Power Choices

Designing an electricity system for a rapidly changing world

ONTARIO CLEAN AIR ALLIANCE
RESEARCH INC.

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Introduction

The world is at an exciting energy crossroads. The cost of tapping emissions-free sources of energy like solar and wind is dropping at a stunning rate. Other sources such as biogas and geothermal, offer the potential to produce both heat and electricity with renewable, low-emission energy sources. Meanwhile our ability to use energy efficiently is rising exponentially with new technologies like LED lighting, air-source and ground-source heat pumps, connected, smart devices and advanced building controls. And our ability to store energy in everything from batteries to balloons is also quickly advancing.

But the really revolutionary change will come from using all of these elements together in a coordinated system that delivers important climate and economic gains aligned with three key objectives:

1. Meeting our electricity needs at a reasonable cost
2. Minimizing electricity system emissions
3. Creating new economic opportunities

In this report, we look at how Ontario can meet these three objectives by accelerating its transition toward a low-carbon, high efficiency, and highly responsive electricity system.

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Meet our electricity needs at a reasonable cost

Electricity is fundamental to our quality of life and our economic prosperity. It is in all our interests to keep system costs reasonable while ensuring a reliable supply.

But we also need to ensure cost transparency so that we can properly compare and prioritize both supply and conservation options. For example, coal may be cheap to burn, but leads to massive health and environmental damage costs. Similarly, allowing nuclear operators to pass on their capital cost overruns to ratepayers and taxpayers disguises the true cost of nuclear power, as do artificial caps on accident liability. Then there are the huge costs for storing nuclear waste for thousands of years.

There are four key steps the Government of Ontario can take to ensure ratepayers are paying a fair price for electricity:

Put Conservation First

Improving energy efficiency has multiple benefits, from increasing economic productivity to lowering electricity system costs.

Conservation and efficiency measures are by far the lowest cost way to meet our need for a brightly lit house or a cold drink. The Independent Electricity System Operator (IESO) reports that, on average, avoiding the need to generate a kilowatt hour (kWh) of electricity cost just 3.5 cents.[1]

Despite this, the IESO's payments to consumers to save a kWh are dramatically lower than its payments to electricity generators to produce a kWh.

For example, industrial consumers are paid a maximum of 2.3 cents[2] to save a kWh despite the fact that the Pickering Nuclear Generating Station's fuel and operating costs are 8.2 cents per kWh.[3] Similarly, power from a rebuilt Darlington Nuclear Station is projected by OPG (under a best-case scenario) to cost 7 to 8 cents a kWh.

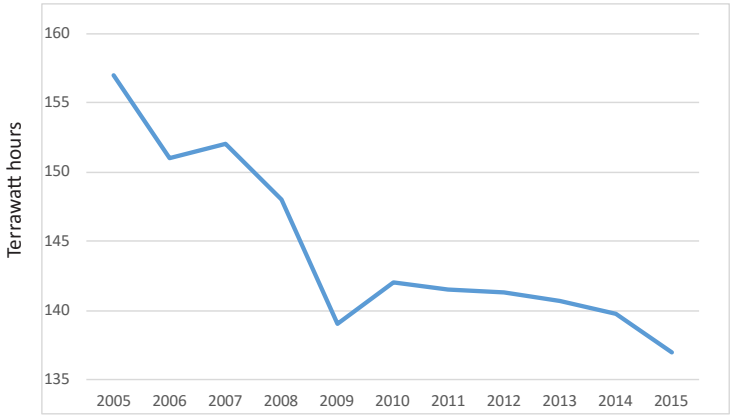
It makes little sense to embark on the long, complex and costly process of rebuilding nuclear reactors until we have exhausted much lower cost efficiency resources. That's especially true when you consider that every nuclear project in Ontario's history has gone massively over budget — on average by 2.5 times.

There is no question that we have significant untapped conservation capacity. Ontarians use 50% more energy per capita than our neighbours in New York State.[4]

We need to widen the net for capturing efficiency in the electricity sector by opening up opportunities to deliver savings to municipalities, co-ops and community organizations (e.g., Green Communities Canada), First Nations communities, our gas utilities (Enbridge and Union Gas), district energy companies (e.g., Enwave, Markham District Energy), energy-efficient appliance and equipment manufacturers and distributors, and other private sector corporations (e.g., Brookfield Global Energy Solutions, Rodan Energy Solutions) rather than limiting our efforts to utilities and a handful of large industrial consumers.

