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

October 8, 2013

ONTARIO POWER AUTHORITY

1.0 EXECUTIVE SUMMARY

This report provides an updated assessment of the rationale for the East-West Tie ("E-W Tie") expansion project, as ordered by the Ontario Energy Board ("Board"). It builds upon and updates the Ontario Power Authority's ("OPA") June 2011 Report, titled "Long Term Electricity Outlook for the Northwest and Context for the East-West Tie Expansion" ("June 2011 Report"), which established the context for the E-W Tie expansion in terms of meeting the long-term electricity needs of Ontario's Northwest.

Since the June 2011 Report, the OPA has undertaken a stakeholder process to update the load forecast for the Northwest, resulting in a more robust outlook for demand growth driven largely by proposals for expansion in the mining sector. Available resources to supply the Northwest were also updated, with the suspension of the conversion of the Thunder Bay Generating Station ("GS") to natural-gas fired operation reflected in this update.

These developments, combined with other changes in the supply and demand outlook, strengthen the case for the E-W Tie expansion. An analysis of its cost-effectiveness compared to the alternative of providing supply resources within the Northwest indicates significant net benefits across a range of assumptions. In addition, the E-W Tie expansion would provide other system benefits that the non-expansion alternative would not.

The E-W Tie expansion continues to be the OPA's recommended alternative to maintain a reliable and cost-effective supply of electricity to the Northwest for the long term.

2.0 INTRODUCTION

The Ontario Government's Long Term Energy Plan, published in November 2010, identified five priority transmission projects needed for maintaining system reliability, enabling renewable energy connections, and accommodating increasing electricity demand. One of these priority projects is a new E-W Tie line, which would expand the existing E-W Tie, a transmission line running between Wawa and Thunder Bay. On March 29, 2011, the Minister of Energy wrote to the Board to express the Government's interest in the Board undertaking a designation process to select the most qualified and cost-effective transmitter to develop the E-W Tie project.

In response to the Minister's letter, the Board initiated a process to designate a transmitter to undertake development work for the E-W Tie project. The Board requested that the OPA provide a report documenting the preliminary assessment of the need for the E-W Tie expansion. In response, the OPA produced its June 2011 Report. The Board then proceeded with the designation process, which concluded on August 7, 2013, when the Board issued its Phase 2 Decision and Order, and identified Upper Canada Transmission Inc. (o/a NextBridge Infrastructure) as the designated transmitter. In its

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decision, the Board also ordered the OPA to provide two further need updates, one in the early stages of NextBridge Infrastructure's development schedule and one at the mid-point. The OPA committed to providing these need update reports to the Board by October 8, 2013 and May 5, 2014, respectively, and on September 26, 2013 the Board issued a Decision and Order, which requires the OPA to file by these dates.

This report constitutes the early detailed need update report requested by the Board. The June 2011 Report provided substantial background information on the history and development of the power system in Northwestern Ontario to set the context for the E-W Tie expansion. Rather than repeat that material, which has not substantially changed, this report focuses on major changes that have occurred since the June 2011 Report and, based on these changes, an updated statement of the need for the E-W Tie expansion.

Section 3 of this report provides an updated conservation and demand forecast for the Northwest. It reflects changes since 2011 and identifies major drivers for future electricity demand. Sections 4 and 5 analyze current and future internal and external resources that supply the Northwest and provide an update on Northwest capacity and energy supply needs. Section 6 provides an updated analysis of two alternatives to maintain a reliable electricity supply to the Northwest: meeting the needs exclusively through the addition of gas-fired generation in the Northwest; and the E-W Tie expansion combined with incremental gas-fired generation. Section 7 concludes that these updated factors strengthen the case for the E-W Tie expansion, and states that the E-W Tie expansion continues to be the OPA's recommended alternative to maintain a reliable and cost-effective supply of electricity to the Northwest for the long term.

