEB for the E-W Tie Expansion project. Their

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[4] On January 1, 2015, the Ontario Power Authority ("OPA") merged with the Independent Electricity System Operator ("IESO") to create a new organization that combines the OPA and IESO mandates. The new organization is called the Independent Electricity System Operator. Any assessments prior to January 1, 2015 were provided by the former OPA.

[5] OEB Decision and Order Regarding Reporting by Designated Transmitter dated September 26, 2013, page 4, and January 22, 2015, page 5.

[6] The OEB assigned file numbers EB-2017-0182 and EB-2017-0194 to the NextBridge and Hydro One applications respectively.

applications included new evidence provided by the IESO related to the preferred staging of the project's station facilities. Staging the construction of the station facilities was recommended to reduce the cost of the project, by deferring costs until the facilities are needed. The OIC, issued under the authority of section 96.1(1) of the *Ontario Energy Board Act, 1998*, satisfies the usual need requirement for obtaining section 92 approval.

The project costs included by NextBridge in its LTC application are higher than what was assumed in the IESO's December 2015 Report. Therefore, on August 4, 2017 the Minister requested the IESO to prepare an updated need assessment, consistent with the scope of previous need assessments requested by the OEB. The 2017 LTEP, published in October 2017, also addressed the need to review all options for meeting capacity needs in the Northwest to ensure ratepayers are protected as the E-W Tie Expansion project continues to be developed.[7]

This report provides an updated assessment of the E-W Tie Expansion project, reflecting changes that have taken place since the December 2015 Report, namely revised project costs and an updated demand and supply outlook for the Northwest.

3.0 CHANGES TO THE PLANNING ASSUMPTIONS

Major changes to the planning assumptions since the December 2015 Report are identified here in order to provide context for the updated results and the information presented in subsequent sections of this report.

Cancellation of TransCanada's Energy East Pipeline Project

The December 2015 Report included demand associated with TransCanada's Energy East project, in both the Reference and High demand outlooks. On October 5, 2017, TransCanada announced the termination of the Energy East project.[8] As a result, the anticipated demand associated with the Energy East project is no longer considered in any of the demand outlooks.

The Energy East project accounted for approximately 110 MW of peak demand and 1 TWh of energy demand in the December 2015 Report's Reference demand outlook.

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[7] Ontario's 2017 Long-Term Energy Plan: Delivering Fairness and Choice, page 39.

[8] "TransCanada Announces Termination of Energy East Pipeline and Eastern Mainline Projects", https://www.transcanada.com/en/announcements/2017-10-05-transcanada-anounces-termination-of-energy-east-pipeline-and-eastern-mainline-projects/.

Updated Load Supply Needs

The analysis in the December 2015 Report included a westbound E-W Tie limit of 155/175 MW[9] based on the thermal limitation of the underlying 115 kV circuit from Marathon TS to Lakehead TS. It is assumed that this limit remains the planning limit for the existing E-W Tie. This limit, however, relies on support from Manitoba following contingencies on the E-W Tie. The magnitude of support required is the highest for the loss of the E-W Tie from Wawa TS to Marathon TS since that contingency separates Northwestern Ontario from the rest of the province and leaves it connected only to Manitoba and Minnesota.

Relying on short-term support from neighbouring jurisdictions is an assumption made when operating the system province-wide. However, this support should not be relied on for an extended period of time without an agreement with the neighboring jurisdiction. The current practice is to operate the system such that we're not counting on this support for more than 30 minutes following a disturbance.[10]

The requirement to return the flow on the Manitoba and Minnesota interfaces to zero, or to the scheduled flow, within 30 minutes following a contingency on the E-W Tie is a requirement that is now being included in this update report when determining whether the Northwest has adequate resources to reliably meet its outlook for demand.

Staging of Station Facilities

In September 2014, as a result of the findings of the May 2014 Report , the IESO wrote a letter to the OEB recommending the deferral of the in-service date of the E-W Tie Expansion from 2018 to 2020. The letter indicated that the additional time would allow for the optimization of equipment and system design, including the staged construction of station facilities. Prior to Hydro One's LTC application being filed in July 2017, the IESO worked closely with Hydro One to evaluate the technical and economic feasibility of different staging alternatives for the required station facilities. The IESO's evidence outlines the staging alternatives that were compared and the rationale behind the recommended staged implementation of the station facilities.

[9] The planning limit for the existing E-W Tie is a thermal limitation, 155 MW reflects summer conditions and 175 MW reflects winter conditions.

[10] Market Manual 7.4: IESO Grid Operating Policies

The recommended staging includes an initial stage that provides 450 MW of transfer capability, with a station facility cost of $147 million. The second stage would be implemented only once the full 650 MW transfer capability of the line is needed, at an additional cost of $60 million.

