

ONTARIO'S GREEN FUTURE:

How we can build
a 100% renewable
electricity grid
by 2027

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Ontario Clean Air Alliance Research Inc. is the research affiliate of the Ontario Clean Air Alliance. The Ontario Clean Air Alliance is a coalition of health and environmental organizations, faith communities, municipalities, utilities, unions, corporations and individuals working for cleaner air through a coal phase-out and a shift to a renewable electricity future.

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EXECUTIVE SUMMARY

The Ontario Government is planning to spend upwards of \$59 billion to rebuild much of the province's electricity system. However, the plan developed by the Ontario Power Authority (OPA) for replacing dirty coal-fired generation and aging nuclear units is heavily focused on maintaining the status quo of a highly centralized generation system that serves electricity consumers through a system of long-distance high-voltage transmission lines.

This decision to maintain the status quo will be costly for Ontario. Building or refurbishing nuclear units is one of the highest cost – and riskiest – options available for meeting our electricity needs. Similarly, maintaining and expanding a long distance transmission system will cost billions of dollars.

Many other jurisdictions are moving away from such inflexible and inefficient systems toward what are called “distributed” energy systems. In distributed systems, the emphasis is on meeting electricity needs in the most efficient and lowest cost manner possible. Many smaller generation sources located near centres of electricity demand are used instead of a handful of large power stations. The result is a system that wastes much less energy during generation, transmission and use, and that thereby reduces costs and polluting emissions.

The OPA's current plan has four fundamental flaws:

1. It fails to aggressively promote energy efficiency and demand management and treats the government's minimum targets as maximums for these sources.
2. It fails to maximize the efficiency of Ontario's natural gas consumption and does not fully act on the government's directive to make combined heat and power generation an important part of efforts to improve efficiency.
3. It fails to ensure that Ontario obtains the majority of its electricity from clean renewable sources by 2027, instead treating the government's nuclear baseload generation recommendation as a “must achieve” target instead of as an “if necessary” element.
4. It fails to protect Ontario's electricity consumers from nuclear reactor capital cost overruns.

MANY OTHER JURISDICTIONS ARE MOVING AWAY FROM SUCH INFLEXIBLE AND INEFFICIENT SYSTEMS TOWARD WHAT ARE CALLED “DISTRIBUTED” ENERGY SYSTEMS.

In fact, with its overwhelming emphasis on high-cost nuclear power, the OPA's approach will act as an anchor on efforts to improve efficiency, develop renewable power sources and to develop a more productive distributed system. With spending dominated by the multi-billion dollar costs of building new nuclear plants, and a resultant need to run these plants as close to capacity as possible to justify these expenditures, all other options will be squeezed to the sidelines.

However, Ontario could use the current need for a major renewal of its electricity system to rebuild it on a new, more modern foundation. This approach offers multiple benefits, from more efficient industries and new business (and job) opportunities to cleaner air and lower costs. To truly create a Green Future for Ontario, we believe the government should take the following four steps.

1. Level the playing field

Eliminate special subsidies for nuclear power, such as the ability to pass on capital cost overruns to ratepayers and taxpayers. And make nuclear companies fully responsible for the costs of managing nuclear waste and decommissioning reactors. No other type of power producer can pass on these kinds of costs — it's time to stop the special treatment for nuclear power.

2. Build on success

Ontario's Standard Offer Program for Renewable Power (RESOP) has been a huge success, attracting more projects in one year than the OPA projected would be available in 10. It's time to extend this simple and effective program to energy efficiency and demand management programs and to clean combined heat and power projects.

3. Take the lid off clean power

We also need to make the Standard Offer Program model more robust by removing arbitrary project size limits and raising the standard offer price to reflect the true comparative cost of obtaining power from new nuclear units and associated transmission systems.

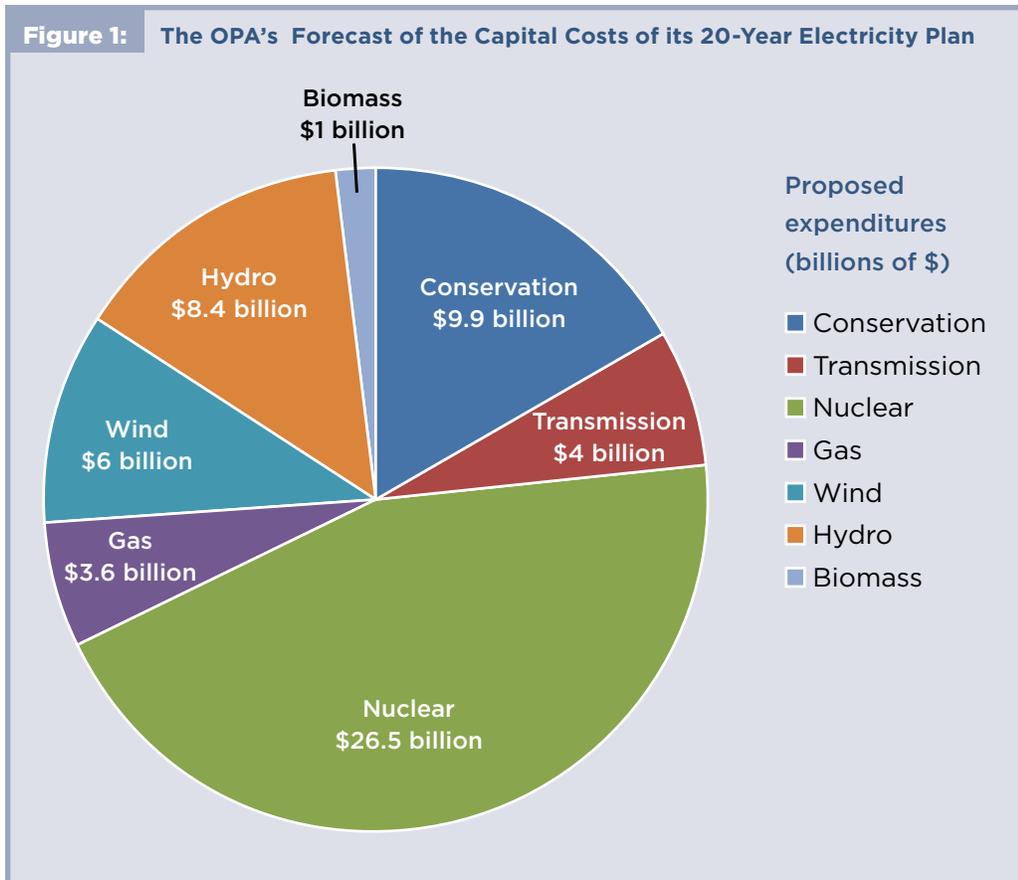
4. Make nuclear the last choice, not the first

Break the nuclear industry's monopoly by eliminating plans to reserve almost two-thirds of Ontario's future power supply mix exclusively for nuclear projects. Given its high costs, poor reliability and safety issues, the last thing we should do is bank on nuclear to provide the vast majority of our future power. Nuclear should be required to compete fairly with all other potential power sources to meet our electricity needs.

Introduction

The Ontario Power Authority (OPA) has prepared a 20-year plan to meet our electricity needs while phasing out coal-fired electricity. The key features of the plan are as follows.

1. It will reduce Ontario's total annual electricity demand by 2% by 2015. However, after 2015 the plan anticipates electricity demand increasing by just under 1% per year for the remainder of the planning period. As a consequence, in 2025 our electricity demand is predicted to be 7.5% higher than it was in 2007.¹
2. It will increase our nuclear generation capacity by 23%, from 11,426 to 14,000 megawatts (MW)². As a consequence, the plan forecasts that in 2027 nuclear-generated electricity will be equivalent to approximately 61% of our total annual electricity consumption.³
3. According to the OPA's projections, the plan will have a capital cost of \$59.4 billion (2007 \$).⁴



