Toward Evidence-based Planning

Long-term Energy Plan Submission

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Introduction

Ontario has more than 150 different large electricity generating stations in addition to more than 10,000 FIT and microFIT generators connected to consumers via the electricity grid of more than 30,000 kilometres of high voltage lines, 122,000 kilometres of low-voltage lines, and 300 transmission stations. At any given moment the amount of generation must match demand, or the reliability of the system can be quickly compromised. To make that happen on a daily basis is an impressive feat of engineering, technology, and skill. To ensure Ontario is able to maintain the energy system's integrity over the span of decades requires a Long-term Energy Plan that emphasizes evidence-based planning and transparent decision-making. As history has shown, when we get energy planning right, Ontario's sizable investment in infrastructure pays dividends in Ontarians' quality of life, environmental health, and economic well-being. However, we also know that if the government fails to get planning issues right, the results can be very costly, resulting in wasted time, wasted effort and wasted public money.

For these reasons, The Society of Energy Professionals, IFPTE Local 160 ("The Society"), appreciates the opportunity to contribute to the discussion of Ontario's long-term energy planning and to respond to the important issues raised in the government's *Making Choices* discussion paper.

The Society believes Ontario needs an energy policy that addresses three key priorities:

1. Rigorous, evidence-based and transparent long-term planning

Proper long-term planning processes must be the basis for all power system decisions.

2. Environmental sustainability

   Energy policy must continue to drive down greenhouse gas (GHG) emissions used to power the province.

3. Economic driver

   To grow Ontario's economic prosperity, the province must use its resources efficiently to allow for competitive energy prices for household and industrial consumers. Moreover, Ontario's energy sector has been and will continue to be a key driver of good, middle-class jobs that make communities across Ontario thrive. The government should prioritize energy investments that create and maintain jobs within the province.

These three priorities will be woven into The Society's comments on *Making Choices.* Our priorities reflect the fact that The Society believes the underlying assumptions of the 2010 Long-term Energy Plan (LTEP) were generally, though not without exception, well-founded and, barring significant new developments, should remain intact in the next LTEP.

Getting it right: evidence-based approaches to balancing reliability, sustainability and cost

The best way for Ontario to properly balance ratepayer costs, system reliability and environmental sustainability when it makes supply mix decisions is to reduce political interference in the sector and put into place a framework that ensures decisions are made in a transparent manner with broad expert and stakeholder participation, and appropriate regulatory oversight. This would entail:

- The government setting high-level goals and parameters for system planning that reflects the priorities of Ontarians;
- The Ontario Power Authority (OPA) using its expertise to independently develop an Integrated Power System Plan (IPSP) - a cost-effective, reliable plan with a procurement process that meets the government's expectations; and,
- The Ontario Energy Board (OEB) reviewing the OPA's plan and procurement process in an independent and transparent hearing process that would examine rate impacts, reliability issues, and GHG emissions.

Following the approach set out above requires that the government severely curtail past practice of issuing prescriptive system planning directives to the OPA (and other crown corporations/agencies). Previous directives, which have sometimes served political needs rather than the operational needs of the electricity system, have saddled Ontario ratepayers with significant and unnecessary costs while also creating reliability

concerns. This approach of planning by fiat is all the more regrettable given that the government has at its disposal a capable planning framework of its own device, the Integrated Power System Plan IPSP process.

Unfortunately, in *Making Choices* the Ministry does not make a single reference to an IPSP following the finalization of the LTEP or a process of independent review by the OEB.

The IPSP process allows government to exercise its rightful responsibility to set goals and parameters for system planning that reflect the priorities of Ontarians with respect to reliability, environmental sustainability and cost. Through robust public consultations and regulatory hearings, the IPSP capitalizes on the knowledge of system experts, as well as industry and public stakeholders. This generates a depoliticized plan that achieves the government's stated policy goals with maximum efficiency, cost effectiveness, and public approval. The process is intended to be evidence driven, generating practical and achievable plans that prioritize long-term thinking, while still ensuring that short-term needs are met. However, the IPSP is not intended to be a path carved in stone. Rather, an IPSP is a living document to be updated every three years to respond to changing conditions such as consumer demand, evolving public priorities and emergent technologies.

The first IPSP process was initiated in 2006 and was in the process of final OEB hearings when it was suspended in September of 2008 for the purpose of establishing new targets in a number of areas including renewable energy sources and conservation.

In November 2010, the government released its first LTEP. A Supply Mix Directive[1] from the government issued on February 17, 2011 outlined the objectives the OPA was intended to meet in the updated IPSP. A second IPSP process was initiated in the fall of 2011; however, it, too, was suspended.

A full IPSP has yet to be completed. The process itself appears to have been abandoned. Instead, the government has issued a series of directives to the OPA[2], requiring it to undertake or abandon generation procurements, conservation and demand management activities, incentive programs, and other activities.

Much of the Minister of Energy's directive power resides in the *Electricity Restructuring Act*[3]. These powers were to be eliminated following the completion of the OEB's review and approval of the first IPSP. However, it now appears clear that the Ministry prefers giving very specific direction to the OPA. This is problematic because these directives come without an effective and institutionally embedded process for transparent public and stakeholder consultation or any independent oversight. These directives are also not reviewed by the OEB to determine cost effectiveness or economic prudence. The electricity system, industry, investors, the public nor ratepayers are served well under this highly politicized, opaque policy and planning regime.

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[1] Minister of Energy's Supply Mix Directive, February 17, 2011: http://www.powerauthority.on.ca/sites/default/files/new_files/IPSP%20directive%2020110217.pdf

[2] Ontario Power Authority. Directives to OPA from Minister of Energy. April 16, 2013: http://www.powerauthority.on.ca/about-us/directives-opa-minister-energy-and-infrastructure

[3] Government of Ontario. An Act to Amend the Electricity Act, 1998 and the Ontario Energy Board Act, 1998 and to make consequential changes to other Acts, December 9, 2004: http://www.e-laws.gov.on.ca/html/source/statutes/english/2004/elaws_src_s04023_e.htm

The importance of relying on independent experts for planning and oversight of investments cannot be overstated given the extraordinary amount of financial and other resources that are at stake. The OPA's most recent *Progress Report on Contracted Electricity Supply* states that: "As of the end of the first quarter of 2013, the OPA administered contracts for 22,282 megawatts (MW) of electricity supply generation […] 17,607 MW was procured from new development, expansion, redevelopment, or refurbishment of existing facilities. This capacity represents over $37 billion of new capital investment in power generation in Ontario's electricity system since 2005."[4] Not one dime of this $37 billion in investment was reviewed by the OEB for cost effectiveness or economic prudence.

It is also critical to recognize that the prevailing view of Ontario's electricity sector is that it lacks independent and transparent planning and oversight, which has resulted in detrimental impacts on ratepayers. For example:

- A recent Mowat Centre Report, "Getting the Green Light: The Path to Public Support for Ontario`s Power Plans", noted that: "These contracts are not subject to the same regulatory oversight as are the investments of rate-regulated transmission and distribution entities. Nor are they subject to the discipline of market forces. In the end, ratepayers and taxpayers pay for the Ontario electricity system, while very little private investment is at risk."[5]

[4] Ontario Power Authority, A Progress Report on Contracted Energy Supply, First Quarter, 2013: http://www.powerauthority.on.ca/sites/default/files/news/Q1-2013-Progress-Report.pdf

[5] Getting the Green Light: The Path to Public Support for Ontario's Power Plans, Richard Carlson, Eric Martin, Pamela Nowina & Mary Ellen Richardson, June, 2013: http://mowatcentre.ca/research-topic-mowat.php?mowatResearchID=86

- The Auditor General of Ontario noted: "Although the OEB has played an oversight role in the connection of renewable energy to the grid by evaluating construction, expansion, and reinforcement projects of transmission and distribution systems, its limited involvement in reviewing the procurement and pricing of renewable energy has limited the effectiveness of its normal role in protecting the interests of consumers with respect to prices and overall cost-effectiveness in the electricity sector."[6]
- Robert Warren of WeirFoulds LLP noted: "Electricity consumers are going to have to pay a hefty price for poor government decisions, and for the lack of independent, transparent, and accountable decision-making."[7]

The consequences of the lack of independence, expert input, and transparent planning and oversight processes are plainly obvious in the numerous, highly publicized problems occurring in the electricity system, including the relocation (and associated costs) of gas plants in Oakville and Mississauga to alternative sites.

Many, if not most of these cascading problems could have been avoided or unnecessary had the government restrained itself to setting high level policy direction. The OPA should have been permitted to use its expertise to develop a technically sound and economically efficient IPSP that would be reviewed by the OEB in an open and

[6] 2011 Annual Report, Auditor General of Ontario, Fall 2011: http://www.auditor.on.ca/en/reports_en/en11/303en11.pdf

[7] Bill 75 and the Auditor General's 2011 Report: Lessons Not Learned**,** Robert Warren, June 2012: http://www.weirfoulds.com/bill-75-and-the-auditor-generals-2011-report

transparent process that would have more appropriately balanced ratepayer costs, system reliability, and environment goals.