Updated Transmission Cost Estimates

For this update, the IESO used the updated capital cost estimates for the new line and the station upgrades that the transmitters filed with the OEB on July 31, 2017 in their LTC applications. Based on its filed evidence, NextBridge estimates a cost of $777 million for the E-W Tie line, an increase from the previous planning estimate of $500 million used in the December 2015 Report. NextBridge has stated that the cost increase reflects unbudgeted costs, new scope requirements, other unforeseeable factors such as the delay to the in-service date, and development phase project refinements.

As previously outlined, the cost of the station facilities required for the 650 MW E-W Tie Expansion project is approximately $207 million, up from the previous planning estimate of $150 million. This estimate accounts only for costs directly attributable to the E-W Tie Expansion project. As outlined in the IESO's evidence filed with the OEB in support of Hydro One's LTC application, facilities required to address the existing high voltage problem at Lakehead TS are required regardless of whether the E-W Tie project proceeds and are not considered as part of the cost of the E-W Tie station facilities.

The total project cost for the initial 450 MW stage is $924 million, and implementing the full 650 MW would increase overall costs to $984 million.

4.0 NORTHWEST DEMAND OUTLOOK

Throughout the planning and development of the E-W Tie Expansion project, the IESO has held regular discussions with stakeholders, customers and communities in the Northwest and the IESO continues to monitor developments that may affect electricity demand in the region. The demand outlook in this report reflects updated information and engagement which has taken place since the Minister's request for the IESO to provide a need update. Engagement with stakeholders and communities in the Northwest continues to provide valuable insight into the status of future developments. The IESO's outlook considers the likelihood of identified projects proceeding under three potential economic outlooks.

The Reference, Low and High demand outlooks reflect the inherent uncertainties related to industrial development in the Northwest. As noted in the previous three need update reports, Northwest electrical demand is dominated by large, industrial customers and can fluctuate significantly in response to changing economic and market conditions. The Northwest remains

a winter-peaking region, in contrast to Southern Ontario, where electricity demand usually peaks during the summer months.

In this update, the demand outlook has materially decreased in magnitude. This is driven by two significant developments: a continued decline in historical demand in the Northwest and the cancellation of TransCanada's Energy East Pipeline project and its subsequent removal from the Reference and High demand outlooks.[11]

4.1 Historical Northwest Demand

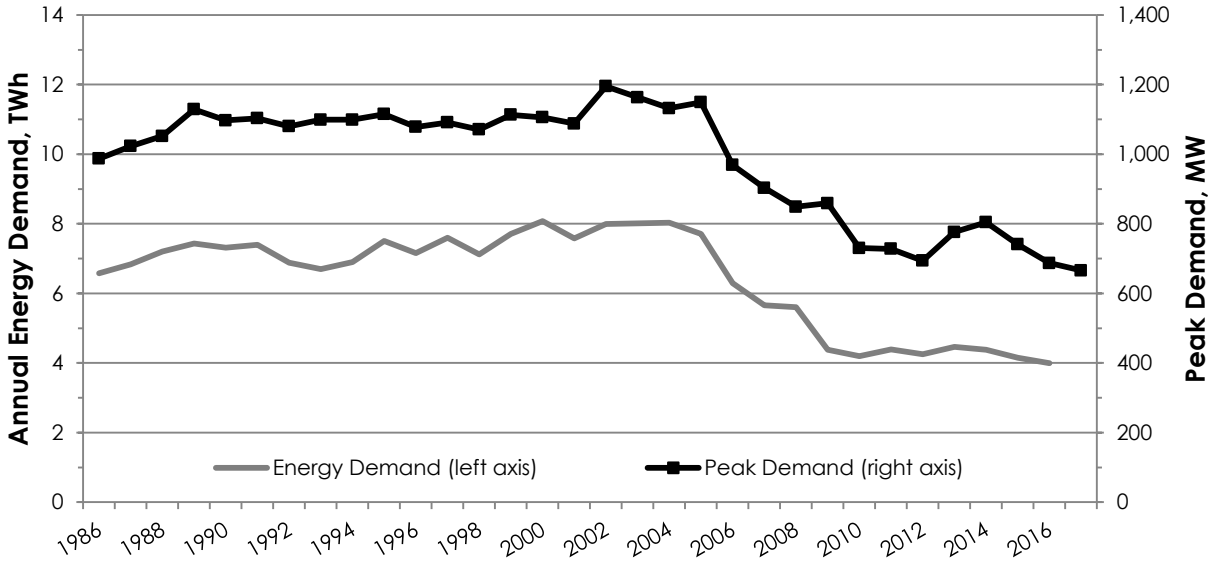
Historical electricity demand in the Northwest is presented in Figure 1 below. This update includes actual energy and peak demand data from 2015 and 2016 and preliminary data from 2017, which was not available when the December 2015 Report was prepared. While the winters of 2013 and 2014 saw an increase in demand in the Northwest, this was primarily driven by extreme low temperatures in the Northwest caused by a southward shift of the North Polar Vortex.[12] This resulted in a higher than average electric heating demand, driving winter peak demand to its highest level in five years.