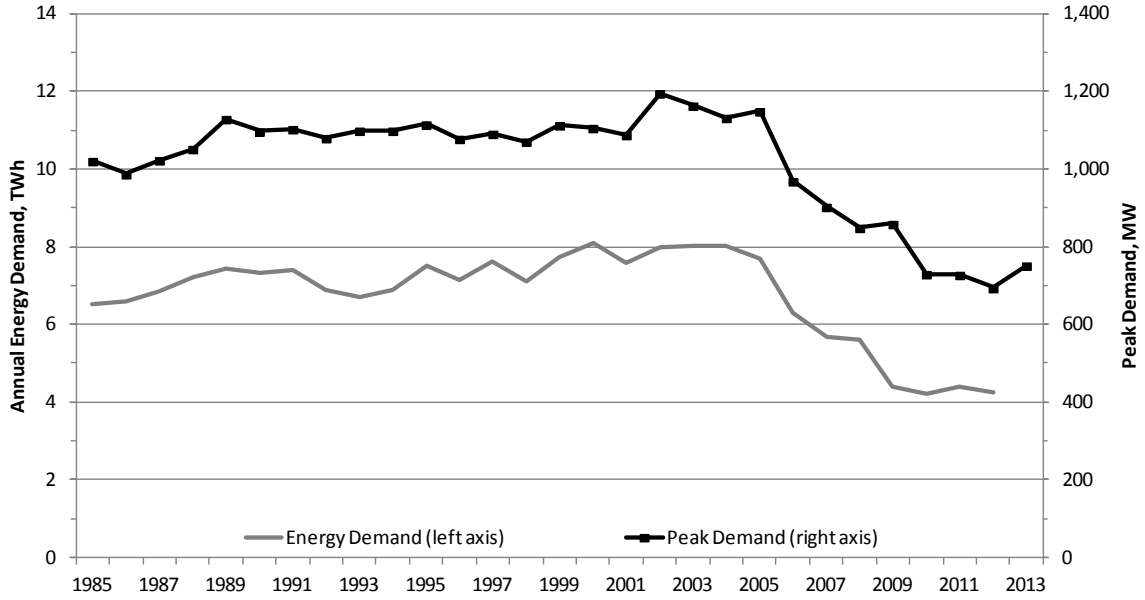
3.0 NORTHWEST CONSERVATION AND DEMAND

One of the major changes in this update is the potential for more robust growth in electricity demand in the Northwest. This growth is primarily driven by activities in the mining sector in the region over the past few years. Because Northwest demand is dominated by large industrial facilities, historical and forecast future demand in the Northwest fluctuates significantly in response to changing economic and market conditions. Going forward, future demand is expected to be driven by the pace and extent of industrial recovery and growth in the Northwest.

3.1 Historical Northwest Demand

As presented in the June 2011 Report, electricity demand in the Northwest peaked at 1,200 MW in 2002, and then steadily declined over the last decade. Altogether, the drop in Northwest demand since the 2002 peak has been about 500 MW and 4.1 TWh. In the two years since the June 2011 Report, regional demand appears to have levelized at around 700 MW and 4 TWh (see Figure 1).

Figure 1. Historical Northwest Electricity Demand



Note: 2013 peak demand is preliminary. Energy demand for 2013 is not available at this time.

3.2 Drivers of Northwest Demand

Since the filing of the June 2011 Report, the OPA has undertaken an extensive process to understand the drivers for demand in the Northwest through engagement with stakeholders such as Common Voice Northwest and mining companies, as well as discussions with the Ontario Ministry of Northern Development and Mines. The updated forecast reflects the potential for substantial changes in the outlook for industry, as well as other developments in the Northwest.

This update considers changes in the following factors driving Northwest demand: expansion in the mining sector, including Ring of Fire development; recovery of the pulp and paper and forestry sectors; connection of remote communities; residential, commercial and other industrial activities in the region; and conservation impacts.

Mining sector and Ring of Fire

Electricity demand growth in the Northwest is expected to be driven primarily by mining sector growth, which is affected by factors such as commodity prices, the cost to develop resources, access to capital, and required regulatory approvals. Commodity market fundamentals in the past few years have been generating numerous proposals for the expansion of existing mines, development of new mines and

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reconnection of old mines in Northwest Ontario. The prospects for developing these proposals depends on various factors, which are discussed below.

Currently, around twenty projects are in development in the Northwest with their proponents working toward being in operation before the end of the decade, a number of them within the next three to five years. In addition, mining development in the Ring of Fire area, including mines and ore processing facilities, may add load to the Northwest through transmission expansion.

To forecast the number, size and timing of mining developments, the OPA looked to the following key milestones as indicators of project development status: the project's stage in the mining development cycle (i.e., from preliminary economic assessment through to construction); whether the project has applied to the Independent Electricity System Operator ("IESO") for a System Impact Assessment; whether a positive feasibility study has been completed; and whether the project is in the process of conducting an environmental assessment ("EA") or has received EA approval. Projects that have achieved some or all of these milestones are considered more likely to materialize than other projects that are in the preliminary economic assessment phase. Based on stakeholder input, the OPA has obtained a better understanding of the progress of these anticipated mining projects. Nonetheless, there is uncertainty in the location, size and timing of actual mining load development, and a range of scenarios was used to develop the forecast. Overall, forecast growth in mining sector demand contributes close to 70% of the forecast peak demand growth in the Northwest.

Pulp and paper and forestry sectors

These sectors have seen significant declines in the last decade due to decreasing demand for their products. Pulp and paper sector demand in the Northwest dropped by about 70% between 2004 and 2012, and the remaining mills continue to be affected by temporary shutdowns and have been operating at roughly half of their pre-downturn capacity. The strengthening of the Canadian dollar, the slowdown in the U.S. housing sector, and the recent economic recession have also led to declining forestry sector demand.