Observers have also noted that the government's continued strong and ever changing direction over the electricity sector has created a highly unstable policy environment that has had the detrimental effect of discouraging investment in the province's electricity sector. For example, Guy L.F. Holburn, in the journal Energy Policy, notes:

> "The cumulative impact of repeated policy 'flip-flopping' on the renewable industry in Ontario has been profound. During late 2008, a survey of renewable energy firms active in Canada and internationally found that policy stability consistently rated as one of the worst aspects of doing business in Ontario […] One CEO was quoted as saying that his board considered Mexico to be more stable. Another CEO publicly compared political uncertainties in Ontario to those in African countries."[8]

Further, a survey of 63 international wind power firms revealed that policy stability ranked among the most important factors in firms' assessments of the attractiveness of alternative jurisdictions in their location decisions[9]. Given that the commitment to renewables embedded in the Green Energy Act was driven not only by the goals of reducing emissions, but also in aid of fostering a domestic industry by incenting private

[8] Assessing and managing regulatory risk in renewable energy: Contrasts between Canada and the United States, Guy L.F. Holburn, Energy Policy, 45, 2012.

[9] Policy Risk and Private Investment in Ontario's Wind Power Sector**,** Guy L.F. Holburn, Kerri Lui and Charles Morand, Canadian Public Policy, Analyse De Politiques, Vol. XXXVI, No. 4, 2010

investment, it should have been a tremendous wake up call to hear major investors unfavourably compare the stability of Ontario's electricity policy environment to that found in politically volatile African nations.

The ultimate strength of an IPSP process lies in its use of the OEB hearing process to allow a final vetting of the plan in an open, transparent and accessible venue. It is natural, and in fact desirable, that complex and contested issues such as electricity system planning should attract competing visions, approaches and interests. The open nature of OEB processes allows industry stakeholders, consumer and ratepayer representatives, community and specific interest groups, as well members of the general public to make comment or participate as intervenors. They may introduce their own evidence, seek to have plan proponents provide additional evidence upon request, challenge evidence that has been presented by others and make arguments based on evidence on the record. All of this happens in open proceedings and all of it becomes part of the public record.

Detractors of the IPSP process have suggested that it takes too long, is too cumbersome and complex and lacks the nimbleness required to make rapid changes in energy policy. Without a doubt, the process of developing and approving an initial IPSP does take significant time. However, the length and cumbersome nature of process is the price of thoroughness, rigour and wide public and stakeholder participation. Moreover, once an initial IPSP has been approved, the review and refinement process mandated to occur every three years could be completed much more expeditiously. When one considers the hundreds of billions of dollars at stake in ensuring the safe, reliable operation of an economically and environmentally sustainable electricity system

over the planning horizon of 20 years, the investment of time upfront must been viewed as not just defensible, but in fact indispensible.

Many of the subsequent questions raised in *Making Choices* relate to various aspects of the question of supply mix. While we, above all else, recommend that these issues should ultimately be examined and decided within the sound governance processes already discussed, we, as expert stakeholders, do have views that we have submitted, and intend to submit, into these processes. These views are backed up by evidence that we believe will be persuasive within a transparent and evidenced-based evaluation process.

Conservation and demand management

The Society of Energy Professionals acknowledges and supports the important role that both conservation and demand management (CDM) play in meeting Ontario's energy needs. The Society believes that the current CDM goals are appropriate and should not be reduced or broadened. Consistent with our overall position on evidence-based planning, we believe that as specific CDM programs are implemented to meet our CDM targets, they must be evaluated using sound economic principles to compare their benefits to those of alternative means to satisfy Ontario's energy needs.

While a great deal of work was done within Ontario Hydro on CDM, much of Ontario's capacity for these programs was lost with its break up in 2000 and the deregulation of Ontario's electricity markets in 2002. Ontario has been building capability in CDM over the past seven years and a great deal of progress has been made in these programs with Ontario now being a world leader in setting ambitious targets for CDM, and incorporating them into our planning processes. While some may argue that a portion of the 1,900 MW of conservation cited in the *Conservation First* document can be attributed to demand loss due to economic downturns, there is clear evidence that our conservation programs are having an impact on demand.

However, even if we accept 1,900 MW as purely the result of programs, it is far below the previously established targets. There is no indication that we will be able to meet the interim target of 4,500 MW by 2015 established in 2010. While The Society is not advocating a reduction in the 2010 LTEP targets, we see no evidence that they should be increased. For the purposes of something as important as system planning, our targets need to be achievable, not aspirational.

In order to ensure that we meet the targets established in the 2010 plan, it is important that Ontario affirm its commitments to these targets. CDM programs take time to develop and implement, and require stable funding and policy in order to be effective.

The Society agrees that over time, CDM programs will need to evolve to become more effective. For example, programs must include incentives for behaviour and operational improvements rather than relying so heavily on “widget” based programs such as appliance replacement. The Society also believes that it is essential to start creating more localized programs that are targeted to the specific characteristics and needs of a particular region. This would allow for recognition of the value of CDM in dealing with areas of local supply constraints, but also to allow for programs to reflect local industry and consumption patterns. That is not to say, however, that the responsibility for CDM should be decentralized, merely the design of the programs must be allowed to adapt to the needs of regions.

The Society believes that for Ontario to achieve our goals, we require a strong central body to coordinate our conservation efforts. Strong CDM programs require significant expertise which Ontario has been rebuilding since the breakup of Ontario Hydro. This effort must continue. Further, there are important programs that can only be achieved through central coordination. For example, it is essential that Ontario take an aggressive approach to the adoption of tighter codes and standards, as well as embedding robust evaluation, measurement and verification regimes into all ratepayer funded CDM programs.

Finally, one significant obstacle to demand management programs in particular has been the quality of Ontario’s energy market prices. For a combination of reasons, there is essentially no difference in the on peak and off peak commodity cost seen by

consumers. For example, according to the IESO Monthly Summary for July 2013[10], with a global adjustment of 5.1 cents per KWh for Class B consumers, the commodity price on peak was 8.81 cents per compared to 8.0 cents per KWh off peak. With only a ten percent different in cost, large consumers face a very weak signal on the value of shifting consumption. With such a low incentive, it is extremely difficult to cultivate any behavioural and operational changes from consumers.

[10] IESO Monthly Summary, July 2013: http://www.ieso.ca/imoweb/pubs/marketReports/monthly/2013jul.pdf

Nuclear Generation

Our nuclear fleet has served Ontario well and made the province one of the lowest emission jurisdictions in the world for electricity generation. However, now we are at a crossroad. Ontario's nuclear fleet is aging and is in need of maintenance and renewal. The success of our renewal program is critical to keeping Ontario's baseload electricity clean and affordable.

Current state of Ontario's nuclear fleet

Several of the CANDU reactors in Ontario are reaching the design mid-life refurbishment point. As the pressurized tubes in the core of the reactor are the life-limiting portion of the reactor, the reactor core was designed to allow for the removal and replacement of pressure and calandria tubes. Several of Ontario's nuclear reactors are reaching the point when they will require tube replacement while others have already undergone tube replacement programs (Pickering Units 1 and 4 and Bruce Power Units 1 and 2) . OPG has recommended and begun preparatory work to re-tube the units at the Darlington station slightly ahead of schedule so as to coordinate with possible life extension work at the Pickering Station. The goal is to have the Darlington Station fully restored before the end of life of the Pickering Units 5, 6, 7, and 8 reactor tubes. Also, Bruce Power has recently completed refurbishment of two reactors and has plans to systematically refurbish the six remaining units at that site.

The Society of Energy Professionals strongly recommends the Province of Ontario support the Bruce Power and OPG refurbishment projects in order to maintain the gains already realized in improving the CO_2 footprint of our electricity supply. The Society

believes that it is imperative to sustain those gains. For this to happen, the Province must maintain the proportion of nuclear power capacity currently on the grid and ensure that baseload electricity demand is met by reliable nuclear and hydroelectric generation.

To achieve this in the eastern sector of the province (and maintain the roughly 3,000 MW of nuclear capacity on the grid that is scheduled to be removed by 2020), the four Darlington units must be refurbished and two new nuclear units added at the approved site next to the existing Darlington station. There is an option to re-tube Pickering units 5, 6, 7, and 8 rather than build new units; however this is not the preferred option. The refurbishment of Pickering would need to be made with the full understanding of the higher operating costs that follow from the older design of a smaller capacity core and the fact more moving parts are located within containment.

The Society of Energy Professionals fully supports the Bruce Power Nuclear Generating Station as a strategically located, valuable long-term asset for the province. The Bruce Power site is now at its full capacity and serviced by the new Bruce-Milton transmission line completed by Hydro One in 2012. A full refurbishment program, funded by private capital investment, starting with Unit 4 in 2016, will ensure that this asset continues to supply generation to the west and north sectors of the province for decades to come. Willing host communities, with infrastructure already in place and extensive work already completed on this Unit, taken together with lessons learned from the refurbishment of Units 1 and 2 mean that Unit 4 will be the first in a series of successful refurbishment projects at the Bruce Power site over the next 15 years.

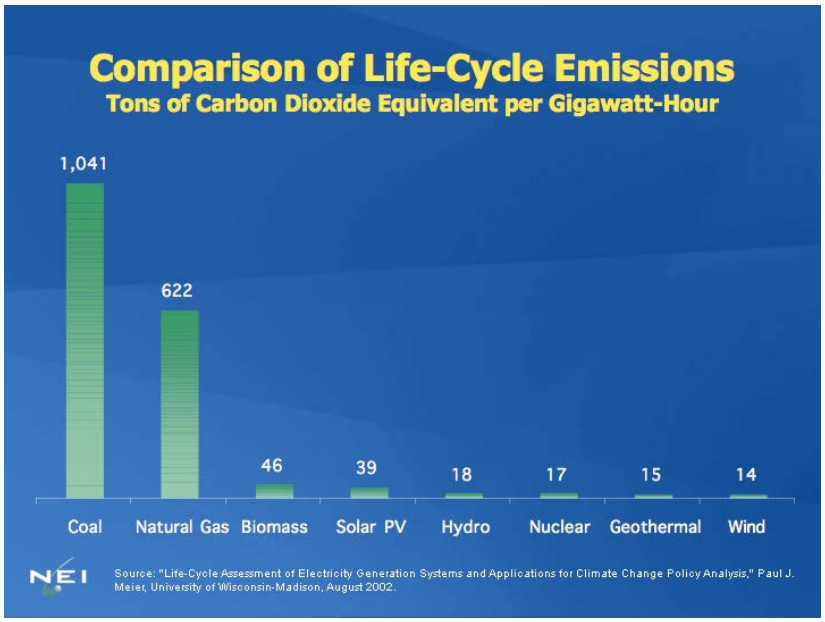
Extensive capital investment in upgrades are already being made at all three nuclear

sites in light of Fukushima lessons learned. In addition there are upgrades underway at Pickering for station life extension. Some examples of these upgrades are: the installation of passive hydrogen re-combiners; increased use of digital controllers; smart positioners; and, the provision of additional backup cooling water and power supplies. As determined by the regulator, solutions to meet possible newly imposed risk thresholds would be implemented as well as due diligence reviews of world-wide nuclear industry benchmarks.

Nuclear generation: the backbone of Ontario's low GHG grid

Reliance on nuclear power coupled with hydroelectric generation for baseload generation has allowed the province to meet three quarters of its electricity demand while reducing the CO_2 emissions associated with electricity production. In fact, it is precisely because of the increasing contribution of nuclear and hydro that Ontario's electricity is among the cleanest in the world, moving from approximately 300 grams of CO_2 per kilowatt hour in 2000 to the current level of just 100 grams of CO_2 per kilowatt hour.

The decline in Ontario's CO_2 emissions from the electricity system is attributable to increases in nuclear generation rather than wind and solar generation. In 2000, nuclear only accounted for 37% of Ontario's electricity while 36% of our electricity came from fossil fuels. With a 20% increase in nuclear power and the corresponding reduction in fossil fuel use, Ontario has been able to cut emissions by a factor of three.



Numerous comparative life cycle assessment (LCA) studies of carbon footprints, comparing a variety of electricity generation technologies, have confirmed that nuclear generation is among the lowest CO_2 energy sources, cleaner even than most renewables.[11] [12] In fact, the carbon footprint of nuclear energy is roughly equivalent to wind generation, and has about half the footprint associated with photovoltaic generation.

Lifecycle emissions from Canadian nuclear generation are well below the international norm, owing both to advantages of geography, and of innovation and design. The carbon footprint of the nuclear fuel cycle is partly a function of the quality of uranium ore extracted, and the uranium oxide concentrations of ore from Saskatchewan mines are the highest on the planet. In addition, the unique CANDU design of Ontario's current nuclear fleet uses unenriched uranium and can refuel while still producing electricity. This means that highly energy intensive and inefficient steps in the nuclear fuel cycle are

[11] *Postnote: Carbon Footprint of Electricity Generation,* Parliamentary Office of Science and Technology, UK, October 2006. (http://www.parliament.uk/documents/post/postpn268.pdf)

[12] P. J. Meier, *Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis,* University of Madison-Wisconsin, 2002.

entirely forgone.[13] Further, because both the CANDU technology and ore are generated within Canada, there are fewer transportation costs and less energy use associated with the fuel cycle than in many nuclear nations where fuel must be imported from abroad. Moreover, given that the 2,000 MW of nuclear new build would be developed at the existing Darlington site, with much of the required nuclear infrastructure already in place, the LCA of Ontario's nuclear new build will likely be even more favourable than current data suggest.

Ontario's nuclear advantage does not end here. The statistics cited above evaluating the contaminant effects of nuclear energy are based on the full environmental impact of the nuclear life cycle, including new build. Given generation of 10,000 MW of capacity through the refurbishment of existing plant (and thereby avoiding the emissions associated with new construction) there is little doubt that these additional megawatts of nuclear capacity will be among the cleanest anywhere in the world.

Nuclear benefits the socio-economic environment

As a labour organization, The Society is deeply cognizant of the role that good jobs play in the socio-economic environment through the creation of healthy labour markets and prosperous communities. While critics often deride the undeniably large upfront costs of nuclear, the resulting positive economic impacts cannot be ignored. Not only is the maintenance of Ontario's nuclear footprint an essential component of Ontario's clean energy future, but it will also serve as a major driver of Ontario's economic future. The

[13] P. Boczar, A. Dastur, K. Dormuth, A. Lee, D. Menely, D. Pendergast, *Global warming and sustainable energy supply with CANDU nuclear power systems*, Progress in Nuclear Energy 32 (3/4), 1998. pp. 297-304.

nuclear industry in Canada directly and indirectly supports a total of 71,000 well-paid jobs; as such, it helps power our economy and prosperity at the same time as it helps power our electrical grid[14].

A full slate of nuclear refurbishments and two units of new build would help Ontario's economy by creating large numbers of high quality jobs in the near future and for generations to come, through increased direct employment of OPG employees and construction workers, increased employment at firms that will act as vendors and suppliers of goods and services to the project, and through spin-off employment created as a result of income spent in local and regional economies by those directly and indirectly employed.

Ontario's nuclear industry has consistently been a source of high-quality jobs and economic benefit. An examination of the economic impact of new build shows that nuclear will continue to deliver economic prosperity to Ontario at a time when the province is struggling to grow its economy. An example of how nuclear benefits the Ontario economy may be helpful in illustrating this point. The proposed new build at Darlington has undergone economic analysis. A new build involving two reactor units begins with the site preparation and construction phase, which requires an on-site workforce of approximately 3,500 for as many as eight years. The total number of direct, indirect and induced jobs created in this phase of the project is estimated to be 7,500[15].

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[14] Natural Resources Canada, The Canadian Nuclear Industry and its Contributions to the Canadian Economy: http://www.nrcan.gc.ca/energy/sources/uranium-nuclear/1526

[15] OPG, New Nuclear Darlington Environmental Assessment: SocioEconomic Environmental Effects Technical Support Document, 2009

During the operation and maintenance phase of the project, the project will continue to support thousands of direct, indirect and induced jobs.

Just as important as the sheer quantum of jobs is the quality of the jobs that will be created. These will not be subsistence jobs; this is the sort of employment that begets new employment. The induced job creation effect of project-related household spending in Durham Region alone is expected to amount to $375 million per year during site preparation and construction and $143 million per year during the operation and maintenance phase. This spending will create and support a diverse range of jobs running the gamut from retail to real estate law, most of which will benefit the local economy[16].

A nuclear kick-start for manufacturing and energy-intensive industries

The construction of two new nuclear reactors is highly capital intensive piece of infrastructure investment, and most of the capital purchasing will be done in Canada, providing a tremendous indirect boost to Canada's flagging manufacturing industry. A 2008 study commissioned by the Canadian Energy Research Institute of the economic impact of new build nuclear estimated that the construction of two CANDU 6 reactors would result in the 2011 dollar equivalent of approximately $138 million in domestic purchases of iron and steel structural materials, iron and steel pipes, tubes and fittings, and prefabricated metal structures alone.[17] This could provide a tremendous job creation boon to workers in the Canadian steel industry, which has been decimated by the global recession.

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[16] ibid

[17] *The Canadian Nuclear Industry: Contributions to the Canadian Economy,* CERI, June 2008

The same study suggests the total GDP impact of the construction operations necessary to construct two CANDU 6 reactors would be approximately $2.66 billion[18] in 2011 dollars and at its peak create as many as 3,500 construction jobs in management, trades and labour. In addition to this, the construction phase would also engage a project team of up to three hundred direct OPG employees.

The operation and maintenance phase, lasting more than 50 years, would create up to 1,500 new ongoing positions in management, nuclear operations, skilled trades and administration, as well as thousands of indirect and induced jobs. The need for additional nuclear fuel for operations would provide some job creation stimulus in the uranium mining and refining industries. One-hundred percent of the project's ongoing uranium mining and refining needs could come from domestic sources[19].

Electricity Resource Costs to Meet Energy Needs (Baseload and Intermediate Resources, 2009-12)[20]			
Fuel Type/ Technology	**Procurement**	**Average Annual Production (MWh)**	**Unit Cost Energy Production ($/MWh)**
Nuclear	Bruce Power Refurbishment	35,000,000	58

[18] All conversions from 2005 to 2011 $CAN made at http://www.bankofcanada.ca/en/rates/inflation_calc.html

[19] *The Canadian Nuclear Industry: Contributions to the Canadian Economy*, CERI, June 2008

[20] http://www.powerauthority.on.ca/about-us/electricity-pricing-ontario/opa-generation-and-conservation-resource-costs/resource-costs-meet-needs

	Implementation Agreement		
Hydroelectric	Renewable Energy Supply, Hydro Contract Initiative, Hydro Electric Supply Agreement	2,290,000	81
Wind	Renewable Energy Supply/FIT	3,364,000	90
Bioenergy	Renewable Energy Supply	53,000	84
Combined Heat and Power	Combined Heat and Power (various phases)	1,380,000	111
Combined Cycle Gas	Accelerated Clean Energy Supply Clean Energy Supply Early Movers CES	10,887,000	86

While they are considerable, the benefits of nuclear generation to the industrial economy extend far beyond the direct and indirect stimulative impacts of the nuclear industry itself. According to Ontario Power Authority data, nuclear produces the lion's share of Ontario's electricity at a lower Unit Cost of Energy Production than any other generating source. By keeping rates low, nuclear helps provide Ontario with a more competitive environment for investment in electricity intensive resource extraction, refining and manufacturing industries.

In summary, at a time when Ontario's economy and labour market is clearly in need of a boost, a full slate of refurbishments and Darlington new build would spur massive economic activity, creating a boom in the industrial construction sector, and providing a much needed boost for flagging domestic manufacturing industries. In the process it would create, both directly and indirectly, thousands of highly skilled, well-paid, value-added jobs across a wide spectrum of occupations. At the same time, the relative affordability of nuclear generation and its long-term moderating impact on rates would help attract and retain investment in energy intensive industries.

Given a down job market, declining incomes and an inevitable need to replace aging baseload infrastructure, government spending which creates such a large number of good jobs, at the same time as it provides much needed infrastructure for reliable baseload electricity generation, should not only be regarded as wise, but necessary.

Stark choices for Ontario's supply mix: modelling two futures

A recent study by Strategic Policy Economics assessing the relative merits of Ontario's supply mix options illustrates the value of hard data, rigorous modeling and evidence based analysis[21]. The report compared two possible supply mix scenarios on the basis of total energy costs, electricity rates, economic impacts to bring the alternative scenarios online, and overall effect on greenhouse gas (GHG) emissions:

1. The LTEP contemplated wind build out with a reduced nuclear footprint

[21] "Ontario Electricity Options Comparison: Illustrating the Economics of Ontario Energy Supply Options", Marc Brouillette, June 2013

("Retained Wind Scenario"). This scenario requires additional gas fired generation capacity be constructed in lieu of the retired nuclear assets.

2. The LTEP contemplated nuclear build out with a reduced wind footprint ("Retained Nuclear Scenario").

Study results indicate that, over the period to 2035, the retained nuclear scenario would deliver $56 billion in direct benefits to Ontario's economy through $27 billion in savings to ratepayers (Exhibit A) and $29 billion in direct Ontario investment. While this involves reducing investments in wind generation, when compared to the retained wind scenario, the net incremental benefit of choosing to maintain Ontario's nuclear footprint is $60 billion. The retained nuclear scenario would also accommodate up to 75% more imported energy on an hourly basis[22].

Additionally, this model suggests that retaining our nuclear footprint through maintaining the 2010 LTEP commitment to refurbishment and new build provides $9 billion more in direct employment income benefits (a primary factor driving secondary economic impacts) over and above the gas/wind build-out scenario and would create over 100,000 more person years of employment. At the same time as it would be providing this significant economic boost to Ontario's economy, the Retained Nuclear scenario would reduce incremental GHG emissions after 2023 by 108 million tonnes, This represents 80% less emissions than the Retained Wind scenario would add. Prior to the refurbishment period 2020-2022, emissions reductions for the Retained Nuclear

[22] ibid

scenario would be 4% lower than the Retained Wind scenario[23].

In summary, according to this model, reducing the nuclear footprint in favour of enhanced reliance on gas/wind would result, in more costly energy, less investment and job creation for Ontario's economy, and increased GHG emissions.

[23] ibid

Natural gas

> *"[T]he government must do everything in its power to ensure the future restructuring of the electricity sector is undertaken in such a way to prevent the high usage of natural gas implicit in the OPA's upper emissions scenario. Much of this will depend on the timing and extent of the refurbishment of Ontario's nuclear facilities."*[24]
>
> Gord Miller, Environmental Commissioner of Ontario

The 2010 LTEP established that natural gas would only be used for specific purposes; i.e. it would be used strategically to:

- Complement the supply from intermittents such as wind and solar;
- Fill unexpected temporary reductions in both local and provincial supply, and
- Ensure adequate generation is available when nuclear plants are taken offline and modernized.

The Society of Energy Professionals believes that natural gas electricity generation should be confined to those "smart gas" purposes contemplated in the 2010 LTEP. Despite temptation owing to declines in the cost of natural gas prices in recent years, Ontario should not pursue a strategy that results in significantly increased use of natural gas to generate electricity. The Province would be particularly ill-advised to use natural gas for baseload generation to displace GHG-free nuclear and hydroelectric generation,

[24] Failing Our Future: Review of the Ontario Government's Climate Change Action Plan Results, Annual Greenhouse Gas Progress Report 2013, Environmental Commissioner of Ontario, June 2013, p. 10.

as *Making Choices* appears to contemplate doing. The objective of the Province's off-coal program (to be completed by 2014) was to reduce GHG and other harmful emissions that result from the burning of fossil fuels. Despite being lower in emissions than coal, natural gas is still a GHG-intensive fossil fuel. For that reason, the Province also needs to be extremely wary of using natural gas generation to back up an expanded fleet of non-hydro renewable generation.

Wind and solar are intermittent generation sources. Wind is available less than 25% of the time in Ontario and solar even less than that. This means that for every unit of wind or solar generation brought online, another unit of reliable on-demand generation also must be brought online. For the most part, that generation will be natural gas. This means that should non-hydro renewables be overbuilt and/or the Province opts to use natural gas generation for baseload, displacing nuclear and hydroelectric generation, Ontario would eventually return to the GHG emission levels that were the norm before it undertook the off-coal program. In summary, billions of dollars would have been invested in renewable generation without any positive effect on GHG emissions.

Ontario's heavy investment in intermittent non-hydro renewable generation and low-flexibility combined cycle gas turbines (CCGTs – see discussion below) heightens the need for load following generating plants. Thus, The Society believes that the Province should pursue the conversion of its valuable existing fossil assets (long since paid for by the ratepayers of Ontario) to use natural gas or biomass on a conventional steam turbine (CST) basis before contracting for new and expensive natural gas fired generating plants. The Society commends the Government for its decision to convert the Atikokan Generating Station (GS) to use biomass. The Society continues to advocate for a similar

conversion of the Thunder Bay GS. The Province's additional load following requirements, The Society believes, should be met by the conversion to natural gas or biomass of the Nanticoke and Lambton GS rather than the construction of expensive, new natural gas generating stations, particularly CCGT.

Although natural gas prices have decreased in recent years (largely driven by increased supply made possible by the use of 'fracking' technology), long-term volatility of natural gas prices cannot be ruled out and would be passed on to electricity consumers should the Province become reliant on too much gas generation. Given the widespread use of natural gas for heating during the winter, volatility in both electricity and gas bills could occur with a resulting negative impact on Ontario's economy.

Making Choices suggests that natural gas plants can economically provide both baseload generation and be 'fired up quickly to produce electricity. Unfortunately, this cannot be accomplished economically with one plant design. Facilities can be constructed as peak load plants and cycling plants that optimally match equipment designs and life expectancy with fast, responsive electricity production. The corresponding lower operational efficiencies and higher capital costs correctly position these facilities on the supply curve. Combined cycle plants designed for efficient baseload operation dispatched to fill the role of peak load or cycling plants, come at the price of lower plant availability, reliability, shorter life span and higher levelized project costs.

Although natural gas is often touted as a clean energy source, a 2008 LCA study comparing Ontario's baseload generation sources concluded that the carbon emissions of natural gas are "several orders of magnitude higher than those of nuclear".[25] Most of nuclear's already low carbon footprint is attributable to construction, fuel extraction and processing, and decommissioning. Very little is of the carbon footprint is associated with actually generating electricity, since it uses relatively little fuel. By contrast, most of the carbon footprint associated with gas generation is directly attributable to the burning of the fossil fuel during the generating process. The long operational lifespan of nuclear assets and their low fuel use rate help dilute the impact of nuclear's front- and back-end emissions. By any measure, nuclear is undisputedly the cleaner baseload option (see Appendix A of this submission).

Another concern with respect to fossil fuel options for heavier baseload generation, as compared to nuclear, is that, in the absence of an effective price on carbon, almost all of the environmental costs of gas generation are externalized. Currently, nuclear operators accumulate funds on a per kilowatt electrical energy basis in a reserve account that will eventually fund station decommissioning and waste disposal. These funds are invested so that sufficient monies will be available at the time they are required to return nuclear power generation sites to green-field and dispose of the used fuel in safe and secure repositories deep underground.

The costs and environmental risks associated with fossil fuel exploration, extraction and

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[25] S. Jazayeri, P. Kralovic, et al, *Comparative Life Cycle Assessment (LCA) of Baseload Electricity Generation in Ontario*, October 2008. p. xxi. (http://www.ceri.ca/Publications/documents/MainReportCERILCAJune2009.pdf)

transportation, particularly for gas extracted using hydraulic fracturing ('fracking") should also be of great concern. The GHG footprint and other environmental issues are quite significant including the high use of fresh water, pollution due to the use of fracking fluids and the resulting radioactive tailings that are large in volume and difficult to manage. Fracking technology - which involves pumping water at high pressure into shale beds to release trapped gas - also leaks methane into the atmosphere and methane is a much more potent greenhouse gas than CO_2[26].

[26] Fracking could accelerate global warming, Fred Pearce, New Scientist, 17:44 12 August 2013 http://www.newscientist.com/article/dn24029-fracking-could-accelerate-global-warming.html#.UjauRdJwrE1

Conversion of existing fossil fuel stations: the need for load following capacity

All of Ontario's coal-burning generating stations will be closed by the end of 2014. This section of The Society's submission deals with how these important and valuable assets might best be used to the continued benefit of the people of Ontario. The electricity system has and will continue to have a need for generation with superior load following capability. The conversion of the existing fossil fuel stations to use other fuels to meet the ongoing need for load following capacity should be seriously considered as part of an evidence-based, transparent planning process prior to any construction of more expensive new natural gas generating stations.

Preserving the niche role of conventional steam turbines

Critical in maintaining and improving the sustainability of the province's electricity system is its ability to produce just enough electricity to satisfy demand when—and only when—it is needed. In this regard, it must be acknowledged that Ontario's coal plants have helped maximize Ontario's load following capacity, since the electricity generated through Conventional Steam Turbine (CST) technology is flexible and dispatchable. These properties are crucial ingredients in maintaining the integrity of the province's electricity system and must be preserved. Furthermore, in order to use gas generation as strategically and as sparingly as possible to reduce GHG emissions, the system requires the greatest possible load following capability. The conversion of Ontario's existing fossil stations to burn other fuels should be very seriously considered

so that their superior load-following properties are not lost.

There are those who argue that the coal-fired units should simply be closed (and the assets wasted), replacing the lost generation capacity with distributed gas generation using combined cycle gas turbine (CCGT) technology since such technology has a lower gCO_2eq/MWh ratio than gas-fired CST.

However, this would be a mistake both from an environmental perspective and from the standpoint of the electricity system's integrity. On a strict gCO2eq/MWh basis, it is true that CCGT technologies have a lower carbon footprint than CST, but this simple comparison fails to account for the eventual impact of the differences in the way the two technologies are employed within the system.

CCGT technologies typically have a minimum operating capacity of 60 percent. In other words, once running, a 550 MW CCGT station must produce at least 330 MW of electricity, regardless of demand while it is operating. By contrast, a 550 MW CST station with a seven percent minimum operating capacity can produce between 38 and 550 MW at any given time. At a moment where only 100 MW of additional electricity is required, it makes no sense to be generating 330 MW from a CCGT station when 100 MW could be dispatched by a CST station.

If the province simply closes existing coal units, the system will lose crucial CST capacity and risk substantial escalation of surplus baseload generation.

The table below provides a hypothetical example of the differences between CST and

CCGT units in their ability to generate a 1,000 MW of load-following availability and their potential for generating surplus base load:

Gas-fired Generation Sources	**CCGT Unit**	**CST Unit**
Maximum Capacity Rating MW	550	550
Minimum Capacity Rating MW	330	38
Load-Following Capacity MW	220	512
1,000 MW load-following availability:		
Number of Units required	5	2
Minimum MW of production required	1,650	76

Atikokan GS conversion to biomass

The Society is very supportive of Ontario Government's decision to convert the Atikokan GS from burning coal to burning biomass. The Society is hopeful that this decision is broadly indicative of the Province's recognition of the value of the coal generating stations; that when these stations cease burning coal in 2014 that they will be seriously considered for conversion to burn other fuels and thereby continue to bring value to the ratepayers of Ontario.

As it has with its decision to convert the Atikokan GS to burn biomass, The Society recommends that the Province consider the conversion of the other coal burning stations to use other fuels as a part of an evidence-based planning process so that they might continue to bring value to Ontarians.

Nanticoke and Lambton redevelopment

There are two options for converting the Nanticoke GS. The first is a full conversion to use natural gas. Such a conversion would provide up to 2,000 MW of generating capacity. The second option is to implement a smaller gas conversion using an existing pipeline together with advanced biomass co-firing. This would result in a generating capacity of 450 MW. The Society suggests that an evidence-based planning process is the best approach to determining which option best meets the needs of Ontario's electricity system and is a prudent, cost effective investment. Either option would continue to make use of the Nanticoke GS as a valuable public asset.

The Society believes that a full gas conversion of the Lambton GS should also be seriously considered as part of an evidence-based planning process to meet Ontario's electricity needs in a prudent and cost effective manner.

Thunder Bay Advanced Biomass Conversion

The Thunder Bay GS is an extremely valuable asset. The case for its conversion to use another fuel is compelling and based on credible evidence[27]. Capacity from this station is critically needed to ensure that the vast mineral wealth of Ontario's NW is unlocked together with the billions of dollars in investment and thousands of jobs that would result.

[27] Northwestern Ontario Municipal Association, Advantage North West: Mining Readiness Strategy: http://www.noma.on.ca/upload/documents/mining-readiness-strategy.pdf

Hydroelectric

The Society believes that the evidence will support a number of Ontario's potential new investments in hydroelectric generation. Hydroelectric generation is unique among renewable sources of electricity in that it is the only renewable that can be used to meet baseload, load following, and peaking demands. In addition, current and potential pumped storage capacity allows for the storage of electricity on a large scale. For these reasons, hydroelectric is singular among all electricity generating technologies and crucial in terms of its ability to facilitate the integration of intermittent renewables such as wind and solar.

There should be no controversy over the place of hydroelectricity in the Province's generation mix: it is cheap, dependable, and sustainable with the smallest carbon footprint among renewables.[28] In light of the unique and diverse properties of water as a renewable fuel for the generation of electricity, ongoing investment in hydroelectric power to meet base load, load following, and peaking demands should be a key element of any green energy strategy for Ontario.

The OPA's Integrated Power System Plan I, released in November 2006 identified 3,024 MW of committed and planned capacity in new plant and expansion to existing plants, to be developed by 2027. It stated:

[28] *Postnote: Carbon Footprint of Electricity Generation,* Parliamentary Office of Science and Technology, UK, October 2006. (http://www.parliament.uk/documents/post/postpn268.pdf)

The first priority for feasible and economic renewable supply is that "all feasible hydroelectric resources are included on the basis that hydroelectricity is the most economic of the renewable resources.[29]

The Society is optimistic that the development of the hydroelectric generation sites listed in the table below will be found to be prudent and should be prioritized in the short-term.

Project Name	Status	New GS, Re-development or Expansion	Capacity (MW)
Little Jackfish	Planned - In Definition Phase	Greenfield Site	78
Mattagami Lake Control Dam	Planned - In Definition Phase	New plant at existing control dam site	6
New Post Creek	Planned – Awaiting Final Contract Terms Phase	Greenfield Site	25
Ranney Falls	Planned - In Definition Phase	New unit at existing plant	10

[29] Integrated Power System Plan I. Ontario Power Authority.2006.

Long Lake Control Dam	Planned - In Definition Phase	New plant at existing control dam site	7-8.5

Mid to longer-term opportunities for development

Ontario Power Generation (OPG) is also studying opportunities for redevelopment of the existing “end-of-life” stations, new projects at existing control dams, embedded generation projects on rivers near the Ring of Fire in partnership with First Nations, and large hydro projects (over 500MW each) on the Lower Albany River and in the Moose River basin. These projects are still in early concept phase but The Society believes that they are important projects that should receive serious consideration in any planning process going forward.

Non-hydro renewables: too much of a good thing?

The Society of Energy Professionals believes that energy from all sources, including conservation and renewables, can have an important part to play in meeting Ontario's energy needs. However, Ontario's head-long rush into a rapid build-up of renewables, without adequate forethought and at very high prices, has created difficult problems integrating these intermittent generators and has saddled the Ontario economy with rising energy prices. Even worse, it is far from clear that the current approach optimizes the reduction of greenhouse gas emissions because of the need for heavy investments in fossil fueled generation to backstop the renewables investments.

A level playing field approach based on sound economics is what is called for. One such approach to this would have been via an economy-wide carbon tax that would have allowed renewables to compete head-to-head with other forms of electricity generation without the extremely costly subsidies these technologies have enjoyed. The result would have been a slower but more economically rational and sustainable build-out of renewable generation.

Apples-to-apples comparisons based on sound economics will avoid common errors such as simple reliance on "nameplate" capacity ratings as seen on page 5 of *Making Choices*. The 700 MW of solar photovoltaic (PV) quoted as being "online" is actually available only about 11% of the time in Ontario. The 3300 MW of "renewable power ... online" quoted on the same page is primarily the "nameplate" generator output of wind turbines, which are available less than 25% of the time under Ontario conditions.

Conventional non-emitting generation alternatives in Ontario can operate 90% or more of the time. This comparison of real and “nameplate” outputs is seldom made clear when generation is being described to the public.

There can be no dispute that non-hydro renewable energy is intermittent in nature, or, as the IESO refers to such generation “variable”. Wind power is available when the wind blows, and output fluctuates with the fuel source. Worse, the 25% availability of wind power represents an average number, which is misleading as wind has higher availability off-peak when there is less need for the energy it produces. The same intermittent nature is true for solar power.

Advocates of wind power argue that intermittent generation can be accommodated using storage and demand management. Unfortunately, the only viable bulk storage method at this point in time is pumped storage, and we only have one such storage station in Ontario. If additional storage is to be built purely to accommodate intermittent generation sources, the cost of that storage must be included in the cost of wind generation.

Evidence based planning requires realistically acknowledging the characteristics and costs of all supply options, including non-hydro renewable energy. We must also consider the current state of technology in accommodating this supply into Ontario’s energy mix. We cannot simply set an arbitrary target for any supply option out of desire to promote this energy source over other sources.

As such, the question we should be most concerned with is: What role can intermittent generation play in meeting Ontario's energy demands? Should it be used to supply energy for baseload, peak or both?

Baseload generation represents minimum demand and must be met 24 hours per day, seven days per week. If, in a system planning timeframe, intermittent generation such as wind is planned to supply baseload power, it requires a complementing supply that can fill the gap when wind is not available.

The only viable, large scale back up source is through fossil fuel, which in Ontario means natural gas since coal will be phased out by 2014. This means that any plans to use wind to provide baseload energy will lead to increased use of GHG emitting fossil fuel for baseload power. While natural gas generation only emits about two-thirds of the GHGs of coal plants, this is still quite significant. Currently Ontario relies on non-GHG emitting nuclear and hydroelectric power for baseload generation. Any change leading to fossil fuels replacing nuclear or hydroelectric for baseload power would lead to increased GHG emissions and would reverse the progress made over the past 10 years with Ontario's off-coal program. There is no evidence available which would lead The Society of Energy Professionals to support a long-term energy plan that relies on intermittent wind and solar generation in baseload capacity. From a long-term planning perspective, this leaves these resources as peaking generation.

The difference between daily peak demand and baseload demand must be met by a resource mix that allows the system operator to vary the output to meet demand. The difference between baseload and peak demand varies, but is in the order of 10,000 MW. It is within this region that non-hydro renewables have the opportunity to help meet Ontario's energy goals. Daily peak energy requirements are typically met by a mix of energy limited hydroelectric power plus fossil fuel generation. The use of renewable hydroelectric power for peaking power results in reduced GHG emissions. Because of the intermittent nature of this supply, we cannot eliminate entirely the use of all fossil fuels. Significant amounts of natural gas generation must be kept on line in order to ensure availability, and to allow matching of supply with demand as it varies throughout the day. Combined cycle natural gas plants (CCGTs) have very high minimum operating points, usually about 60% of their full output, which means that multiple plants have to be on line to give the same maneuverability that was allowed by coal fired generation. Coal fired generation has minimum outputs as low as 20% of full power. So for example, with a 500 MW combined cycle gas plant, we have to accept 300 MW of generation on line in order to have access to the ability to increase output by an additional 200 MW.

Improvements are being made in our ability to forecast wind output up to three hours in advance. However, the nature of this resource still introduces additional uncertainty and variability into the process of matching supply and demand in real-time. If wind output is dropping, it means that other sources of supply must be called upon to fill the gap. If this occurs during a period such as early morning when demand is already increasing and other resources are already increasing output, it creates an even greater need for maneuverable resources. Coupling the change to gas from coal with increased wind

capacity is having a significant impact on how we operate our system. We are spilling water, manoeuvring nuclear units and are now creating the ability to dispatch wind off the system when its energy is not required. The resulting inefficient use of resources cannot and should not be ignored as we devise our long-term energy strategy.

According to the IESO[30], Ontario already has 9,987 MW of installed gas capacity and 1,560 MW of wind capacity. The IESO also has indicated that there will be an additional 3,300 MW of renewable supply coming on-line over the next 18 months[31]. In addition, Ontario already has installed capacity of approximately 4,700 MW of non-baseload hydroelectric capacity. In short, Ontario already has enough peaking capacity. There is still an additional 7,000 MW already under FIT contract scheduled to come on line during the span of the LTEP. This will represent a serious issue for efficient system operation.

The challenge going forward is ensuring that adding further intermittent generation does not create a situation where Ontario ends up increasing its GHG emissions by pushing non-GHG sources such as hydroelectric and nuclear out of baseload generation. The system operator has indicated that it can operate the system reliably with the anticipated 10,000 MW of renewable supply; however, reliability is not the same thing as efficiency or cost effectiveness. The system operator does not speak to that question. These are precisely the issues that would be discussed in a proper evidence based and transparent public planning process.

[30] http://www.ieso.ca/imoweb/media/md_supply.asp

[31] http://www.ieso.ca/imoweb/pubs/corp/IESO_2012AnnualReport.pdf

The consequence of operating without an evidence-based and transparent planning process is that the Society cannot see – and does not believe there is – any basis for how the current non-hydro renewables targets were established in LTEP 2010 (19.8 TWh of wind and 3 TWh of solar PV by 2030). It appears that the Energy Minister of the day simply chose an arbitrary number. Accommodating this amount of intermittent generation into the supply mix will lead to an inefficient use of resources, and puts the progress in GHG emission reductions made by Ontario's Off-Coal program at risk.

The Society believes that the best approach is to slow the rate of introduction of non-hydro renewable power into the system and to review the targets established in LTEP 2010 in an evidence-based and transparent planning process to ensure that the targets do not result in inefficiency, unnecessarily high costs and an increase in GHG emissions.

Pumped Storage is a proven and powerful technology, already in use in Ontario. There are opportunities to expand the role of pumped storage however mechanisms must be created to properly value its benefit to the province. Battery storage presents future opportunities, particularly when considered in conjunction with the significantly increased use of electric vehicles (EVs).

Energy storage

Pumped storage

Hydroelectric pumped storage facilities such as OPG's Pump-Generating Station (PGS) in Niagara Falls provide tremendous flexibility for system operation. During periods of low electricity demand, the excess electricity produced by wind, solar and nuclear sources can be stored by a PGS, for later use during peak electricity demand periods. Electricity is generally an instantly perishable commodity but this energy can be stored for later use by a hydroelectric pumped storage facility. Pumped Storage is currently the only proven large scale means of energy storage.

Recently, there has been considerable interest in pumped storage because, like Ontario, many jurisdictions are adding increasing amounts of intermittent and renewable resources to their systems. For example, the California Public Utilities Commission refers to storage as EES: "EES (Electric Energy Storage) offers California multiple economic and environmental benefits. By utilizing EES technologies to store intermittent renewable power, the State may reduce greenhouse gas emissions from carbon-based electricity production, avoid the need to build expensive new transmission lines and power plants to meet peak energy demand, increase system reliability and generate economic activity through the manufacturing and operation of these EES technologies."[32]

[32] California Public Utilities Commission: Electric Energy Storage: An Assessment of Potential Barriers and Opportunities, July 9, 2010

In Ontario, traditionally, the economics for pump storage were based upon the difference between the cost of energy to pump the water during off-peak periods and value of energy generated during on-peak periods. In Ontario's current reality, the small difference between on peak and off peak prices do not make pump storage economical. More importantly, this approach to the economics of pump storage fails to recognize two major costs to the province. Firstly, "Marginal Price versus Avoided Costs" - pricing in Ontario is not reflecting the value of avoiding peak generation. Secondly, "Value of Avoided Green House Gas" - the price of electricity in Ontario is not currently reflecting the cost of GHG (greenhouse gasses).

In other words, the true value of pumped storage, while it may be recognized from a system planning perspective, is not reflected in the market mechanism typically applied to it. Indeed, as noted by the California Public Utilities Commission:

> The major barrier for deployment of new storage facilities is not necessarily the technology, but the absence of appropriate regulations and market mechanisms that properly recognize the value of the storage resource and financially compensate the owners/operators for the services and benefits they provide.[33]

The Society believes that pumped storage could be a potentially important,

[33] ibid

environmentally sustainable component of Ontario's Long-term Energy Plan. The Society views pumped storage as a transmission system benefit/asset. If the avoided costs of new generation and the value of carbon-free electricity generation were taken into consideration, in addition to the marginal cost savings between peak and off-peak electricity usage, we believe that the cost of pumped storage would be price-competitive with other renewable sources. Additionally, the development of pumped storage projects such as the Sir Adam Beck PGS and the Lower Notch PGS would reduce the burning of natural gas during peak demand periods and thereby help reduce the level of Ontario's GHG emissions

As Pumped Generation is the only proven source of bulk storage, the expansion of its use should be seriously considered as part of an evidence-based review of the Long-term Energy Plan.

Battery and flywheel storage

At least in terms of their relationship to the bulk energy network, batteries and flywheels are better viewed as a source of regulation than a storage mechanism. While there has been some interest over claims of longer sustained power output and greater efficiency in the latest generation of flywheels, they still do not qualify as energy storage devices for the bulk electricity system. While flywheels and batteries do present interesting technology for regulation services, there is no evidence available which would lead The Society to believe that Ontario has a need for additional regulation services beyond what is currently in place.

With respect to the distribution network and islanded or remote locations off the grid, the Society sees potential warranting further investigation for batteries (and electric vehicle batteries in particular) to play a useful storage role. Continued investment in research and development, and carefully selected demonstration projects are certainly merited.

Transmission Planning

The success or failure of the LTEP depends on well-functioning transmission infrastructure, including 30,000 km of high-voltage lines, 122,000 km of low-voltage lines, and 300 transmission stations that act as arteries to keep electricity flowing when and where it is needed. Transmission assets like power lines and underground cables work with transmission stations to move electricity around the province. Transmission stations consist of power transformers, circuit breakers, ancillary systems, insulators, surge arrestors, capacitor banks, reactors, protection, control and grounding systems, the physical buildings that house these assets, and more.

Without adequate investment in transmission infrastructure—not only for maintenance but expansion as well—Ontario's ability to move the cleanest energy from one part of the province to another will be compromised. Shortcomings in transmission infrastructure will result in Ontario squandering its potential to move clean hydro and nuclear electricity from source to load and inappropriately increase Ontario's reliance on carbon-emitting, distributed gas-fired generation facilities.

There is a need to prepare for the future and ensure continued reliable supply and delivery of electricity. There are new demands on the transmission system due to changes in the generation supply mix (i.e. some of the existing generation facilities will need to be replaced, existing coal-fired generation is being phased out, and addition of new renewable resources), which will require the existing transmission assets to be renewed as new supply resources may have different operating characteristics or will

require new transmission assets to be built as resources are in different geographic locations.

However, the planning of transmission projects in the future will also need to focus on: sustaining the existing asset base as many of these assets are aging, accommodating the overall load growth, and alleviating internal system constraints to ensure the customer needs are met and the transmission system continues to operate in a safe and reliable manner in accordance with reliability, environmental standards, regulatory and legal requirements.

The proposed priority transmission projects outlined in the 2010 LTEP included:

1. Southwestern Ontario Series Compensation (2014)
2. Rewiring West of London (2014)
3. West of London New Transmission Line (2017)
4. East-West Tie (2016-17)
5. New Line to Pickle Lake (pending consultation)

These projects were included in Hydro One's 10 Year Outlook and continue to be a priority (except for the installation of Static Var Compensator at Milton SS).

When expanding or modifying the transmission system to address load growth or increase in supply mix, synergies should be pursued to replace or refurbish the aging transmission system in order to make the most cost-effective investments for customers.

Renewing aging transmission system infrastructure

Hydro One is responsible for managing most of the province's transmission assets. However, the majority of these assets are in the middle or late stages of their expected life. Without significant reinvestment in transmission infrastructure, there will be unavoidable cost increases, and the reliability of the system will face steadily increasing risk.

Indeed, every aspect of Ontario's transmission system is based on a variety of large and small components, each with a varying life expectancy. To manage the system, Hydro One invests in a complex process of evaluating the overall health of the transmission and distribution system from generation to transformation to load. To illustrate the urgency of addressing the issue of aging infrastructure, Hydro One reported in 2010 that there are a substantial number of assets in use today that are more than 40 or 50 years old.[34] It should be understood few transmission assets have life expectancies greater than 40 or 50 years. In other words, a large number of Hydro One assets are at the end of their life. Hydro One reports that over half of its circuit breaker population is comprised of 30 to 65 year-old oil circuit breakers. Half its overhead lines assets are more than 50 years old, as are one-fifth of its power transformers.

Expanding transmission for imports

Ontario's transmission system is capable of importing or exporting depending on system conditions. Ontario's recent trend in the past 3 years has seen exports of electricity

[34] Hydro One Networks Inc. Ontario Energy Board Application, filed May 19, 2010 EB-2010-0002, Exhibit D1, Tab 2, Schedule 1, pp. 1-12.

(approx. 14TWh) exceeding its imports of electricity (approx. 5TWh) with the addition of new generation to the transmission system.

The maximum Ontario import capacity is limited to approximately 4,800MW. Unless there is a significant change in the supply mix or there is another societal benefit to imports, the cost-benefit justification to customers for the expense (estimated to be hundreds of millions of dollars) of additional transmission requirements to import more electricity may be challenging. This is particularly so since Ontario's supply already exceeds its demand. This excess supply has led to situations where Ontario experiences negative prices for electricity. When this energy is exported we pay foreigners to take our power. In short, we don't currently need the imports and we don't want to export at negative prices. Thus intertie expansion is not currently a high priority.

Hence there should be a cost-benefit evaluation that takes into consideration: customer preferences, reliability of the system, capability to import from neighbouring utilities, legal requirements, impact of how increased imports with have on existing generation and future electricity prices, and financial evaluation comparing the importing of electricity to other alternatives of supply.

The Society suggests that the following transmission projects and portfolios should receive particular consideration in the planning process:

1. Reinforcement of the Sudbury to Wawa portion of the transmission system in the North-east

Following a commitment to proceed with the East-West Tie Reinforcement, attention must be given to reinforcing the transmission system between Sudbury and Wawa to allow the full potential of the East-West Tie to be realised. Unless the Sudbury to Wawa section of the transmission system is reinforced, its transfer capability will be limited to approximately 350MW, both eastwards and westwards. Although there could be a contribution from the generating facilities within the Great Lakes Power System, this is not expected to be sufficient to supply the increasing demand that has been forecast within the north-west, particularly during dry years when the output from the hydroelectric facilities will be reduced.

2. Reinforcement West of Lakehead

Depending on the location of the expected new loads in the north-west, reinforcement of the transmission system to Mackenzie TS or Dryden TS may be necessary. If the system were to be reinforced to Dryden TS to supply the additional loads then it would be beneficial to continue through to Kenora TS and to the Manitoba border. This would then provide an opportunity to consider 'clean-green' imports from the Manitoba hydroelectric facilities.

3. Extension of the John-to-Esplanade Link from Esplanade TS through to Hearn SS

The capability to transfer loads between the Manby Sector and the Leaside Sector is limited by the existing underground circuit between Esplanade TS and

Hearn SS. Not only does it have a low impedance but its thermal rating is very low. Consequently it cannot be operated in parallel with the two existing overhead circuits between Esplanade & Hearn; effectively minimising any contribution that it can make to any transfers between the two sectors.

4. Development of a 230kV busbar at Milton TS and the extension of the existing 230kV transmission facilities from Hurontario SS through to Milton.

   The exposure of the significant amount of load west of Claireville TS to possible supply interruptions is a concern because of the radial nature of many of the existing transmission facilities. The existing facilities are also approaching their supply limit and an additional source of supply is needed to serve the growing demand in the Milton & Georgetown areas. Milton TS is ideally located to satisfy this need, but will require additional transmission lines along the existing right-of-way to interconnect with the existing facilities at Hurontario SS.

5. New 500/230kV Autotransformer Station in east GTA to address the overload of equipment at existing stations when Pickering NGS is retired and improve reliability to stations in the east GTA.

Smart grid

Making Choices outlines the technological developments referred to as “smart grid” in the industry. As the document points out, there is potential for the use of smart grid technology to improve efficiency in the electricity sector. The Green Button program and the underlying standards for data and privacy are important developments that pave the way for future programs. Looking forward, one of the most promising applications for smart grid technology would be to help manage the expected increase in the use of plug-in electric vehicles (EV). Existing distribution systems were not designed for the increased load that a large penetration of EV would pose. Smart grid technology offers at least a partial solution to managing charging loads.

While there is great potential in smart grid technology, future investments need to be based on sound economic principles. It is important to note that there has never been a full costing of Ontario’s smart meter program to date. There has not been an accounting of the smart meters, stranded costs associated with the previous non-smart meters nor the associated system upgrades required by electricity distributors to implement time-of-use pricing, and any other related costs. The full cost of the program is not known, but at least $1 billion had been incurred as of the end of September 2010. Without a cost accounting, Ontario ratepayers lack assurance that the benefits of the smart meter program outweigh the costs of its implementation. Looking ahead, any future investments in smart grid technology must be properly evaluated. As with other technologies discussed in *Making Choices*, smart grid investments need to be based upon a comparison of alternatives in an evidence-based, transparent manner.

Fostering Aboriginal participation in Ontario's electricity sector

In order to effectively engage Aboriginal community participation in Ontario's energy sector there are a few important considerations that should be taken into account. From a legal perspective, Canada has statutory, contractual and common law obligations to consult with Aboriginal groups based on judicial interpretation of the obligations of the Crown (federal, provincial and territorial governments) that relates to asserted or established Aboriginal or Treaty rights of the Aboriginal peoples of Canada. This was recognized and affirmed in section 35 of the Constitution Act, 1982. First and foremost, these obligations must be respected and honoured by all levels of government and any Crown agencies, boards or corporations involved in activities which have the potential to impact the interests of Aboriginal communities.

In particular, The Society of Energy Professionals recommends continued and expanded collaboration between Aboriginal peoples and the Crown and private sector entities involved in the development of generation, transmission and distribution projects that may adversely impact asserted or established Aboriginal or Treaty rights. To further expand on this, it is critically important for Aboriginal peoples to have the opportunity to share the benefits of energy initiatives that occur within their traditional territories. Partnership initiatives such as the one between Hydro One Inc. and the Saugeen Ojibway Nation (currently seeking approval before the Ontario Energy Board) are recommended, encouraged and supported, as this is an excellent opportunity to establish the building of strong and economically viable communities.

"We wanted to make sure there was a lasting legacy for our people, as long as the line was in place. The best way to do that was to look at how we'd become owners." [35]

Randall Kahgee, Chief of Saugeen First Nation

In order to reinforce these partnerships at the grassroots level and make possible a larger number of more rewarding employment opportunities for Aboriginal people over the short- and medium-term, programs which support education and skills training for Aboriginal youth are key. In addition to benefiting Aboriginal youth and their communities, electricity sector employers can benefit by expanding the pool of skilled workers who are available to fill their recruiting needs. Statistically, Aboriginal youth are the fastest growing demographic. Statistics Canada predicts that by 2031, the Aboriginal population will grow to between 1.7 million and 2.2 million which represents a growth rate between 1.1% and 2.2% compared to 1.0% for non-Aboriginals[36].

[35] Saugeen Indian bands buy $72 million stake in power line, John Spears, The Toronto Star, May 9 2013. http://www.thestar.com/business/2013/05/09/saugeen_indian_bands_buy_72_million_stake_in_power_line.html

[36] **Projections of the Aboriginal populations, Canada, provinces and territories 2001 to 2017, Statistics Canada,** http://www.statcan.gc.ca/pub/91-547-x/2005001/4072106-eng.htm

Roberta Jamieson, CEO and Director of Indspire, states that "the convergence of the economy's skills shortage and the explosion in the number of Aboriginal young people represent an economic opportunity unparalleled in modern Canadian history"[37].

The Society of Energy Professionals strongly recommends programs to support educating Aboriginal youth through not only scholarships but also through programs targeted at youth that make them aware of the opportunities for future careers in the energy sector.

To summarize, Society recommends the following measures as helpful to support Aboriginal community participation in Ontario's energy sector:

1. Continue with collaboration with Aboriginal communities in the planning, design and implementation of projects within the energy sector where there is an impact to these communities;
2. Encourage partnerships between corporations and Aboriginal communities.
3. Invest in the education of Aboriginal youth so they are able to gain employment within the sector as they are the richest resources available and are an important component to meet future workforce needs.

[37] Young aboriginal population growing dramatically, crucial to economy to offer employment opportunities, Matt Moir, The Hill Times, June 17, 2013. http://www.hilltimes.com/policy-briefing/2013/06/17/young-aboriginal-population-growing-dramatically-crucial-to-economy-to/35055

Conclusion

It was less than three years ago that The Society welcomed the government's decision, expressed in the February 2011 supply mix directive, to maintain Ontario's nuclear base load capacity. This decision committed the Province to a long-term total capacity of 12,000 MW, of which 10,000 MW would be delivered through the refurbishment of existing nuclear capacity at the Bruce and Darlington Nuclear Generating Stations. The remaining 2,000 MW were to come from two new generating units at Darlington. The Society agreed with the important proposition embedded in that 2010 LTEP that fossil fuels, while having an appropriate and necessary role in load following and peaking generation, do not have any place in base load. Above all, we agreed with the government's commitment to vet these proposals using the IPSP process.

In the intervening 30 months, our economy experienced some serious negative impacts due to the global recession. However, it is yet to be proven that these recession-driven impacts have fundamentally and forever changed the nature of Ontario's economy or Ontarians' consumption of energy. And, we are certain that this economic disruption did not fundamentally alter the principles of sound power engineering science and practice.

For these reasons we are concerned to see the government seemingly contemplating serious departures from the established nuclear supply strategy such as abandoning new build, delaying some refurbishments and putting GHG-intensive fossil generation into base load in place of nuclear. This, in the absence of a robust process to determine that such changes would indeed represent the most prudent course of action from the

perspective or reliability, sustainability and economics, seems highly inadvisable, perhaps to the point of recklessness.

The Society recognizes that our views on the merits of nuclear power generation, while shared by a great many experts in the electricity sector, are not shared by all. While we find the Strategic Policy Economics study on this matter to be quite convincing in its methodological rigour, reasonable and transparent assumptions and heavy reliance on publicly available data, we recognize that some interest groups might find cause for quarrel with some of the assumptions or offer alternative, and perhaps contradictory, data. However, given the huge import to Ontarians of the grid reliability, GHG reductions and economic prosperity that ride on which viewpoints are in fact correct, agreeing to disagree is simply not an option.

Everyone is entitled to their own opinions, but they are not entitled to their own facts. Most of the key questions of power system planning are, in fact, empirically knowable; they are questions of engineering, of environmental science, of economics. These are not questions that should be answered via web consultations with the general public, nor should they be answered according to which special interest lobby has the largest e-mail list or the most fervent believers in the moral correctness of their positions. We have seen the failures and limitations of the faith-based system of planning they hold dear.

These empirical questions should be advanced, argued, debated and decided through processes where fact and evidence are placed above politics and spin. They should be heard through processes where proponents of contrary views have an equal opportunity to be heard, to advance the evidence that supports their respective positions and to

challenge the evidence advanced by those with whom they disagree. They should be decided through processes that are open to broad stakeholder, expert, and public participation; transparent in their function and decision-making; and, that generate decisions for which institutions and governments can be held to account.

It is exactly these cornerstones of evidence-based planning that the government embedded in the Integrated Power System Plan process when it was first designed and introduced. The Society is firm in its belief that most of the errors, inefficiencies and controversies that have plagued the electricity system in the intervening years are the direct or indirect result of the wilful failure to develop and implement a properly approved IPSP. We are equally firm in our belief that it is not too late to correct course and get electrical system planning right for the people of Ontario.

All of which is respectfully submitted,

Scott Travers, President
The Society of Energy Professionals

Appendix A

LIFE CYCLE POLLUTION FROM POWER GENERATION IN ONTARIO[38]

Pollutants	Unit	Nuclear	Coal	Natural Gas
Total Criteria Air Contaminants	(CAC) t/TWh	12.42	6,712.78	1,452.63
Oxides of Nitrogen	(NO2) t/TWh	2.45	1,676.58	720.12
Sulphur dioxide	t/TWh	8.54	3,907.36	363.32
Carbon Monoxide	t/TWh	0.00	418.11	274.47
Total Particulate Matter	t/TWh	0.61	685.68	20.91
Volatile Organic Compounds	(VOC) t/TWh	0.81	25.05	73.81
Other Air Pollutants	Unit	Nuclear	Coal	Natural Gas
Lead and its compounds	kg/TWh	0.09	22.21	0.61
Mercury and its compounds	kg/TWh	0.00	10.59	0.00
Arsenic and its compounds	kg/TWh	0.00	23.07	0.61
Radionuclides	TBq/TWh	39.85	0.06	0.92

[38] S. Jazayeri, P. Kralovic, et al, *Comparative Life Cycle Assessment (LCA) of Baseload Electricity Generation in Ontario*, October 2008. p. xxi. (http://www.ceri.ca/Publications/documents/MainReportCERILCAJune2009.pdf)

Water Pollutants	Unit	Nuclear	Coal	Natural Gas
Lead and its compounds	kg/TWh	0.00	0.47	0.00
Mercury and its compounds	kg/TWh	0.00	0.13	0.00
Arsenic and its compounds	kg/TWh	0.19	1.56	0.00
Radionuclides	TBq/TWh	21.04	0.00	0.01