Historical data now available for 2015 and 2016 and preliminary data available for 2017 shows a continuation of the declining trend for electrical demand in the Northwest due to the impacts of continued population decline, conservation, distributed generation and continued decline of the pulp and paper industry. This provides a lower starting point than in the December 2015 Report.

[11] The Energy East project was never included in the Low demand scenario.

[12] "Thunder Bay has coldest winter in 35 years, stats say", http://www.cbc.ca/news/canada/thunder-bay/thunder-bay-has-coldest-winter-in-35-years-stats-say-1.2580059.

Figure 1. Historical Northwest Electricity Demand



4.2 Drivers of Northwest Demand

The IESO continues to work with interested parties to understand the drivers of demand in the Northwest, engaging with stakeholders such as Common Voice Northwest ("CVNW"), mining companies, industry associations, and the Ontario Ministry of Northern Development and Mines. The updated outlook reflects changes in the status of developments throughout the Northwest.

In comparison to the December 2015 Report, the Northwest demand outlook has been impacted by a few key factors including: updated information on the status of mining developments; cancellation of TransCanada's proposed Energy East project; and continuing decline in the pulp and paper sector.

Mining Sector

The IESO has continued to engage mining companies with developments in Ontario and review technical documents to understand the feasibility, timing, and likelihood of potential mining developments. Factors such as commodity prices, access to capital and environmental considerations are indicators of potential growth in the sector. A mining project in the Fort Frances area has advanced to construction and initial production, and various other projects throughout the region have had success raising capital and advancing both their feasibility and environmental assessments. However, several other projects have experienced set-backs due to factors such as low commodity prices. The demand outlook considers the latest available information on the location, size, and stage of development of mining projects in the Northwest.

Pulp and Paper Sector

Ontario's pulp and paper sector has been in decline for over 10 years and this decline has continued since the December 2015 Report was published. While there is potential for demand stabilization, a return to the demand levels of a decade ago is considered unlikely.

TransCanada Energy East Pipeline

Demand associated with the Energy East Pipeline project which was previously included in both the Reference and the High demand outlooks has been removed.

Remote Communities

Connection of remote communities is assumed to begin in 2024, a delay of four years compared with the December 2015 Report.

Other Components of the Demand Outlook

Minimal or no change has been made to account for the remaining components of the Northwest demand outlook since the December 2015 Report:

- Forestry sector
- Natural growth in residential, commercial and other industrial sectors

The IESO continues to work with local distribution companies ("LDCs") to implement the Conservation First Framework, consistent with both the 2013 and 2017 LTEPs and the March 31, 2014 Conservation First Directive from the Ministry of Energy to the IESO. LDC progress towards meeting the conservation targets was tracked through Conservation and Demand Management ("CDM") Plans and evaluation, measurement and verification ("EM&V") activities, and the conservation assumptions for the Northwest were updated accordingly.

4.3 Northwest Demand Outlooks

An updated demand outlook for the Northwest was developed, taking into account the impacts of the drivers described above. Consistent with the previous three update reports, the IESO has represented demand growth uncertainty in the region by developing three outlooks to explore the robustness and flexibility of options to meet the need in the Northwest under a range of outcomes. Key aspects of the outlooks are as follows:

- **Reference demand outlook -** In this outlook, mining sector demand includes proposed mines that have passed significant development milestones. Mining loads are assumed to persist for the expected lifetime of the proposed developments. This outlook assumes

modest growth in the forestry sector in the short term and assumes stabilization of the pulp and paper sector.

- **High demand outlook -** This outlook considers the impact of stronger and faster development in the mining sector which could potentially be driven by factors such as increased commodity prices. This outlook also reflects modest growth in the forestry sector and the stabilization of the pulp and paper sector.
- **Low demand outlook -** This outlook describes a more restrained outlook in the mining sector and continuing decline in the pulp and paper sector.

The demand assumptions for Remote Communities, residential, commercial and other industries (other than those mentioned above) are the same in each outlook. The Energy East Pipeline project is not included in any outlook.

The resulting Northwest peak and annual energy demand outlooks, net of savings from planned conservation, are shown below in Figure 2 and Figure 3. The Reference demand outlook shows demand in the Northwest increasing quickly in the medium term, due to advancing mining developments that are expected to come online, followed by more gradual growth in the long term. The range between the High and Low outlooks reflects the uncertainty in the assumptions underlying the electricity demand growth in the Northwest.