As the remaining pulp and paper mills are restructured and work to improve the cost-competitiveness of their operations, it is expected that the remaining operating facilities will slowly recover. In addition, recovery in the U.S. housing market is creating the potential for revitalization of the lumber industry, and a few new sawmills are currently being constructed in the region.

Connection of remote communities

There are 25 remote communities in the Northwest that are currently served by diesel generation and are not connected to the transmission network. Consistent with the OPA's August 2013 "North of Dryden Draft Reference Integrated Regional Resource Plan", this demand forecast includes the connection of 21 remote communities to the Northwest electricity grid between 2017 and 2025.

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Residential, commercial and other industrial sectors

Residential and commercial sector electricity demand growth is driven by growth in population and economic activity, which is linked to industrial sector activity in the Northwest. The load forecasts for these sectors were developed to be consistent with the scenarios of industrial growth and development in the Northwest considered in this forecast update. Population during the forecast period is projected to increase by 11% to 23%, depending on the extent of industrial sector activity. Demand growth from other industries is also included in the updated forecast.

Conservation

The effects of planned conservation are included in the load forecast. Planned conservation is based on provincially established targets and is achieved through incentive programs operated by local distribution companies and the OPA, as well as savings achieved through codes and standards and time of use rates.

3.3 Northwest Demand Scenarios

An updated demand forecast for the Northwest was developed taking into account the impacts of the various drivers described above. To account for the significant uncertainties inherent to these drivers, the OPA developed three demand scenarios to explore the robustness and flexibility of transmission and supply options under a range of outcomes. Key aspects of the scenarios are as follows:

- **Reference Scenario**. In this scenario, mining sector demand includes proposed mines that have passed significant development milestones, as well as a portion of additional proposals, including a moderate level of Ring of Fire activity. Mining loads are assumed to persist for the expected lifetime of proposed mining development; this is reflected in the variation in demand in the later years of the forecast. This scenario reflects some growth in the pulp and paper sector and a recovery in the forestry sector to its 2004 demand level. Residential and commercial sector demand growth is in line with the economic view of this scenario. Demand growth from residential and commercial sectors, the connection of remote communities, and other industrial sectors is also included.
- **High Scenario.** This scenario is based on stronger development of the mining sector, with all currently proposed facilities being fully developed, and additional load assumed to connect in the Ring of Fire area. This scenario also reflects growth in the pulp and paper sector. Higher residential and commercial sector growth is also forecast, consistent with these higher levels of industrial activity.
- **Low Scenario.** This scenario describes the impact of more modest growth in the mining sector. Assumptions for other sectors are the same as in the Reference scenario.

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The resulting Northwest peak and annual energy demand scenarios, net of savings from planned conservation, are shown in Figures 2 and 3. The Reference demand scenario brings the Northwest forecast back to the level of demand that was sustained for over a decade before the downturn, and the High and Low scenarios reflect uncertainty in the underlying factors driving demand.

For comparison, the scenarios prepared for the June 2011 Report are included in Figures 2 and 3, along with actual historical demand for the last decade. While the outlook for electricity demand in the Northwest is for higher net growth than was previously forecast, the actual loads for 2011 and 2012, which were not available in the June 2011 Report, provide some support to the new outlook, as they are higher than the previous forecast. It should be noted that in the June 2011 Report, Demand Scenario A (the higher of the two scenarios produced) was used as the Reference assumption for analysis purposes. As a result, the Reference load forecast assumption in this update is roughly 100 MW greater in 2025 than that used previously, and by 2031 the two planning scenarios converge.