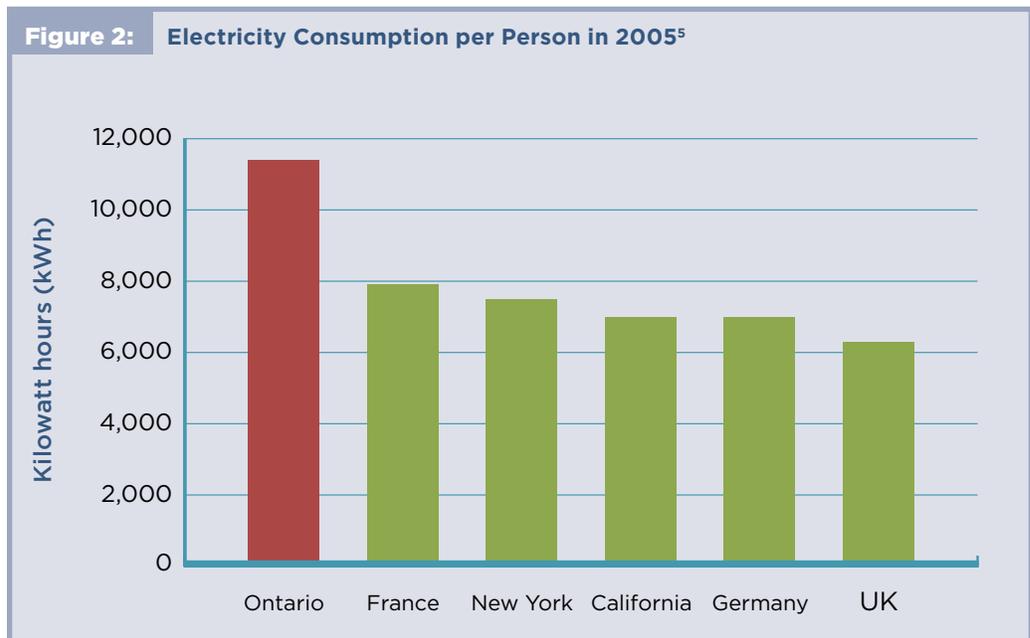
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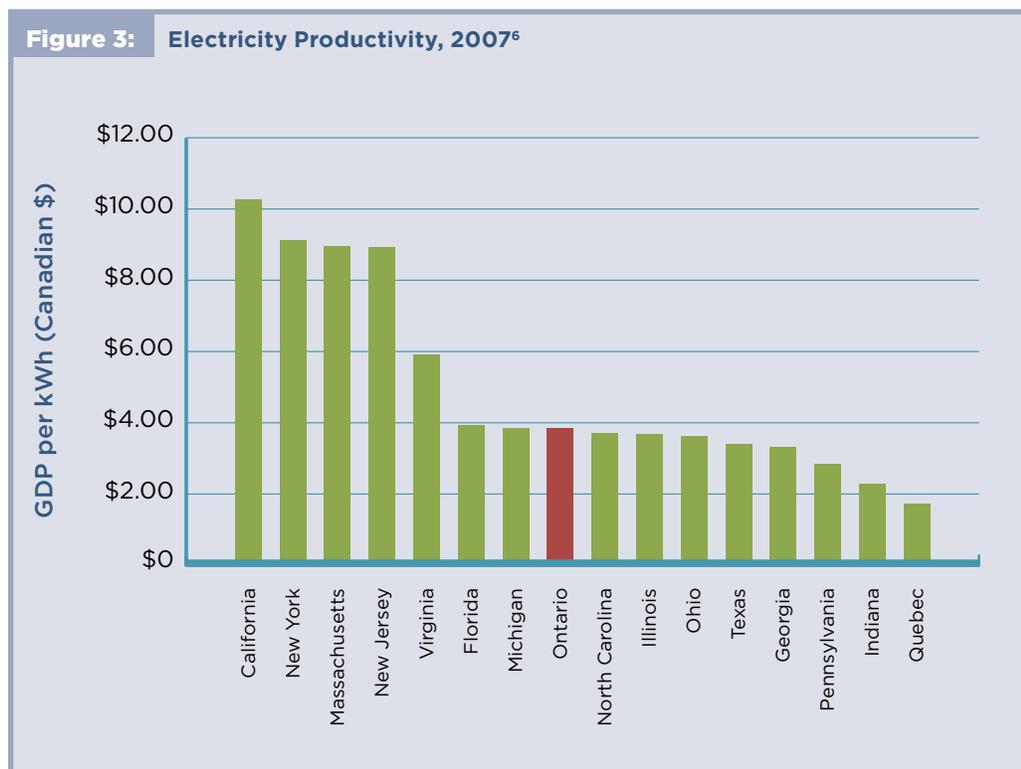
At a broader level, the OPA's plan is primarily a continuation of the status quo system of large, centralized generating stations at a time when many other jurisdictions are adopting innovative, forward-looking approaches that emphasize efficiency, clean, renewable generation and smart, small-scale distributed generation.

Failure to Aggressively Promote Energy Efficiency and Demand Management

Ontario is one of the most wasteful jurisdictions for electricity use in the world. As Figure 2 shows, our electricity consumption per person is 50% greater than that of neighbouring New York State.



As a result of Ontario's historic failure to promote energy efficiency, our electricity productivity (Gross Domestic Product or GDP per kWh) is much lower than those of North America's leading knowledge-based economies. As Figure 3 reveals, California's, Massachusetts', New Jersey's and New York's electricity productivity is more than double that of Ontario's.



If Ontario were to achieve New York State's existing level of electricity productivity by 2027, our total electricity consumption in 2027 would be 30% lower than it was in 2007.⁷

As of December 31, 2007, the OPA's total expenditures on energy conservation and demand management were \$158 million. In contrast, as of May 2008, it had contracted for 11,279 MW of new supply at a capital cost of \$18.9 billion.⁸ That is, for every dollar that it has spent on energy conservation and demand management, the OPA has contracted to spend \$119 on new supply.

According to the OPA's plan, over the next 20 years, it will spend \$49.5 billion on new supply and \$9.9 billion on energy conservation and demand management. That is, for every dollar that it will spend on conservation, \$5 will be spent on supply despite the fact that energy efficiency can meet our electricity needs at a lower cost and much more quickly than new supply. According to the OPA, its energy efficiency programs can reduce our electricity consumption at an average cost of only 2.7 cents per kWh.⁹ On the other hand, the cost of

The real cost of nuclear power



THE DARLINGTON NUCLEAR STATION WAS \$10.3 BILLION OVER BUDGET.

The OPA is forecasting a much lower cost for new nuclear electricity than we use in this report. However, the OPA's estimate is based on at least two key assumptions that are simply not credible:

- First, the OPA assumes that the capital cost of a new nuclear reactor will be only \$2,900 per kW. This is 30% less than the actual historic capital cost, \$4,085 per kW (1993\$), of the last nuclear power plant (the Darlington Nuclear Station) built in Ontario. Simple inflation has raised prices by more than 30% since 1993 and in Ontario the actual capital cost of building or retrofitting nuclear reactors has always been greater than forecast. According to an October 2007 Moody's Investors Service report, the cost of a new nuclear reactor is likely to be between \$5,000 and \$6,000 per kW. In May 2008, Moody's raised its estimate of the cost of a new nuclear reactor to \$7,500 per kW.
- Second, the OPA assumes that a nuclear power company's pre-tax required rate of return on capital would be only 4% real (net of inflation). However, in 2005, CIBC World Markets estimated

that Bruce Power's pre-tax cost of capital for its Bruce A Units 1 & 2 re-start project would be 10.6% to 13.8%. Moreover, it is important to

note that the CIBC cost of capital estimate was based on the assumption that Bruce Power would be allowed to pass a very significant portion of its capital cost overruns on to Ontario's electricity consumers. If this loophole had been eliminated, Bruce Power's required rate of return would have been even greater.

In response to a request from Pollution Probe, the OPA re-estimated the cost of nuclear power assuming a capital cost of approximately \$6,000 per kW and a pre-tax cost of capital of 12% real. According to the OPA, with these two amendments to its analysis, the cost of electricity from a new nuclear power plant is forecast to be 15.7 cents per kWh.

Finally, it is important to note that even this cost estimate (15.7 cents per kWh) is based on the OPA's optimistic assumptions that new nuclear reactors will have average annual capacity utilization rates of 90% and 40 year lives. In fact, during the last 25 years, the average capacity utilization rate of Ontario's fleet of nuclear reactors has never equaled 90%.

obtaining a kWh of electricity from a new nuclear reactor will be at least 15.7 cents per kWh.¹⁰

By directing the OPA to increase its spending on energy efficiency and to reduce its spending on new nuclear reactors, the Government of Ontario can lower our electricity rates and bills, increase our electricity productivity and increase the competitiveness of our industries, while reducing toxic and radioactive wastes.

Other leading jurisdictions have recognized the many added advantages of improving electricity efficiency, whether it is the cost savings from eliminating the need for new generating stations and high-voltage transmission lines or reducing air polluting emissions. Essentially, these jurisdictions treat electricity conservation as the preferable “least cost” option for meeting power needs and have aggressive plans to capture as much of this resource as possible *before* spending on new supply sources.