For comparison, the Reference outlook prepared for the December 2015 Report has also been included in Figures 2 and 3. The current Reference outlook has a slower near-term growth rate than the December 2015 Reference outlook and is lower in the long term due to the continued decline in Northwest historical electrical demand and the cancellation of the Energy East Pipeline project.

Figure 2. Northwest Net Peak Demand Outlooks

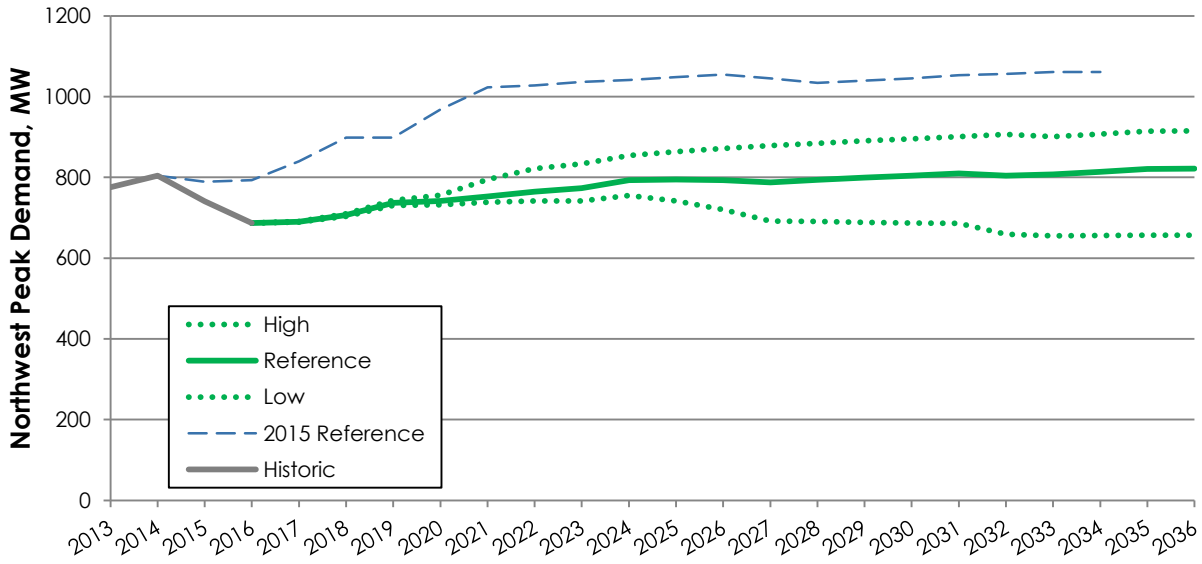
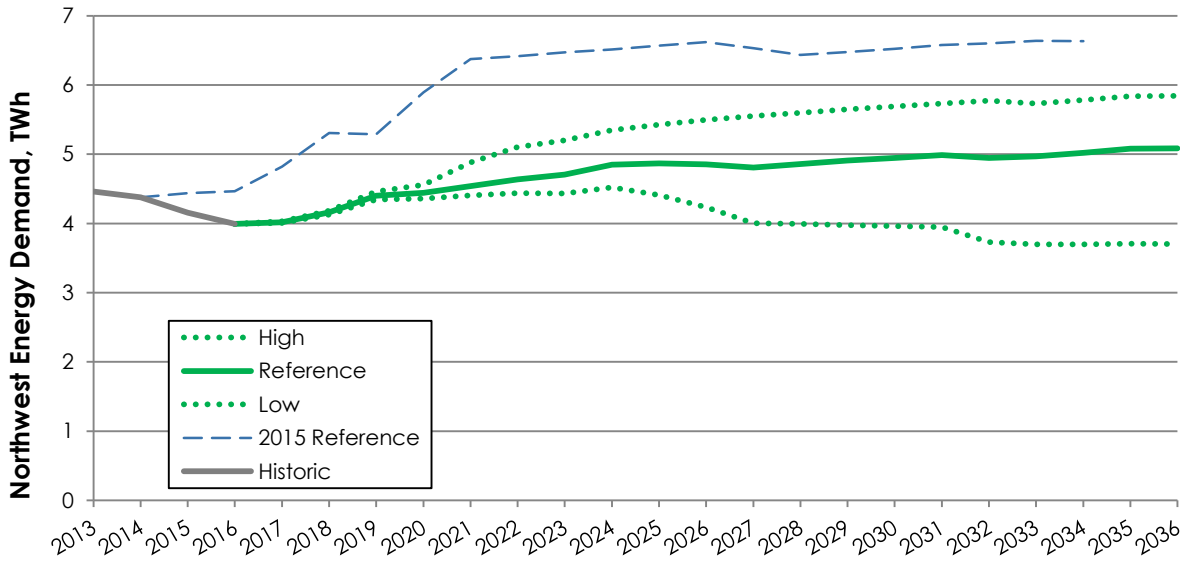


Figure 3. Northwest Net Energy Demand Outlooks



5.0 EXISTING RESOURCES TO SUPPLY NORTHWEST DEMAND

The Northwest relies upon both internal resources (generation located in the Northwest) and external resources (generation outside the Northwest accessed through existing ties) to meet its electricity supply and reliability requirements. An update on the Northwest supply outlook since the December 2015 Report is provided below.

