

Delivering Fairness and Choice LTEP 2017

Chapter 2. Ensuring a Flexible Energy System

Ontario has made significant progress in rebuilding its electricity system. We invested over \$35 billion in **generation** between 2005 and 2016 to ensure we had a clean and reliable supply of electricity for households and businesses. Ontario's fuels sector can not only supply all the energy needed for our transportation, heating and manufacturing, but the network of pipelines and retail outlets can be used to deliver alternatives, such as renewable natural gas (RNG). Ontario now has a healthy and stable supply of energy, and an electricity system that is well-positioned to pursue emerging opportunities and meet any future challenges.

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The Need for Flexibility

To meet these challenges, Ontario is moving away from the use of long-term contracts for electricity supply to relying more on market-based structures. While long-term contracts have ensured reliability, they have also contributed to increases in electricity prices. A market-based approach, which has been successful in other jurisdictions, can provide the most cost-effective source of electricity regardless of the technology, but also offer more flexibility to react quickly to any changes.

Additional flexibility is also needed to handle the recent addition of large amounts of flexible generation. Over 7,000 MW of wind, solar and bioenergy has been connected to the province's transmission and distribution networks in the last 10 years. The cost of these technologies has declined substantially¹ over the same period, so moving to a more vigorous marketplace will ensure these resources can compete with other source of electricity to deliver the benefits of clean power for all Ontarians.

Ontario has a limited window in which to make these changes. While there is currently a robust supply of electricity, this supply is expected to decrease during the refurbishment of the Darlington and Bruce nuclear facilities and when current procurement contracts expire. The current period of energy security presents an opportunity for Ontario to adopt a different approach to meeting the province's future energy needs.

To meet these long-term needs, the Independent Electricity System Operator (IESO) has begun a Market Renewal program to redesign the province's wholesale electricity markets. A key aim of Market Renewal is to acquire the electricity resources we need more efficiently. In the past, Ontario relied on long-term contracts to ensure sufficient generating capacity. The IESO is now developing an capacity auction that uses competition to get the resources we need

¹ For example, OPO (Pg. 13) reports solar PV module prices have declined by 70-80% over the last decade.

in a technology-neutral manner. Generators, demand response providers, and importers could all participate in the auction, with the lowest cost resources being selected.

Another important aim of Market Renewal is to get additional benefits from Ontario's existing generation assets by extending their use. This will deliver further cost savings to electricity consumers. The current market does not fully utilize existing wind, solar and nuclear, and hydro generation², or incentivize innovative solutions to meet system flexibility needs.

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Market Renewal will ultimately result in a more competitive marketplace that efficiently meets system needs at the lowest cost and ensures Ontario's climate change policy objectives are met. It will also help prepare Ontario for the future by creating a framework that can effectively incorporate new and emerging technologies.

When the wholesale electricity market first opened in 2002, the Independent Market Operator (IMO) brought in a "two-schedule" system for buying electricity from generators. This was to be an interim measure before moving towards a more efficient "single-schedule" system. The "two-schedule" process does not take into account constraints, or bottlenecks in the transmission system when establishing the market price for electricity. As a result, generators can be paid for electricity that can't be used. They have gained stable and sufficient compensation from the "two-schedule" system, but it has led to inefficiency and extra costs for ratepayers.

A reformed electricity market will not only reduce costs by improving the efficient use of our generation facilities, but it will also increase the import and export of electricity from other jurisdictions. More efficient scheduling will allow for increased imports of lower-cost generation, and greater revenue for Ontario generators who will have more flexible access to export markets.

The IESO is working closely with stakeholders to develop high-level designs and a work plan for the significant changes that will become the foundation of Market Renewal. The work plan will set out the specific changes that will be implemented and the timelines for completing the work. This will allow IESO and stakeholders to address the known challenges of our existing markets while laying a solid foundation for a more competitive and flexible energy market that can meet future needs.