By comparison, the OPA plan calls for fairly aggressive action to secure conservation resources in the short term (up to 2010) and then rapidly scales back spending and effort. This approach does not fit with the findings of other jurisdictions, which, unlike Ontario, have deep experience in pursuing conservation. (The OPA fully acknowledges that electricity conservation efforts were essentially abandoned in Ontario during the 1990s. This was a direct result of the need to justify the huge expenditure on the Darlington Nuclear Station by keeping electricity demand high.)

New York State, for example, found that after 14 years of investing significantly in improving energy efficiency, it had almost the same potential for further improvements as it had when the program began in 1989¹¹ In other words, thanks to improvements in technologies and systems, the level of the potential “pool” of possible efficiency improvement remains stable even as we tap into this low-cost power source.

That’s why jurisdictions like New York and California that have aggressively pursued efficiency for many years see huge potential to continue to improve. In fact, California plans to achieve a larger percentage reduction in its electricity consumption by 2013 than Ontario is planning to achieve by 2025.¹² Despite Ontario’s huge untapped potential, the OPA has set its efficiency targets in a way that treats the objectives set by the government for efficiency programs as maximums rather than minimums.

According to one of the OPA’s consultants, MK Jaccard and Associates, the savings potential from energy efficiency in the commercial sector is only likely to continue to increase for a number of reasons:



**THE LEVEL OF
THE POTENTIAL
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REMAINS STABLE
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POWER SOURCE**

COMBINED HEAT
AND POWER (CHP)
PLANTS CAN HAVE
ENERGY EFFICIENCIES
OF 80-90%



“...it is likely that energy efficiency will be accelerating, particularly after 2015, due to:

- *Aging of the existing stock [machinery and equipment] which will force significant renovation and demolition activity,*
- *The green construction revolution will significantly accelerate and likely transform the market after 2015,*
- *Research efforts to improve the efficiency in some end-uses such as lighting will bear fruit after 2015 with available products,*
- *Continued pressure on energy prices will bring about more aggressive energy efficiency.”¹³*

This all means that the OPA’s approach of a short ramp up in spending on efficiency followed by a hands-off approach makes little sense. As the cleanest and lowest cost solution available for meeting our power needs, there is little to be gained from taking such a passive approach, unless, of course, the real goal is to justify large expenditures on new supply.

As Scudder Parker of the Vermont Energy Investment Corporation notes, “A genuine conservation culture will recognize the multiple benefits of efficiency: peak reduction, reduced consumption, lower GHG emissions, lower bills for all customers, increased comfort and convenience, jobs and economic benefits.”¹⁴

Failure to Maximize the Efficiency of Ontario's Natural Gas Consumption

Most buildings and factories in Ontario use natural gas to produce just one service, namely heating. It is much more efficient to use natural gas to simultaneously produce two services, namely, heat and power. Combined heat and power (CHP) plants can have energy efficiencies of 80 to 90%.¹⁵ These power plants are much more efficient than nuclear reactors and simple-cycle natural gas-fired power plants which have energy efficiencies of 33% and 36% respectively.¹⁶

CHP plants can be installed in apartment buildings, condominiums, shopping centres, hospitals, schools, airports, offices and factories.

As a result of their very high efficiency, CHP plants can meet our electricity needs at a lower cost than a new nuclear reactor even assuming very high natural gas prices. Specifically, according to the OPA, CHP plants can supply electricity at a total cost of only 5.7 to 6.0 cents per kWh assuming natural gas costs \$8 per MMBTU. If gas costs were to rise to \$15 per MMBTU, the cost of electricity from a CHP plant would be 8.3 to 9.0 cents per kWh.¹⁷ (On September 8, 2008 the U.S. spot price of natural gas was slightly less than \$8 per MMBTU.) That is, even assuming very high gas costs, the cost of CHP generated electricity is at least 40% lower than the cost of electricity from a new nuclear power plant (15.7 cents per kWh).

In addition, as a result of its very high-efficiency, the greenhouse gas emission rate of a CHP plant is 80% lower than that of a coal-fired power plant.¹⁸

While nuclear power plants can have even lower greenhouse gas emission rates than CHP plants (assuming they have access to high grade ores for fuel), the cost of achieving incremental greenhouse gas emission reductions, by building nuclear reactors instead of CHP plants, would exceed \$270 per tonne.¹⁹ Nuclear, therefore, is not a cost-effective greenhouse gas emission reduction option for Ontario.

Ontario's existing CHP capacity is 1,281 MW. According to a report prepared for the Ontario Ministry of Energy, Ontario's total potential CHP capacity is 16,514 MW by 2020. Nevertheless, the OPA's 20-year energy plan is proposing to increase our actual CHP capacity to only 2,281 MW by 2017. Furthermore, according to the OPA's plan, there will be no increase in Ontario's CHP capacity after 2017.²⁰

If Ontario could install a total of 16,500 MW of CHP capacity by 2027, our total demand for grid-supplied electricity in 2027 would be 58% lower than it was in 2007.²¹

By contrast, a failure to maximize the efficiency of our natural gas consumption will lead to higher electricity rates, lower energy productivity, a less competitive

3,000 MW COULD BE PRODUCED WITHOUT ADDED FOSSIL FUEL BY RECYCLING WASTED ENERGY FROM INDUSTRY



economy, excessive natural gas-related greenhouse gas emissions and an excessive wealth transfer from Ontario to Alberta to purchase natural gas.

CHP systems offer some other major advantages over large, centralized nuclear plants, while being well-suited to replacing the baseload power these plants produce (like nuclear plants, CHP plants run at maximum efficiency when run for long uninterrupted periods). Because CHP plants are much less complex than nuclear generating stations, their level of reliability is much higher. A service outage at a CHP plant will also be much less disruptive to the overall electricity system due to their smaller size and the higher number of plants. The result is that the “spare” capacity required in a system that uses diverse distributed generation sources like CHP compared to a centralized system is much lower. Power lost in transmission networks is also much lower because CHP systems must be located close to where the power and heat is actually being used.

CHP expert Tom Casten estimates that a conventional centralized system such as Ontario’s requires 1.44 MW of capacity for every 1 MW of actual electricity usage. A distributed system, by comparison, may require as little as 1.06 MW of capacity for every megawatt of usage.²² Therefore, a distributed system represents a much more efficient use of capital dollars and ratepayers’ money.

As efficiency expert Scudder Parker noted in testimony for the Ontario Energy Board, issues such as climate change and steadily increasing costs for fossil fuels “will be driving innovation in efficiency technology, distributed generation, and new financing mechanisms in ways we are not easily able to anticipate. For instance, it is not at all unreasonable to anticipate that solar hot water applications could become standard practice within five to ten years. Nothing on that order is included in OPA projections. Very small-scale CHP applications now in use in Europe might come down in cost and become standard appliances.”²³

Once again, Ontario’s potential in this area is enormous. According to Casten, “[we] estimated a potential for clean local power of 11,400 megawatts [MW], of which 3,000 MW would be produced without added fossil fuel by recycling wasted energy from industrial activities such as steel mills, chemical plants, refineries, carbon black production, gas compressor stations and steam pressure drop.”²⁴ In other words, Ontario has the potential to generate 3,000 MW of electricity – enough to replace 75% of the giant Nanticoke coal station – without using a single drop of additional fossil fuel by using “waste” heat that is currently pumped out smokestacks or discharged into waterways.

Casten points out that “Denmark embarked on a program to promote local generation and now produces 54% of the nation’s power by recycling otherwise wasted energy. A comparable 54% of Ontario’s generation would be 16.2 gigawatts [16,200 MW]”.²⁵

Failure to Ensure that Ontario Obtains the Majority of its Electricity from Renewable Sources by 2027

In 2007, 23% of Ontario’s electricity was generated using renewable sources.²⁶

According to the OPA’s plan, in 2027 renewables will be supplying slightly more than one-third (35%) of Ontario’s electricity.²⁷

Table 1 below provides a break-out of Ontario’s existing renewable electricity generation in 2007 and the OPA’s planned renewable generation in 2027.

Table 1: Ontario’s Existing and Planned Renewable Generation²⁸

	2007	2027
Hydro-Electric	33.4 billion kWh	49.77 billion kWh
Wind	1.04 billion kWh	10.08 billion kWh
Biomass	Nil	3.15 billion kWh
Solar	Nil	Nil

Contrary to the OPA’s modest renewable electricity goals, Ontario has huge untapped renewable energy potential.

Wind Power

According to a report prepared for the OPA by Helimax Energy Inc., a leader in the field of independent wind energy consulting, Ontario’s total on-shore (land based) wind power potential equals 1,711 billion kWh per year. That is, our total on-shore wind power potential is more than 10 times greater than Ontario’s total annual electricity consumption (approximately 150 billion kWh).