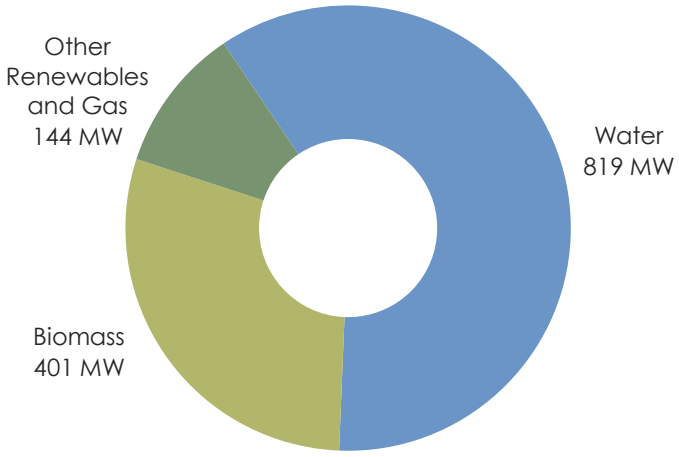
5.1 Internal Resources in the Northwest

The IESO has updated its assumptions regarding supply resources in the Northwest, where new information is available. The following material changes have been made since the December 2015 Report:

- Improved representation of water resources in the Northwest to better reflect run-of-river limitations.
- Incorporation of additional historical water data for the Northwest to better inform the probability of low water conditions.
- Some small-scale distribution-connected generation that began operation prior to 2017 is now included in the demand outlook as embedded generation; these resources have been removed from the supply-side model.

The installed capacity of internal resources in the Northwest for the year 2018 is approximately 1,360 MW and is shown by fuel type in Figure 4.

Figure 4. Northwest Internal Resources - Installed Capacity



5.2 External Resources Supplying the Northwest

Additional supply is provided to the Northwest through the existing E-W Tie; a 230 kV double-circuit transmission line that extends between Wawa TS and Lakehead TS, linking the Northwest system to the rest of Ontario.

The E-W Tie planning limit, consistent with the December 2015 Report, is 155/175 MW which respects the loss of the E-W Tie from Marathon TS to Lakehead TS. Staying under this limit ensures that, following contingencies on the E-W Tie, voltage levels in the Northwest are within

acceptable ranges, and equipment, including the Manitoba and Minnesota ties, stays within thermal limits.

However, as previously discussed, this E-W Tie planning limit relies on support from Manitoba following contingencies on the E-W Tie, which cannot be counted on for more than 30 minutes. As a result, there must be sufficient capacity in the Northwest to not only adequately supply the expected demand in the Northwest while staying under this planning limit, but also to reduce flows on the Manitoba and Minnesota ties to zero (or the scheduled transfer level) within 30 minutes.

For example, following the loss of the E-W Tie from Wawa TS to Marathon TS, the Northwest will be separated from the rest of Ontario and power will automatically flow from Manitoba and Minnesota to supply the Northwest. Action must then be taken to re-dispatch resources within the Northwest to return to scheduled flow levels and there must be sufficient capacity in the Northwest to do so.

6.0 THE NEED FOR ADDITIONAL SUPPLY FOR THE NORTHWEST

As described in previous reports, the outlook for supply needs in the Northwest comprises both capacity and energy components. The IESO updated its assessment of resource adequacy in the Northwest system, which is described below.

