Expert Report of Steve Dorey[1]

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TABLE OF CONTENTS

I. OVERVIEW AND ORGANIZATION OF REPORT 1
II. THE FUNDAMENTALS OF ELECTRICITY 2
a. Physical Characteristics of Electricity 2
b. Electricity Supply Mix 3
c. Ontario's Current and Projected Supply Mix 7
III. Electricity Market Structure 8
IV. Transmission and Distribution Systems 10
a. Technical Properties of Transmission Systems 11
b. The Structure of Ontario’s Power Delivery System 12
i. Ontario’s Transmission Grid 12
ii. Ontario's Distribution System 13
V. CRITICAL FACTORS IN ELECTRICITY SYSTEM PLANNING 14
a. Reliable Supply 15
b. Economic Efficiency 15
c. Sustainability 16
d. Critical Factors in Transmission Systems Planning 17
VI. THE ONTARIO ELECTRICITY SYSTEM 18
a. History of the Ontario Electricity System: Vertically Integrated Until 1998 19
b. Deregulation (1998-2002) 22
c. Ontario’s Hybrid Electricity System 23
d. Ontario's Integration of Renewable Energy 25
e. GEGEA and the FIT Program 27
f. The Green Energy Investment Agreement 29
g. Challenges in Renewable Integration 30
h. Long Term Energy Plan 2010 31
VII. THE BRUCE TO MILTON TRANSMISSION LINE 31
a. Transmission Capacity in the Bruce Region 32
i. A Brief History of the Bruce Nuclear Complex 32

ii. **Transmission Capacity out of the Bruce Electricity Area** **33**

b. **Development of the Bruce to Milton Transmission Reinforcement Project** **35**

i. **Public Knowledge of the Need for Transmission Capacity in the Bruce** **35**

ii. **Factors Affecting the Development of the Project** **37**

iii. **Approvals Processes** **38**

iv. **Delay and Uncertainty** **42**

v. **Construction** **43**

VIII. Conclusions **44**

I. OVERVIEW AND ORGANIZATION OF REPORT

1. The purpose of this report is to provide a fundamental understanding of how electricity systems are planned with a particular focus on the Province of Ontario's ("Ontario") electricity system. More specifically, this report will reflect on recent transmission planning in Ontario with respect to the impact of the Ontario Feed-in Tariff ("FIT") Program and the Bruce to Milton Transmission Reinforcement Project.

2. Electricity is unlike any other commodity. It is not easily stored and must be consumed at virtually the moment it is generated. As a result, electricity system planning is complex. A proper understanding of the allegations at issue in this arbitration requires a fundamental grounding in the nature of electricity, the unique attributes of different forms of electricity generation, how electricity is delivered to consumers and how electricity systems are planned to ensure a safe and reliable supply of electricity for consumers.

3. This report provides a roadmap through these complexities by addressing the following topics:

- Section 2 examines the basic characteristics of electricity supply and the properties of various generation sources, including renewable energy sources;
- Section 3 provides an overview of electricity markets;
- Section 4 describes the nature and operation of transmission and distribution systems;
- Section 5 describes electricity planning processes and the roles of reliable supply, economic efficiency and sustainability in those processes;
- Section 6 provides an account of the evolution of Ontario's electricity market since 1998 and the development of renewable energy procurement programs in Ontario;
- Section 7 describes the need for, and development of, the Bruce to Milton Transmission Reinforcement Project; and
- Section 8 sets out my conclusions.

II. THE FUNDAMENTALS OF ELECTRICITY

4. The reliable and affordable generation and delivery of electricity to business and residential consumers plays a critical role in the economic health of modern developed economies. The following section will address the physical characteristics of electricity as well as the electricity supply mix, including the current and projected supply mix in Ontario. The section will demonstrate that an adequate mix of generation sources is required to ensure system reliability, economic efficiency and lower environmental impact.

a. Physical Characteristics of Electricity

5. Unlike other commodities, electricity supply and demand must balance at all points in the system at all times. Without constant and near instantaneous balancing, sudden fluctuations in voltage can cause brownouts and blackouts resulting in significant consumer inconvenience, expensive damage to physical infrastructure as well as fire hazards. This creates the need for complex systems of production, delivery and marketing. Until recently, large generating sources, often distant from major markets, provided the most cost-effective source of electricity. Coal-fired, nuclear and hydroelectric generating sources all exhibit major economies of scale. In order to deliver power from these large facilities to consumers with limited losses, electricity output is normally transformed to higher voltages and transmitted over high-voltage transmission lines, and then stepped down to lower voltages for use by large, directly connected customers and by local distribution utilities.

6. Since there is generally little capacity to store electricity, central control systems are required to ensure a continual balance between power supply and each customer's demand

across the system. Furthermore, a balanced supply of power at affordable prices requires a mix of large volume, relatively inflexible sources that run most of the time, and more flexible resources that can respond rapidly to changes in demand and supply.[2]

b. Electricity Supply Mix

7. This section describes the fundamental characteristics of different types of generation facilities and sources of electricity in the Ontario context.

8. Most electricity systems rely on a mix of generation sources to ensure a reliable and cost-effective supply of electricity.[3] Some generating plants are relatively expensive to build, but have low operational costs. Others are relatively inexpensive to build, but have high fuel costs. Modern electricity systems attempt to optimize the mix of baseload, intermediate and peak load facilities to take maximum advantage of certain forms of generation and minimize overall costs. More recently, there has been greater demand for generation from sources with lower environmental impacts. As a result, the intermittent generation of certain renewable sources of electricity must also now be factored into the mix.

9. Baseload generating facilities are designed to run a high percentage of the time and provide for the minimum daily electricity demand (or "load"). These facilities tend to be capital-intensive with relatively low fuel costs. Their generation output, however, cannot be easily adjusted (i.e. dispatched) in response to changes in demand and they cannot be started up or shut down quickly. Steady operation allows the recovery of the relatively high capital costs normally

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[2] **C-0320** Overview of the Electricity system in the Province of Ontario, William Hogan (December 21, 2011) (“Hogan Report”) p. 11.

[3] The main exceptions are systems with large amounts of storable hydro, where this resource can meet baseload, intermediate and peaking power needs.

associated with baseload generation investment. Essentially, they operate non-stop to provide the "base" level of electricity needed, but need to be supplemented with more flexible generation sources to provide for periods of higher demand.

10. In Ontario, hydro production provided most baseload power until the 1950s. Over the subsequent two decades, coal-fired generation was increasingly used to also provide baseload power. From the early 1970s, nuclear power came into the picture. Nuclear power now provides over half of Ontario's current power supply.[4]

11. Hydroelectric power from facilities like the Sir Adam Beck Hydro Power Station at Niagara Falls accounts for 23 percent of Ontario's power output.[5] There are four basic forms of waterpower, three of which operate in Ontario. Run-of-the-river hydropower provides regular baseload supply, with some flexibility for daily fluctuations in supply through water flow regulation. Storable hydropower provides base- and peak-load supply, with enough storage capacity in reservoirs to operate independently of hydrological inflows for periods of weeks or months and has the ability to shut down or start up at short notice. Pumped storage provides peak-load supply, using water cycled between lower and upper reservoirs by pumps, which utilize surplus energy from the system at times of low demand. Off-shore wave and tidal power are not currently used in Ontario.

12. Coal-fired generation accounts for 40 percent of the world's electricity supply and serves as the primary baseload fuel in most of the mid-western U.S. adjacent to Ontario, accounting for

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[4] **Dorey-034**, IESO, *IESO Releases 2013 Data* (January 8, 2014). In 2013, nuclear generation provided 59 percent of Ontario's power output p. 1.

[5] Ibid.

50-90 percent of the power supply in those states.[6] Prior to the development of Ontario's nuclear fleet, coal-fired generation played a similar role in the province. While coal is an abundant and relatively inexpensive fuel, it is also a primary source of greenhouse gases ("GHGs") and smog-causing emissions. Whereas coal-fired facilities such as the Nanticoke Generating Station once provided a significant quantity of baseload electricity, Ontario has committed to eliminating coal-fired power by the end of 2014.

13. Nuclear power serves as the baseload workhorse in some jurisdictions, most notably France and Ontario. Nuclear facilities are generally large and inflexible. In Ontario, it takes 48 to 92 hours to return to service nuclear units that have been taken out of service. However, recent developments, such as in France and with Bruce Power LP (which operates Ontario's Bruce Nuclear Generating Station), have demonstrated some limited additional flexibility.[7]

14. Intermediate generation resources have the capacity to supply power much of the time, and can be shut down when demand is low. Thus, they are used when demand is above the minimal level (such as during the day and early evening). Intermediate gas-fired resources can take up to an hour to ramp up to their minimum production levels and are required to run for a minimum period of time in order to avoid equipment damage. The capital costs associated with intermediate generation tend to be lower than those associated with baseload generation, but higher than those of peaking generation sources. By shutting down when prices are too low to cover fuel and other variable costs, these facilities make efficient use of fuel. Such facilities usually run during the day and evening on weekdays, when prices are on average higher. In most

[6] **Dorey-032**, Ontario Ministry of Energy, *Achieving Balance, Ontario's Long-Term Energy Plan,* (LTEP 2013) (December 2, 2013), p. 10.