Table 2: Ontario’s On-Shore Wind Power Potential²⁹

	Megawatts (MW)	Billion kWh Per Year
Entire Province	628,067	1,711
North of 50th Parallel	598,884	1,632
South of 50th Parallel	29,183	79

In another report for the OPA, Helimax identified and assessed 64 potential off-shore wind power sites in the Great Lakes. According to Helimax, these sites could support 34,500 MW of wind power capacity which would produce 111.5 billion kWh of electricity per year.³⁰ That is, these wind power sites in the Great Lakes could provide Ontario with approximately 75% of its electricity needs.

According to the OPA, the cost of producing electricity from large-scale, on-shore wind farms is between 10 and 13 cents per kWh.³¹ The OPA has not estimated the cost of electricity from wind farms located in the Great Lakes.³²

WIND POWER SITES IN THE GREAT LAKES COULD PROVIDE ONTARIO WITH APPROXIMATELY 75% OF ITS ELECTRICITY NEEDS



Biomass Power

According to a BIOCAP Canada Foundation report, Ontario’s total biomass power potential from agriculture and municipal waste is 42 billion kWh per year or more than one quarter of Ontario’s total current annual electricity consumption. Table 3 below provides a break-out of our biomass power potential from agriculture and municipal solid waste.

Table 3: Ontario’s Biomass Power Potential³³

	Billion kWh Per Year
Agriculture	
Crop residues	6.22
Animal manure	3.10
Biomass crops (e.g., willow, switchgrass)	31.1
Total Agriculture	40.4
Municipal Waste	
Solid Waste	1.48
Biosolids	0.12
Total for Municipal & Industrial Wastes	1.60
Grand Total	42.0

According to the BIOCAP report, the cost of biomass power is between 5.5 and 9.7 cents per kWh.³⁴

The aggressive promotion of biomass power and a vibrant bio-economy will stimulate innovation and Ontario’s rural economy.

Solar Power

Ontario has a huge technical potential for producing electricity directly from the sun (Southern Ontario’s solar potential is actually better than Germany’s, the world’s solar power leader).³⁵ However, currently the cost of solar photovoltaic electricity is dramatically higher than the cost of wind, water or biomass energy. Nevertheless, according to McKinsey & Company, a new era for solar power is fast approaching:

“Long derided as uneconomic, it is gaining ground as technologies improve and the cost of traditional energy sources rises. Within three to seven years, unsubsidized solar power could cost no more to end customers in many markets, such as California and Italy, than electricity generated by fossil fuels or by renewable alternatives to solar. By 2020, global installed solar capacity could be 20 to 40 times its level today.”³⁶

Solar thermal technologies (e.g., hybrid solar/electric water heaters) are cost-effective now in comparison to electric water or space heating.

Hydro-Electricity imports from Quebec

Quebec's electricity productivity (GDP per kWh) is more than 50% lower than Ontario's. If Quebec raises its electricity productivity up to Ontario's level, it could export more than 87 billion kWh of electricity per year to Ontario from its existing hydro-electricity generating stations.³⁷ This is an enormous reservoir of clean power on our doorstep.

Renewable advantages

Renewable power can often be brought into service much more quickly than large, centralized nuclear stations. Germany, for example, added 14,000 MW of renewable power between 2000 and 2004. In fact, it added enough new renewable capacity in just one year (2007) to eliminate the need for one nuclear plant.³⁸

In 2006, the German Renewable Energy Agency published figures on cost reduction of renewable energy technology since 1990 based on industry information: 68% cost reduction for solar, 60% for wind and 40% for solar heat – which amounts to an average cost reduction of roughly 50% since 1990.³⁹ Renewable energy technologies also have much greater potential for efficiency improvements than long-established (mature) conventional generation technology. In 2007, Germany replaced 108 first generation wind turbines with 45 new ones. Although the number of turbines decreased, the total output of these turbines increased 2.5 fold: from 41 MW to 103 MW.⁴⁰

Integration the key

To fully exploit Ontario's vast renewable potential, we need to build a smart, integrated power grid that can quickly balance multiple power sources with rising and falling demand. Such a "smart grid" can, for example, balance wind power with hydro resources, using hydro when wind is not available and storing hydro power (water) when it is. Similarly, if wind resources fall in one area, the smart grid can feed power from another part of the province.

There are enormous reliability and security benefits to such an approach. When a wind farm is inactive, the disruption to the grid is minimal; when a nuclear reactor suddenly goes offline, it leaves a huge hole that has to be filled by dirty coal power. In terms of storms, or other disruptions, the distributed grid is also far more reliable because it avoids the vulnerability of a few major power lines linking central power sources and major demand centres.

IN 1999, AS A RESULT OF THE COST OVERRUNS AND POOR PERFORMANCE OF ITS NUCLEAR REACTORS, ONTARIO HYDRO WAS EFFECTIVELY BANKRUPT.



Table 4: Cost Comparison: Energy Efficiency versus New Supply

Energy Efficiency	Biomass	Natural Gas Combined Heat and Power	Wind	Nuclear
2.7 cents per kWh	5.5 to 9.7 cents per kWh	5.7 to 9 cents per kWh	10 to 13 cents per kWh	15.7 cents per kWh

Failure to Protect Ontario’s Electricity Consumers from Nuclear Reactor Capital Cost Overruns

Ontario’s nuclear industry (the former Ontario Hydro, Ontario Power Generation and Bruce Power) have repeatedly persuaded the Government of Ontario to approve their generation projects by grossly underestimating costs. For example:

- In 1983, Ontario Hydro estimated that the total capital cost of the Darlington Nuclear Station would be \$4 billion. Its actual cost was 3.6 times greater, at \$14.3 billion.⁴¹
- In 1999, Ontario Power Generation (OPG) estimated that the total cost of returning Pickering A Unit 4 to service would be \$457 million. Its actual cost was 2.7 times greater, at \$1.25 billion.⁴²
- In 1999, OPG estimated that the total cost of returning Pickering A Unit 1 to service would be \$213 million. Its actual cost was 4.8 times greater at \$1.016 billion.⁴³
- Bruce Power estimated that the total cost of returning Bruce A Units 3 and 4 to service would be \$375 million. Its actual cost was two times greater, at \$750 million.⁴⁴
- In 2005 the OPA signed a contract with Bruce Power for the return to service of Bruce A Units 1 and 2. In 2005 the estimated capital cost was \$2.75 billion. The units have still not returned to service, but in April 2008 Bruce Power estimated that the project would be \$350 million to \$650 million over budget for a total cost of \$3.1 to \$3.4 billion.^{44b}

In 1999, as a result of the cost overruns and poor performance of its nuclear reactors, Ontario Hydro was effectively bankrupt. As a consequence, it was broken up into five companies. Its nuclear generating stations were transferred to Ontario Power Generation and its stranded nuclear debt (\$20.9 billion) was transferred to the Ontario Electricity Financial Corporation. (The nuclear debt was “stranded” because it would have bankrupted Ontario Power Generation and Bruce Power if they had been required to pay it off.)

This means responsibility for paying off the stranded nuclear debt has been transferred from Ontario’s nuclear power companies (Ontario Power Generation and Bruce Power) to Ontario’s electricity consumers and taxpayers. In 2007, the

average (residential, commercial and industrial) electricity customer paid \$377 to the Ontario Electricity Financial Corporation to help pay off the stranded nuclear debt. These payments will continue for many years to come since, as of December 31, 2007, the outstanding debt was still \$18.3 billion.⁴⁵

As of May 2008, the OPA had signed 363 contracts with private sector developers, co-ops, First Nation communities and individuals for electricity supplies from renewable and natural gas-fired electricity generation projects. In order to protect Ontario's electricity consumers, none of these projects are allowed to pass any capital cost overruns on to Ontario's electricity consumers or taxpayers. However, the Government of Ontario has continued to allow OPG and Bruce Power to pass their capital cost overruns on to Ontario's electricity consumers.

In July 2008, the Government of Ontario announced that it is planning to sign a contract in March 2009 with Areva NP, Atomic Energy Canada Limited or Westinghouse Electric Company for the construction of a two-unit nuclear power plant at Darlington.⁴⁶ Once again, it is the Government's intention to sign a contract with one of these nuclear power companies that will allow the company to pass its capital cost overruns on to Ontario's long-suffering electricity consumers and/or taxpayers. (Areva's efforts to build a new nuclear plant in Finland are already 18 months behind schedule and its share of the loss on this project is projected to be at least \$700-900 million.)⁴⁷

Recently, the Canadian nuclear industry directly requested that the federal government cover cost overruns and provide it with discounted financing in order to "compete" with similarly subsidized foreign reactor suppliers.⁴⁸

Creating a Green Electricity Future for Ontario

Ontario can obtain virtually 100% of its grid-supplied electricity from renewable sources by 2027 by making the following five key amendments to its 20-year electricity plan.