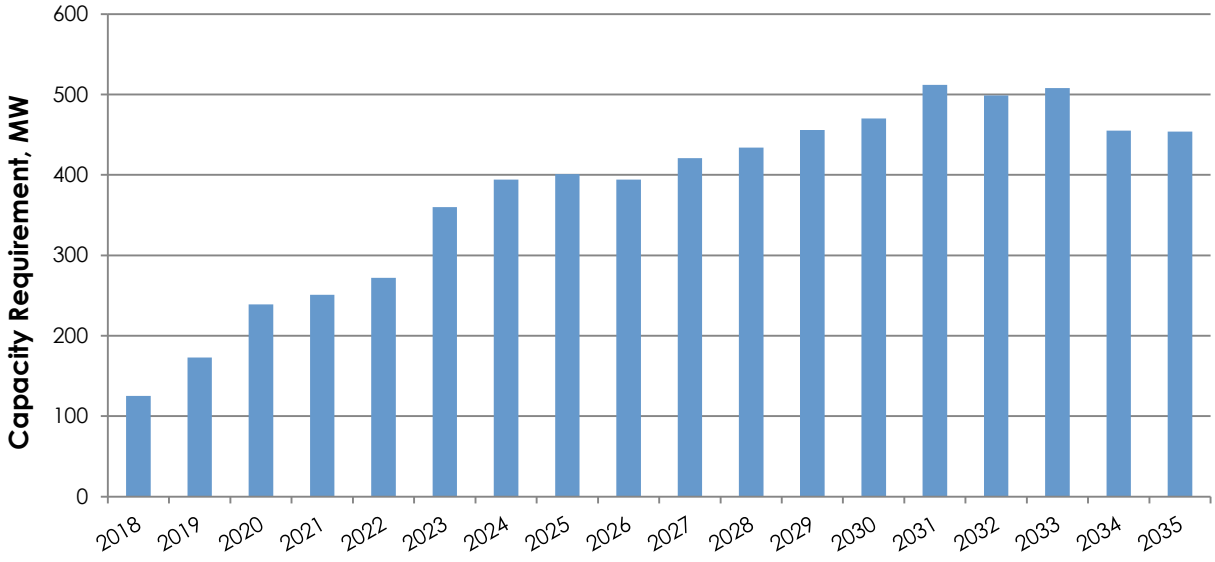
6.1 Capacity Adequacy Requirement

Consistent with the December 2015 Report, the IESO conducted a reliability assessment using a probabilistic approach to determine capacity requirements in the Northwest. As water conditions have a strong impact on overall supply availability in the Northwest, the probabilistic approach reflects a range of water conditions.

The updated capacity need, based on the Reference demand outlook with no E-W Tie Expansion, is shown in Figure 5. A 100 MW capacity need already exists today, and this need continues to grow to approximately 240 MW by the original 2020 in-service date. By 2022, the capacity need exceeds 260 MW, and grows to approximately 400 MW by 2024. The need for additional capacity increases to about 500 MW by 2035 as demand continues to grow and as supply changes.

As noted in earlier need update reports, there is a projected capacity need in the interim years before the E-W Tie Expansion in-service date, based on an assessment of applicable planning criteria. The near-term need is higher than in the December 2015 Report because it includes the capacity needed to reduce the flow from Manitoba to zero (or the scheduled flow level) following a contingency on the E-W Tie.

Figure 5. Expected Incremental Northwest Capacity Requirement under Reference Demand

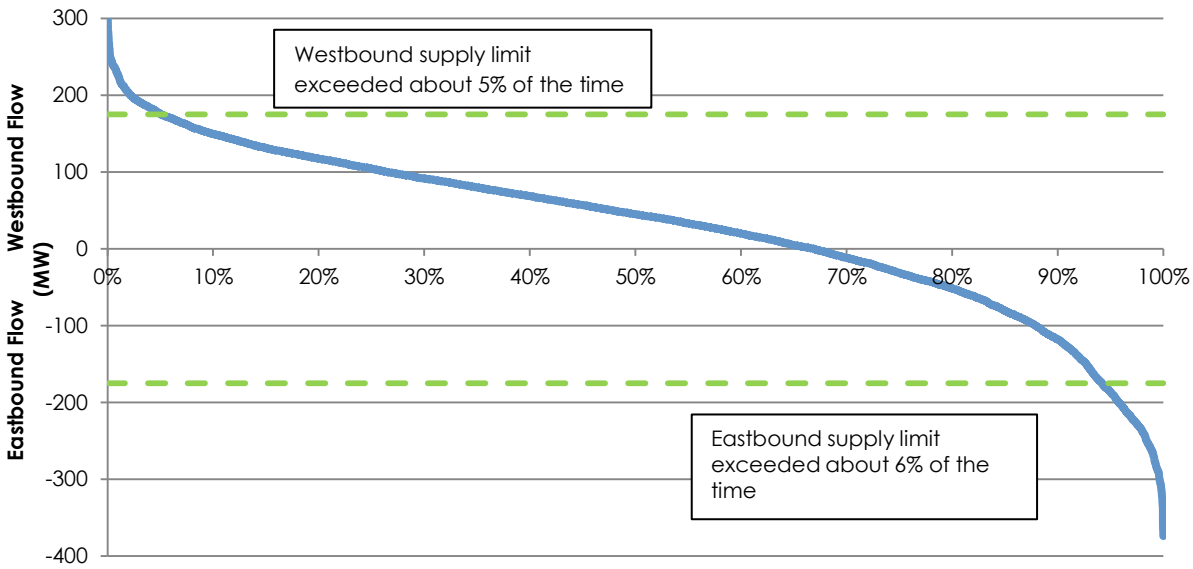


6.2 Energy Requirement

The expected energy requirement in the Northwest is defined by the energy demand outlook, as well as the supply capabilities of local generation and the existing E-W Tie. Figure 6 provides an updated E-W Tie flow duration curve, for all hours of the year 2023,[13] based on the updated Reference demand outlook and median water conditions. In this update, expected westbound flows exceed the existing E-W Tie capability approximately 5% of the time. This is based on application of the winter rating of 175 MW throughout the year. Applying the more restrictive limit of 155 MW during the summer months would result in a higher level of westbound congestion. Eastbound congestion is expected to occur approximately 6% of the time in 2023. The westbound energy requirement is expected to increase with the demand outlook over the planning horizon.