[7] **Dorey-026** IESO, SE-91, Floor Price Update, August 8, 2012, p. 11.

North American markets, coal-fired and combined cycle natural gas-fired generation account for the bulk of intermediate generation. In Canada, hydro production is also often used to meet intermediate power needs. In Ontario, combined-cycle natural-gas fired generation is the most commonly used intermediate generation source at present.

15. Peaking resources are used to meet short-term or unusual changes in demand. They play a critical role in ensuring supply and demand are balanced in real time. Thus, they operate during peak demand (e.g. during the hottest summer days), which in some jurisdictions could mean only a few hours of operation a year. Single cycle gas-fired generation facilities have relatively low capital costs, but are less efficient than combined cycle facilities. As a result, they have relatively high fuel costs and can only profitably operate when power prices are high. Combined cycle gas-fired facilities already on line can also respond to increasing demand by ramping up their output. In addition, dispatchable hydro facilities provide "quick start" capacity and have the ability to respond rapidly to increases or decreases in demand.

16. Intermittent resources are those whose availability depends on natural conditions, such as the availability of wind or sunshine. Wind power provides an emission-free source of power and has been the fastest growing form of power generation globally. While wind power is emission-free, it is also intermittent. As a result, wind sometimes makes a limited contribution to meeting Ontario peak power needs, particularly on hot summer days. It therefore needs to be backed up by gas-fired generation or flexible hydro power.

17. While still more expensive than most conventional power sources, the cost of wind power is declining as technology improves and economies of scale are realized. Globally, costs for wind turbines came down by a factor of three between 1980 and 2004, before rising slightly over

the 2004-2008 periods due to equipment shortages.[8] Subsequently, wind power costs resumed their decline.

18. Solar power is also intermittent and expensive relative to conventional power sources. Unlike wind power, however, it tends to be available on peak summer days. Solar power is also well suited to smaller installations and will continue to be a major part of the FIT and microFIT Programs going forward. Like wind, solar costs are declining rapidly.[9]

19. Finally, imported and exported electricity also make important contributions to electricity systems. Imported electricity from other interconnected markets can also provide baseload, intermediate or peaking resources. Imports and exports can also play a valuable role in balancing supply within the wider interconnected region.

c. Ontario's Current and Projected Supply Mix

20. The table below shows power output and capacity shares by source for 2013 and the projected mix in 2025, as outlined in the recent Long-Term Energy Plan.

[8] **Dorey-029** World Energy Council, *World Energy Resources, 2013 Survey*, p. 10. Available at: http://www.worldenergy.org/wp-content/uploads/2013/10/WEC_Resources_summary-final.pdf

[9] **R-149** Ministry of Energy, Feed-In Tariff Program Two-Year Review FIT 2 Year Review p. 17; **Dorey-23** Ontario Power Authority, FIT 3.0 Price Schedule, 2012.

Shares of output and capacity, by power source (percent)[10]

Source	2013 Output[11]	2013 Capacity	2025 Output	2025 Capacity**
Nuclear	59.2	34	42	20
Hydro	22.3	22	29	21
Coal	2.8	6	0	0
Gas	14.6	26	12	23
Wind	3.0	6	11	15
Other*	0.8	6	6	15

* Includes solar, bioenergy and demand response.
** Does not total to 100 percent, since LTEP includes 6percent for “planned flexibility”, which could be more demand response or imports.

III. ELECTRICITY MARKET STRUCTURE

21. Given the unique characteristics of electricity, power markets need to address challenges other markets do not face, including ensuring continuous balance between supply and demand, ensuring a high level of reliability, coordinating delivery in real-time across large integrated markets, and ensuring adequate investment to meet future power needs.[12]

22. Historically, electricity markets worldwide were dominated by large utilities that controlled major generation sources, the associated transmission and distribution systems and the customer base within a well-defined geographic area. Under this model, the utility could set prices to ensure it fully recovered its costs over the life of its generation assets and transmission

[10] **Dorey-032** LTEP 2013, pp. 31 & 35.

[11] **Dorey-034** IESO, 2013 Energy Data, op. cit.

[12] **C-0320** Hogan Report pp. 17-18.

and distribution infrastructure. It could also directly manage a range of generation resources and dispatch power to where it was required. Where other firms were better equipped to provide goods or services, the utility could contract directly with that supplier, via either a Request for Proposals or a bilaterally negotiated contract. Until 1998, Ontario Hydro operated in this fashion. It owned and operated most of Ontario's major electricity generation facilities, most of its transmission and distribution infrastructure, in addition to operating the entire system and contracting with Non-Utility Generators for additional supply.

23. In the late 1980s and early 1990s, a number of factors came together to undermine the integrated utility model, particularly in high cost jurisdictions. Advances in the efficiency of jet-engine style natural gas-fired turbines, combined with low and stable natural gas prices through the 1990s undercut the cost advantages of large coal-and nuclear-based utilities.[13] This trend was reinforced by growing concern about GHGs and other by-products of coal-fired generation. At the same time, advances in computer technology made the economic coordination of multiple smaller scale generators more practical. In the US, the Federal Energy Regulatory Commission ("FERC") set the stage for industry restructuring by introducing Regulation 888, which made transmission systems common carriers, open to all suppliers.

24. In competitive wholesale markets, multiple suppliers make competing bids in day-ahead and real-time markets to provide power. With profit-maximizing suppliers bidding their marginal costs, an optimization engine or algorithm can run to identify the most efficient mix of technically feasible energy sources and issue dispatch instructions to those generators to provide

[13] **C-0320** Hogan Report p.6.

the required power. For this system to work effectively, all suppliers must have access to the power grid on a non-discriminatory basis.

25. However, while competitive markets generally provide market discipline and efficient dispatch, challenges remain. For reliability reasons, regulators require such markets to maintain sufficient reserves so as to address shortages and outages. Most markets also impose price caps that serve to limit disruptive price volatility. As a result of these factors, prices seldom rise high enough to allow generators to recover their full fixed costs. The resulting “missing money” problem is not easily remedied in these so-called “energy only” markets, and can result in inadequate investment in new generation and refurbishment.[14]

26. In order to ensure adequate investment, and the right balance of investments, governments, regulators and system operators resort to a variety of mechanisms to supplement wholesale market results. Mechanisms include contracts for differences that top up wholesale market returns, capacity markets that pay generators to be present in the market even when not providing energy, regulated prices and fixed price contracts.

IV. TRANSMISSION AND DISTRIBUTION SYSTEMS

27. Adequate transmission and distribution infrastructure is essential to the proper functioning of electricity systems. This section will discuss the technical properties of transmission systems as well as describe Ontario's transmission and distribution systems.

[14] **C-0320** Hogan Report, pp. 16-17.

a. Technical Properties of Transmission Systems

28. Transmission systems are the high voltage lines that move large amounts of electricity, often over long distances.[15] In competitive markets in North America, most electricity systems are controlled by Independent System Operators ("ISOs"), who ensure that electricity flows smoothly in real time to balance supply and demand. Transmission system owners and System Operators commit to meet common reliability standards set by the North American Electric Reliability Corporation ("NERC") as a condition for operating as part of the interconnected grid. The interconnected grid in north-eastern North America is sometimes referred to as "the world's largest machine", since all of its operations are synchronized in real time. NERC standards identify acceptable technical practices and precautions. Regular inspections ensure these standards are adhered to. These standards and procedures continue to evolve in light of changing technologies and supply composition. Increasingly, system operators and transmitters are incorporating advanced smart grid technologies into their grid management systems to control complex flows and sense potential equipment problems.[16][17]

29. Connecting generators to the transmission system directly, or through transmission-connected distribution systems, can be a complex and time-consuming exercise. Each connection must be assessed for impacts on the system as a whole and on existing customers and other connected generators. When most of the generators connected were large, these assessments were built into development plans for these major generation projects. With the

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[15] In Ontario, high voltage systems are defined as those over 50 kV. Some other jurisdictions use higher definitions of "high voltage".

[16] **Dorey-021** IESO, Enabling Tomorrow's Electricity System, Report of the Ontario Smart Grid Forum, 2011, p. 11, Available at: https://www.ieso.ca/imoweb/pubs/smart_grid/Smart_Grid_Forum-Report.pdf.

connection of large numbers of smaller scale generators, the task of assessing potential impacts under a wide range of circumstances has become more complex.

30. Distribution systems are the lower voltage grids that deliver electricity, via transformers, from transmission lines to residential and business customers. In Ontario, these distribution systems are normally run by Local Distribution Companies ("LDCs"). Urban distribution systems are increasingly incorporating the smart grid technology and redundancy previously found only in transmission systems. With the rapid expansion of small-scale generation connecting directly to distribution systems, what were once one-way "energy highways" with a straight-forward delivery function, are increasingly becoming sophisticated two-way gathering and distribution systems. Unlike urban distribution systems, rural distribution systems tend to be smaller radial systems that were historically designed to deliver power to the end of the line.

b. The Structure of Ontario's Power Delivery System

i. Ontario's Transmission Grid

31. Ontario's high voltage transmission system is comprised of approximately 30,000 km of 500 kV and 230 kV transmission lines and interconnections with 5 neighbouring jurisdictions: Québec, New York, Michigan, Minnesota and Manitoba. Ontario's high voltage transmission system delivers large volumes of power to approximately 60 large directly connected customers and to about 80 LDCs.

32. A key feature of the system is the ability to respond instantaneously in the event of outages on major lines, by shifting power flows to alternate paths. With the exception of radial lines from northern Ontario, Ontario's high voltage grid has substantial redundancy through multiple paths to major power markets. As a result, developments in one region can affect the

capacity and reliability in other regions. When planning transmission expansion, projects are expected to increase the reliability of the network, in line with NERC reliability standards or, at a minimum, not to have a negative impact on system reliability.

33. Historically, the Ontario transmission system was designed to deliver large amounts of power from a limited number of generation sources to major markets, most notably the Greater Toronto Area. The large majority of Ontario's power supply came from 8 generation stations (3 nuclear, 3 coal-fired and 2 hydro). Over the past decade, as coal-fired generation has been phased out and renewable power has expanded, sources have been increasingly diversified. This has required major investments in Ontario's transmission system. Since 2003, Hydro One has invested $11 billion[18] in its transmission and distribution system, effectively doubling its asset base.[19] This investment is a combination of spending to restore or refurbish the existing grid, expansion to connect and deliver new generation, spending to connect new and growing load centres, and investments in smart grid technology.

ii. Ontario's Distribution System

34. Ontario's distribution companies range in size from Hydro One's mainly rural distribution system that serves 1.3 million customers to several small utilities that serve only a few thousand customers.

35. Major urban utilities have invested heavily in modernizing their systems. Ontario is a North American leader in the implementation of smart grid technology. Ontario was the first major jurisdiction to commit to smart meters for all power consumers. That in turn has provided

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[18] All figures herein are in Canadian dollars.

[19] **Dorey-032** LTEP 2013, p. 2.

a technology platform that enables time-of-use pricing, smart home services, automated outage detection, and the efficient integration of distribution-connected generation.[20]

36. Many of the rural distribution systems in Ontario are old and are not equipped to address the challenges of complex two-way power flows. Plans to dramatically increase the use of smaller scale renewable power, like *Ontario's Green Energy and Green Economy Act* 2009 ("GEGEA") often entail major investments to upgrade the intelligence and carrying capacity of distribution systems. With 123,000 km of mainly rural distribution lines, upgrading Hydro One's system alone to accommodate increased renewable generation connections is a formidable task.

V. CRITICAL FACTORS IN ELECTRICITY SYSTEM PLANNING

37. Given the need to match electricity supply and demand in real time (i.e. virtually instantaneously) and the long lead times associated with the development of large generation and delivery investments, there is a need for an integrated planning process. Electricity system plans must balance the need for reliable supply with economic efficiency and sustainability.[21] While all three considerations are important, the focus among them can, and does, shift to reflect economic and social circumstances. This section provides an overview of how system planners balance these drivers in the context of changing technology, economic circumstances and policy priorities. It also provides a description of how these drivers must be accounted for, specifically with respect to planning transmission capacity expansion.

[20] **Dorey-021** IESO, *Smart Grid Forum*, 2011, p. 2.

[21] **Dorey-028** World Energy Council - *World Energy Trilemma 2012* (December 2012), p. 4.

a. Reliable Supply

38. Key supply considerations include the volume and composition of the generation supply mix, projected demand for power and the ability of the transmission system to deliver power from where it is produced to where it is needed.

39. While power demand continues to grow rapidly in the developing world, it has peaked and in some cases declined in many developed countries. The historic relationship between economic growth and power demand no longer holds in many countries for a variety of reasons, including: a shift from energy-intensive manufacturing towards less energy-intensive service industries; breakthroughs in energy efficiency technology such as LED lighting; and supportive conservation programs that encourage businesses and households to reduce energy consumption in general and peak power consumption in particular. The slowdown in industrial activity following the 2008 financial crisis further slowed power demand.

40. In terms of the supply mix, the fastest growing sources of supply are renewable energy, particularly wind and solar power. Given the intermittent nature of these resources, system plans need to ensure adequate dispatchable resources are available when wind or sunshine are not available. Planners also need to ensure there is adequate transmission and distribution capacity to move power from these intermittent sources to markets when it is available.

b. Economic Efficiency

41. In an increasingly competitive global economy, the cost of energy resources can have a major impact on the location of investment and jobs. Equally important, rising energy costs can impose a serious burden on consumers, particularly in times of economic uncertainty. The choice of generation technologies is largely driven by the relative costs of available generation

options. Associated delivery and environmental costs are also key considerations. System planners strive to minimize the overall cost of system supply, within the constraints imposed by the need to maintain reliability and address other environmental and sustainability goals. While coal and nuclear power historically benefited from economies of scale relative to other forms of generation, improvements in engine efficiency and the prospect of low and stable natural gas prices, associated with shale gas technology, increasingly make natural gas-fired power generation an attractive economic option, while also providing environmental benefits compared to coal-fired generation.[22] At the same time, technological advances and economies of scale are bringing down the cost of wind, solar and other renewable generation sources. Planners need to balance these cost trends with other policy goals and with the need to ensure system reliability when seeking the optimum supply mix.[23]

c. Sustainability

42. This section discusses the range of policy considerations that influence energy plans in many countries. These considerations include environmental concerns and economic and social goals.

43. Environmental and health policy drivers have become increasingly relevant to electricity system planning, from the perspective of planning both future generation capacity and associated infrastructure expansion. Many jurisdictions have committed to meeting ambitious greenhouse gas reduction targets and, as part of meeting those commitments, put in place policy initiatives to ensure a greater share of electricity generation comes from renewable sources of energy such as

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[22] **Dorey-007** Ontario Power System Planning Integrated Power System Plan I (2007), p. 2. Available at: http://www.powerauthority.on.ca/sites/default/files/page/7763_B-1-1_updated_2008-09-04.pdf

[23] **Dorey-030** World Energy Council, World Energy Perspectives: Cost of Energy Technologies, (October 2013) Available at: http://www.worldenergy.org/publications/2013/world-energy-perspective-cost-of-energy-technologies/

hydro, wind, solar, biomass and biofuel.[24] These initiatives are often coupled with conservation and efficiency policies and policy choices such as reducing or eliminating the use of fossil fuels.

44. Investment in energy production and delivery can also provide significant economic benefits in terms of job creation. Manufacturing equipment and servicing the energy sector is one of the fastest growing economic sectors globally. Countries like Germany, Denmark and China have built large “green economy” sectors in support of global renewable energy growth. Small-scale renewable energy projects can also provide important economic development opportunities for communities. In the Canadian context, energy projects can provide unique economic opportunities for Aboriginal communities that have few other economic development options.

d. Critical Factors in Transmission Systems Planning

45. A key feature of the bulk transmission system in north-eastern North America is the need to respond instantaneously to outages on major transmission lines, shifting flows to alternate paths without interruption. The Ontario power grid, with the exception of radial lines from northern generation sources, achieves this redundancy through multiple interconnected paths to major markets. For example, supply from the Bruce, West and Niagara Zones all flows through the Southwest Zone toward the Greater Toronto Area (“GTA”).

46. A primary goal of transmission planners is minimizing transmission system congestion, where the system is unable to deliver the full volume of economic power supply. Congestion can be costly to consumers in terms of payments for locked-in energy that cannot be

[24] For example, given the economic and health costs associated with coal-fired generation, the Ontario Government committed to eliminate all of Ontario’s coal-fired power plants by the end of 2014. The phasing out of coal is the largest GHG reduction initiative in North America and will contribute a 22 percent reduction in Ontario emissions from 2008 levels.

delivered and for the environment where emission-free sources must be replaced with less environmentally benign sources. Standard practice is therefore to size transmission systems to accommodate the maximum potential output of the connected generation sources (known as their "nameplate capacity").[25]

47. Following the 2003 blackout in north-eastern North America, regulators have imposed increasingly demanding maintenance and service standards on system operators and transmitters, in recognition that an outage on a single line can cascade into a catastrophic system-wide failure. New transmission lines must be planned to improve the overall reliability of the system or, at a minimum, not have a negative impact on overall system reliability.[26]

48. For transmission planning, transmission zones are defined in terms of the high-voltage transmission lines generators and loads are connected to, rather than geographic boundaries. As a result, efficient planning requires a flexible approach that permits connections at points that can best accommodate new supply or load, allowing the best overall system performance.

VI. THE ONTARIO ELECTRICITY SYSTEM

49. This section will discuss the recent history of the Ontario electricity sector to provide context for the more focused discussion of the Bruce to Milton Transmission Reinforcement Project. In particular, it will address: the development of the Ontario electricity sector from the monopoly Ontario Hydro to the present-day hybrid system; Ontario's recent activities in

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[25] **Dorey-008** Ontario Energy Board – Hydro One Argument in Chief Bruce to Milton Transmission Reinforcement Project, pp. 17-20. Available at: http://www.hydroone.com/Projects/BrucetoMilton/Documents/Record_of_Consultation-Amended-Nov02[1].pdf

[26] When planning system upgrades or new connections, system operators carry out System Impact Assessments (SIAs) to ensure that these projects do not have negative consequences for the rest of the system and Customer Impact Assessments (CIAs) that ensure that projects do not negatively affect other generators or loads.

integrating greater use of renewable sources of power, including under GEGEA initiatives; the challenges in integrating renewables; and Ontario's recent long-term energy planning.

a. History of the Ontario Electricity System: Vertically Integrated Until 1998

50. The Hydro-Electric Power Commission of Ontario ("HEPCO" until renamed "Ontario Hydro" in 1974) was established in 1906. While its initial role was to build the transmission and distribution infrastructure for Ontario's electricity system, it later moved into generation, planning and system operation and coordination. Thus, like most other electricity systems prior to the 1990s, Ontario Hydro operated as a large integrated utility and had an effective monopoly in the generation, delivery and sale of electricity in most of Ontario.[27] It operated under the motto "power at cost", recovering its full operating, fuel and capital costs, but not profit, from its rate base.

51. Until the 1950s, water power was the primary source of Ontario Hydro's power, with major dams located at Niagara Falls (Sir Adam Beck Hydroelectric Generation Stations) and St. Lawrence (R.H. Saunders Generation Station). In the 1950s, the supply of easily accessible hydro power was insufficient to meet the province's growing power needs and the hydro fleet was augmented with a number of coal-fired plants, located in Mississauga, Nanticoke, Lambton, Thunder Bay, Atikokan. Since Ontario has no domestic coal sources, these plants were located on the Great Lakes and relied primarily on Appalachian coal.

52. With the development of nuclear technology in Canada and elsewhere in the 1970s, Ontario Hydro undertook an ambitious program of nuclear power development, initially with the

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[27] There were a few small exceptions: Cornwall Hydro which is connected to the Québec system, Great Lakes Power around Sault Ste. Marie, which was effectively isolated from the provincial grid until the 1960s, generation and transmission from a private hydro generator at Niagara Falls that pre-dated the creation of Ontario Hydro.

completion of four reactors at the Pickering site in 1974 followed by additional reactors in Darlington and Bruce, using the Canadian Deuterium Uranium ("CANDU") technology developed by Atomic Energy of Canada Ltd. By the 1980s, nuclear power had become a major source of Ontario's baseload power supply, accounting for half of the generation. As in many other jurisdictions, the 1973 Oil Supply Crisis served as a catalyst for energy self-reliance. In order to meet peak power need, however, Ontario Hydro continued to rely on coal-fired generation, complemented by storable hydro and later, by a dual fuel (gas and oil) plant in Lennox County.

53. Investment planning by Ontario Hydro at that time was a complex, and largely internal, exercise intended to balance long-term supply delivery capability investments with long-term demand projections thereby ensuring system reliability. As affordable power was seen as a critical factor in the province's economic development, these planning exercises were subject to extensive public scrutiny. Therefore, economic efficiency was also a primary goal. A number of legislative reviews were undertaken and the Ontario Energy Board was tasked to review Ontario Hydro's Demand-Supply Plans ("DSP").

54. The final Ontario Hydro DSP review took place over the 1989-1992. The DSP projected peak load of 35,000 MW by 2014, but recommended building additional generation capacity to accommodate a 40,000 MW peak. In order to meet the projected demand, the Plan called for 5,000 MW of demand management, refurbishment of the coal-fired fleet, 12 new nuclear reactors, and 7,000 MW of natural gas-fired generation.[28] Ontario had also entered into a long-term contract with Manitoba Hydro for the development of the Conowapa site on the Lower

[28] **Dorey-033** IESO, Notes for Remarks Ontario Energy Networks Luncheon, Bruce Campbell (Jan. 8, 2014) p. 4.

Churchill River and delivery of bulk power from Manitoba to Ontario. However, this contract was subsequently terminated. The difference between plans and actual demand highlight the need for flexibility.[29]

55. As Ontario sunk into a severe industrial recession over the 1989-1992 period, the need for major supply additions was increasingly questioned and the DSP exercise was effectively abandoned by 1992. Construction of the Darlington Nuclear Generating Station, which had been repeatedly delayed since the early 1980s, was however completed in 1994, at a cost of $14.4 billion, compared to an initial estimate of $3.7 billion. Ontario Hydro's long-term debt more than doubled between 1980 and 1996. As the costs associated with the Darlington project entered the rate base, electricity prices surged by 30 percent.[30] In response to concern that power costs would undermine Ontario's industrial competitiveness, Ontario Hydro negotiated Load Retention Rates with major industrial consumers, which provided power at prices that reflected the marginal cost of production. That in turn contributed to higher rates for other ratepayers in the province and to public displeasure with Ontario Hydro, in particular, and monopoly power supply, in general.

56. At the same time, other jurisdictions such as the UK and New Zealand, as well as neighbouring states like New York and Michigan, were in the process of replacing monopoly systems with open and competitive natural-gas-based systems that promised lower prices and the shift of risk from the public to the private sector.

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[29] **Dorey-032** LTEP 2013, p. 4. The Ontario Minister of Energy recently announced that the Ministry would carry out annual reviews of supply and demand trends as a basis for fine-tuning its planning process.

[30] **Dorey-001** Ontario Ministry of Energy, Science and Technology, Direction for Change: Charting a Course for Competitive Electricity and Jobs in Ontario, November 1997, p. 5 Available at: https://archive.org/stream/directionforchan00ontauoft#page/n1/mode/2up.

b. Deregulation (1998-2002)

57. In 1995, the Ontario Government at the time appointed the Advisory Committee on Competition in Ontario's Electricity System. A year later, that Committee recommended the rapid introduction of competition in the wholesale and retail sectors. The government responded in 1997 with a White Paper, which laid out a nine-point plan to fundamentally reform Ontario's power sector by 2000. Key elements of this plan included: full wholesale and retail competition; separating competitive businesses from monopoly transmission and distribution businesses; putting the successor commercial companies to Ontario Hydro on a sustainable basis by removing debt that would effectively be stranded in a competitive market, creating an independent regulator by extending the OEB's jurisdiction to regulation of the electricity (and natural gas) sector; and, establishment of an Independent Market Operator.[31] Furthermore, municipally-owned LDCs were corporatized under the *Ontario Business Corporations Act*. The *Electricity Competition Act, 1998* enacted these changes.

58. For open and competitive markets to operate successfully, market participants must have the opportunity to compete fairly with each other and with incumbent suppliers. In order to achieve this, access to the transmission grid must be open on a non-discriminatory basis. In Ontario, this was achieved by separating the competitive supply function from the entities that own and control the grid. Ontario Hydro was divided into five separate entities, each with their own management and Boards of Directors:

- Ontario Power Generation ("OPG") assumed ownership of Ontario Hydro's generation assets.

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[31] Ibid, p. viii.

- Hydro One (initially known as Ontario Electricity Services Corporation) assumed the transmission and rural distribution assets of Ontario Hydro as well as its retail business and its remote service business.[32] As a result, it owns most of the Ontario transmission system and is the single largest distributor of electricity in Ontario.

- Ontario Electricity Financial Corporation assumed Ontario Hydro's $38.1 billion in debt and liabilities, over half was determined to be "stranded", i.e. not recoverable or serviceable in a competitive market.

- The Independent Electricity Market Operator ("IMO" later renamed the Independent Electricity System Operator or "IESO") took over the management of the electricity market and grid operations. It also had primary responsibility for ensuring reliability on the interconnected transmission grid.