1. Aggressively promote energy efficiency to reduce the demand for grid-supplied electricity. The lower the demand for electricity, the easier it will be to meet 100% of our needs from renewable sources.
2. Pay electricity consumers to install small-scale combined heat and power and tri-generation (heating, cooling and electricity) plants in their apartments, condominiums, shopping and recreation centres, hospitals, office buildings and factories. Once again, the more electricity that consumers self-generate, the lower the demand for grid-supplied electricity and the easier it will be to meet 100% of our demand for grid-supplied electricity from renewable sources.

**AT THE TIME OF
THE SUMMER SYSTEM
PEAK, 40% OF
ONTARIO'S TOTAL
ELECTRICITY
GENERATION IS
USED TO POWER
AIR-CONDITIONERS**



3. Aggressively procure renewable electricity supplies from individuals, cooperatives, First Nations communities, local electric utilities, private sector developers and the Province of Quebec.
4. Eliminate the subsidies for electricity generation and consumption and raise the price of electricity up to its full cost while protecting consumers with rebates based on savings from ending nuclear subsidies.
5. Close the loophole that allows nuclear power companies to win electricity supply contracts by low-balling their cost estimates and then passing on inevitable capital cost overruns to Ontario's electricity consumers.

Aggressively Promoting Energy Efficiency

The Government of Ontario should direct the OPA to establish standard offer programs for energy efficiency and demand management. These standard offer programs would require the OPA to pay companies a standard price per kWh for each kWh of consumption that they save or shift from peak to off-peak hours. Furthermore, the OPA would be required to purchase all the kWh savings that are available at the standard contract price (e.g., no arbitrary caps or other limits).

Demand Management Standard Offer Program

The demand for electricity in Ontario peaks on hot summer days when air-conditioners are running full out. In fact, at the time of the summer system peak, 40% of Ontario's total electricity generation is used to power air-conditioners. The cost of meeting these peaks in electricity demand, which occur during only approximately 1% of the total hours in a year, has been estimated to be approximately \$1.64 per kWh.⁴⁹

Demand management programs, which reduce the demand for electricity during these super peak hours, will reduce the need for Ontario to spend \$1.64 per kWh to meet these spikes in demand. Therefore, the OPA's demand management standard offer program should pay companies at least \$1.64 per kWh to shift some of their consumption from peak to off-peak hours on peak demand days.

The OPA's demand management standard offer program should be open to Hydro One, all of Ontario's municipal electric utilities (e.g., Toronto Hydro, Hydro Ottawa), energy service companies (e.g., Rodan Energy) and large volume commercial, institutional and industrial consumers (e.g., Loblaws, universities, General Motors).

Energy Efficiency Standard Offer Program

Unlike demand management or peak shifting programs, energy efficiency programs reduce the demand for electricity throughout the year by increasing the energy efficiency of electric appliances, equipment and motors. As a consequence,

energy efficiency programs can reduce the need for new nuclear reactors and new transmission and distribution lines. The cost of electricity from a new nuclear reactor would realistically be at least 15.7 cents per kWh. Therefore the OPA's energy efficiency standard offer program should pay at least 15.7 cents per kWh plus the avoided transmission and distribution costs for each saved kWh.

The OPA's energy efficiency standard offer program should be open to Hydro One and all of Ontario's municipal electric utilities (e.g., Toronto Hydro, Hydro Ottawa).

Paying Electricity Consumers to Install Combined Heat and Power and Tri-Generation Plants in their Buildings and Factories

The Government of Ontario should direct the OPA to establish a standard offer program for combined heat and power (CHP) and tri-generation plants. This program should pay a standard price per kWh for each kWh of electricity supplied by CHP and tri-generation plants. Furthermore, the program should be open to all CHP and tri-generation plants irrespective of their size.

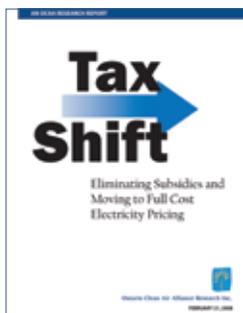
New CHP and tri-generation plants will reduce the need for new nuclear power plants and new transmission and distribution lines. As noted above, the cost of electricity from a new nuclear power plant would be at least 15.7 cents per kWh. Therefore the CHP and tri-generation standard offer program should pay these facilities at least 15.7 cents per kWh plus the avoided transmission and distribution costs for each kWh that they produce.

Aggressively Procuring Renewable Electricity Supplies

In March 2006, Ontario launched its renewable energy standard offer program (RESOP). RESOP establishes prices for the purchase of renewable energy by the OPA from small-scale (10 MW or less) power projects. The RESOP price for wind, biomass and hydro-electricity is 11 cents per kWh. For solar photovoltaic it is 42 cents per kWh. When the program was launched the OPA predicted that it would result in up to 1,000 MW of new small-scale renewable energy projects in Ontario over the next 10 years.⁵⁰ In fact, RESOP has been much more successful than the OPA expected – as of May 2008, the OPA had signed contracts for approximately 1,300 MW of RESOP power.⁵¹

To help Ontario move to a 100% renewable electricity grid by 2027 the following amendments should be made to RESOP.

1. The 10 MW cap should be eliminated. That is, RESOP should be open to all renewable electricity projects regardless of size.
2. The standard offer price should be raised. Ontario's minimum price for renewable electricity supplies should be at least as great as the cost of electricity from a new nuclear reactor, i.e., at least 15.7 cents per kWh.



**ELIMINATING
NUCLEAR SUBSIDIES
AND MOVING
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ONTARIO COULD
TAKE TO PROMOTE
ENERGY EFFICIENCY**

3. Renewable electricity projects that are located in the regions of Ontario that are experiencing rapid population growth (GTA, Kitchener, Waterloo, Guelph & Cambridge) can also help to reduce the need for new electricity transmission and distribution infrastructure. Therefore a price premium should be established for projects that also provide transmission and distribution cost savings for the Province of Ontario.
4. The geographic boundaries for RESOP should be expanded. Specifically, RESOP should also be open to renewable electricity supplies from the Province of Quebec.

In addition, renewable energy supplies should have priority access to the grid. That is, they should be put into use before we turn to fossil or nuclear supplies. And Ontario’s electric utilities (e.g., Hydro One, Toronto Hydro) should be required to connect new renewable generators to the grid whenever it is cost-effective to do so. The costs of these grid connections should be recovered from all of the utilities’ customers.

Eliminating the Subsidies and Moving to Full Cost Electricity Pricing

During the last 100 years, successive provincial governments have established ten major subsidies that artificially reduce the price of electricity. Table 5 below provides a list of these subsidies and estimates their values where possible.

Table 5: Current Electricity Subsidies in Ontario

Subsidy	Value
Subsidy #1: Below-Market Water Royalty Rates	\$1.9 billion
Subsidy #2: OPG’s Below-Market Return on Equity	\$0.851 billion
Subsidy #3: Corporate Income Tax Revenue Subsidy for Nuclear Debt	\$0.949 billion
Subsidy #4: Sales Tax Exemption	\$1.085 billion
Subsidy #5: Northern Pulp and Paper Electricity Transition Program	\$0.047 billion
Subsidy #6: Public Health and Environmental Subsidy for Coal-Fired Generation	\$3.1 billion
Subsidy #7: Subsidies for Nuclear Reactor Decommissioning and Long-Term Storage of Radioactive Nuclear Wastes	Unknown
Subsidy #8: Nuclear Liability Act	Unknown
Subsidy #9: Average Cost Pricing	Unknown
Subsidy #10: Bulk Metering	Unknown
TOTAL	\$7.932 billion

Source: Ontario Clean Air Alliance Research Inc., *Tax Shift: Eliminating Subsidies and Moving to Full Cost Electricity Pricing*, (2008).

Eliminating these subsidies and moving the price of electricity up to its full cost is the single most powerful and cost-effective action the Government of Ontario could take to promote energy efficiency and demand management; maximize the efficiency of our natural gas consumption and move Ontario towards a 100% renewable electricity grid.

The single largest subsidy for grid-supplied electricity is the \$3.1 billion public health and environmental subsidy for coal-fired electricity generation. In August 2007, the Province of Ontario issued a legally binding regulation that requires the phase out of coal-fired generation – and hence this subsidy – by December 31, 2014. We believe that the best option to eliminate the public health and environmental subsidy for coal-fired generation is to phase-out coal burning as soon as possible.