Ontario officially adopted a Conservation First objective as part of its 2013 Long Term Energy Plan, but the concept has still not taken hold in the province. For a more detailed discussion of what needs to change to make Conservation First a reality here, see the Ontario Clean Air Alliance factsheet *Putting Conservation First: The Next Two Steps.*

Fig 1: Electricity demand in Ontario (2005-2015)



Electricity demand has been falling steadily for the past decade in Ontario due to a changing economy, new technologies and conservation programs.

Create a market that puts all sources of supply *and* conservation on a level playing field

Many jurisdictions have already moved away from centrally planned electricity systems anchored by energy mega projects. It is time for Ontario to do the same.

In an open market, many different power suppliers and efficiency aggregators can bid to meet our need for energy on an ongoing basis.

This is the sensible way to procure the bulk of our power rather than handing out opaque contracts that make it impossible to compare value for money. It also reflects the rapid evolution currently taking place in how power is made and how it is used, by allowing many different players to offer competing proposals, including industries that want to co-generate heat and power or produce renewable energy onsite, efficiency experts who want to help groups of companies or large buildings conserve power, or our provincial neighbours rich in low-cost water power.

Greater transparency can help us make informed choices about the best way to meet our energy needs.

It makes little sense to simply set aside close to half of our electricity market as the private fiefdom of nuclear power at a time when costs for alternatives are falling rapidly and new technologies are slashing our energy use. The inflexibility, high capital costs and long lead times of nuclear projects all undermine the objective of maximizing responsiveness and cost control in our electricity system. Ed Clark, former CEO, TD Bank, has stated, for example, that the Darlington Re-Build "is a project which carries enormous risks. Cost overruns can dwarf any savings which can be had elsewhere in the system."[5]

The good news is that the IESO says it is committed to establishing a competitive procurement process to obtain new *electricity supply* resources:

"The IESO's aim going forward is to secure new capacity on a competitive basis across a variety of resource types through a capacity auction or competitive procurement with broad eligibility. The IESO is currently developing a capacity auction, to secure incremental capacity resources in a flexible, cost-effective manner while allowing all potential resources to compete on an even footing in the marketplace."[6]

The bad news is that the IESO has given no indication that this market will include energy efficiency resources along with supply sources or that it will also require nuclear projects to compete on a level playing field. Ironically, the IESO has moved to competitive procurement for large renewable projects with good results, but it continues to cut secret backroom deals with nuclear operators instead of creating a level playing field.

A broad market has the added advantage of bringing much greater responsiveness to a rapidly changing electricity market. Electricity demand has fallen by 13% in Ontario since 2005 despite an economy that has grown by more than 10% over the same period and a population that has increased by 8%.[7] Ontario is not unique in this regard: a move away from heavy industry and the development of new energy efficient technologies is driving down electricity demand in many Western jurisdictions.

As Bloomberg New Energy Finance explains: "[G]rowth in demand for electricity is slowing. The reason: efficiency. To cram huge amounts of processing power into pocket-sized gadgets, engineers have had to focus on how to keep those gadgets from overheating. That's meant huge advances in energy efficiency. Switching to an LED light bulb, for example, can reduce electricity consumption by more than 80 percent.... In the next 25 years, global demand will grow about 1.8 percent a year, compared with 3 percent a year from 1990 to 2012. In wealthy OECD countries, power demand will actually decline."[8]

We know exactly what we are paying for renewable energy. We know little about what we are really paying for nuclear power.

Instead of locking in electricity supply that we won't actually need, we are better off with a market that dynamically matches supply to actual demand. Unfortunately, at the moment, it looks like the IESO's planned market will be less than truly open, which would be a major missed opportunity.

End hidden subsidies

Ontario's payments to green energy suppliers have raised a lot of controversy. But whatever you think of the province's decision to pay set prices for solar, wind, biomass, biogas and water power, the fact is these prices are fully transparent and project costs are simple to calculate. The same can't be said for many other electricity suppliers, especially nuclear operators.