- The Electrical Safety Authority, a not-for-profit agency, assumed responsibilities for all aspects of electrical safety in Ontario, including licensing contractors, inspections and investigations.

c. Ontario's Hybrid Electricity System

59. The 1998 restructuring of Ontario's electricity market was based in part on the Ontario Government's expectation that private investors would respond to real-time price signals with generation investments that would meet the Ontario's growing power needs. The new competitive market opened in May 2002. However, it faced immediate challenges. There was still no central planning authority to ensure adequate supply. Furthermore, during this restructuring, supply continued to decline as old generation assets went off-line for refurbishment. Meanwhile, a particularly hot summer that year caused electricity prices to spike resulting in significant impact to ratepayers. By November 2002, the Government was forced to implement price controls and a freezing of transmission and distribution rates to moderate

[32] Hydro One's retail business: Ontario Hydro Energy, was subsequently sold to Enbridge subsidiary, Union Gas, and renamed Reliance Home Comfort in 2005.

ratepayer concerns. Furthermore, very little private investment occurred as a result of continued lack of financing in a post-Enron world. By the summer of 2003, Ontario faced power shortages and was heavily dependent on imports from Michigan and New York to meet peak power demand. This was still further exacerbated by the consumer reaction to artificially low rates, continued barriers to new generation financing and consumption that was continuing to grow.

60. In response to this situation, the Ontario Government appointed the Electricity Conservation and Supply Task Force ("the Task Force"). The Task Force noted four key developments that drove the need for a new roadmap for the power sector in Ontario: 1) the demise of merchant generation and related financial markets following the collapse of Enron and other energy traders; 2) the increase in the level and volatility of natural gas prices; 3) the Ontario Government's commitment to coal plant closure by 2007; and 4) the Ontario Government's commitment to keep its energy sector resources in public hands.[33] It also observed that most of Ontario's generation capacity needed to be refurbished or replaced by 2020.

61. Early in 2004, this Task Force reported to the Minister of Energy with a series of recommendations, including the creation of an agency to undertake long-term energy planning and procurement of needed energy supply through long-term contracts at sufficient prices to encourage investment; measures to increase the supply of renewable energy; a hybrid system that would compensate generators through a mix of market revenue, contract payments and regulated power rates; and, measures to keep existing private generators whole in the new market.

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[33] **Dorey-003** Electricity Conservation and Supply Task Force, *Tough Choices: Addressing Ontario's Power Needs*, (January, 2004), p.1.

62. In response, the Ontario Government enacted the *Electricity Restructuring Act, 2004*, which included a number of reforms including the creation of the Ontario Power Authority ("OPA") as an independent non-profit corporation responsible for conservation, electricity procurement and long-term planning; granting the Ontario Energy Board ("OEB") the authority to review and approve the OPA's Integrated Power System Plans ("IPSP") and procurement policies; and, assigning responsibility for directing procurement to the Minister of Energy until such time as the OEB approved the OPA's first IPSP.[34]

63. The OPA filed its first IPSP with the OEB in 2007, but before the OEB review could be completed, a new Minister of Energy directed the OPA to revisit the IPSP, with a view to increasing the volume of renewable energy and increasing community and Aboriginal participation.[35] As a result, the OPA withdrew its application.

d. Ontario's Integration of Renewable Energy

64. With the Government's new focus on increasing the use of renewable energy sources, the OPA conducted three procurement processes for large renewable energy projects between 10 and 200 MW over the 2005 and 2009 period. Three subsequent Renewable Energy Supply request for proposals ("RES" 1, 2 & 3) were issued for a total of about 1,800 MW of large scale renewable energy, primarily wind. The initial procurement was judged primarily on the economic bids submitted. By RES 3, the process had been refined to ensure that projects brought capacity to areas of Ontario where power was needed, as well as to assess bids on the basis of investors' technical capability, financial strength, previous experience, management

[34] **R-152** Ontario Energy Board website excerpt: "Electricity Restructuring Act, 2004".

[35] **Dorey- 014** Letter (Directive) from Georges Smitherman, Ministry of Energy to Colin Andersen, Ontario Power Authority (September 17, 2008).

skills and other criteria in order to ensure that successful bidders could complete projects on time and on budget.[36]

65. The Government of Ontario also directed the OPA to develop a Renewable Energy Standard Offer Program ("RESOP") for projects of less than 10 MW.[37] These projects were expected to use existing excess capacity on distribution networks. The OPA identified regions where distribution capacity and associated transmission capacity existed and designated these as "Green Zones". Areas where capacity was limited were designated as "Yellow Zones". Areas such as the Bruce region with no available capacity were designated as "Orange Zones". Under RESOP, wind, water and bio-energy resources were paid 11 cents per kWh, with water and bio-energy having a premium for production during peak periods. Solar output was priced at 42 cents per kWh. The program was heavily oversubscribed and, as a result of the first-come first-served policy, there was intense competition for queue positions, which quickly became valuable. Interest far exceeded the ability of Hydro One and other distributors to connect generators to the existing distributions systems in a timely manner.

66. In response to dissatisfaction with RESOP and the Government's belief that a German-style feed-in tariff program would lead to greater penetration of distribution system embedded generation as well as more community-level and Aboriginal involvement, Minister Smitherman tasked the OPA to work with the OEB, Hydro One and the IESO to develop a much broader feed-in tariff program. Key differences included differentiated prices, reflecting differences in

[36] **Dorey-006** Letter (Direction) from Dwight Duncan to Jan Carr (August 27, 2007).

[37] **R-034** Letter (Direction) from Donna Cansfield to Jan Carr (March 21, 2006).

technology and project size; stringent timelines for transmitters and distributors to connect renewable energy projects; and, the removal of project size limits.[38]

e. GEGEA and the FIT Program

67. In 2009, the Government of Ontario saw the development of a green economy as a prime opportunity to spur economic growth. The GEGEA had four main components: 1) the FIT Program; 2) the creation of the Renewable Facilitation Office in the Ministry of Energy; 3) the streamlining of environmental approvals processes for renewable energy projects; and 4) the expansion of conservation programs and targets across the province.[39]

68. The FIT Program was launched at a time of global economic uncertainty. Like many infrastructure programs undertaken by governments in the wake of the 2008 global recession, it was focused on ensuring early economic activity and jobs.[40] Given the desire to create 50,000 jobs in the green energy sector over three years, the Government sought to ensure that renewable energy projects had the maximum possible benefits to the Ontario economy. To ensure this would happen, FIT Contracts included domestic content requirements and tight timelines for construction and connection of contracted projects.

69. FIT prices were designed to reflect the technology and scale of each source. The prices were designed to cover costs and provide an 11percent rate of return for a typical project. On-shore wind was paid 13.5 cents per kWh. Solar prices ranged from 44.3 cents to 80.1 cents per

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[38] **C-0264** September 24, 2009 Letter (Direction) from George Smitherman, Minister of Energy and Infrastructure to Colin Andersen, OPA, (September 24, 2009).

[39] **R-057** *Green Energy and Green Economy Act*, SO 2009, c. 12 ("GEGEA"); pp. 2-3.

[40] **Dorey-020** Ontario Ministry of Energy, FIT Two Year Review, 2011, p.7. Available at: http://www.energy.gov.on.ca/en/fit-and-microfit-program/2-year-fit-review/#.UwPNiXmkJG4

kWh, depending on scale and location (rooftop or ground-mounted). Adders were also included for projects that incorporated Aboriginal or community participation.

70. The FIT Program was launched in October 2009 and saw an immediate surge of applications. By August 2012, 10,299 FIT applications had been received, totalling 21,292 MW of capacity. In addition, over 38,000 microFIT applications, for projects under 10 kW, had been received.[41] While the fundamental approach was to rank projects according to the application date, the OPA created a process to assess all applications received during the October to November "launch period" according to four criteria intended to provide a province-wide ranking of projects based on their "shovel-readiness".[42] These criteria were: major equipment control; experience developing similar projects; whether financing was in place; and whether the project required renewable energy approval. The OPA hired London Economics International, LLC to undertake a detailed review of the process and found that it had been performed fairly and consistently.[43]

71. By the end of 2011, approximately 2,000 FIT Contracts, totalling more than 4,000 MW, had been issued. In addition, approximately 12,000 microFIT Contracts had been tendered. Before Contracts were issued, larger projects were subjected to a transmission availability test ("TAT") and, when connecting to a distribution system, a distribution availability test ("DAT") as a screening process to evaluate whether there was likely adequate transmission or distribution

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[41] **Dorey-024** Ontario Power Authority, Bi-Weekly FIT Report, August 7, 2012. Available at: http://microfit.powerauthority.on.ca/sites/default/files/page/Bi_WeeklyReportAugust7-2012.pdf.

[42] Approximately 500 FIT applications were submitted during the launch period and 184 Contracts for a total of approximately 2500 MW were awarded.

[43] **R-082**-London Economics Report, Feed-in-Tariff Launch Period Criteria Evaluation – Independent Process Review (March 31, 2010) p. 15.

system capacity to connect them to the grid. Projects that lacked transmission or distribution system capacity were to be assessed according to an Economic Connection Test ("ECT") to determine whether it would be economic to build additional transmission or distribution infrastructure to enable greater capacity to connect more projects to the grid. Due to subsequent policy decisions capping the procurement of renewables, the ECT was ultimately deemed unnecessary.

f. The Green Energy Investment Agreement

72. The Ontario Government was also attempting to secure the objectives of the GEGEA in other ways. In particular, it was actively seeking investors who would commit to job creation in Ontario. In January 2010, through a process separate from the FIT Program, the Ontario Government signed a $7 billion agreement – the Green Energy Investment Agreement ("GEIA") with a Korean Consortium, led by Samsung, to develop 2,500 MW of wind and solar generation.[44] The agreement also included provision of priority access to the Ontario grid for the Consortium if it met milestone deliverables for each of five phases of wind and solar generation development throughout the province. Costs would be recovered through electricity rates. The Korean Consortium also committed to open four renewable energy manufacturing facilities in Ontario. Further, if it met the manufacturing and jobs commitments, it would be entitled to a $437 million economic development adder. The GEIA ensured that the wind and solar manufacturing capacity required to provide renewable energy machinery and equipment to FIT project developers would be rapidly developed.[45] The GEIA also included provision of priority

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[44] **C-0322**, Green Energy Investment Agreement (Jan. 21, 2010), s. 3.2., pp. 2-3.

[45] **C-0322**, Green Energy Investment Agreement (Jan. 21, 2010), s. 3.2., Recital B.

access to the Ontario grid for the Korean Consortium, if it met milestone deliverables for each of five phases of wind and solar generation development throughout the province.[46]

73. In 2011, the GEIA was amended to modify the commercial operation date for the five phases, amongst other things.[47] In 2013, the GEIA was renegotiated with the Korean Consortium again, committing instead to develop 1,369 MW of wind and solar generation in three phases. The compensation was also renegotiated to a maximum of $110 million.

g. Challenges in Renewable Integration

74. The Ontario Government recognized that the integration of large amounts of renewable energy would require major expansion of transmission and distribution capacity and changes in the processes used to manage the Ontario power supply process. Thus, the then Minister asked Hydro One to begin the development of 20 major projects to expand transmission and distribution capacity in order to accommodate renewable power.[48]

75. The Government established ambitious targets for the completion and connecting of renewable energy projects. By the end of 2010, it had become clear that most proponents would not be able to gain the necessary approvals to meet their committed milestone date for Commercial Operation. As a result, the Government of Ontario requested that the OPA grant

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[46] Ibid. Section 7.3 b).

[47] **C-0282** July 29, 2011 Green Energy Investment Agreement – Amending Agreement, By and Among Her Majesty The Queen In Right Of Ontario as represented by the Minister of Energy And Korea Electric Power Corporation And Samsung C&T Corporation, July 29, 2011.

[48] **Dorey-018** Ministry of Energy, Letter to James Arnett, Hydro One from George Smitherman, Minister of Energy (Sept. 21, 2009).

project proponents extensions of up to a year.[49] By the end of 2012, only 257 MW of 4,545 MW of FIT-contracted wind power had come into service.[50]

h. Long Term Energy Plan 2010[51]

76. On November 23 2010, the Minister of Energy tabled the Government of Ontario's Long Term Energy Plan ("LTEP 2010").[52] It recommitted to the Government of Ontario's objective of eliminating the use of coal-fired generation by the end of 2014. LTEP 2010 also committed to a continuation of the FIT and microFIT programs, but set a target of 10,700 MW of non-hydro renewable power for 2018. Furthermore, it committed to building two new nuclear units at the Darlington site and converting the Thunder Bay Generating Station from coal to natural gas. Finally, the LTEP 2010 committed to move forward with development work on five priority transmission projects, in addition to completing the Bruce to Milton Transmission Reinforcement project. The five new projects were expected to strengthen overall provincial transmission reliability and provide additional transmission capacity for future generation capacity, including from renewable sources.

VII. THE BRUCE TO MILTON TRANSMISSION LINE

77. This section addresses Ontario's expansion of transmission infrastructure between the Bruce region and the GTA. In particular, it will address Transmission Capacity in the Bruce region, the development of the Bruce to Milton Transmission Reinforcement Project, approvals

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[49] **Dorey-022** Ontario Power Authority, One year extension of Milestone Date for Commercial Operation available for FIT contract holders, February 9, 2011. Available at: http://fit.powerauthority.on.ca/february-9-2011-one-year-extension-milestone-date-commercial-operation-available-fit-contract-holder.

[50] **Dorey-027** Ontario Power Authority, *Quarterly Progress Report on Contracted Electricity Supply,* Quarter 4, 2012, p. 34.

[51] **C-0414**, 2010 Long Term Energy Plan, Ministry of Energy (November 23, 2010), p. 31.

[52] **C-0414**, 2010 Long Term Energy Plan, Ministry of Energy (November 23, 2010), p. 31.

processes, and finally, the construction of the transmission line. As such, this section provides a detailed summary of how and why the Bruce to Milton transmission line was expanded.

a. Transmission Capacity in the Bruce Region

i. A Brief History of the Bruce Nuclear Complex

78. The Bruce Generating Station is the largest operating nuclear facility in the world. It currently accounts for approximately 25 percent of Ontario's electricity generation, with a total capacity of 6,268 MW when all eight units are fully operating. Ontario Hydro also owned two heavy water processing plants adjacent to the nuclear site. These plants operated from 1973 until final shut down in 1997.

79. During the 1990s, Ontario experienced deteriorating nuclear performance and sharply reduced power demand.[53] In response, Ontario Hydro shut down several operating nuclear units in 1997, including units at the Bruce A facility, as part of its Nuclear Asset Optimization Plan ("NAOP").[54] The lay-up of these units across Ontario plus the earlier removal from service of Bruce A, unit 2 meant that over 5,000 MW of nuclear generated electricity had left service in Ontario. However, there were contingencies to ensure that the reactors could be returned to service as future load growth warranted.

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[53] **Dorey-001** Ontario Ministry of Energy, Science and Technology, Direction for Change: Charting a Course for Competitive Electricity and Jobs in Ontario, November 1997, p. 5 Available at: https://archive.org/stream/directionforchan00ontauoft#page/n1/mode/2up.

[54] **Dorey-031** World Nuclear Association – Nuclear Power in Canada, December 2013, Available at: http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/Canada--Nuclear-Power/

80. As part of the Government's plan to reduce OPG's[55] dominance of the Ontario electricity market, OPG agreed in 2000 to lease the Bruce Nuclear Generating Station to Bruce Power LP, then a subsidiary of British Energy, for 18 years with an option for a 25-year extension.[56] Bruce Power took operational control of the Bruce Complex in 2001. Bruce Power has operated the Bruce B units since 2001, returned the Bruce A, units 3 and 4 to service in 2003 and 2004, and negotiated a contract with the OPA to undertake complete refurbishments of Bruce A, units 1 and 2, extending their service life to 2038. Under the Bruce Power Refurbishment Implementation Agreement, Bruce A, units 1 and 2 were expected to return to service in 2009. The expected return to service of this generation capacity was built into the Bruce to Milton Reinforcement Project plans.[57]

ii. Transmission Capacity out of the Bruce Electricity Area

81. Prior to completion of the Bruce to Milton Transmission Reinforcement Project in 2012, transmission facilities from the Bruce Nuclear Generation Station consisted of three 230 kV double circuit lines and two 500 kV double circuit lines. These five lines provided approximately 5,000 MW of total transmission capacity out of the Bruce Region.[58] This transmission capacity was sufficient when all 8 Bruce Generating Station nuclear units were operating in the 1980s and 1990s.[59] However, a number of developments between the early-

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[55] Ontario Power Generation inherited responsibility and ownership of the generation assets of the former Ontario Hydro.

[56] **Dorey-002** OPG, *Ontario Power Generation and Bruce Power Announce Leasing Agreement at Bruce Nuclear*, July 11, 2000.

[57] However, due to delays in the refurbishment process, the two units were not returned to service until 2012.

[58] **Dorey-009** Joint Presentation by Hydro One, the OPA and the IESO to the Section 92 Technical Conference, October 15-16, 2007, p.11. Transmission Capacity was typically 5000 MW, but could range from 4500 MW to 5400 MW.

[59] **Dorey-009** Joint Presentation by Hydro One, the OPA and the IESO, op. cit.

1990s and the mid-2000s resulted in the need for additional transmission capacity from the Bruce Region beyond the 5,000 MW of capacity already in place.

82. First, there were significant changes in regional power flows over this period, most notably increased imports from Michigan, eastward through the Bruce region, into the GTA where there was significant load growth. This contrasts with the earlier period in time during which electricity tended to flow west, in order to be exported to Michigan.

83. Second, system voltage stability standards established by the NERC became more stringent over this period, particularly after the 2003 blackout in north-eastern North America. As a result, the IESO needed to plan for the potential outage of one of the 500 kV lines out of Bruce region.[60]

84. Third, 700 MW of new wind generation was expected under the RES 1 and 2 request for proposal procurements.

85. Finally, the closure of the two heavy water production plants substantially reduced electricity consumption in the Bruce region. With significantly reduced consumption within the region itself, more electricity generated in the Bruce needed to flow out of the region.

86. The Bruce to Milton transmission line was planned to accommodate the name-plate capacity of the aggregate generation capacity it was intended to deliver. This is consistent with minimizing congestion on the transmission system and avoiding locked-in energy. The OPA estimated that, in the absence of the new line, Ontario would face an estimated cost (in net present value terms) for locked-in energy of $1.3 billion, primarily as a result of the take-or-pay

[60] Ibid, p.10

obligations under the OPA's contract with Bruce Power to refurbish the Bruce nuclear facility.[61] In line with these principles, it is industry practice to build transmission to meet existing, contracted and expected generation capacity.

87. The OPA forecast of generation consisted of:

- 1,500 MW of refurbished nuclear generation at the Bruce A nuclear facility, in line with the Minister's direction;
- 700 MW of committed wind generation under RES I and II;
- 1,000 MW of planned wind generation; and
- The continued operation of 8 Bruce Power nuclear units (or equivalent new build) into the foreseeable future.[62]

b. Development of the Bruce to Milton Transmission Reinforcement Project

i. Public Knowledge of the Need for Transmission Capacity in the Bruce

88. In light of the developments cited above and, in particular, the OPA's agreement with Bruce Power to refurbish and return to service Bruce A, units 1 and 2, the OPA, Hydro One and the IESO examined a series of options to expand transmission capacity out of the Bruce region. The foregoing need for a new transmission line from the Bruce site was presented as far back as 2006.

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[61] **Dorey-013** Ontario Energy Board – Hydro One Argument in Chief Bruce to Milton Transmission Reinforcement Project, citing the evidence presented by Bob Chow at the OEB Section 92 hearing and associated Technical Presentations, June 23, 2008. Available at: http://www.ontarioenergyboard.ca/documents/cases/EB-2007-0050/HONI_ARGChief_20080623.pdf

[62] **Dorey-013** Ontario Energy Board – Hydro One Argument in Chief Bruce to Milton Transmission Reinforcement Project, citing the evidence presented by Bob Chow at the OEB Section 92 hearing and associated Technical Presentations, June 23, 2008. Available at: http://www.ontarioenergyboard.ca/documents/cases/EB-2007-0050/HONI_ARGChief_20080623.pdf

89. The OPA then summarized the rationale in correspondence with Hydro One's. In particular, the OPA noted that given the committed and anticipated new generation capacity planned in the Bruce region "…the only technically acceptable and practical solution is a new 500 kV double-circuit line from the Bruce area directly to the GTA."[63]

90. Carr also noted that stakeholders "generally concurred that the transmission capability out of Bruce should be reinforced, particularly to permit the development of renewable generation potential in the Bruce area."[64] The Canadian Wind Energy Association ("CanWEA") pointed out its strong support for a new 500 kV transmission line and asked the OPA to consider ensuring that the 1,000 MW of forecasted transmission capacity be "explicitly reserved for future wind energy development", also encouraging the OPA to take additional steps to create greater capacity over the next 20 years.[65]

91. The OPA went on to advise Hydro One:

> We [the OPA] believe that it is crucial that implementation work on the Bruce to Milton transmission line project proceed as quickly as possible. This project was included in the OPA's preliminary IPSP. Although this project is consistent with the IPSP, we do not believe that it can await the outcome of the IPSP proceeding if it is to meet the earliest possible in-service date, which Hydro One staff have indicated is December 1, 2011. If you choose to proceed with this project as project proponent, you will have the support of the OPA in the regulatory process for this project.[66]

[63] **R-036,** Letter from Jan Carr, CEO, Ontario Power Authority, to Laura Formusa, President and CEO (Acting), Hydro One Inc. (March 23, 2007).

[64] **R-036,** Carr, op. cit.

[65] **Dorey-004** Letter from Robert Hornung, President of Canadian Wind Energy Association ("CanWEA") to the Ontario Power Authority ("OPA"), (Dec. 15, 2006). Available at: http://www.powerauthority.on.ca/sites/default/files/page/4661_C-11-2_Att_5.pdf.

[66] **R-036** Carr, op cit.. Hydro One filed its Leave to Construct Application with the OEB six days after Carr's letter, with the support of the OPA and the IESO.

92. By the end of 2006, the OPA and Hydro One had consulted with 11 municipalities, 4 counties and one region that would be affected by the project, explaining the need and rationale for routing the new line in an expanded Bruce to Milton corridor. There was, thus, widespread public knowledge among industry participants and potentially affected parties of the need for expanded transmission and the OPA's preferred option by the end of 2006. With the launch of Hydro One's Leave to Construct application before the OEB and other associated approvals processes, including the Environmental Assessment process, the public had ample opportunities to examine the case for the project and any concerns affected parties might have. Over 50 interveners registered for the hearing, including the main associations that represent generators in Ontario such as CanWEA and the Association of Power Producers of Ontario. These interveners in turn provided industry participants and the public analysis of the progress of the application and the issues involved. Hydro One also created a dedicated section of its website to provide updates on approvals processes and construction progress for this project.

ii. Factors Affecting the Development of the Project

93. While there was ample public evidence of the key energy agencies' commitment to having the project approved and developed as quickly as possible, there was also strong opposition from landowners[67], First Nations[68] and anti-nuclear groups[69]. The GEGEA moved aggressively to streamline the siting of renewable generation projects through the removal of municipal powers to block such projects, the consolidation of environmental and land use

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[67] See below.

[68] See below.

[69] **Dorey-005** Ontario Clean Air Alliance – A New Bruce Transmission Line –April 16, 2007.

approvals under the Renewable Energy Approval process, and the creation of the Renewable Energy Facilitation Office.[70]

94. It did not, however, address approvals processes for major transmission projects. Major transmission projects continued to require multiple approvals from a number of agencies. Several of these approval processes include appeals processes, judicial review and ultimately discretion on the part of the responsible Minister.

95. Linear infrastructure projects, such as pipelines and transmission lines, are particularly vulnerable to legal and extra-legal delays because access to all properties on the route is required before a project can be completed. They also often have to cross environmentally sensitive territory, such as the Niagara Escarpment. Thus, as would always be the case with such a project, there was some uncertainty regarding whether, and when, the Bruce to Milton transmission line would be built as planned. At the same time, the Ontario Government was clearly committed to the earliest possible development of renewable energy projects under its FIT Program.

96. By the end of May 2011, Hydro One had received key regulatory approvals, including OEB Leave to Construct, Expropriation Authority, Environmental Approval and a conditional Development Permit from the Niagara Escarpment Commission. It also had protocols in place with the Aboriginal communities most affected by the project and had commenced construction.

iii. Approvals Processes

[70] **R-057**, *Green Energy and Green Economy Act*, S.O. 2009, c. 12 ("GEGEA"); pp 2-3.

1. Section 92 of the *Ontario Energy Board Act, 1998* Leave to Construct

97. Hydro One filed its Section 92 Leave to Construct Application on March 29, 2007. The project proceeded ahead of the filing of the IPSP and was addressed through separate approval processes. Following an 18-month review process, the OEB granted Hydro One approval to proceed with the project. A major advantage of the Bruce to Milton proposal was that it largely followed an existing transmission corridor, effectively twinning the pre-existing line. This is consistent with Ontario's Provincial Land Use Policy, which calls for the use of existing corridors wherever possible.

98. As part of the OEB Section 92 review process, Hydro One, supported by the OPA and the IESO, was required to satisfy the OEB on several issues, including project need, cost, project alternatives, interim measures, reliability and quality of electricity service, land access and acquisition, and aboriginal consultation and accommodation.

99. The OPA's detailed assessment of committed generation, expected renewable generation in response to supply mix directives and its assessment of the longer term future of the Bruce Nuclear Complex, were the primary elements Hydro One used to establish the need for the project.[71] The OEB granted Hydro One approval to proceed with conditions on September 15, 2008.

2. Other Approvals and Consultations Processes

100. There were a number of major regulatory hurdles to the timely construction of the line such as: Environmental Approval, Niagara Escarpment Commission Review, land access and acquisition, and consultation with affected First Nations and Métis communities. Hydro One also

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[71] **Dorey-008** Ontario Energy Board – Hydro One Argument in Chief Bruce to Milton Transmission Reinforcement Project, pp. 1-3. Available at: http://www.hydroone.com/Projects/BrucetoMilton/Documents/Record_of_Consultation-Amended-Nov02[1].pdf.

undertook detailed archaeological and environmental impact studies. These studies played a pivotal role in negotiating the necessary permits and approvals with a wide range of agencies including regional Conservation Authorities, the federal Department of Fisheries and Oceans and the Ontario Ministry of Natural Resources. The more significant of these processes are discussed below.

101. Hydro One filed its Environmental Assessment ("EA") Terms of Reference for its Environmental Approval with the Ontario Ministry of the Environment on August 3, 2007. These Terms of Reference reflected detailed consultations with potentially affected communities, landowners and Aboriginal communities, including Public Information Centres in seven communities and engagement with Aboriginal groups thought to have potential interest in the project. These Terms of Reference were also posted for public review and comment.

102. The final EA was submitted on December 1, 2008 and posted for public review and comment by the Government Review Team ("GRT"), which is a Ministry of Environment-led group that consolidates comments and concerns from a variety of federal, provincial and municipal governmental agencies. The public, affected parties, municipalities and Aboriginal groups were also invited to comment on Hydro One's Environmental Assessment.

103. The Ministry of Environment was satisfied that Hydro One had followed the Terms of Reference and had consulted adequately with the GRT, the public and Aboriginal groups. It also concluded that Hydro One had considered available alternatives and identified appropriate options and mitigation measures. The review identified four areas that required particular attention: potential impacts on wetlands; visual and aesthetic concerns raised by the Niagara Escarpment Commission ("NEC"); Hydro One's proposed Biodiversity Initiative; and Saugeen

Ojibway Nation ("SON") concerns over the cumulative impact of energy projects in its traditional territory and issued approval on December 16, 2009 to proceed with conditions that addressed these concerns.[72]

104. Of the 180 km of transmission line, 6.7 km were within land subject to the NEC's jurisdiction.73 Within that area, Hydro One planned to erect 27 towers, 6 of which are in the Escarpment Protection Area. The other 21 are in the Escarpment Rural Area and the Mineral Extraction Area. These 27 towers were twinned with 27 towers currently within the Niagara Escarpment lands. The Commission and its staff raised a number of concerns about the potential impact of the project on the visual appearance of the Escarpment. As the EA Report observed, Hydro One successfully addressed many of NEC's initial concerns and outstanding issues could be dealt with through the permitting process.[74]

105. Throughout the approvals processes, Hydro One also undertook regular and extensive discussions with directly affected landowners who would have to be bought out because homes or major buildings were within the corridor; owners whose properties would be crossed; landowners within 500 meters of the line, federal, provincial and local agencies and affected Aboriginal groups.[75] The consultation process was agreed to as part of the approval of the EA Terms of Reference and the Record of Consultation formed an essential part of the Final EA

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[72] **Dorey-011** Ministry of Environment, Bruce to Milton Transmission Reinforcement Environmental Assessment Review, April 4, 2008, p. 17 http://www.ene.gov.on.ca/environment/en/industry/assessment_and_approvals/environmental_assessments/projects/STDPROD_082721.html?page=2.

[73] The Niagara Escarpment Commission is a regulatory agency, operating at arm's length from the Ontario Government, charged with ensuring that any development within the Escarpment and its vicinity is compatible with maintaining the natural environment. Source: Niagara Escarpment Commission website.

[74] **Dorey-016** Hydro One, Environmental Assessment Report – Bruce to Milton, Part 1- ES-1-ES-4, December 2008.

[75] **Dorey-017** Hydro One, Records of Consultation Available at: http://www.hydroone.com/Projects/BrucetoMilton/Pages/Public%20Consultation.aspx

Report. While the initial landowner consultation addressed a wide range of issues including: impacts on property values, impacts on community facilities, the impact of electromagnetic fields, impacts on agricultural activities and the potential for a third line, later discussion focused on compensation issues. The majority of directly affected landowners joined a group called Powerline Connections and this group ultimately reached agreement with Hydro One on compensation.

106. Hydro One also undertook extensive consultation with several First Nations and Métis to ensure that their rights were respected and the Government's duty to consult was met. As a result, Hydro One signed Protocol Agreements with the SON, comprised of the Chippewas of Nawash First Nation and the Chippewas of Saugeen)[76], the Six Nations Haudenosaunee Confederacy[77] and the Métis Nation of Ontario.[78] These agreements addressed archeology, biodiversity, treaty rights, economic participation and ongoing monitoring.

iv. Delay and Uncertainty

107. Delays in approvals processes led Hydro One to shift its target date for completion of the project from December 2011 to December 2012. As noted above in Section VI.2.a, public information on approvals processes and construction progress for the Bruce to Milton Transmission Reinforcement was widely available to industry participants, including developers of FIT project applications. The fact that the Bruce to Milton project would, provide over 3,000

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[76] **Dorey-013** Hydro One - Hydro One and Saugeen Ojibway Nation, Press Release (May 30, 2008). Available at: http://www.hydroone.com/OurCompany/MediaCentre/Documents/NewsReleases2008/HydroOne_SaugeenOjibway_May30.pdf

[77] **Dorey-015** - Hydro One and Métis Nation of Ontario, Press Release (Sept. 30, 2008). Available at:http://www.hydroone.com/OurCompany/MediaCentre/Documents/NewsReleases2008/MNO_Release_Hydro_Protocol_Signing_Sept_2008.pdf

[78] **Dorey-010** Hydro One, Aboriginal Peoples Reference Binder, Feb 29, 2008

MW of transmission capacity was common knowledge. With key approvals and protocols with key landowner and Aboriginal groups in place and construction approaching the halfway point, it was increasingly evident that the project was likely to be completed in 2012.

108. In terms of the allocation of that capacity, the OPA had provided details on its plans to optimize the allocation of limited transmission connection capacity by publishing transmission availability tables and allowing proponents to revise their connection points.[79] Bob Chow, Director of Transmission Integration at the OPA, also detailed the ECT process in a presentation to Ontario's pre-eminent conference for Ontario generators, pointing out that Changes in Connection Points was a key step in the allocation of connection capacity.[80] Given this information, it should not have been unexpected that this process would be used to allocate the newly available capacity provided by the Bruce to Milton Transmission Line.

109. Indeed, on June 3, 2011 the Minister issued a Direction asking the OPA to enter into 1,050 MW of new FIT Contracts (700 MW in the Bruce region and 350 MW in the West of London region).[81] This exceeded the previously estimated transmission capacity availability for renewables in the region by 50 MW and still accommodated the required capacity for the Bruce nuclear facilities and the set-aside for the Korean Consortium.

v. Construction

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[79] **C-0034**, OPA Presentation, "The Economic Connection Test Process**", C-0088**, Ontario Power Authority Presentation: "The Economic Connection Test – Approach, Metrics and Process" (May 19, 2010) ("OPA Presentation, The Economic Connection Test – Approach, Metrics and Process").

[80] **Dorey-019** Bob Chow, *FIT Status and the ECT Process*, Presentation to 2010 APPrO Conference, November 17, 2010, p.3.

[81] **C-0046** June 3, 2011 Letter from Minister Brad Duguid, Ministry of Energy to Colin Andersen, Ontario Power Authority, Direction to the OPA, (Jun. 3, 2011).

110. Recognizing the urgency of completing the project as early as possible, Hydro One signed conditional engineering and construction contracts and pre-ordered materials. With Leave to Construct and Construction and Environmental Approval in hand, construction began in early 2010 at the Tiverton end of the line. Construction was phased to avoid areas such as the Niagara Escarpment, where additional approvals and permits were still required or where properties still had to be expropriated.

111. The line was brought into service on June 19, 2012 by Hydro One CEO Laura Formusa and Minister of Energy Chris Bentley.[82]

VIII. CONCLUSIONS

112. The foregoing overview of the Ontario electricity system as it pertains to recent electricity system and transmission system planning highlights the complexity in orchestrating such infrastructure projects. There are many variables to planning and because of constantly changing economic, technological and social policy imperatives planning is in continual flux. Furthermore, there are a myriad of environmental, land-use and community interests that must be acknowledged, appreciated and dealt with at every step along the process. Governments, planners, system operators, utilities, proponents, regulators and the public all have a role to play in how electricity infrastructure planning and development occurs. The scope of a project like the Bruce to Milton Transmission Reinforcement Project demonstrates the complexities, positions and difficulties faced by all of these participants.

[82] **Dorey-025** Hydro One, Bruce to Milton Transmission Line Now In Service to Support New Clean Energy, June 19, 2012.