[13] The year 2023 has been shown for illustrative purposes. The energy assessment was carried out for years 2022 to 2035.

Figure 6. Unconstrained Flow and Planning Limits on the Existing E-W Tie for the Year 2023



7.0 ANALYSIS OF ALTERNATIVES TO MEET NORTHWEST SUPPLY NEEDS

In this updated need assessment, a number of alternatives to the E-W Tie Expansion were assessed taking into consideration updated information since the December 2015 Report. The two lowest cost options to meet the Northwest capacity and energy needs were identified to be: i) meeting Northwest needs through the addition of new local natural gas-fired generation, and ii) expanding the existing E-W Tie. These options are described further below:

(1) **No E-W Tie Expansion -** In this option, all of the identified capacity and energy needs are met through the addition of new natural gas-fired simple cycle gas turbine ("SCGT") generation in the Northwest, with the size of units and the timing of installation defined to meet the needs as they arise during the planning period. Under the Reference demand outlook, a total of 500 MW of generation is added. As in the previous update, it was assumed that, due to the difficulty and cost associated with obtaining firm gas service in the Northwest, all new-build natural gas-fired generation utilizes on-site reserve fuel.

(2) **E-W Tie Expansion -** In this option, the E-W Tie Expansion project provides a foundation for meeting the Northwest needs, with additional generation installed to meet any incremental supply requirements. In this update, a staged implementation of the E-W Tie Expansion was adopted, with the interim 450 MW E-W Tie stage and the final stage, to provide the full 650 MW transfer capability, added as required to meet the

capacity needs throughout the study period. Under the Reference demand outlook only the interim stage of the E-W Tie Expansion is required.

The assumptions and the results of the economic analysis comparing these two options are presented in section 7.1. As in the previous update reports, the economic analysis includes an assessment of the sensitivity of the results to changes in key variables to better understand their impact on the economic merits of both options.

No E-W Tie Expansion Option – Other Considered Alternatives

A number of the non-gas options for meeting Northwest needs were discussed in the May 2014 and December 2015 Reports. These were re-examined in the IESO's 2017 assessment. These options include utilizing existing biomass resources in the Northwest, building new non-emitting generation including storage, and firm imports from Manitoba. Although opportunities may exist to develop these resources to meet future provincial electricity needs, they were found to be insufficient for meeting the identified need in the Northwest due to technical and economic considerations.

New non-emitting resources such as wind and/or storage were also considered in this assessment. These were identified to be uneconomic for meeting Northwest needs relative to new natural gas-fired generation, and additional investments in transmission would be required to connect these resources. In addition, without expansion of the bulk transmission system, additional non-emitting generation resource development in the Northwest would increase surplus energy and congestion during periods of increased energy production from existing hydroelectric resources.

The use of the existing Manitoba intertie for either a short-term deferral of the need, or as part of an integrated solution for the long term, was also revisited. As discussed in the December 2015 Report, without major system expansion, only about 150-200 MW of firm capacity imports from Manitoba can be accommodated before running into constraints on the transmission system between Kenora and Dryden. Due to the magnitude of the need, firm Manitoba imports alone would not be sufficient to meet Northwest needs and would need to be paired with other resources.

7.1 Cost-Effectiveness Comparison of Generation and Transmission Alternatives

Consistent with previous E-W Tie Expansion need update reports, an economic analysis of the E-W Tie Expansion and the lowest cost generation option was conducted and their relative net present value ("NPV") was compared. A sensitivity analysis was performed to test the robustness of the results under a variety of conditions. Among the sensitivities tested were the

Reference, Low and High demand outlooks, ranges in the cost of the generation and transmission alternatives, and other cost-related assumptions.