Eliminating the array of other subsidies for which we know the costs would cause electricity rates to rise by approximately 35%. However, the savings from eliminating subsidies could then be used to provide an annual Hydro Rebate Tax Credit to all residential electricity consumers and farmers.

This would result in a net gain (money in pocket) for most residential and small farm electricity consumers (Ontario has approximately 88,000 small farms and 1,000 large farms), while maintaining a strong incentive through real pricing for them to use electricity wisely. As the Premier himself has stated, “artificially reducing electricity prices is the single worst policy you could advocate if you want to see industry and consumers reduce their energy use.”⁵²

The table below shows the rebate that could be created from eliminating just some of the existing electricity subsidies. These rebate amounts would be more than enough to offset a 35% increase for the average household.

Table 6: Annual Hydro Rebate Tax Credit

Family Size	Hydro Rebate Tax Credit
1 person	\$386
2 people	\$772
3 people	\$1158
4 people	\$1544
5 people	\$1930
6 people	\$2316

To ensure that higher electricity rates do not lead to higher electricity bills for non-residential consumers, we can phase-in the rate increase over ten years. Instead of raising electricity rates by 35% in year one; raise them by 3.5 percentage points each year for ten years. This will give users the time they need

HISTORICALLY, THE NUCLEAR INDUSTRY HAS PERSUADED SUCCESSIVE GOVERNMENTS TO APPROVE THEIR PROPOSED POWER PROJECTS BY LOW-BALLING THEIR COST ESTIMATES AND THEN PASSING THEIR CAPITAL COST OVERRUNS ON TO ONTARIO'S ELECTRICITY CONSUMERS AND/OR TAXPAYERS.

to make the energy efficiency investments that will prevent their electricity bills from rising.

We can also pay large electricity users to reduce electricity demand during peak periods and to self-generate electricity, both of which would offer new income to offset increased costs. Low-cost financing can also be provided to help with improving efficiency, which will also make our industries and businesses more competitive.

Phasing out the subsidies for grid-supplied electricity and moving to full cost pricing will provide multiple benefits for Ontario.

1. It will raise our electricity productivity and make Ontario's industries more competitive.
2. It will lower our electricity bills.
3. It will raise our standard of living.
4. It will reduce air pollution and greenhouse gas emissions.
5. It will encourage a culture of conservation and small-scale local power generation.
6. It will reduce the need for new high-cost nuclear reactors.

In essence, a full-cost pricing strategy represents a tax shift from subsidizing wasteful consumption to rewarding efficiency, which in turn is a much more economically efficient and beneficial use of government revenues.

Closing the Nuclear Loophole

According to the OPA, the capital cost of its proposed nuclear plan is \$26.5 billion. However, this estimate is based on the extremely optimistic assumption that the cost of a new nuclear reactor will be only \$2,900 per kW. According to Moody's Investors Service, the cost is more likely to be \$7,500 per kW.⁵³ That is, the total cost of the nuclear program alone could be \$68.5 billion and, therefore, the total cost of the OPA's 20-year electricity plan could exceed \$101 billion.

Historically, the nuclear industry has persuaded successive Governments to approve their proposed power projects by low-balling their cost estimates and then passing their capital cost overruns on to Ontario's electricity consumers and/or taxpayers. The Government of Ontario has wisely decided not to allow renewable or natural gas-fired power plants to pass any capital cost overruns on to consumers or taxpayers. However, they are planning to maintain the nuclear capital cost overrun loophole.

While this loophole is beneficial to a very powerful special interest group, it is not in the best interests of Ontario's electricity consumers and taxpayers. It also

represents money that could be used for other public purposes, such as schools, hospitals or public transit.

Therefore to protect consumers, taxpayers and our economy and to create a level playing field for all energy efficiency and supply options, the Government of Ontario should eliminate the nuclear capital cost overrun loophole from all its future contracts with nuclear power companies.

Ontario's Electricity System in 2027

Table 7 below provides the OPA's forecast of our electricity production, consumption and exports in 2027.

Table 7: Ontario's Electricity Production, Consumption & Exports in 2027⁵⁴

Nuclear Generation	100 billion kWh
Renewable Generation	63 billion kWh
Natural Gas-Fired Generation	18 billion kWh
Total Generation	181 billion kWh
Ontario Consumption	164.2 billion kWh
Exports	16.8 billion kWh

That is, according to the Government's 20-year plan, in 2027, Ontario's nuclear production will be equivalent to 61% of our total electricity consumption.

Fortunately, a much cleaner and greener future is possible. As this report has shown, we can obtain 100% of our grid-supplied electricity from renewable sources by 2027 by raising our electricity productivity, maximizing the efficiency of our natural gas consumption and aggressively procuring renewable electricity supplies. Furthermore, there are many combinations of these options which could lead to a 100% renewable electricity grid by 2027.

Increasing Our Electricity Productivity

According to the OPA's plan, Ontario's renewable electricity generation in 2027, 63 billion kWh, will be equivalent to 38% of our total domestic electricity demand in 2027. However, by simply increasing our electricity productivity and reducing our electricity demand, we can increase the percentage of our electricity supply that is provided by renewable sources. For example, New York State's electricity productivity is 2.4 times greater than Ontario's. If we achieve New York State's year 2007 level of electricity productivity by 2027, then our total electricity consumption in 2027 would be 106.9 billion kWh or 35% less than the Government's forecast.⁵⁵ Under this higher productivity scenario, approximately 60% of our electricity needs would be met by renewable sources.

Increasing our Combined Heat and Power Capacity

We can also reduce our demand for grid-supplied electricity by paying consumers to meet some of their electricity needs by installing combined heat and power (CHP) or tri-generation (heat, power and cooling) power plants on their premises. As we have noted above, Ontario has the potential to increase its CHP capacity by an additional 14,210 MW by 2020. If Ontario were to achieve this potential by 2027 then all of our demand for *grid-supplied* electricity could be met by renewable energy even if we do not increase our electricity productivity.⁵⁶

Alternatively, if Ontario achieves New York State's year 2007 level of electricity productivity by 2027 then 100% of our demand for *grid-supplied* electricity could be met by renewable energy if we tap into only 41% (5,826 MW) of our additional CHP potential.⁵⁷

Increasing Renewables

Alternatively, Ontario could obtain 100% of its electricity supplies from renewable sources in 2027 by simply procuring an additional 101.2 billion kWh of renewable electricity. According to Table 8, Ontario's total wind and biomass renewable electricity potential is over 1,800 billion kWh. Therefore, Ontario could meet 100% of its electricity needs from renewable sources by harnessing an additional 5.5% of its wind and biomass renewable electricity potential.

Table 8: Ontario's Wind and Biomass Power Potential

On Shore Wind Power	1711 billion kWh per Year
Off Shore Wind Power in Great Lakes	111.5 billion kWh per Year
Biomass Power	42 billion kWh per Year
Total	1864.5 billion kWh per Year

Alternatively, if Quebec were to raise its electricity productivity up to Ontario's level, it could export more than 87 billion kWh per year of renewable power to Ontario from its existing hydro-electric generating stations.

Conclusion

Ontario's current electricity plan contains a huge amount of optimism about the costs and performance of conventional supply solutions, such as nuclear power. This is despite a nuclear track record that suggests this optimism is based on little more than wishful thinking – thinking that ignores Ontario's historical experience with nuclear power and the hard reality of increasing safety concerns and rising material, construction and fuel costs. (As one expert noted, “nuclear grade concrete and steel are substantially scarcer than ordinary concrete and steel.”⁵⁸)

Meanwhile, the plan essentially expresses deep skepticism about solutions like renewable power, distributed clean power and efficiency gains – solutions that are already proving their worth in many other jurisdictions.

The outcome of Ontario's current direction is easy to predict. In order to make costly nuclear plants even remotely economic, they will need to run as continuously as possible at full capacity (assuming they can technically achieve these levels of performance, always a question mark with Ontario's nuclear fleet). This means there will be a strong disincentive to increasing electricity efficiency or developing other cleaner, more reliable supply sources.

And the enormous capital costs of developing nuclear plants and their associated transmission infrastructure will essentially starve out other options. The Canadian nuclear industry, for example, is already requesting that the federal government pay for its inevitable cost overruns, money the federal government might be better off spending on an upgraded east-west transmission grid. The result will be higher electricity costs, decreased reliability, and increased greenhouse gas and air-polluting emissions.