Ontario Hydro's big bet on nuclear power was a financial disaster, effectively bankrupting the provincially owned utility. In the end, the province had to assume a close to $20 billion stranded debt to make Hydro's successor, Ontario Power Generation (OPG), viable. Yet this debt is seldom mentioned when we talk about the cost of nuclear power.

No electricity suppliers other than Ontario Power Generation and Bruce Power — whether those suppliers use wind, solar or natural gas — get to pass their capital cost overruns onto ratepayers and taxpayers. Underestimate your project costs and the damage comes out of your own bottom line. Not so for nuclear operators, who have routinely dumped huge cost overruns onto the public purse, leading to a debt retirement charge on provincial electricity bills and the diversion of all dividends from Hydro One and OPG, along with the provincial income taxes paid by OPG, Hydro One and every local electrical utility, to nuclear debt repayment.

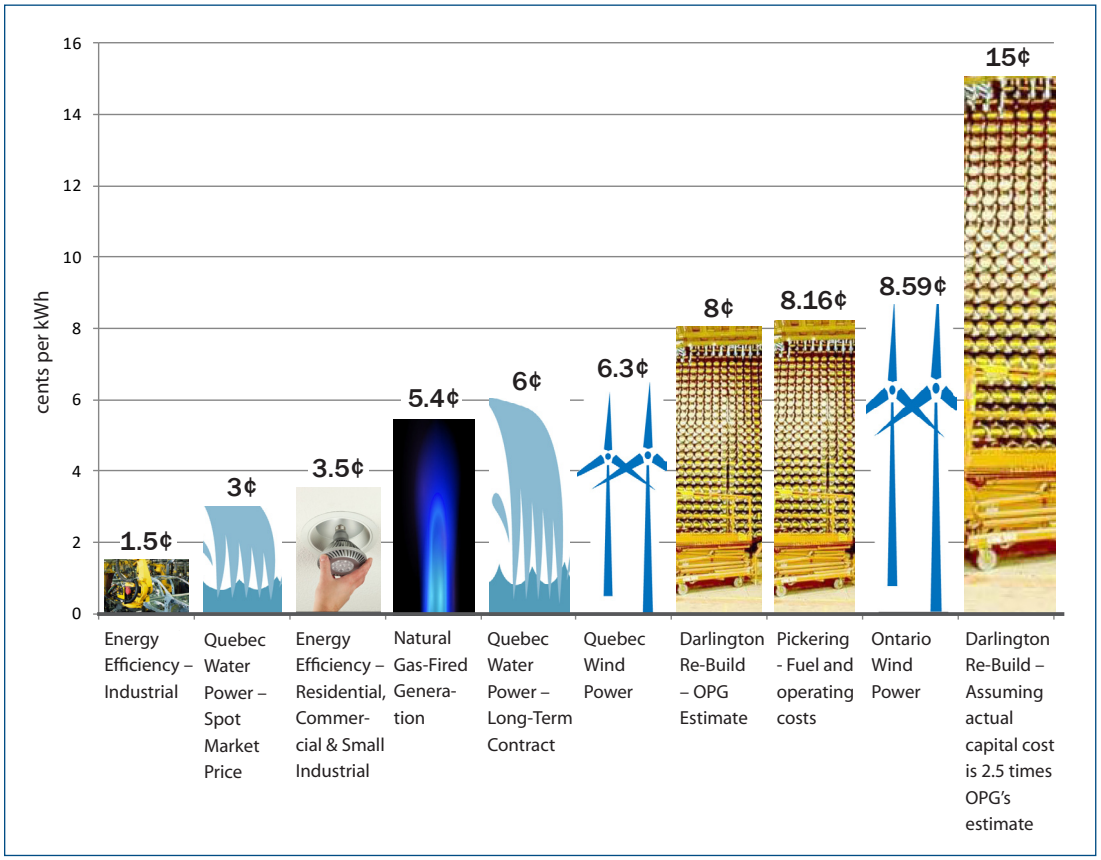
In the same vein, OPG has used profits from its low-cost heritage water power projects to cross subsidize its high-cost nuclear operations. In 1999, the former Ontario Hydro valued its water power assets at $2.755 billion. In 2001, OPG valued these same assets at $7.754 billion — an increase of roughly $5 billion above their actual cost minus depreciation.[9] In 1998, Ontario Hydro's cost of producing water power was 1.1 cents per kWh; in the first half of 2015 OPG's Ontario Energy Board (OEB)-approved rate for its water power facilities was 4.5 cents per kWh.[10] This rapid increase in payments for water power is really what has kept OPG (barely) in the black.

Similarly, the province has had to provide large "out of market" payments to OPG to cover operating losses at its Pickering Nuclear Station. In 2014, Pickering's fuel and operating costs alone (8.16 cents per kWh) were more than double the average market price of

electricity (3.60 cents per kWh[11]). As a result, the IESO had to provide OPG with "out-of-market" payments of approximately $900 million to subsidize Pickering's operating deficit.[12]

Finally, the government has recently inked a deal with Bruce Power to re-build six reactors at the Bruce Nuclear Station. The government claims that the deal fully protects ratepayers from cost overruns. The preliminary estimate of the capital cost of the Bruce Re-Build contract is $13 billion. But the rate that Ontario consumers will pay will be based on the "final cost" estimates, which have not yet been determined. If the final cost estimates exceed $13 billion, these cost overruns will be passed on to electricity consumers. Again, this is far more conditional than the fixed price, fixed condition contracts offered almost every other type of power supplier.[14]

Figure 2. Cost comparison of electricity options[13]



In an attempt to justify its sole-source contract with Bruce Power, the Government has issued a "Fairness Opinion" prepared by NERA Economic Consulting. But the 14-page NERA report provides no real justification for the sole-source deal, stating:

"We have not been asked to and have not reviewed how the ultimate costs and benefits of power provided under the Agreement compare to the costs and benefits of power from other sources."[15]

Unfortunately, the Minister of Energy has refused to agree to refer the Bruce deal to the Ontario Energy Board (OEB) for a full public review, including a comparison to other lower-cost energy options, which brings into question the government's assertion that this is a good deal for Ontarians.

Import low-cost water power from Quebec

Our neighbours in Quebec have a growing surplus of water power, but due to transmission system constraints, Hydro Quebec can only export 10 billion kWh per year during high-price periods to its major customers in the U.S. northeast.[16]

According to the Quebec Energy Commission, most of Quebec's electricity is exported at an average price of 3 cents per kWh. The commission says that the amount of power for which Quebec is earning low export rates could grow by 50% by 2022.[17] This is due to Hydro Quebec's rising supply of renewable energy, growing competition from cheap shale-gas fired generation in the United States and declining electricity demand in export markets driven by economic changes and new technologies.[18]

In 2015, Quebec's average export price was 5.7 cents per kWh, a roughly 6% decrease from 2014.[19]

Quebec has a large and growing electricity surplus and can further increase supply by improving its energy efficiency.

Quebec needs new markets for its power and one of the easiest to access is right next door in Ontario. Quebec can export up to 2,788 MW to Ontario using existing transmission lines.[20] However, due to transmission constraints on the Hydro One system, Ontario cannot import 2,788 MW of electricity from Quebec *during every single hour of the year*.

According to the IESO, the total cost of eliminating these constraints is $825 million. However, $325 million worth of these upgrades need to be made in any case to improve local reliability in Ottawa. Therefore, the incremental cost of ensuring we can import 2,788 MW from Quebec on a continuous basis during every hour of the year is $500 million.[21] If these upgrades are made, we will be able to import 24.4 billion kWh per year from Quebec,[22] which is equivalent to 97% of the annual output of the Darlington Nuclear Station.[23]

In addition, Ontario's ability to import power from Quebec could be increased by an additional 50% by building a new 1,500 MW intertie with Quebec near Cornwall at a cost of $1.4 billion.[24] This would allow us to import enough power to meet 27% of Ontario's current electricity needs.[25]

In 2010, Hydro Quebec signed a 26-year contract with Vermont at a starting price of 5.8 cents per kWh.[26] If Ontario struck a similar deal, it could save more than $14 billion over a 20-year period compared to the projected cost of re-building the Darlington Nuclear Station (assuming that savings are split evenly between Ontario and Quebec and the far more unlikely event that the Darlington project is finished on budget).[27]

For Quebec, sending power to Ontario should be an attractive option given the transmission constraints it faces in the United States and opposition to building new transmission corridors through sensitive areas like the Adirondacks.[28]

Quebec also has a number of options to *further* increase its electricity surplus and exports to both Ontario and the U.S.

First, by increasing the energy efficiency of its domestic customers, Hydro Quebec could free up more of its existing heritage hydro capacity for export to Ontario. Since Quebec's electricity consumption per person is the highest in the world,[29] it has a huge opportunity to lower its domestic customers' electricity bills and increase its export sales by investing in energy efficiency.

Second, Quebec can increase its export sales by contracting for more wind energy. In December 2014, Hydro Quebec contracted for 446.4 megawatts (MW) of wind power at an average cost of 6.3 cents per kWh.[30] By combining wind power with its massive hydro-electric reservoirs, Hydro Quebec can convert intermittent wind power into a firm 24/7 electricity supply for Ontario.

So both wind and water power from Quebec can meet our electricity needs at a lower cost than Bruce Power's and OPG's forecasts of the costs of power from their re-built nuclear reactors. In all likelihood, given the trajectory of wind power prices, Quebec will be able to push its costs even lower over the next decade. And, of course, with the renewable energy option, there are no costs for storing radioactive waste or decommissioning radioactive plants (Quebec estimates it will cost $1.8 billion to decommission its Gentilly-2 nuclear plant, which only has two reactors.[31] The estimated cost of decommissioning the eight-reactor Pickering Nuclear Station is $5 billion.[32])

Quebec wind power costs are already lower than the projected cost of power from rebuilt reactors in Ontario

Today, Quebec has power available for export during at least 99 out of every 100 hours of the year.[33] Most of this power is currently sold cheaply on the spot market, meaning Quebec is getting poor value for the bulk of its exports. It can significantly increase export revenues, and therefore provincial revenues available for everything from transit to hospitals, by striking a deal with Ontario.

Quebec water power can also be integrated with Ontario wind and solar power to make these sources "firm" sources of supply. Using Quebec's massive and underused reservoir capacity, the province can store water when Ontario has a surplus of wind and/or solar energy to send to Quebec. This water can then be used to generate power for Ontario when wind and solar resources are lower. Manitoba Hydro has already entered into a similar agreement to backstop wind power with North Dakota.[34]

In a similar vein, Quebec's new provincial energy policy calls for the expansion of its electricity transmission capacity with the rest of Canada and the United States and the development of wind power for export.[35]

To keep Ontario electricity prices reasonable, the government should:

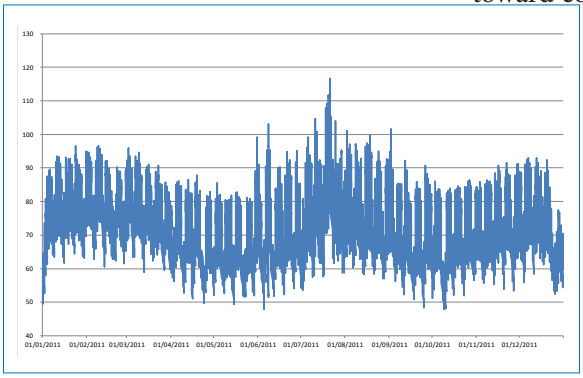
- Upgrade interconnection capacity between Ontario and Quebec to 4,300 MW to allow Ontario to get up to 27% of its annual electricity supply from Quebec.
- Sign a long-term deal with Quebec to acquire low-cost water power instead of proceeding with the re-building of the Darlington Nuclear Station.
- Establish a competitive procurement process to obtain energy savings and large-scale renewable and conventional electricity supply at the lowest possible price.
- Close the Pickering Nuclear Station — one of the highest-cost nuclear stations in North America — by 2018 at the latest.
- Properly compare the Bruce Nuclear deal to other electricity supply options through a public Ontario Energy Board review to determine if the deal should be cancelled before the first re-build commences in 2020.

Minimize electricity system emissions

Ontario's decision to phase out dirty coal-fired electricity resulted in a significant reduction in emissions of everything from greenhouse gases (GHGs) and air pollutants to mercury and lead. But there is still more we can do to reduce emissions from the electricity sector.

Cut peak power demand and develop clean sources of peak power

One of the major sources of emissions from electricity generation is the use of natural-gas-fired power plants, especially to meet our demand for power in peak periods on hot summer days when air conditioners are running full out. The Ontario Energy Board's recent decision to increase the differential between peak and off-peak prices is a good step toward cost-effectively reducing the need for gas-fired peaking, as are its pilot programs testing critical peak pricing — paying bonuses to reduce consumption during those few hours each year when demand reaches an extreme peak.[36]



It is far more cost effective to use demand reduction measures to deal with "needle peaks" in electricity demand that occur on a few days a year as charted in the example above.

It is far more cost effective to deal with peak demand by shifting or reducing consumption than by increasing generation and transmission capacity. So we all benefit from lower system costs and emissions when action is taken to reduce peak demand. As outlined in previous sections, we need to pay a fully competitive price for conservation measures to maximize these savings.

Of course, solar power reaches its maximum output on hot sunny days, when our power demand also peaks. Solar generation is often located close to or in electricity demand centres such as major cities, with the vast majority of the province's solar generation connected to local power distribution grids. And, of course, solar produces no harmful emissions during some of the worst air-quality hours of the year. With solar costs falling rapidly, we should continue to develop this source of zero greenhouse gas emissions peak energy and require solar integration in new homes and buildings.

Don't bet on nuclear to maximize greenhouse gas reductions

The nuclear industry likes to portray itself as a source of zero emissions energy, but this is a half truth. Large nuclear plants require large amounts of natural-gas fired backup for when they are shutdown for maintenance or for when they have unexpected breakdowns — a frequent occurrence in Ontario's fleet of aging CANDU reactors. The Darlington Nuclear Plant, for example, has run at 83% of capacity over its lifetime.[37] This means that gas-fired replacement generation is needed 17% of the time. (In the past, it was primarily coal that backed up Darlington.) On a fleet-wide basis, Ontario's nuclear reactors had a capacity utilization rate of only 81% in 2015.[38]

By contrast, Quebec has clean water power available for export during at least 99% of the hours of the year, meaning that replacing Darlington with water power from Quebec could significantly reduce emissions.[39]

Of course, it was the closure of seven reactors for extensive repairs in the late 1990s that led to a 120% increase in the use of coal fired electricity in Ontario. After billions of dollars in cost overruns on these reactor re-build projects, only five eventually made it back into service. And despite the billions spent on fixes, the Pickering Nuclear Station has remained a poor performer, with frequent breakdowns and outages. Pickering has one of

the highest operating costs of any nuclear plant in North America, meaning its emissions benefits are no bargain.

In fact, even compared to the better performing Darlington Station, avoiding greenhouse gas emissions by importing water power from Quebec would give us a significantly better climate mitigation impact at a lower cost. Ontario's base-load electricity needs could be met at a lower economic and environmental cost with an integrated combination of water power from Quebec (99%) and natural gas-fired generation (1%) than by re-built nuclear reactors (83%) and natural gas-fired generation (17%).

Ontario has been investigating using imported water power from Quebec while reactor re-builds are underway. The question is, why would we temporarily import lower-cost power from Quebec only to return to higher-cost nuclear energy a decade or so later? In fact, Ontario's current plan is to once again use fossil fuel-fired generating stations to cover for shutdown nuclear plants, which could double the GHG emissions from the province's gas-fired generators by 2025.[40]

Locking into "always on" nuclear will undermine efforts to improve efficiency and reduce emissions

With electricity demand actually falling in Ontario due to economic and technological changes, locking into inflexible nuclear energy will actually undermine broader efforts to reduce emissions by increasing efficiency. Nuclear plants are designed to run at close to 100% capacity 24/7, meaning they are ill suited to an environment where our energy demands fluctuate dramatically on a daily and seasonal basis.

Make better use of natural gas

Another key step for reducing emissions is to make gas-fired generation more efficient by increasing our use of combined heat and power (CHP) systems. These systems capture and use waste heat meaning that we could get twice the service from the natural gas we currently use for building heat alone.

It also means that we can create much more robust emergency power services for everything from high-rises and schools to hospitals and care facilities, where conventional diesel generators generally provide only essential power and no heat. (For more on the emergency power advantages of CHP systems, visit www.cleanairalliance.org/support-a-clean-energy-future/creating-local-power-solutions/). Clearly, there are many viable low or zero emission alternatives to nuclear available if we are willing to look.

To reduce greenhouse gas and air polluting emissions, Ontario should:

- Pay a price that reflects the true cost of supplying peak power for demand shifting and conservation programs.
- Allow a variety of entities — including municipalities, co-ops, energy-efficient appliance and equipment manufacturers and distributors — to deliver efficiency programs along with utilities.
- Recognize the additional advantages of CHP systems and integrate them into new or expanded health-care facilities while also improving emergency power requirements for new multi-residential buildings.
- Use Quebec water power to reduce the need for gas-fired backup of nuclear facilities.
- Require all new homes and buildings be net-zero by 2030.

Create new economic opportunities

The race between the combination of renewable energy, efficiency and energy storage and nuclear power to provide de-carbonized electricity is over. Nuclear has lost. Today, with more reactors on the verge of being shutdown than new ones being built, nuclear energy's share of world electricity supply has flatlined at around 10% while installations of solar and wind power have soared.[41]

Renewable energy is now the fastest growing sector in the world energy industry[42] and where the smart money is moving, with worldwide investment in renewable energy surging 16% between 2013 and 2014[43] and reaching a record $286 billion (U.S.) in 2015.[44]

Move on from a dying nuclear industry

We can create 16,000 years of employment and save millions by moving directly to decommission the aging Pickering Nuclear Station when its licence expires in 2018.

It's a completely different story for nuclear. As Jonathan Porritt, cofounder of Forum for the Future, explains: "The consistent history of innovation in the nuclear industry is one of periodic spasms of enthusiasm for putative breakthrough technologies, leading to the commitment of untold billions of investment dollars, followed by a slow, unfolding story of disappointment caused by intractable design and cost issues. Purely from an innovation perspective, it's hard to imagine a sorrier, costlier and more self-indulgent story of serial failure."[45]

That, of course, hasn't stopped Ontario and Canada from pouring billions into CANDU nuclear technology, with the same dismal results Porritt points to. The last CANDU reactor sale anywhere in the world was in 1990 — 25 years ago. In 2011, the federal government sold Atomic Energy Canada Ltd. (AECL), CANDU's developer, to the giant engineering company SNC Lavalin for spare change — $15 million. SNC was the only bidder. (The sale price was offset by the $20 billion in subsidies AECL had already absorbed from the federal government and a further commitment of $75 million in government funds to SNC to fund CANDU 6 development).[46]

Even in developing economies where the future for nuclear is supposed to be brighter, the tide is running against this 1950s technology. According to the World Nuclear Report, "China, Germany, Japan—three of the world's four largest economies—plus Brazil, India, Mexico, the Netherlands, and Spain, now all generate more electricity from non-hydro renewables than from nuclear power. These eight countries represent more than three billion people or 45 percent of the world's population."[47]

As Professor Mark Cooper, Senior Fellow For Economic Analysis at the Institute For Energy And The Environment, Vermont Law School, points out:

"Economic reality has slammed the door on nuclear power.

- In the near-term old reactors are uneconomic because lower cost alternatives have squeezed their cash margins to the point where they no longer cover the cost of nuclear operation.
- In the mid-term, things get worse because the older reactors get, the less viable they become.
- In the long term new reactors are uneconomic because there are numerous low-carbon alternatives that are less costly and less risk."[48]

The one area with actual growth potential in the nuclear industry is decommissioning. Like many other jurisdictions with aging reactors, Ontario needs to shut down its Pickering Nuclear Station — in this case, no later than August 2018 when the station's licence expires. Closing the station and embarking on immediate decommissioning would re-

duce decommissioning costs by $800 million to $1.2 billion and create 16,000 person years of employment.[49]

Across the lake, two nuclear stations are either slated for closure or on temporary ratepayer-funded life support in New York State and pressure is mounting to close a third — Indian Point outside New York City.[50] Vermont recently closed its only nuclear plant and is starting the decommissioning process.[51] The Pilgrim Nuclear Plant in Massachusetts will close in 2019.[52] According to figures from the European Union, decommissioning all of Europe's nuclear sites will take more than 100 years — even if no new nuclear power stations are ever built.[53]

So when it comes to nuclear, our best bet for future jobs and economic development is to use the Pickering Plant closure to develop valuable expertise in decommissioning nuclear facilities and exporting that expertise to deal with dozens of nuclear plants on the brink of closing across North America in the next couple of decades.[54]

Continue to build on our early lead in renewable energy

But by far the bigger economic and jobs opportunity is to continue to develop this province's expertise in renewable energy, energy efficiency technologies, and clean technology. The global market for clean technology is now estimated to be $1 trillion and is poised to triple over the next decade.[55]

Costs for renewable energy are falling rapidly and many observers predict that sources like wind and solar will dominate the world's electricity supply within just a few decades

Ontario's support for renewable energy development is paying off in jobs and new economic opportunities. The province now boasts a plant manufacturing wind turbine towers and one manufacturing wind turbine blades. According to the Canadian Solar Industries Association, there are now 100 manufacturers of solar system components in Canada, mostly in Ontario. Thanks to the supportive policies put in place by the Green Energy Act, Ontario attracted more than half of Canada-wide investment in renewable energy in 2014, investment which has grown by 88% since 2013.[56]

More than 40,000 Canadians are now employed in the clean tech sector, equivalent to employment in many major manufacturing sectors. The sector is also a strong exporter, with more than 40 per cent of sales going to non-U.S. countries. Seventy-four percent of clean technology companies are exporters in 2014.[57]

And clean tech companies invest heavily in R&D, with "estimated industry-wide R&D expenditures that were greater than the combined R&D spending by natural resource industries (oil and gas extraction, mining, agriculture, forestry and fishing), and only $200 million less than the aerospace manufacturing sector."[58]

Strong recent growth in the sector has come from companies focused on improving efficiency in everything from energy to water use. But it is also benefitting from worldwide growth in renewable energy.

Bloomberg New Energy Finance reports that clean-energy investment climbed 16 per cent to $310-billion (U.S.) in 2014 and says renewable sources are poised to dominate power systems in the near future.[59]

"The price of solar power will continue to fall, until it becomes the cheapest form of power in a rapidly expanding number of national markets. By 2026, utility-scale solar will be competitive for the majority of the world . . . The lifetime cost of a photovoltaic solar-power plant will drop by almost half over the next 25 years."[60]

Bloomberg projects that the "all in" project cost for wind will fall by 32% and for solar by 48% by 2040 and projects that wind power will be the lowest-cost source of new power worldwide within ten years, only to be eclipsed by utility scale solar five years later.[61]

They state: "About $6.1 trillion, or two thirds of the world's spending on new power capacity over the next 25 years, will go toward renewables."[62]

Clearly, if Ontario wants to be where the economic action is, we will be far further ahead focusing on renewable energy and clean technology than on propping up a nuclear industry that is still largely using technology developed in the 1950s and '60s.

To grow Ontario's economy and create new jobs:

- We need to continue to grow green energy by not allowing the nuclear industry to continue to artifically dominate our electricity supply.
- We need to continue to rapidly develop a provincial smart grid to allow for a more responsive and decentralized electricity system.
- We need to develop strong and innovative energy conservation programs that help drive the need for new services and technologies, from building retrofits to smart controls.

Conclusion

Ontario's electricity system is at a crossroads. We can continue with a 1950s-style system dominated by a couple of huge, aging nuclear plants or we can embrace the future of decentralized "smart" energy. Given how rapidly technology is evolving in everything from renewable power generation to smart systems and storage, it makes little sense to cling to the status quo. If we do, we will be left with a high-cost system that is a poor fit for our actual electricity needs.

Ontario has taken some bold steps toward a renewable future while making modest improvements in energy efficiency. It's a start, but we need to accelerate progress if we want to keep up with our major competitors who are wholeheartedly embracing green energy and high levels of efficiency.

With Ontario's knowledge base and early innovation record, we can be a force to be reckoned with in the new green economy. Or we can cling to the past with a cumbersome system designed to fit the needs of another era and watch others pass us by.

Endnotes

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Economic Growth: Statistics Canada, CANSIM Tables 13-018-x and 384-0038.

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9 Ontario Energy Board Docket No. EB-2013-0321, Hearing Transcript, July 14, 2014, (Volume 12), page 130.

10 Ontario Hydro, *Final Annual Report: January 1998 – March 1999*, page 67; and OPG, *Management's Discussion and Analysis: 2015 Second Quarter Report*, page 9.

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