Figure 2. Northwest Peak Demand Forecast Scenarios

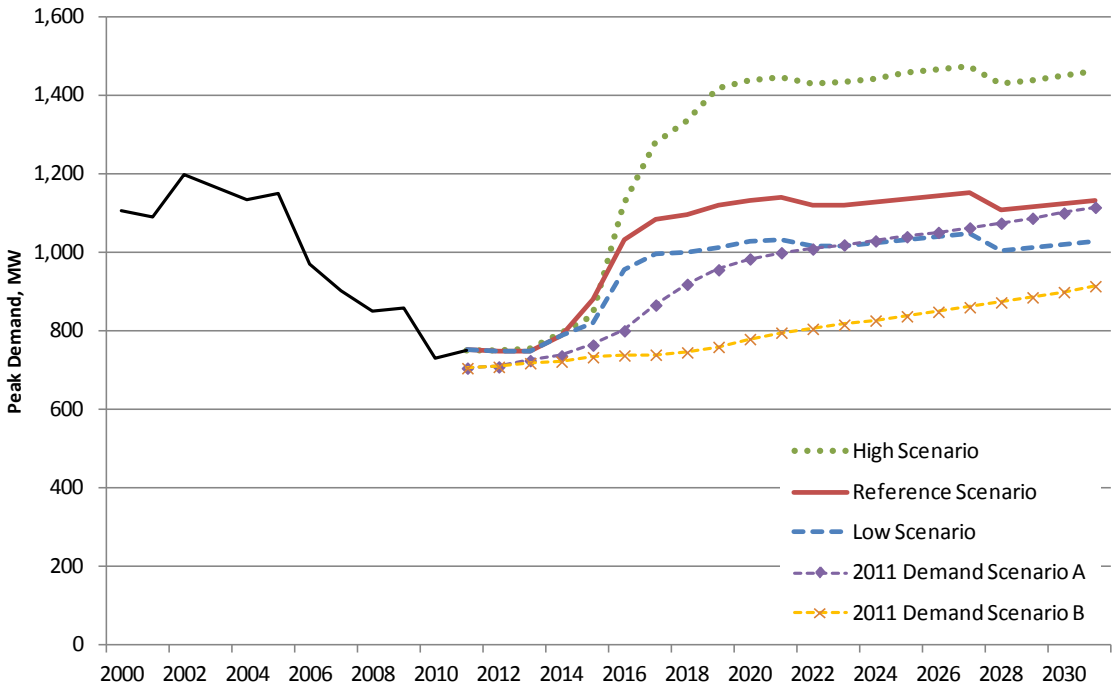

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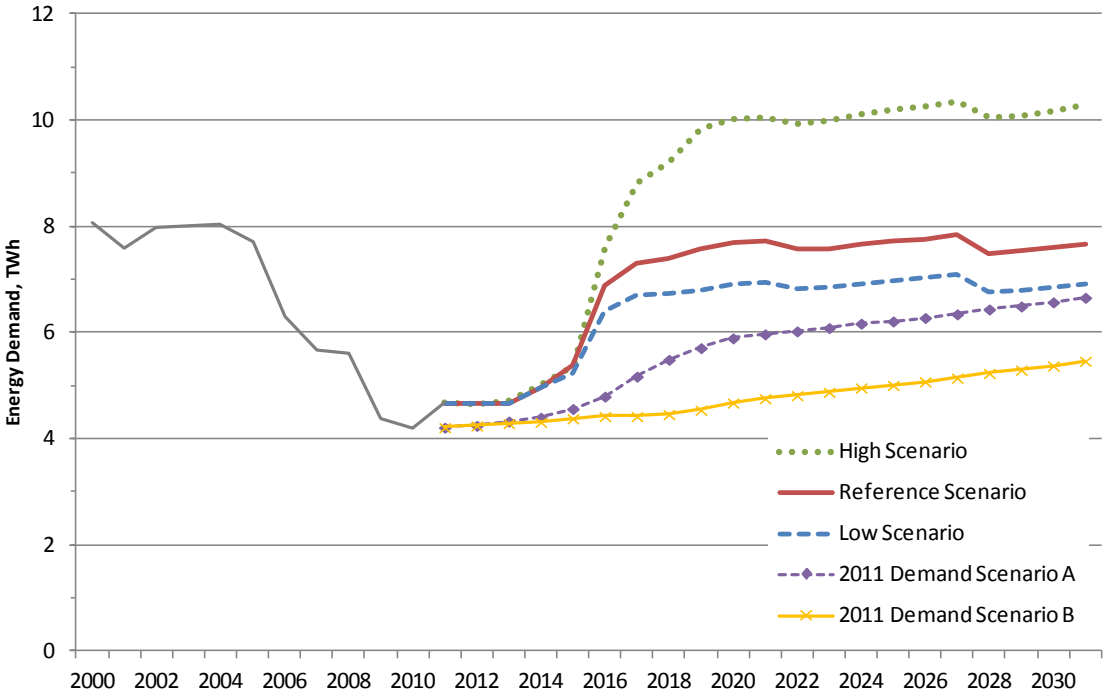
Figure 3. Northwest Energy Demand Forecast Scenarios



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4.0 EXISTING RESOURCES TO SUPPLY NORTHWEST DEMAND

As noted in the June 2011 Report, 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 requirements. An update on the Northwest supply outlook since the June 2011 Report is provided below.

4.1 Internal Resources in the Northwest

The province has continued to move forward with the shut-down of coal-fired resources, including the coal facilities in the Northwest. The conversion of Atikokan GS to biomass operation is underway and is expected to be in-service in 2014. In the interim, while Atikokan GS is offline, the IESO has concluded that one of the two Thunder Bay GS units is required to maintain reliability in the Northwest.[1] Accordingly, Ontario Power Generation ("OPG") and the IESO executed a Reliability Must Run ("RMR") agreement in February for the year 2013.

A major change in the assumptions for internal generation in this update is the availability of Thunder Bay GS after 2014. At the time of writing the June 2011 Report, based on the planned conversion of Thunder Bay GS to natural-gas fuelled operation, the OPA assumed that the full 300 MW capacity of this facility would be available to supply the Northwest between 2014 and 2024. Since that time, the government has announced that it is suspending this conversion. Although a final decision on the future of Thunder Bay GS is still pending, Thunder Bay GS is not assumed to be available in this update.