This is exactly the scenario that Ontario experienced with the completion of the vastly over-budget Darlington Nuclear Station in 1993. First, Ontario Hydro's energy efficiency programs were abruptly cancelled in order to stimulate the demand for electricity to help pay off the nuclear debt. Second, when seven of our nuclear reactors were shut down for safety reasons in 1998, it was necessary to increase the output of our dirty coal plants by over 100% to keep the lights on.

This certainly doesn't have to be Ontario's fate. In fact, the province has an enormous – and almost completely unprecedented opportunity – to design its future electricity system from the ground up. Ontario's laudable commitment to eliminating the use of dirty coal combined with its aging fleet of nuclear reactors means that the province is now at a major crossroads with major potential to “get it right.”

THE PROVINCE HAS AN ENORMOUS – AND ALMOST COMPLETELY UNPRECEDENTED OPPORTUNITY – TO DESIGN ITS FUTURE ELECTRICITY SYSTEM FROM THE GROUND UP.



If the Government of Ontario is going to stick to its stated principles of creating a “culture of conservation” and be a leader in clean, renewable power, it must direct the OPA to adopt a plan which will move Ontario towards a 100% renewable electricity grid.

If the Government fails to act, we will miss an enormous opportunity. This is our chance to copy the strategies of fast developing countries like China and India that have bypassed traditional wire-based telephone systems and jumped straight into more efficient wireless systems. We can take an equivalent approach with our electricity system: We can build an electricity system that fits the internet age rather than trying to rebuild our old clumsy mainframe system with all its associated costs and limitations.

We can create an electricity system that tells the world that we are serious about reducing our climate and environmental impact and that we want to be leaders in knowledge-based industries and systems.

The choice is ours.

Recommendations

Energy efficiency and demand management

Direct the Ontario Power Authority to dramatically increase its spending on energy efficiency and demand management programs.

Institute a Standard Offer Program for efficiency measures that pays at least 15.7 cents per kWh (the cost of electricity from a new nuclear power plant) plus the avoided transmission and distribution costs for each kWh saved.

Remove the existing limits on demand management programs (programs that pay power users to reduce use during peak demand periods) and pay a price equal to the actual cost of peak power (\$1.64 per kWh) for demand management actions. And make it mandatory to implement demand management programs (such as *peaksaver*) before importing dirty coal power on hot, smoggy summer days.

Renewables

Strengthen the Renewable Standard Offer Program by:

- Eliminating the 10 MW cap. The program should be open to all renewable electricity projects regardless of size.
- Raise the standard offer price. The minimum price for renewable electricity supplies should be at least as great as the cost of electricity from a new nuclear reactor, i.e., at least 15.7 cents per kWh.

-
- Pay a premium for power from projects in areas where the demand for electricity exceeds local supply and the transmission system is at or near capacity (e.g., GTA).
 - Open the program to renewable electricity supplies from the Province of Quebec.

In addition, renewable energy supplies should have priority access to the grid. That is, they should be put into use before we turn to fossil or nuclear supplies. And Ontario's electric utilities (e.g., Hydro One, Toronto Hydro) should be required to connect new renewable generators to the grid whenever it is cost-effective to do so. The costs of these grid connections should be recovered from all of the utilities' customers.

Combined heat and power

Establish a standard offer program for combined heat and power (CHP) and tri-generation plants and industrial waste heat recovery projects, regardless of size. Such projects can help reduce the need for baseload power from nuclear generating stations without requiring costly new transmission lines or radioactive waste management. Therefore, this Standard Offer Program should pay CHP and tri-generation plants at least 15.7 cents plus the avoided transmission and distribution costs for each kWh that they produce.

Close the nuclear cost loopholes

Eliminate the nuclear capital cost loophole which allows nuclear companies to reach into the pockets of Ontario's electricity consumers and taxpayers to pay for their capital cost overruns. Nuclear companies should be responsible for all excess capital costs, just as renewable and natural gas-fired power companies are now. They should also face strict financial penalties for late projects, just as renewable and natural gas generators do now. We must level the playing field between nuclear power and other lower cost, lower risk electricity sources.

Move to Full Cost Pricing for Electricity

Eliminate the hidden subsidies for electricity generation and consumption and raise electricity rates up to their full cost. This will provide a powerful incentive to increase efficiency and develop renewable power sources. The money saved by eliminating subsidies can be used to create an annual Hydro Rebate Tax Credit to ensure that a move to full cost pricing will lead to lower electricity bills for virtually all electricity consumers. (For more on how Ontario can move to environmentally sound pricing, see the Ontario Clean Air Alliance Research Inc report *Tax Shift: Eliminating Subsidies and Moving to Full Cost Electricity Pricing*).

Endnotes

1. In 2007 Ontario's total electricity demand was 152 billion kWh. Ontario Power Authority, *Integrated Power System Plan (IPSP)*, Exhibit D, Tab 1, Schedule 1, Attachment 2, page 1 and Exhibit D, Tab 4, Schedule 1, page 16.
2. Independent Electricity System Operator (IESO), *18-Month Outlook: An Assessment of the Reliability of the Ontario Electricity System*, (June 23, 2008), page 11; and Infrastructure Ontario, *News Release*, "Phase 2 of Nuclear RFP Latest Step in Ontario's 20-Year Plan to Bring Clean, Affordable and Reliable Electricity to Ontarians", (June 16, 2008).
3. According to the OPA, Ontario's total demand for grid-supplied electricity in 2027 in the absence of its conservation and demand management (CDM) programmes would be 195 billion kWh. The OPA is forecasting that its CDM programmes will reduce demand in 2027 by 30.8 billion kWh for a net demand of 164.2 billion kWh. The OPA is forecasting that Ontario's total nuclear generation in 2027 will be 100 billion kWh. *IPSP*, Exhibit D, Tab 1, Schedule 1, Attachment 2, page 1; Exhibit, D, Tab 4, Schedule 1, Attachment 3; and Exhibit D, Tab 9, Schedule 1, page 23.
4. *IPSP*, Exhibit I, Tab 22, Schedule 177, page 2 (June 18, 2008).
5. Ontario population: <http://www40.statcan.ca/101/cst01/demo02a.htm?searchstrdisabled=2004%20population&filename=demo02a.htm&lan=eng>.
Ontario's total electricity consumption in 2005 was 157 billion kWh. We have multiplied this figure by 0.925 to adjust for transmission and distribution system losses. http://www.ieso.ca/imoweb/media/md_demand.asp
US State population: <http://www.census.gov/popest/states/tables/NST-EST2006-01.xls>.
US State retail electricity sales: http://www.eia.doe.gov/emeu/states/sep_sum/html/rank_use_per_cap.html.
Europe population and kWh per capita: <http://devdata.worldbank.org/data-query/>.
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Ontario electricity demand from http://www.ieso.ca/imoweb/media/md_demand.asp.
Quebec electricity demand from Hydro Quebec, Annual Report 2007, p.101, http://www.hydroquebec.com/publications/en/annual_report/2007/pdf/hydro2007en_complete.pdf.
US State population data: http://factfinder.census.gov/servlet/SAFFPopulation?_submenuId=population_0&_sse=on.
US State GDP figures: <http://www.bea.gov/regional/gsp/>.
US State electricity generation: http://www.eia.doe.gov/cneaf/electricity/epm/epm_ex_bkis.html, March 2007, Table 1.6.B.
We used the OECD's Purchasing Power Parity Index (1.21 to 1) to convert US GDP estimates to Canadian dollars: http://www.oecd.org/document/47/0,3343,en_2649_34357_36202863_1_1_1_1,00.html#cpl.
7. In 2007 Ontario's electricity demand was 152 billion kWh. If Ontario achieves New York State's year 2007 level of electricity productivity by 2027, its demand for electricity in 2027 will be 106.9 billion kWh. See endnote #55.
8. *IPSP*, Exhibit I, Tab 31, Schedules 10, 24, 50 & 96 and Exhibit G, Tab 2, Schedule 1, page 7; OPA, *A Progress Report on Electricity Supply: First Quarter 2008*; and OPA, *A Progress Report on Renewable Energy Standard Offer Program*, (May 2008).
9. *IPSP*, Exhibit I, Tab 22, Schedule 28, page 2.
10. The OPA is forecasting a much lower cost for new nuclear electricity. However, the OPA's estimate is based on at least two key assumptions that are simply not credible. First, the OPA assumes that the capital cost of a new nuclear reactor will be only \$2,900 per kW. Second, the OPA assumes that a nuclear power company's pre-tax required rate of return on capital would be only 4% real (net of inflation). The \$2,900 per kW capital cost estimate is not credible for the following reasons. First, it is 30% less than the actual historic capital cost, \$4,085 per kW (1993\$), of the last nuclear power plant, the Darlington Nuclear Station, built in Ontario. Second, inflation has raised prices by more than 30% since 1993. Third, in Ontario the actual capital cost of building or retrofitting nuclear reactors has always been greater than forecast. Fourth, according to an October 2007 Moody's Investors Service' report, the cost of a new nuclear reactor is likely to be between \$5,000 and \$6,000 per kW. Fifth, in May 2008 Moody's Investors Service raised its estimate of the cost of a new nuclear reactor to \$7,500 per kW.
The OPA's estimate that the pre-tax cost of capital for a new nuclear power plant would be only 4% real is not credible given that CIBC World Markets estimated that Bruce Power's pre-tax cost of capital for its Bruce A Units 1 & 2 re-start project would be 10.6% to 13.8%. It is important to note that this cost of capital estimate was based on the assumption that Bruce Power would be allowed to pass on a very significant portion of its capital cost overruns on to Ontario's electricity consumers.
In response to a request from Pollution Probe, the OPA re-estimated the cost of nuclear power assuming a capital cost of approximately \$6,000 per kW and a pre-tax cost of capital of 12% real. According to the

OPA, with these two amendments to its analysis, the cost of electricity from a new nuclear power plant is forecast to be 15.7 cents per kWh (assuming a 90% annual capacity utilization rate and a 40 year life for new nuclear reactors).

Letter from Rosemary Watson, Freedom of Information Coordinator, OPG to Ravi Mark Singh, OCAA, April 27, 2004; OPG, *Sustainable Development Report 2004*, page 41; Moody's Investor Services, *Special Comment: Moody's Corporate Finance*, "New Nuclear Generation in the United States", (October 2007), page 11; Moody's Investors Service, *Special Comment: Moody's Corporate Finance*, "New Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities", (May 2008), page 15; Letter to James Gillis, Deputy Minister, Ontario Ministry of Energy from CIBC World Markets Inc., (October 17, 2005); and IPSP, Exhibit I, Tab 31, Schedule 89, page 2.

11. IPSP, Exhibit L, Tab 8, Schedule 3: Scudder Parker, Vermont Energy Investment Corporation, *Optimizing the CDM Resources in Ontario*, (August 1, 2008), page 49.
12. IPSP, Exhibit L, Tab 8, Schedule 3: Scudder Parker, Vermont Energy Investment Corporation, *Optimizing the CDM Resources in Ontario*, (August 1, 2008), page 56-57.
13. IPSP, Exhibit L, Tab 8, Schedule 3: Scudder Parker, Vermont Energy Investment Corporation, *Optimizing the CDM Resources in Ontario*, (August 1, 2008), page 36.
14. IPSP, Exhibit L, Tab 8, Schedule 3: Scudder Parker, Vermont Energy Investment Corporation, *Optimizing the CDM Resources in Ontario*, (August 1, 2008), page 71.
15. Danny Harvey, "Clean building: contribution from cogeneration, trigeneration and district energy", *Cogeneration and On Site Power Production*, (September-October 2006), pages 108 and 110; and OPA, *Supply Mix Analysis Report*, Volume 2, (December 2005), pages 210 and 212.
16. IPSP, Exhibit G, Tab 2, Schedule 1, page 7.
17. Assuming energy efficiencies of 80 to 90% and an average annual capacity utilization rate of 90%. IPSP, Exhibit I, Tab 31, Schedule 90.
18. OPA, *Supply Mix Analysis Report*, Volume 2, (December 2005), page 226; and IPSP, Exhibit I, Tab 31, Schedule 94.
19. As noted above, the cost of a new nuclear reactor is likely to be at least 14 cents per kWh and the cost of a CHP plant is unlikely to exceed 9 cents per kWh. According to the OPA, the greenhouse gas emission rates of a CANDU 6 nuclear reactor and a CHP plant, with an 80% efficiency, are 12 grams and 223 grams per kWh respectively. Therefore building a nuclear reactor instead of a CHP plant will reduce greenhouse gas emissions by 211 grams (223-12) per kWh at a marginal cost of at least 5 cents (14 - 9) per kWh. Therefore the cost of the greenhouse gas emission reduction is 0.02369 cents per gram (5 cents/211 grams). This is equivalent to a cost of \$237 per tonne (0.2369 x 1,000,000). *Supply Mix Analysis Report*, Volume 2, (December 2005), page X; and IPSP, Exhibit I, Tab 31, Schedule 94.
20. IPSP, Exhibit D, Tab 8, Schedule 1, Table 9; Exhibit I, Tab 31, Schedule 21; and Hagler Bailly Canada, *Potential for Cogeneration in Ontario: Final Report*, (August 2000), p. 25.
21. Assuming an 80% average capacity utilization rate, an extra 14,219 MW of CHP capacity (16,500 - 2,281) located on customers' premises would reduce the demand for grid-supplied electricity by 99.6 billion kWh per year. As we have noted previously, the OPA is forecasting that the demand for grid-supplied electricity will be 163.4 billion kWh in 2027. In 2007 it was 152 billion kWh.
22. IPSP, Exhibit L, Tab 8, Schedule 7: Thomas R. Casten, Recycled Energy Development LLC, *The Role of Recycled Energy and Combined Heat and Power (CHP) in Ontario's Electricity Future*, page 8.
23. IPSP, Exhibit L, Tab 8, Schedule 3: Scudder Parker, Vermont Energy Investment Corporation, *Optimizing the CDM Resources in Ontario*, (August 1, 2008), page 62.
24. *The Role of Recycled Energy and Combined Heat and Power*, page 3.
25. *The Role of Recycled Energy and Combined Heat and Power*, page 5.
26. Independent Electricity System Operator, *News Release*, "IESO Releases 2007 Generation and Consumption Figures", (January 10, 2008).
27. IPSP, Exhibit D, Tab 9, Schedule 1.
28. IPSP, Exhibit D, Tab 5, Schedule 1, page 4; Exhibit D, Tab 9, Schedule 1, page 23; and Exhibit G, Tab 1, Schedule 1, page 43.
29. Helimax, *Analysis of Wind Power Potential in Ontario*, (November 2005), p. 15.
30. IPSP, Exhibit D, Tab 5, Schedule 2, Attachment 1, pages 4, 23 & 25.
31. IPSP, Exhibit D, Tab 5, Schedule 1, page 28.
32. Tyler Hamilton, "Wind power a dilemma for Ontario", *Toronto Star*, (June 30, 2008).
33. David Layzell, Jamie Stephen & Susan Word, BIOCAP Canada Foundation, *Exploring the Potential for Biomass Power in Ontario: A Response to the OPA Supply Mix Advice Report*, (February 2006), Appendix C.
34. David Layzell, Jamie Stephen & Susan Word, BIOCAP Canada Foundation, *Exploring the Potential for Biomass Power in Ontario: A Response to the OPA Supply Mix Advice Report*, (February 2006), page 10.
35. Personal correspondence with Danielle Murray, City of Toronto Energy Efficiency Office.
36. Peter Lorenz, Dickon Pinner & Thomas Seitz, "The economics of solar power", *The McKinsey Quarterly*, (June 2008).

37. In 2007 Quebec's domestic electricity consumption was 173.2 billion kWh. Hydro Quebec, *Annual Report 2007*, page 3.
38. *IPSP*, Exhibit L, Tab 8, Schedule 6: Hermann Scheer, *Shifting to Renewable Generation: Planning Recommendations for Ontario*, pages 7 & 8.
39. *Shifting to Renewable Generation Planning*, page 12.
40. *Shifting to Renewable Generation Planning*, page 10.
41. Ontario Energy Board Docket No. H.R. 12, Exhibit No. 7.3.1, June 13, 1983; and letter from R.C. Watson, Freedom of Information Coordinator, OPG to Ravi Mark Singh, Ontario Clean Air Alliance, April 27, 2004.
42. Jake Epp, Peter Barnes & Robin Jeffrey, *Report of the Pickering "A" Review Panel*, (December 2003), pages 3 & 4.
43. Report of the Pickering "A" Review Panel, page 3; and OPG, News from Ontario Power Generation, "Ontario Power Generation Reports 2005 Third Quarter Financial Results", (November 11, 2005).
44. Letter to James Gillis, Ontario Deputy Minister of Energy from CIBC World Markets Inc., October 17, 2005.
- 44b. Tyler Hamilton, "Reactor repairs confirmed over budget", *Toronto Star*, (April 18, 2008).
45. In 2007 Ontario's electricity consumers paid \$991 million in debt retirement charges and Ontario's Ministry of Finance's forgone tax revenue from the electricity sector was \$757 million. In 2007 Ontario's total number of electricity customers was 4,634,998. