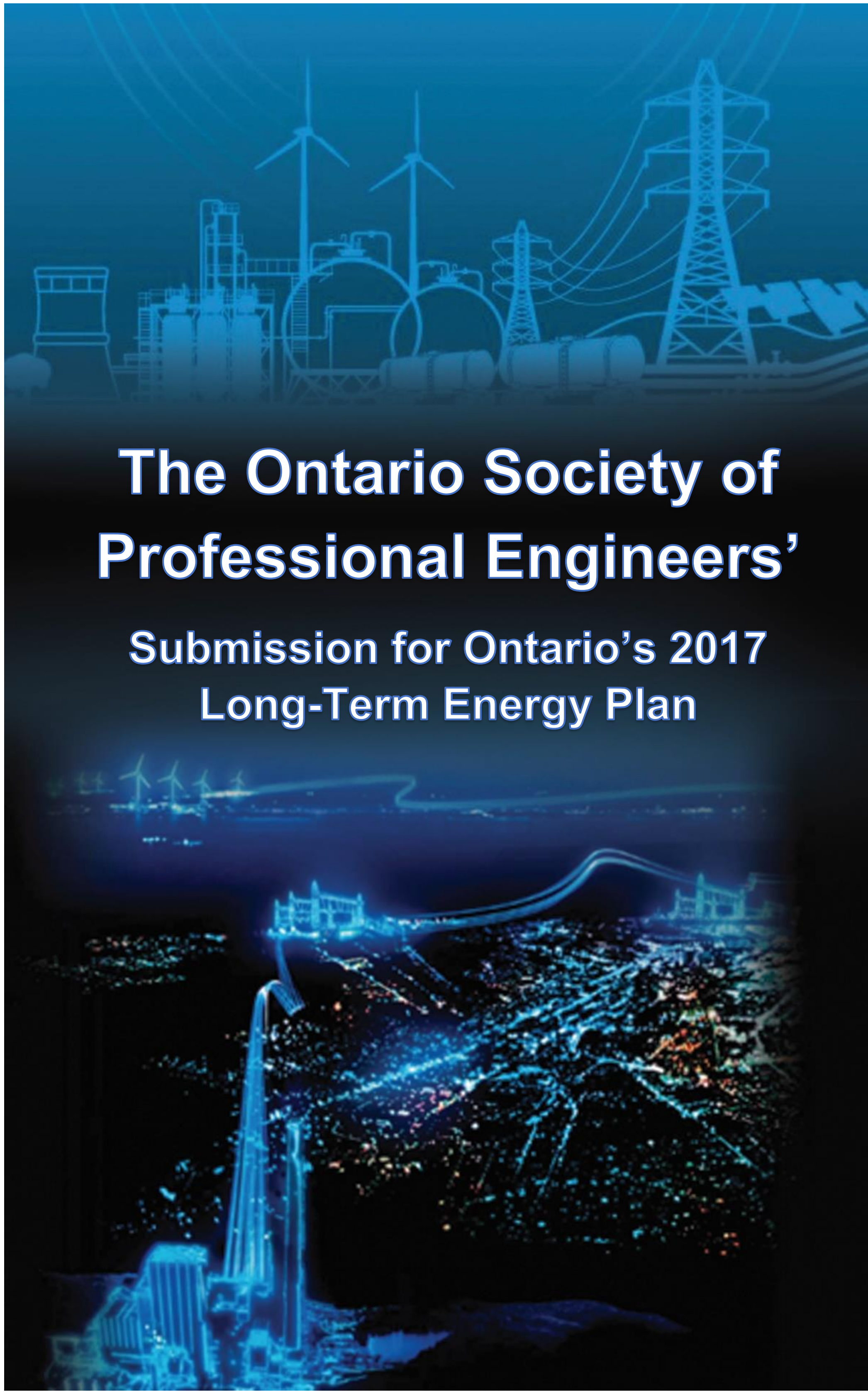
ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

POWER TO LEAD

The Ontario Society of Professional Engineers'

Submission for Ontario's 2017 Long-Term Energy Plan



Andrea Pastori
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Toronto, Ontario M7A 2C1

December 16, 2016

Ontario's 2017 Long Term Energy Plan (LTEP): Planning Our Energy Future

Dear Ms. Pastori:

The Ontario Society of Professional Engineers (OSPE) appreciates the opportunity to submit commentary to support the development of the 2017 Long-Term Energy Plan (LTEP).

When it comes to Ontario's energy future, the importance of proper planning cannot be overstated. The management of our energy sector is arguably one of the most complex and integral responsibilities of the provincial government, and in order to plan this sector effectively, the insight of engineers is of paramount importance.

OSPE is the voice of engineers in Ontario and takes its role as a trusted resource and advocate for evidence-based decision-making very seriously. Engineers have the technical knowledge that is required to develop an optimal power system plan and an integrated energy system plan for the economy as a whole. It is imperative that the Government of Ontario grant its professional engineers more independence in planning and designing the provincial energy systems in accordance with the outcomes-based objectives determined by government and public consultation.

It is OSPE's position that the government should return to its prior role of establishing high-level goals for Ontario's energy systems and leave the detailed planning and design to the agencies and organizations that have the required engineering expertise to develop those systems in a cost-effective manner. Determining the supply mix and where that supply should be located are an integral part of the detailed planning and design process.

Looking to the future, Ontario must achieve balance between its environmental commitments and its economic welfare. Reducing carbon emissions in non-electrical sectors of the economy will be more difficult to achieve and potentially far more costly than Ontario's experience with the electrical sector if it is not done in an optimal way. Close attention must be paid to the engineering that is required to efficiently achieve these complex transitions.

As part of the consultation and engagement process, the Ministry has held a number of information sessions across the province. OSPE's involvement in these sessions has been significant, with board members, subject matter experts, members of our Energy Task Force, and general members providing input on behalf of Ontario's engineers.

Engaging OSPE's submission: the first section highlights areas for consideration; the second section offers high-level recommendations; and the final section contains pointed responses to the questions forwarded in the LTEP Discussion Guide, *Planning Ontario's Energy Future*. In an effort to relieve cost pressures on ratepayers, Appendix A details OSPE's recent policy research to put downward pressure on electricity rates. All told, this document is the culmination of months of research and consultation with contributions from OSPE participants in the LTEP meetings noted above, and aligned stakeholder groups.

If you have any questions or wish to meet to further discuss the information communicated in this submission, please contact Patrick Sackville, Lead, Policy & Government Relations at patrick@ospe.on.ca or (416) 223-9961 ext. 225.

Sincerely,

Sandro Perruzza
Chief Executive Officer
Ontario Society of Professional Engineers

Michael Monette, P.Eng., MBA
President and Chair
Ontario Society of Professional Engineers

ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

Areas of Consideration:

1. Technology is Changing Rapidly in the Energy Sector

Prescriptive top-down approaches to power system planning and retail price plans that no longer reflect the current market conditions are ineffective and costly. They also create large amounts of surplus zero emission electricity that cannot be utilized economically in Ontario to help reduce emissions in other sectors. The province needs to establish a more market driven approach that allows new useful technology to flourish when it is developed. Smart electricity price plans are a key enabler of technology innovation and successful market penetration in a low emission environment.

2. Understanding the Capacity Market

The Independent Electricity Market Operator (IESO) is planning to introduce capacity markets to procure capacity competitively rather than using a technology centric procurement approach. OSPE welcomes more competition, however, there are many legitimate types of capacity that are required to achieve an optimal supply mix.

The capacity market must be sophisticated enough to allow all required types of generation to successfully compete where they provide value. For example, nuclear generation is currently the most cost effective technology to reduce base load CO_2 emissions but it cannot compete in a capacity market that procures only short-term capacity.

In addition, wind and solar generation cannot compete with natural gas fired generation if the carbon price is only $50 per tonne of CO_2 as suggested by the federal government. Some of Ontario's impressive emission reductions over the past 12 years can be undone if the capacity market is not sufficiently sophisticated to differentiate among the various economic, technical and environmental requirements.

3. Electricity Prices

Electricity prices are too high relative to Ontario's trading competitors in the North American Free Trade (NAFTA) market. Further, Ontario businesses cannot get access to Ontario's surplus zero emission electricity at the same price as adjoining power systems on the same terms and conditions.

4. Location of Costs in Electricity Prices

Electricity prices include cost components that are not related to a competitively run power system. These extra costs are preventing the use of surplus electricity from being used to reduce emissions in other sectors. See Appendix A for details on which components could be moved to more appropriate tax supported accounts to help lower Ontario's high electricity prices.

5. Sub-Optimal Supply Mix

Ontario's supply mix is sub-optimal. There are significant amounts of non-dispatchable generation that produce power out of alignment with consumer hourly demand. That creates large amounts of zero emission electricity that must be exported at low prices or curtailed (wasted) due to price plans that do not reflect the conditions of the current electricity market.

6. Surplus Sale

Too much surplus zero emission electricity (≈ 10 TWh/yr in 2015) is being sold at very low prices to adjoining jurisdictions on an interruptible basis instead of being used in Ontario for fuel switching applications to help lower emissions in other sectors.

7. Surplus Curtailment

Too much surplus zero emission electricity (≈ 5 TWh/yr in 2015) is being curtailed (wasted) instead of being used in Ontario for fuel switching applications to help lower emissions in other sectors.

8. Market & Price Plans

Ontario does not have an interruptible electricity market or price plan to effectively utilize its surplus zero emission electricity inside Ontario.

- *Electricity Pricing & Energy Management*
  Current electricity price plans are not effective at reducing peak load because they do not produce enough savings for consumers to invest in energy management equipment that will automatically level their load.

- *Residential & Small Business Plans*
  Current residential and small business electricity plans discourage these consumers from using surplus zero emission electricity when it is available during “on peak” and “mid peak” time-of-use hours because there are no provisions to reduce the rates when surplus electricity is available.

- *Large Business & Industrial Plans*
  Current large business and large industrial plans discourage these consumers from using surplus electricity when it is available due to the large global adjustment, transmission, and distribution energy charges. These charges should be capacity based charges not energy based charges.

9. Transmission & Distribution

Transmission and distribution capacity is being inefficiently utilized by intermittent generation that is installed in large farms remote from the load.

10. Lack of Long-Term Storage

Ontario has a low emission power system with relatively little long-term storage. This makes it difficult to effectively use intermittent wind and solar generation economically to supply uninterruptible electrical load.

11. Capacity Characteristics & Peak Demand Are Misaligned

Ontario has too much capacity that cannot be relied upon when system peaks occur and Ontario has too little storage to compensate for that deficiency. About 95% of solar is not available for the winter peak demand. About 90% of wind is not available for the summer peak demand. This means that intermittent generation like wind and solar have little capacity value in Ontario’s power system. The value of wind and solar generation is primarily their fossil fuel displacement value and carbon dioxide reduction value. At current natural gas prices and expected carbon allowance prices that is only a fraction of their contractual cost per kWh.

- *Wind Generation*
  Wind generation has relatively little economic value in Ontario's low emission power system. Wind generation would have greater value if wind could be used to supply interruptible loads that can switch from fossil fuel to electricity and thereby reduce carbon dioxide emissions in other sectors. The value of wind is greater when it is installed close to the load it serves.

- *Solar Generation*
  Solar capacity has already reached its optimum maximum capacity in Ontario's power system. Additional capacity is likely to result in additional surpluses of zero emission electricity that will be wasted. Additional solar generation capacity could be accommodated if solar could be used to supply interruptible loads that can switch from fossil fuel to electricity and thereby reduce carbon dioxide emissions in other sectors. The value of solar is greater when it is installed close to the load it serves.

12. Research & Development
Sponsoring R&D and pilots to improve technology and to find integrated solutions that reduce costs is a wise investment. However, widespread deployment of high cost solutions before their costs have come down will create upward pressure on costs and rates.

13. The CCAP Heat Pump Strategy
The Climate Change Action Plan proposes to deploy heat pumps for building heating and the IESO's Ontario Planning Outlook has two scenarios named C and D that have purpose built electrical capacity to supply heat pumps for winter heating of buildings. This purpose built additional winter capacity will have a relatively low operating capacity factor of about 30 or 35% so it will come at a levelized cost almost double the current cost of electricity.

The additional electricity and capital cost for the heat pumps will add considerably to the cost of heating homes and other buildings. A better strategy is to use available surplus electrical capacity on an interruptible basis and rely on natural gas when electrical capacity is not available, especially on the coldest days when heat pumps require an auxiliary heat source. Electricity should not be used as the auxiliary heat source or that electricity will likely come from natural gas generating plants that will produce double the CO_2 emissions and 5x the energy cost compared to using natural gas directly as the auxiliary heat source.

From an energy efficiency perspective, options within buildings which optimize both the natural gas and electricity infrastructure would represent the best model to support (optimizing peak/off peak cycles, for example).

14. The Industrial Conservation Initiative (ICI)
The ICI is transferring Class A large industrial consumer costs onto Class B residential and commercial consumers because some Class A consumers can game the rules to achieve an overly generous global adjustment (GA) reduction. For example, consumers can test their standby generators on the 5 highest demand days and then achieve a global adjustment reduction for the entire year. The reduced electricity bill for the Class A consumer is much greater than the cost reduction benefit for the power system as a whole so the costs are effectively transferred from ICI participating Class A consumers to non-participating Class A and Class B consumers by the rate calculation formula used to set Class A and B rates.

15. Balancing Conservation, Efficiency & Capacity

A zero-emission electrical system is essentially a fixed cost system. While conservation and energy efficiency is always wise, when overall system demand is dropping as it has for the past several years, the expected power system savings by not investing in additional capacity is not realized. Consequently, conservation and energy efficiency programs lower electricity bills for individual consumers who practice it but increase the electricity bill for those that do not because the fixed system costs have not changed and must be recovered.

16. Attention to the Economy & General Affordability

The large-scale electrification of homes, businesses, and industry would have significant negative impacts for economic and affordability considerations.

Recommendations for the 2017 Long-Term Energy Plan:

Without Thorough Analysis, Avoid the Large Scale Electrification of Fossil Fuels

Large scale electrification of fossil fuel demand will be expensive because electricity currently costs about 5x more than natural gas on an energy content basis. Detailed analysis should be conducted before specific applications are either incentivized or mandated by regulations to ensure the extra cost per tonne of CO2 emission is acceptable.

Use the Right Energy for the Right Application

Electricity and natural gas systems work in a complimentary fashion to meet the province's energy demands. Leveraging existing energy infrastructure and maintaining a diversified energy portfolio will help meet emissions targets in an affordable manner that maintains long term energy supply and reliability.

Realize the Potential of the Electric Vehicle Program

Electric vehicles (EVs) are now cost effective on an energy cost basis provided most of the charging takes place during off-peak hours. Incentives to reduce consumers' anxiety over higher capital cost, range, charging time, and battery life should continue to be provided until those anxieties subside in order to facilitate rapid adoption to reduce CO_2 emissions in the transportation sector. OSPE has indicated its ability to deliver thought leadership and public awareness campaigns to encourage EV market penetration.

Explore Natural Gas Applications for Transportation

Understanding that the transportation sector is the leading contributor of GHG emissions and that EV adoption will take time, Ontario should take advantage of economic and effective solutions to reduce emissions such as supporting the deployment of Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) for fleet and heavy transportation applications.

Offer Consumers Surplus Zero Emission Electricity at its Wholesale Price

Surplus zero emission electricity should be made available on an interruptible basis at its wholesale market price without additional markups to produce zero emission hydrogen using electrolyzers. If this is done, fuel cell electric vehicles (FCEVs) would also be cost effective on an energy basis. Incentives to reduce consumers' anxiety over higher capital cost and degradation should be provided until those anxieties subside in order to facilitate rapid adoption to reduce CO_2 emissions in the transportation sector.

Empower the Market to Achieve an Optimal Supply Mix

Ontario's new capacity market for generation needs to be sophisticated enough to allow all cost-effective generation technologies to successfully bid into that market so that an optimized supply mix can be achieved.

Develop a Market for Interruptible Electricity

Ontario needs to develop a market for interruptible electricity. The market or price plans need to differentiate between surplus zero emission supply and surplus carbon emitting supply. Ontario consumers should be allowed to purchase surplus zero emission supply on an interruptible basis at only its wholesale market price (effectively its marginal cost of production) with no other price markups such as global adjustment, transmission, distribution, debt retirement and regulatory charges. Those charges have effectively been fully recovered from the consumer's uninterruptible electrical consumption. This pricing approach for surplus zero emission electricity will make fossil fuel displacement by surplus zero emission electricity economical for consumers. That will help achieve the 2030 emission reduction goal across the entire economy. Carbon emitting supply should not receive relief from various electricity price markups or that will encourage higher CO_2 emissions.

Price Planning: High Fixed Costs, Low Marginal Costs

In the longer-term Ontario needs to move to an electricity pricing strategy that recognizes zero emission power systems have high fixed costs and very low marginal costs. Low emission electricity should be priced primarily on capacity demand (kWs) and to a much lesser extent on energy demand (kWhs) to better match the cost of providing electrical service and provide a much stronger incentive for all consumers to flatten their load profile across the whole day.

Residential and small commercial plans will likely need to be different than large commercial and industrial plans because residential and small commercial consumers are not familiar with demand charges. It will be easier to develop a special plan for them rather than educate the entire population on how to differentiate between kW and kWh consumption.

OSPE proposed such a plan to the government in 2015.[1] That plan will strongly encourage consumers to level their load demand on an hourly basis over the whole day using automatic load leveling equipment. Over time, power system costs will fall per unit of electricity because it is much cheaper to supply dependable base load electricity than dependable peak load electricity.

Production & Demand Characteristics

Ontario needs to stop adding electrical generation capacity that has production characteristics that are out of alignment with consumer hourly and seasonal demand until storage costs are much lower (typically 10x lower for short term storage and 100x lower for long term storage). Such capacity has relatively low value for supplying uninterruptible electrical demand and only has modest value for interruptible electrical demand used for fossil fuel displacement and carbon dioxide reduction based on the expected prices for natural gas and carbon allowances.

Understand the Respective Strengths of Electrical & Natural Gas Systems

To reduce CO_2 emissions at an affordable cost the energy system planners should take advantage of the strengths of both the electrical and natural gas systems. The Ministry can facilitate optimal system planning and design by developing electricity price plans that reflect the

[1] Smart Pricing for Ontario Electricity, July 2015, at: https://www.ospe.on.ca/public/documents/presentations/smart-pricing-ontario-electricity.pdf

true cost of providing base load and incremental peak load and allow the market to offer technology to meet both needs. System plans should be flexible enough to adjust base load and peak load supply as consumers adjust their demand profile with new technologies like local storage, microgrids, and energy management equipment.

System planners should be aware of the characteristics of each technology including:

a) On the demand side: it is often cheaper to modify the hourly electrical load demand than build capacity to meet the unmodified profile. Price plans that reflect the real cost of providing both base load and incremental peak load electricity so that energy management solutions including local short-term storage are incentivized automatically. Because not all consumers are in a position to purchase energy management equipment, these new price plans can initially be voluntary until more experience is gained.

b) On the supply side: intermittent generation like wind and solar will cause backup supply like natural gas generation to cycle more often and reduce both its efficiency and increase its emissions. Some jurisdictions have found that large penetration of intermittent renewable generation can cause as much as 50% of the expected emission reductions to be lost due to the more frequent load maneuvers required of the natural gas backup supply. Some modest amounts of storage local to the renewable generation facilities (especially solar) may be cost effective to mitigate emission increases described above and curtailment of surplus zero emission electricity during high production hours.

c) Zero-emission base load electricity is much cheaper to produce than peak load zero emission electricity. Finding effective price plans (voluntary or otherwise) to incent consumers to flatten their hourly load demand is important in order to lower the cost to achieve emission reductions.

d) Nuclear achieves its lowest cost per kWh when it supplies base load consumer demand. Hydroelectric, wind and solar costs per kWh increase when they are required to supply base load consumer demand because of the additional storage required to achieve zero CO_2 emissions at the high capacity factors.

e) For base load demand, for each installed kW of capacity, nuclear technology reduces CO_2 emissions 6x more than solar, 2.6x more than wind, and 1.7x more than hydroelectric due to the high operating capacity factor of nuclear generation. Nuclear generation is relatively climate change insensitive compared to hydroelectric, wind, and solar generation.

f) After conservation and energy efficiency, the lowest cost way to reduce carbon emissions in the industrial, building and transportation sector is to switch from fossil fuels to electricity or to hydrogen produced from zero emission electricity. However, building new electrical capacity to displace fossil fuel consumption is 5x more expensive per unit of energy. Even with heat pumps that have a co-efficient of performance of 2x that of electrical resistance heaters, the cost is still 2.5x greater. Consequently, fuel switching is only economic if surplus zero-emission electricity from existing electrical capacity is used to accomplish the fuel switch.

g) Low emission power systems produce large amounts of surplus zero emission energy. That surplus should be sold on an interruptible basis at the wholesale market price (without other markups) to Ontario consumers to facilitate fuel switching out of fossil fuels. Currently the surplus is being sold to adjoining jurisdictions on an interruptible basis at very low prices or being curtailed (wasted).

Responses to the 2017 LTEP Discussion Guide:

Distribution and Grid Modernization

The electrical distribution system will face costly upgrades if the government forces consumers to switch from natural gas heating to air sourced heat pumps with electrical auxiliary heating. OSPE recommends that the government adopt an integrated energy supply approach for winter heating loads and leverage the strength of the both the electrical system and natural gas system to minimize the electrical generation capacity that will only run during the winter.

Smart electricity pricing plans will help incentivize the development of distribution connected technologies in a rational way to provide lower cost energy solutions. Smart price plans will facilitate cost effective implementation of microgrids, virtual power plants, behind the meter thermal and electrical storage and energy management control systems that will help to achieve the province's CO_2 emission goals.

Microgrids

OSPE is concerned high electricity prices combined with electricity price plans that no longer reflect current wholesale electricity market conditions will encourage consumers to deploy natural gas fired microgrids and combined heat and power systems in situations that lead to the displacement of zero emission generation on the transmission and distribution system. This will be a regressive step if Ontario is serious about eventually reducing CO_2 emissions by 80% or more across the entire economy.

The province's and federal government's stated expectations for carbon prices in the medium term are too low to discourage the use of low cost natural gas for electricity production in microgrids or CHP facilities.

Transmission

Transmission should ideally be used to bring electricity to consumers from remote facilities such as hydroelectric sites, from nuclear facilities that cannot be located inside cities and to exchange energy with adjoining jurisdictions.

Large scale solar and wind farms use transmission inefficiently. Intermittent generation like wind and solar have better value if they are located much closer to the load they serve.

Storage

Storage is still much too expensive for large-scale deployment on the power system. However, smaller short-term storage facilities are becoming economic behind the meter to provide a number of load management services including backup during power failures. Unfortunately, the current electricity price plans that do not provide consumers with sufficient financial incentive to deploy local storage solutions. The long term success of a zero emissions economy including wind and solar will depend on significant storage improvements. Investment in R&D and pilot installations for energy storage should be key going forward.

Innovation and Economic Growth

Picking winners is not a recipe for success in a rapidly changing technology environment. OSPE suggests a market driven approach built around smart price plans that automatically incent the market to deploy cost effective solutions.

Government support will still be needed to fund higher-risk R&D and pilot projects until the early technology development reaches a stage that market forces will drive deployment.

Conservation and Energy Efficiency

Conservation and energy efficiency is important and should be encouraged but how it is coordinated with other CO_2 reduction initiatives that require more electricity is important. To be clear, energy conservation is the most cost effective way of reducing carbon in our economy and should continue to be critical tool.

A low emission power system is a fixed cost system. If demand falls off more rapidly from the “conservation first” program and is not compensated for by increased demand for CO_2 reduction initiatives then electricity rates will rise to recover the fixed costs on a declining volume of energy sales. Alternatively stranded publicly owned or guaranteed assets can be written off to a tax supported account but that will increase government deficits and debt.

Clean Energy Supply

Hydroelectric and nuclear generation are best suited for base load demand because of their higher capacity factors and higher fixed costs. If consumers can be incentivized by smart price plans to flatten their hourly load demand then nuclear and hydroelectric generation can meet that additional base load demand at a much lower cost than renewable intermittent sources like wind and solar generation.

A review of jurisdictions around the world demonstrates that low emission power systems all have high hydroelectric penetration, high nuclear penetration or a combination of the two. Wind and solar generation have the highest value when they displace carbon fuels on an interruptible basis (no requirement for dependability or for storage) and they are distributed and located close to the load they serve.

Regional Planning

Provision of infrastructure “reserved” areas or corridors as part of the official planning process is important. The provision of energy centers where the population density is high enough can also relieve pressure on the transmission and distribution system. These energy centers can have gas-fired generation that can be used for both power system reserve and to provide local energy security and resiliency following a severe storm.

Gas-fired generators used for power system reserve should also be distributed around the province especially in urban areas. High-rise buildings are not inhabitable if power is lost so having access to natural gas fired backup power is important in a world where climate change is projected to progress rapidly.

Indigenous Energy Policy

Many indigenous communities are off-grid and use diesel generators for their electricity needs. These communities could benefit from wind generation with storage, or small hydroelectric or biomass generation if those sources are readily available locally. Each community needs to be assessed individually.

Many indigenous communities do not have the financial or technical capacity to develop their own zero emission energy systems. Some support from the government to make those solutions available and train local residents to participate in the design, construction, and operation of those systems would create badly needed high-value employment.
Extending the transmission system to off-grid communities or alternatively creating a separate regional grid to interconnect the off-grid communities would also help to improve electrical services to those communities.

Engineers should be involved in assisting indigenous communities' energy planning and implementation

Supply Mix

The supply mix should be determined and optimized as part of the detailed planning and design process by qualified professional power system engineers. The supply mix should not be determined by the Ministry in advance of the detailed planning process. The Ministry should develop high-level goals for the energy sector and allow detailed planning and design to determine the supply mix and location of that supply. The power system planning must also take into consideration changes in consumer demand and distributed generation that is installed in the distribution system for good economic and environmental reasons.

Overall goals set by the Ministry can be adjusted to reflect analysis performed during the detailed planning and design of the power system.

APPENDIX A:

Policy Changes That Could Lower Electricity Bills for Consumers

IESO has reported that in 2015 the power system had a total cost of $20.5 billion. About $13.1 billion was for generation costs and $7.4 billion was for transmission, distribution and other costs. In addition, consumers paid about $1.3 billion dollars in HST after business input tax credits.

Residential consumers in urban areas pay about 19.8 cents/kWh on average over the whole month (17.5 for electricity and 2.3 for HST). Residential consumers in low-density rural areas pay about 27.5 cents/kWh on average over the whole month (24.4 for electricity and 3.2 for HST). Average residential customers use about 750 kWh per month so urban consumers pay about $150/month, low-density rural consumers pay about $200/month.

Medium sized (Class B) and very large (Class A) businesses can pay additional charges for peak demand capacity and poor power factor. Class A customers can join the Industrial Conservation Incentive (ICI) program and earn discounts by lowering their demand on the highest 5 demand days. On average in 2015 Class A customers achieved a reduction of about 3.6 cents/kWh over the whole year (businesses receive input tax credits for HST payments so they effectively pay the same HST whether or not HST is charged on their electricity costs).

The Ontario government plans to remove the PST portion of the HST beginning in January 2017. The PST portion is 8%, the GST portion is 5%. Currently (Nov 2016) the combined PST+GST or HST rate is 13%.

Electricity rates are set in such a way as to recover total costs from the total demand in the system. Different rates apply to different consumer classes. In general regulators try not to transfer costs unfairly between rate classes. North American rules for trading electricity between power systems can affect rates in Ontario. Trading of interruptible electricity is done in the wholesale market at the marginal production cost not the full production cost. Ontario consumers must pay for the difference through what is called the global adjustment in retail rates.

Electricity is currently about 6 times more expensive than the cost of natural gas on an energy content basis in urban areas. Low-density rural areas do not have easy access to natural gas and typically use other carbon-based fuels such as propane. Achieving low emissions across the entire economy will require some migration from higher emission natural gas to lower emission electricity. Unfortunately electricity will not displace natural gas at current retail prices for electricity and natural gas. The difference in price can be reduced by either lowering the price of electricity or by increasing the price of natural gas or a combination of the two.

There are four ways to reduce the price of electricity for Ontario consumers:

A. Reduce operating costs or increase revenue from the sale of surplus electricity.
B. Move existing costs not directly associated with producing electricity into tax-supported accounts.
C. Transfer market risks from electricity consumers to investors.
D. Remove government sales and water use taxes on electricity.

There is one way to increase the price of natural gas without imposing costs on the economy:

E. Introduce a tax or price on carbon dioxide emissions but rebate the revenue back to consumers.

A - Options that reduce electricity bills by reducing costs or increasing revenue:

Actions to Reduce Rates	**Approx. Savings**	**Remarks**	**Background Notes**
A1. Stop adding planned (directed) capacity to an over supplied system.	100 M$/yr in 2017 up to 500 M$/yr in 2025	Excess capacity drives rates up. The savings accumulate yearly until 2025 when planned capacity increases stop. Estimate is based on 2,500 MW of excess directed capacity by 2025.	The 2008-09 recession, rising electricity rates and conservation programs have permanently changed the demand growth rate. This has not been adequately reflected in planned capacity additions. The recent LRP-II deferral by the government only impacts about 1/3 of the excess planned (directed) capacity.
A2. Cancel committed capacity contracts that have not been built that have cancellation benefits or that are not in compliance with contractual in-service requirements.	200 M$/yr	Excess capacity drives rates up. Estimate assumes about 1,000 MW of higher cost committed capacity can be cancelled.	Currently we have 8% excess overall capacity. However, what nameplate capacity is cancelled will affect carbon dioxide emissions differently because each technology has a different capacity factor. Nuclear operates at about 85% capacity factor and displaces the most carbon dioxide per kW installed, hydroelectric operates at about 50%, wind operates at about 30% and solar operates at about 15% and displaces the least carbon dioxide per installed kW.
A3. Enter into firm delivery contracts for surplus clean energy supply to adjoining power grids instead of using the wholesale (spot) market for interruptible electricity.	0 up to 350 M$/yr	Upper estimate is based on 50% of the 17.3 TWh of surplus clean supply can be sold on a firm basis at $40/MWh more than the wholesale price for interruptible power.	Interruptible power is priced at the marginal cost of production (essentially the fuel cost), uninterruptible power is charged at the full cost of production (includes capacity and labour costs) by agreement in North American. Providing firm clean electricity to adjoining jurisdictions means some of Ontario's domestic demand will have to be supplied by natural gas generation instead of clean electricity.
A4. Allow Ontario consumers to buy interruptible surplus clean electricity at 1 cent/kWh like adjoining power grids do on the wholesale (spot) market.	0 up to 200 M$/y	Reduces consumers' fossil fuel costs (not their electrical costs). Also reduces CO2 emissions by up to 3 million tonnes/yr. Estimate based on a 1.2 cent/kWh price differential between	Choosing option A4 exclusively over option A3 indicates that reducing Ontario's CO2 emissions is a higher priority than reducing electricity rates. Note that item A3 and A4 are mutually exclusive because they use the same energy.

		surplus electricity and natural gas at the home.	
A5. Allow Ontario consumers to buy interruptible surplus natural gas-fired electricity at its marginal fuel cost (approx. 3 cents/kWh).	0 M$/yr up to 300 M$/yr	Would reduce self-generation by consumers with less efficient fossil fueled equipment. Savings depend on amount of self-generation present in Ontario.	Option A5 should only be available to consumers who can demonstrate that they will use the grid supplied gas-fired electricity to achieve lower CO2 emissions compared to their current production practices.
A6. Do not mandate technology choices on the power system. Allow the cap-and-trade program to determine technology choices.	$200/tonne CO2 savings (annual savings are included in other items in this table)	Will lower future costs of reducing carbon emissions from the present $250/tonne to $50/tonne by 2025. The $250/tonne cost is from the Ontario Auditor General 2015 report on the cost of reducing emissions in the electricity sector using renewable energy generating capacity.	Trading allowances in a cap-and-trade program effectively allows lower cost carbon reduction technologies to satisfy the emission reduction targets regardless of the sector in which they are installed.

Note: Items A4 and A5 would require a special electricity price plan and smart controllers to correctly enable the energy flow and billing. The special plan should be voluntary for those consumers who have or will purchase the required automation and other equipment to use surplus electricity effectively. The special plan should remain in effect until the equipment capital costs are recovered – 10 years is suggested.

B - Options that reduce electricity bills by moving costs to more appropriate accounts:

Actions to Reduce Rates	**Approx. Savings**	**Remarks**	**Background Notes**
B1. Adopt the USA approach to subsidizing higher cost clean energy technologies (eg: use tax rebates not global adjustment to pay for extra costs for renewables).	1,700 M$/yr	Estimate is based on 14% additional total costs for renewables in 2017 compared to conventional generation.	Using different rules than our NAFTA trade partner USA to subsidize renewable energy development increases electricity costs in Ontario and makes Ontario businesses less competitive. Move those excess costs from the electricity account to a tax supported account.
B2. Write off poor investment decisions in a tax account rather than the electricity account.	100 M$/yr	Estimate is based on non-productive costs like gas plant relocation, etc. that are not covered in the other items in this list.	Consumers should not be expected to pay for planning errors. In private power systems investors pay for those errors. In a public power system the taxpayer should pay for those errors so that electricity rates remain competitive for businesses that compete in the NAFTA trading zone.

B3. Write off surplus capacity costs in a tax supported account rather than the electricity account.	1,000 M$/yr (850 M$/yr if option B1 is adopted)	Current system has 8% excess installed generating capacity at peak demand. Estimate is based on generation costs only.	Consumers should not be expected to pay for planning errors. In private power systems investors pay for those errors. In a public power system the taxpayer should pay for those errors so that electricity rates remain competitive for businesses that compete in the NAFTA trading zone.
B4. Remove stranded debt charge from larger electricity consumers.	500 M$/yr	Estimate is based on 70 TWh/yr that is subject to the stranded debt charge of 0.7 cents/kWh.	Consumers should not be expected to pay for planning errors. In private power systems investors pay for those errors. In a public power system the taxpayer should pay for those errors so that electricity rates remain competitive for businesses that compete in the NAFTA trading zone.
B5. Transfer the conservation costs to a tax supported account rather than the electricity account.	400 M$/yr	Estimate based on IESO annual budget for conservation.	Conservation costs are not part of electricity production costs and with surplus capacity this charge in not helping to reduce electricity costs. In fact, conservation costs in the presence of excess capacity actually raises electricity rates.

Note: Ensuring that Ontario businesses are competitive in a free trade zone like NAFTA, CETA or TTP is important so that Ontario does not lose the sales, jobs, employment income and government income tax revenue.

C - Options that reduce electricity bills by transferring risks from consumers to investors:

Actions to Reduce Rates	**Approx. Savings**	**Remarks**	**Background Notes**
C1. Pay full production costs only for delivered energy to Ontario consumers.	0 to 850 M$/yr	The maximum savings are estimated assuming the excess costs due to take-or-pay provisions in the contracts is 50% of the total production costs on 17.3 TWh of surplus energy.	Stop signing take-or-pay contracts at full production costs. Build anticipated curtailment into the contract price so that investors assume the risk of future market demand changes or technology changes. Options C1 and B3 are mutually exclusive. Only the savings for one of the options applies even if both options are adopted.

D - Options that reduce electricity bills by eliminating government sales taxes and water use taxes on electrical energy:

Actions to Reduce Rates	**Approx. Benefit**	**Remarks**	**Background Notes**
D1. Eliminate hydroelectric production tax for water use.	400 M$/yr	Estimate based on hydroelectric production of 36.3 TWh and average tax of 1.1 cents/kWh.	Lower tax revenue will impact negatively on Ontario deficits and debt and funding for municipalities near hydroelectric facilities.

D2. Eliminate PST on electricity consumption.	1,600 M$/yr and -800 M$/yr input tax credit	Affects provincial tax revenues.	Ontario has already announced the elimination of the PST on Jan 1, 2017. This will impact negatively on Ontario's deficit and debt.
D3. Eliminate GST on electricity consumption.	1,000 M$/yr and -500 M$/yr input tax credit	Affects federal tax revenues.	This will impact negatively on federal deficit and debt.

E - Options that increase the price of natural gas (and gas-fired electricity) to effect reductions in carbon dioxide emissions:

Actions to Reduce Rates	Approx. Savings	Remarks	Background Notes
E1. Introduce a price on carbon dioxide emissions but rebate the cap-and-trade program revenue on a per capita basis to those families with less than $100,000/yr family income	-100 M$/yr in 2017 to -350 M$/yr in 2025	Higher gas costs will raise the price of electricity for the 10% of electricity produced by natural gas plants. The estimate assumes a carbon price of $15/tonne in 2017 to $50/tonne by 2025. The estimated $2 billion/yr in cap-and-trade revenues in the early years will be cost neutral to the economy if the funds are rebated to consumers.	Consumers can choose to spend the money on emission reduction technologies to reduce their future carbon emission costs or on general consumer expenditures. Both will result in additional economic activity that will offset reduced economic activity and income tax revenue losses due to the carbon price. Mid and low income consumers are likely to spend most of the refund amounts on consumption rather than saving it. Consequently, refunding the cap-and-trade revenue to consumers is likely to produce similar economic benefits as compared to the government purchasing carbon reduction technologies. Refunding the cap-and-trade revenue will likely give consumers more satisfaction because they can allocate the funds to the highest family needs. Emission reductions could be greater if the government spends the cap-and-trade revenues on the most cost effective carbon reduction technologies.

Electricity Price Impact of CCAP Plan to Deploy Electrical Space Heating

The government's Climate Change Action Plan (CCAP) proposes to deploy electric heat pumps for winter space heating. Heat pumps are more efficient than electric resistance heaters but at a higher capital cost. However, installing low-emission electrical capacity to meet the additional demand of space heating in the winter will result in a significant upward pressure on electricity rates. The reason is that electrical capacity dedicated for space heating will operate at approximately 30 to 35% capacity factor rather than the present 65 to 70% capacity factor for the grid overall. During the spring, summer and fall that dedicated capacity will be idle unless we find other uses for the surplus electricity. At half the operating capacity factor the levelized cost of that dedicated capacity will be double the current production costs. That will drive electricity rates higher. Carbon prices will have to be very high, in excess of $600/tonne at current gas commodity prices to make natural gas retail prices comparable to electricity retail prices in order to displace natural gas in the industrial sector. We can price surplus low emission electricity at its marginal cost of production of about 1 cents/kWh to encourage displacement of natural gas in various industrial sectors. However, this means most of the production cost of that surplus electricity must still be borne by the electricity consumer. A comprehensive cost study should be undertaken before deploying dedicated electrical capacity to meet the needs of space heating loads. That study should include an hour-by-hour supply and demand simulation analysis of the power system to correctly quantify the amount of surplus low emission electricity that will be created.

Summary

In 2015 the cost of operating the power system was about $20.5 billion and consumers paid an additional $1.3 billion in HST (after including a business input tax credit estimated at $1.3 billion/yr). Policy changes can reduce the price of electricity in Ontario to levels that are similar to competing jurisdictions in the NAFTA trading zone. Adjusting for mutually exclusive items the financial implications of adopting all of the proposed policy changes are:

Consumer electricity bill reductions = $5.5 to 6.3 billion/yr

Impact on provincial government tax revenue = -$1.2 billion/yr
Impact on federal government tax revenue = -$0.5 billion/yr
Impact on provincial government revenue due to write-offs and transfers = -$3.6 billion/yr

Total impact on provincial government revenues = -$4.8 billion/yr
Total impact on federal government revenues = -$0.5 billion/yr

Cap-and-trade discretionary new funding = $2 billion/yr (based on 2017 carbon price and emissions)