Electricity: Supply and Demand

² Adapted from April 20, 2017 report by The Brattle Group to the IESO entitled: "The Future of Ontario's Electricity Market A Benefits Case Assessment of the Market Renewal Project", available at: https://encrypted.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjJ-cXlhonUAhXLbBoKHfesoD08QFggnMAA&url=http%3A%2F%2Fwww.ieso.ca%2F-%2Fmedia%2Ffiles%2Fieso%2Fdocument-library%2Fengage%2Fme%2Fbenefits-case-assessment-market-renewal-project-clean-20170420.pdf%3F%3Den&usg=AFQjCNGOHvNp-x3p9oaWtIjMu2Kbi6Kh0w&sig2=ssVs2VKfXkFLv_taiH74PA

[Placeholder for descriptive text once forecast is available and to accompany graphs.]

Supply and Demand Forecast

Transmission Forecast

The IESO has indicated that with no increase in the forecast for electricity demand, new transmission investments are not expected to be needed beyond those currently under development. See figure x on page x for projects planned or underway on the high-voltage transmission system.

This will change if there is significant electrification of activities that currently use fossil fuels, such as space and water heating and the transportation of people and goods. New transmission lines would be needed to connect additional sources of generation to users. For instance:

- If big hydroelectric projects are developed in Northern Ontario, a major expansion of transmission lines would be required to connect this potential new generation to the provincial electricity grid. The province-wide network would also need to be reinforced in order to accommodate the greater volume of electricity.
- If existing generation sites in Southern Ontario are expanded, an upgrade and an increase in the capacity of existing transmission lines would be required.
- Additional long-term imports of electricity from Québec or Newfoundland would require upgrades to the transmission system in eastern Ontario. Depending on the magnitude of the imports, these improvements could include station work and upgrades to existing transmission lines.

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The Ministry will direct the IESO to establish a process for planning the future of the province-wide “bulk” transmission system, the high voltage system that is typically 230 kV and 500 kV in Ontario. As part of the process, the IESO will consult with stakeholders and communities.

Major Province-Wide Transmission Projects Under Development

Northwest Bulk Transmission Line

The Northwest Bulk line is needed to support growth and maintain a reliable electricity supply to areas west of Atikokan and north of Dryden. The project will proceed in phases:

- Phase One is a line from Thunder Bay to Atikokan and should proceed immediately. It should come into service as soon as is practical, and no later than 2024.
- Phase Two will be a line from Atikokan to Dryden and should come into service by 2034.

Development work for both phases will proceed at the same time.

Reinforcements (NTD What are reinforcements?) between Dryden and Manitoba may be needed in the future to improve connections between provincial electricity grids.

East-West Tie Transmission Line

The East-West Tie Line will provide a long-term, reliable supply of electricity to meet the growth in demand and changes to the supply mix in Northwest Ontario.

Ontario declared in 2016 that construction of the line was a priority, giving the project the certainty it needed to speed up the approvals process.

NextBridge Infrastructure is engaging with Indigenous communities, the public and stakeholders as it completes the development phase of the project. It expects to get the necessary approvals in time to bring the line into service in 2020.

GTA West Bulk Reinforcement

The growth in demand, the eventual retirement of Pickering Nuclear Generating Station and new renewable generation west of GTA are all adding stress to the transmission system in the West GTA. New transformer stations will be connected to increase the system's ability to restore power.

Clarington Transformer Stations

The population and electricity needs of the eastern part of the Greater Toronto area are growing.

To meet the forecast demands and compensate for the eventual retirement of Pickering Nuclear Generation Station, Hydro One is currently building the Clarington Transformer Station, in the Municipality of Clarington.

Hydro One expects to bring the station into service in 2018.

Lake Erie Connector

ITC Lake Erie Connector LLC is proposing to build a 1,000 MW High Voltage Direct Current transmission cable under Lake Erie, from Nanticoke, Ontario, to Erie County, Pennsylvania. The two-way line would provide the first direct link between the Ontario electricity markets and the markets in 13 states in the Eastern U.S.

The project would be entirely financed by customers buying the right to transmit electricity over the line; Ontario ratepayers will pay none of the costs of building, operating or maintaining the line.

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Fuels: Supply and Demand

The 2017 LTEP is not forecasting any issues with the supply of fuels. It believes there will be appropriate levels of reinvestments and maintenance in processing, storage, transmission and distribution facilities in Ontario. While the existing infrastructure is likely to be sufficient for conventional fuels, new investments in processing and delivery may be required to handle increases in the use of alternative fuels such as ethanol, biodiesel, other biofuels and renewable natural gas (RNG).

[placeholder for key charts/graphs from LTEP]

The Influence of the Carbon Market

On January 1, 2017, Ontario implemented a cap and trade program. It will influence how we plan the province's energy supply and achieve cost-effective reductions in greenhouse gas (GHG) emissions going forward.

The carbon price paid by fossil-fueled generators will affect how often they get called on to meet the demand for electricity. A natural gas-fired electricity generating facility, for example, would have to factor in the costs of the cap and trade program and increase the price at which it offers electricity into the wholesale market. The cap and trade program will increase the competitiveness of non-emitting electricity generation and clean imports, as well as more efficient natural gas generation.

Flexibility in Ontario's Transportation Fuels

The 2017 LTEP recognizes the CCAP commitment to introduce a Renewable Fuel Standard (RFS) for gasoline. This is an important step towards reducing GHG emissions from the transportation sector. Since it uses the existing fuels infrastructure, the RFS is likely to be among the more flexible and cost-effective ways to increase the use of renewable and low-carbon fuels.

Some of the opportunities to increase the use of renewable and low-carbon transportation fuels include:

- increasing the use of renewable liquid fuels by existing vehicles. "Drop-in" fuels such as ethanol can be mixed with gasoline to produce blended fuels and used the same way as regular gasoline;
- having the existing stations offer higher blends of ethanol and biodiesel;
- making renewable liquid fuels availability to more regions of the province;
- adding biomass fuels to the crude oil that Ontario refineries process; and
- lowering the carbon intensity of renewable fuels produced by Ontario manufacturers.

RNG IN TRANSPORTATION – PILOT PROGRAM

Ontario's Climate Change Action Plan (CCAP) committed to increase the availability and use of lower-carbon fuel.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) is now developing a pilot program that uses methane from agricultural materials or food wastes for transportation purposes. The program is expected to demonstrate the business models and technology that will allow agricultural and food sectors to produce RNG, and support businesses as they change their vehicles and fueling infrastructure to use RNG.

In May 2017, OMAFRA issued a discussion paper to gather feedback from businesses, stakeholder groups and the public to help guide the design of the program.

RFS is a technology-neutral standard. It supports many different ways for transforming the transportation sector and achieving deep reductions in emissions. While increased electrification is likely for light-duty vehicles and advanced bioenergy is likely to be important in long-haul road freight and aviation, technological innovation remains unpredictable. The technology-neutral approach of the RFS lets the alternatives compete on their merits.

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Maximizing Existing Infrastructure

Renewable Energy

The 2017 LTEP is maximizing the use of the province's existing energy infrastructure in order to minimize any future cost increases for electricity consumers. Ontario can do this because it is benefiting more than originally expected from the investments made in electricity.

One example is the contracts for renewable energy that helped give Ontario an additional supply of emission-free electricity. Between 2026 and 2035, long-term contracts for over 4,500 MW of wind energy and 2,200 MW of solar energy will be expiring. In many cases, the wind turbines and photovoltaic panels will still be able to generate electricity after their usual 20-year contracts expire. This fact led to the development of Ontario's Fair Hydro Plan.

Some renewable energy projects may also be able to be upgraded to increase output, while keeping the existing equipment. With other projects, some equipment may need to be refurbished or replaced.

Natural Gas

Most experts agree that natural gas turbines can operate beyond their typical 20-year contract life.

This will be important over the coming decade, as the need for electricity will increase with nuclear refurbishment and the retirement of the Pickering Nuclear Generating Station. By sometime in the early 2020s, there will no longer be enough contracted capacity to meet reliability requirements.

Many existing contracts will expire over the same time frame, predominantly natural gas generation that started in the 2006–2014 period. These facilities could generate electricity past their contract life by participating in the capacity auctions contemplated under Market Renewal.

Refurbishing Nuclear

Refurbishing Ontario's nuclear generating stations is the most cost-effective option for meeting the requirements for baseload generation while producing no GHG emissions. Ontario is moving forward with the plans laid out in *2013 LTEP* to refurbish a total of 10 nuclear units between 2016 and 2033: four units at Darlington and six units at Bruce.

Refurbishing these 10 units will secure over 9,800 MW of affordable, reliable and emission-free generation capacity for the long-term benefit of Ontario. It will also support the 180 companies and 60,000 jobs that make up Ontario's globally-recognized nuclear supply chain.

Ontario Power Generation (OPG) is seeking regulatory approvals for the continued operation of the Pickering Nuclear Generating Station to 2022/2024. Ontario supports this plan, as Pickering would provide reliable and "emission-free" baseload power to replace the electricity that will be unavailable during the Darlington and initial Bruce refurbishments.

[placeholder for Financial Accountability Officer report on nuclear refurbishments]

The Darlington refurbishment

OPG is undertaking a multi-year phased approach to refurbishing the Darlington Nuclear Generating Station. This approach benefits from the lessons learned during previous refurbishment projects, which highlighted the need for in-depth planning and preparation prior to beginning the work.

In November 2015, OPG's Board approved a total estimated cost of \$12.8 billion for refurbishing all four Darlington units, which includes all spending to-date, interest and inflation. This is \$1.2 billion lower than OPG's original estimate in 2009.

In January 2016, the government gave OPG approval to proceed with refurbishing the first of the Darlington units, Unit 2. On October 15, 2016, OPG took Unit 2 off-line to begin refurbishment. On January 11, 2017, the first key task, taking the fuel out of Unit 2, was completed within budget and nearly a month ahead of schedule.

On April 13, 2017, OPG announced it had successfully completed Phase One of the Unit 2 refurbishment and isolated the unit from the rest of the Darlington plant. OPG has now moved on to Phase Two and removed key components from the reactor. The entire project is on track to be completed on budget and schedule.

OPG is working with nuclear supply chain companies across Ontario, from Nu-Tech in Arnprior to Laker Energy in Burlington and Cameco in Cobourg.

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ONTARIO COMPANIES WORKING ON NUCLEAR REFURBISHMENT

PROMATION NUCLEAR

Oakville-based Promotion has been designing and building custom-made equipment to maintain, inspect and refurbish nuclear plants since 2007. The company employs over 90 well-paid and highly skilled full-time staff.

On December 6, 2016, Promotion shipped its innovative Accessibility Platform Trolley (APT) to Darlington ahead of time and under budget. The APT allows nuclear workers to move safely and efficiently inspect the CANDU reactor during refurbishment.

LIBURDI AUTOMATION INC.

Hamilton-based Liburdi has been a pioneer in advanced welding technologies for over 30 years. Liburdi's extensive expertise has made the company a key player in the nuclear industry around the world.

Liburdi is supplying all welding technology on the Darlington Retube and Feeder Replacement.

THE BRUCE REACTOR INSPECTION AND MAINTENANCE SYSTEM (BRIMS) TOOL

A consortium of Ontario-based companies has developed a new, state-of-the-art tooling system that will reduce the time and cost associated with reactor inspections and maintenance, as well as improving worker safety.

The innovative Bruce Reactor Inspection and Maintenance System (BRIMS) tool is the result of a collaboration involving Bruce Power, ATS Automation, BWXT Canada Ltd., Candu Energy Inc. and others.

The Bruce Refurbishment

Bruce Power plans to invest approximately \$13 billion of its own funds to refurbish six nuclear units at the Bruce Nuclear Generating Station. Work on the first unit will begin in 2020. The change in the 2013 LTEP schedule will save electricity customers approximately \$1.7 billion compared to what was forecast for the project in the 2013 LTEP.

Bruce Power is currently undertaking a number of activities, including:

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- Implementing an asset management program to optimize the life of the Bruce units before and after refurbishment;
- Developing a final cost estimate for refurbishing the first unit, Unit 6; and
- Executing contracts with suppliers including BWXT Canada and SNC-Lavalin.

The Bruce refurbishment is expected to generate up to \$6.3 billion in annual economic benefits and increase employment by up to 23,000 jobs a year.

Bruce Power has launched the Nuclear Economic Development and Innovation Initiative with the County of Bruce to maximize the local economic impact of Bruce Power's \$13 billion Life-Extension Program. This program seeks to ensure there are long-term benefits for the counties of Bruce, Grey and Huron by:

- asking suppliers to opening offices in Bruce, Grey and Huron counties, and hire local people.
- giving preference to suppliers who generate jobs and economic benefit in Ontario, and where possible, operate close to the Bruce nuclear site.

This effort will have spin-off economic benefits for the region, such as the construction of needed new housing.

Ongoing Operation of Pickering

OPG is working on plans to continue to operate the Pickering Nuclear Generating Station until 2024. Two of the units would be shut down in 2022, with the remaining four units shut down in 2024. Their continued operation will ensure the province has a reliable source of "emission-free" baseload electricity to replace the power that will not be available during the Darlington and initial Bruce refurbishments. It would also reduce reliance on electricity generated from natural gas, saving \$600 million for electricity consumers and reducing GHG emissions by at least eight megatonnes.

The government announced on January 11, 2016 that it had approved OPG's plan to seek the necessary regulatory approvals from the Ontario Energy Board and the Canadian Nuclear Safety Commission to continue to operate Pickering.

The incremental energy from the Pickering life extension is expected to cost an estimated \$65/MWh, which is cost-effective for meeting baseload requirements. The continued operation of Pickering would also protect 4,500 jobs in the region of Durham and \$1.3 billion in local economic activity. The local community as well as labour and industry groups all support the life extension.

Managing the Risks

Oversight

The government will protect ratepayers by strictly controlling the cost and timetable of refurbishments. We will proceed with caution. OPG and Bruce Power will be subject to strict oversight to ensure that they complete the refurbishments on time and on budget.

In addition to OPG's oversight of the project, the government has had an independent set of eyes on the project at all times. During the planning and preparation phase of the project, the ministry had an independent advisor who regularly monitored and updated the government.

Now that the project has moved to the Execution Phase, the ministry has updated the oversight structure. A new independent advisor is ensuring continued and effective oversight, with support from Infrastructure Ontario. All of OPG's expenditures on nuclear refurbishment will also be reviewed by the Ontario Energy Board as part of its rate setting process

The updated agreement with Bruce underwent extensive due diligence by the Province, as well as by financial and technical advisors who were engaged by Independent Electricity System Operator when it negotiated the contract.

The IESO will continue to manage the contract and conduct an "open book" review of costs. It has full-time representatives on-site and will regularly report back to the government.

Off-Ramps

One of the principles of the 2013 *LTEP* was the use of off-ramps for nuclear refurbishment. Off-ramps ensure that refurbishments are only undertaken if they continue to deliver value for ratepayers.

OPG must get government approval before refurbishing each remaining unit at Darlington. These decision points act as "off-ramps" for the project. The government's decision to proceed will depend on:

- OPG's adherence to approved costs and schedules for previous refurbishments; and
- whether the project provides ongoing value to ratepayers.

Under its agreement with the IESO, Bruce Power assumes the full risk of cost overruns on the refurbishing, as well as the operating risk for the units over the life of the contract.

As with Darlington, contractual off-ramps allow the government to stop work on any refurbishment if the estimated cost exceeds a pre-defined amount. Refurbishment at Bruce can also be stopped if demand drops or lower cost resources emerge.