Assumptions regarding other internal resources are similar to those in the 2011 analysis, with the following developments:

- In the June 2011 Report, it was assumed that the 40 MW combined-cycle generating facility at Nipigon, a Non-Utility Generation (NUG) facility, would remain in operation after its contract expires in December 2022. In this update, based on current information, it is expected to retire in that year.

- In addition to 50 MW of non-hydroelectric renewables that were in service as of the June 2011 Report, about 150 MW of additional renewable generation has come into service. A further 100 MW has been contracted through various programs (e.g., FIT and microFIT), which is expected to come into service over the next several years.

[1] See *IESO-OPG Reliability Must-Run Agreement for Procurement of Physical Services from Thunder Bay Generating Station*, included as Attachment 1 in OPG's Request for Approval of a Reliability Must-Run Agreement for Thunder Bay GS, filed with the OEB on February 27, 2013.

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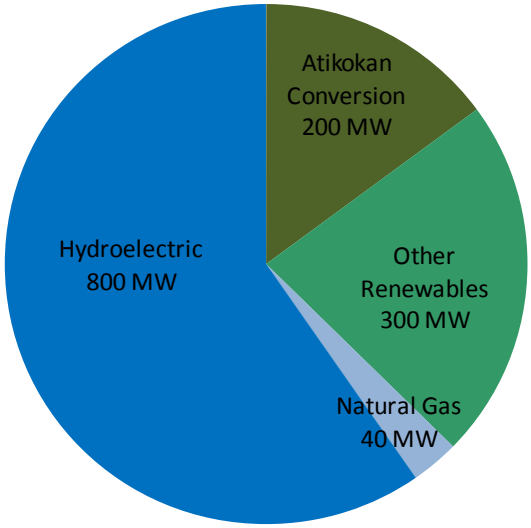
- Currently, about 50 MW of demand response ("DR") capacity is under contract through the DR-2 program. This contract is expected to expire in November 2014. In the June 2011 Report, 90 MW of DR was assumed to be available in the Northwest. In this update, there are no committed DR resources in the Northwest beyond 2014. DR will be treated as a potential alternative to meet identified needs.

The mix of internal resources in the Northwest in 2015 is shown in Figure 4.

Figure 4. Northwest Internal Resources by Type in 2015 (Installed Capacity)



4.2 External Resources Supplying the Northwest

The Northwest also relies on external resources that can be accessed through the existing E-W Tie, as well as interconnections with Manitoba and Minnesota. There has been no change in the capability of these ties since the June 2011 Report. As described in that report, the existing E-W Tie has a transfer capability of 175 MW, as defined by current reliability criteria.

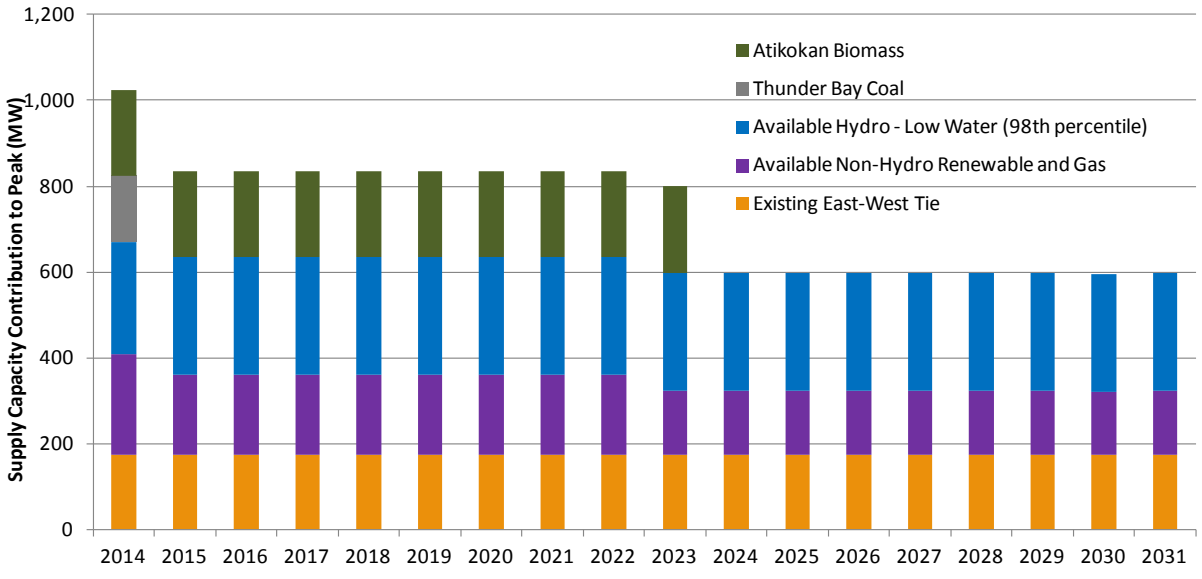
4.3 Summary of Existing Resources

The existing internal and external resources assumed to be available to supply the Northwest in this planning analysis are shown in Figure 5. The figure reflects the available capacity of internal resources to meet Northwest peak demand under low water conditions. It also includes the capability of the existing E-W Tie. Imports from Manitoba and Minnesota are not included for planning purposes as there are presently no contracts in effect for firm import capacity.

As Figure 5 indicates, existing supply is expected to be reduced at two points in the planning horizon. After 2014, the removal of the remaining coal-fired generation in the Northwest will result in reduced

supply. A second reduction in available resources is expected in 2024, corresponding with the expiry of the contract for Atikokan biomass generation.

Figure 5. Northwest Supply Capacity under Low Hydro Conditions



5.0 THE NEED FOR ADDITIONAL SUPPLY FOR THE NORTHWEST

Based on the current outlook for Northwest demand and supply, an assessment of the reliability and adequacy of the Northwest energy system was conducted. Based on this assessment, the OPA forecasts a need for additional capacity and energy supply to meet forecast peak and energy demand in Ontario's Northwest. These needs are described below.

5.1 Expected Capacity Need

To assess capacity needs in the Northwest, the OPA conducted a reliability assessment using a probabilistic analysis approach to determine capacity requirements, which are expressed as a loss of load expectation. As water conditions have a strong impact on overall supply availability in the Northwest, a range of water conditions was analyzed.

The resulting capacity shortfall, based on the Reference peak demand scenario, is shown in Figure 6. The shortfall is expected to begin in 2015, with the retirement of coal-fired resources, and to grow over the next few years as load increases in the Northwest. During these early years, there may be a need for interim resources to supply Northwest demand until a long-term solution can be brought into service. The OPA has been working with the IESO to develop interim measures for this period to ensure that demand can be met in the Northwest. Potential options include negotiating firm imports from

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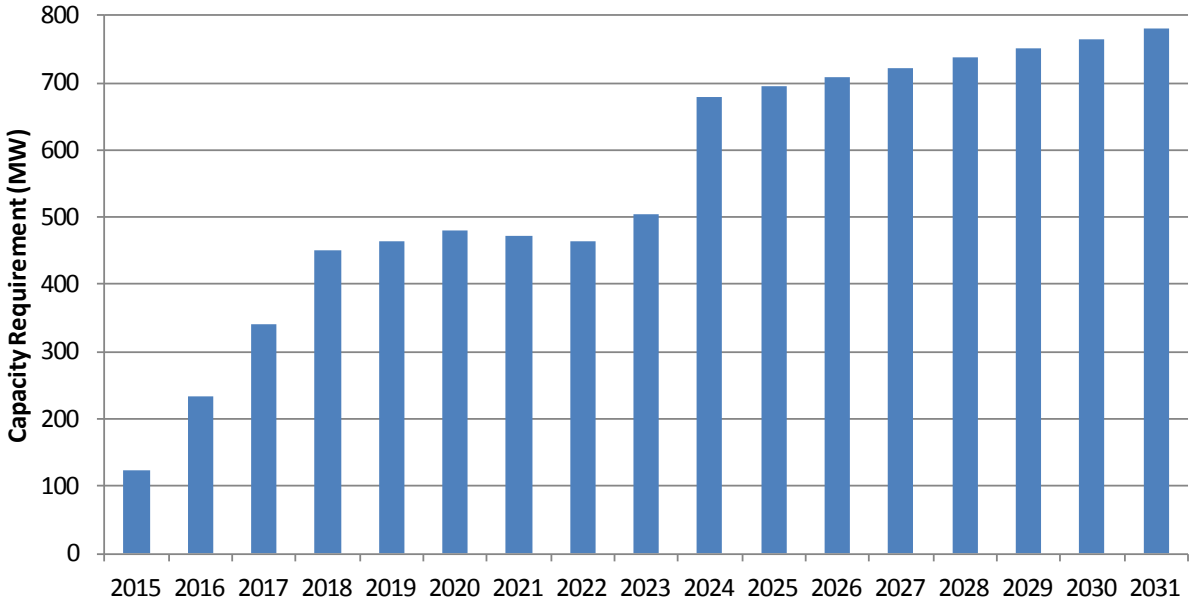
Manitoba/Minnesota, contracting for demand response, updating the Special Protection System ("SPS") for the region to operate the existing transmission system to higher capability, and the addition of gas-fired generation. While the first three options could be short term in nature, the potential addition of gas-fired generation would have longer-term value.

Between 2018 and 2023, the capacity shortfall is expected to be about 500 MW, with slight variations reflecting expected changes in load and the supply mix. In 2024, with the expiry of the Atikokan biomass contract, the shortfall rises to nearly 700 MW. After 2024, the shortfall gradually increases due to continued forecast load growth, eventually reaching almost 800 MW in 2031.

Figure 6. Expected Northwest Capacity Requirement



5.2 Expected Energy Need

The region's energy needs arising from expected changes in Northwest supply and demand were also analyzed. An indication of the need for energy to supply the Northwest is provided by analyzing expected flows on the E-W Tie. Figure 7 shows an illustrative duration curve for the unconstrained flow on the existing E-W Tie, expressed as a percentage of time, for the year 2020 under median-water conditions. This curve represents the amount of energy that would be expected to flow across the E-W Tie, under the current Northwest supply and demand outlook, if there were no transmission constraints. Its shape indicates that, under these conditions, the E-W Tie would be expected to supply the Northwest through westbound flows 95% of the time, while eastbound flows would occur only about 5% of the time. The horizontal dotted lines in Figure 7 indicate the 175 MW eastbound and westbound transfer limits on the existing E-W Tie. Under the conditions shown, the supply limit would

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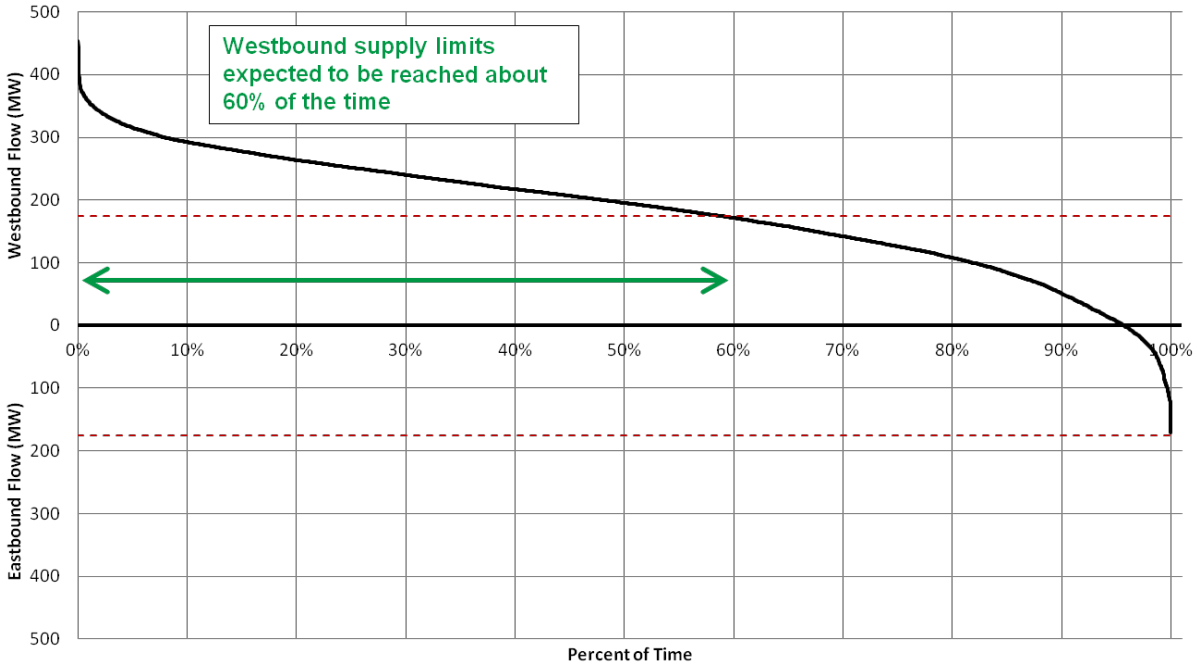
be exceeded approximately 60% of the time. When the supply limit is exceeded, other sources of supply would need to be found to meet Northwest demand. This could include uneconomic dispatch of Northwest generators, or reliance on imports.

As noted, the analysis in Figure 7 is based on median water conditions. Under low water conditions, the required westbound flows are expected to be above the existing E-W Tie capability almost all the time.

Figure 7. Unconstrained E-W Tie Flow and Planning Limits



6.0 ANALYSIS OF ALTERNATIVES TO MEET NORTHWEST SUPPLY NEEDS

Based on the updated planning assessment presented above, there is a need to provide capacity and energy supply to meet forecast demand in the Northwest. Two alternatives for meeting these needs were evaluated:

(1) **No E-W Tie expansion.** In this alternative, all of the forecast capacity and energy needs are met through the staged addition of new gas-fired generation within the Northwest. In the Reference scenario, this involves the installation of a total of 800 MW of gas-fired generation over the study period.

(2) **E-W Tie expansion.** In this alternative, the E-W Tie expansion project provides a foundation for meeting the Northwest's needs, with additional generation included to meet any incremental

supply requirements that arise in the long term. The expansion project, as previously specified, involves a new line between Wawa and Thunder Bay, switched at Marathon; it would bring the combined transfer capability of the E-W Tie from 175 MW to 650 MW. In the Reference scenario, a need for additional supply beyond the capability provided by the E-W Tie expansion emerges after 2024. As a result, 200 MW of peaking gas-fired generation is assumed to be added at that time.

In the June 2011 Report, the OPA compared these two alternatives in terms of their cost-effectiveness and other benefits. Based on recent changes in the outlook for the Northwest, the cost-effectiveness analysis has been revised and is described below.

The other benefits discussed in the June 2011 Report—system flexibility, removing barriers to resource development, reduced congestion payments, reduced losses, and improved operational flexibility—are all still applicable. As there has been no change to these benefits, which are largely qualitative (or in some cases difficult to quantify), an update is not provided in this report.

6.1 Cost-Effectiveness Comparison of Generation and Transmission Alternatives

An economic analysis of the two alternatives was conducted and their relative net-present-value ("NPV") was compared. A sensitivity analysis was performed to test the impact of a variety of factors on the results. The assumptions used in the analysis are as follows:

- The study period extends from 2018 to 2062, to capture the full lifetime of the station upgrades associated with the E-W Tie expansion. For planning purposes, the expanded E-W Tie was assumed to come into service by early 2018. The life of the stations was assumed to be 45 years, and 70 years for the line.

- NPV analysis was conducted using a 4% real social discount rate. Sensitivities were performed using a range of real social discount rates. The results are expressed in 2015$.

- The Reference demand scenario was used in the Reference case. A sensitivity analysis was performed to test the impact of the Low load growth scenario on the cost-effectiveness analysis.

- For planning purposes, capital cost estimates of $100 million for the station facilities and $500 million for the line were used. As costs are expected to be refined through project development work, the OPA employed the same cost estimates used in the July 2011 Report in this update.

- Existing supply resources described in section 4 were included in the analysis. A sensitivity analysis was performed to determine the impact of adding 100 MW of gas-fired peaking generation in the Northwest as a solution to meet interim needs.

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- New capacity in the Northwest and the rest of Ontario was added, as required, to satisfy reliability criteria. These capacity needs were determined as described in section 5.1.

- Median-water hydroelectric energy output was used for energy simulation purposes.

- Natural gas prices were assumed to be an average of $5.50/MMBtu throughout the study period. A sensitivity analysis was performed with average gas prices of $8.50/MMBtu.

Under the Reference assumptions, the E-W Tie expansion results in a net benefit of just over $300 million compared with the no-expansion alternative. The sensitivity analysis indicates that the economics are robust across the range of conditions tested, with positive NPV results in all cases. Based on the sensitivities tested, the E-W Tie expansion ranges from a net benefit of just over $400 million to a break-even proposal associated with a real social discount rate of 7%. Under the Low load growth scenario, the economic benefit of the E-W Tie was lower but still significant, with a net benefit of $120 million.

As discussed previously, the E-W Tie expansion would provide additional benefits, beyond simply meeting the supply needs of the Northwest, which the non-expansion alternative does not provide: system flexibility, removal of barriers to resource development, reduced congestion payments, reduced losses, and improved operational flexibility. While these benefits are not reflected in the cost-effectiveness comparison of the two alternatives, they do form an important part of the rationale for the E-W Tie expansion. The OPA expects to provide a more detailed discussion of these benefits than was provided in the June 2011 Report as part of future evidence in support of the E-W Tie expansion.

7.0 CONCLUSION AND RECOMMENDATION

As outlined in this report, a number of factors have evolved since the publication of the OPA's June 2011 Report. Electricity demand forecasts for the Northwest have increased, due to increased activity in the mining sector. At the same time, with fewer internal resources available to supply this demand (i.e., the suspension of the conversion of Thunder Bay GS to natural gas), there is a greater urgency to plan supply for the Northwest. The expanded E-W Tie provides a long-term foundation for supplying the Northwest, providing greater system flexibility around which internal supply resources can be developed. Together, these updated factors strengthen the case for the E-W Tie. The OPA continues to recommend the E-W Tie as the preferred alternative to maintain a reliable and cost-effective supply of electricity to the Northwest over the long term.

It is the OPA's expectation that the new E-W Tie line will be a double-circuit design, providing total westbound capability of 650 MW in conjunction with the existing E-W Tie. Given the current outlook for supply and demand in the Northwest, the OPA also expects that the E-W Tie project be designed to provide the full 650 MW transfer capability when the line comes into service, rather than staging the

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expansion. A double-circuit design has greater potential for future expandability, which means its capability could be increased in the future through the addition of further voltage control or compensation equipment, resulting in a higher thermal rating of up to about 800 MW.

The E-W Tie expansion is an important component of the long-term integrated plan for the Northwest. The OPA notes that a 2018 in-service date is appropriate for the E-W Tie project, and would not recommend increasing costs significantly in order to bring the line into service by 2017. Development work for a double-circuit line, as proposed by NextBridge Infrastructure, should proceed at this time, toward an in-service date of early 2018.

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