Changes in assumptions since the December 2015 Report are as follows:

- The Reference demand outlook was updated as per the changes identified in section 4.3. Sensitivities to test the impacts of the updated Low and High demand growth outlooks on the NPV were performed.
- Existing supply resources were updated as described in section 5.
- Operating conditions were used in the energy assessment to better reflect the potential economic impact of each option.
- The transmission costs for the E-W Tie Expansion were assumed to be $777 million for the line and $207 million for the stations (see section 3). A portion of the station cost is deferred consistent with the staged expansion of the E-W Tie included in this update. The second stage is only required under the High demand outlook.
- The study period extends to 2051, when the first asset replacement decision is expected; this decision is associated with the generation alternative. Sensitivities of a 20-year and 70-year study period were assessed based on the typical planning horizon and the lifetime of a transmission line, respectively.
- Natural gas prices were assumed to be an average of $5.80/MMBtu throughout the study period – inclusive of carbon price. Sensitivities were assessed with the combined gas and carbon price ranging from $4.50/MMBtu to $10.50/MMBtu.
- The USD/CAD exchange rate was assumed to be 0.78. Sensitivities were assessed for 0.67 and 1.
- Additional sensitivities were analyzed including +20% and -15% for transmission capital costs, a +/- 75 MW margin of error on the capacity need analysis, and the impacts of electricity trade on energy prices.
- The NPV of all cash flow is expressed in 2017 $CDN.

The following assumptions remain unchanged from the December 2015 Report:

- The NPV analysis was conducted using a 4% real social discount rate. Sensitivities at 2% and 8% real social discount rate were also performed.
- The assessment is performed from an electricity ratepayer perspective.
- Median-water hydroelectric energy output was used for energy simulation in the economic analysis.
- Dual-fuel gas-fired generation was assumed to be added to the Northwest due to natural gas fuel supply limitations. Oil was assumed as the on-site reserve fuel. Other

options, such as compressed natural gas and liquefied natural gas stored on site, were also considered. However, these are expected to be higher cost than oil back-up.

- A sensitivity of +/- 25% was assessed on the capital and ongoing fixed costs for generation in the Northwest.
- The life of the station upgrades was assumed to be 45 years; the life of the line was assumed to be 70 years; and the life of the generation assets was assumed to be 30 years.
- New capacity in the Northwest and the rest of Ontario was added, as required, to satisfy Northeast Power Coordinating Council, Inc. ("NPCC") resource adequacy criteria.[14] These capacity needs were determined as described in section 6.1.

Under the Reference case assumptions, the E-W Tie Expansion project is approximately $200 million lower in net present cost compared to the no-expansion alternative. To test the robustness of this result against uncertainty in the assumptions, the IESO considered high and low sensitivities on a number of key parameters, of which changes to the demand outlook, discount rates, and assumed cost of the generation alternative had the largest impacts. Based on the sensitivities tested, the E-W Tie Expansion project, compared to new gas-fired generation in the Northwest, ranges from a net cost savings of approximately $500 million to a net cost of about $100 million.

The E-W Tie Expansion provides additional benefits, beyond meeting the reliability requirements of the Northwest, which are unique to a transmission solution. These include system flexibility, removal of a barrier to resource development, reduced congestion payments, reduced line losses, increased economic imports from Manitoba, decreased carbon emissions, and improved operational flexibility. These benefits are additive to the economic benefits and form an important part of the rationale for the project.

8.0 COMMUNITY INPUT

Stakeholder and community input is an important aspect of the planning process. Providing opportunities for input throughout the IESO's planning processes enables the views and preferences of stakeholders throughout the community to be considered in the development of demand outlooks and in the consideration and development of different alternatives to address identified needs.

[14] NPCC Regional Reliability Reference Directory # 1. Design and Operation of the Bulk Power System.

As part of the E-W Tie need update process, stakeholders throughout the Northwest were contacted to provide input into the outlook for electricity demand. The stakeholders directly involved included mining customers and other large industrial power consumers, CVNW, the Ministry of Northern Development and Mines, Union Gas Limited, TransCanada PipeLines Limited, and Thunder Bay Hydro Electricity Distribution Inc. Stakeholder input helped inform the status of developments in the region and their associated demand impacts. The list of stakeholders contacted throughout the development of the demand outlooks was consistent with previous update reports. The IESO also received written feedback from a variety of stakeholders, speaking to their continued support for the East-West Tie Expansion.

Finally, the IESO hosted a planning forum in Thunder Bay in October 2017 where stakeholders once again voiced their support for the project. Some have provided recommendations regarding alternatives to be considered for meeting Northwest capacity needs. Stakeholders at the forum also commented that the chosen solution should have the flexibility to accommodate demand uncertainty, decreasing the impediment to additional developments.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The IESO's updated assessment of Northwest capacity needs and the options to address them demonstrates that the E-W Tie Expansion project continues to be the preferred option for meeting Northwest supply needs under a range of system conditions.

The IESO continues to recommend an in-service date of 2020 for the E-W Tie Expansion project. Discussions with the transmitters confirmed their ability to meet this date, dependent on timely regulatory approvals. The IESO will continue to support the implementation of the project and monitor electricity supply and demand in the Northwest until the E-W Tie Expansion project comes into service.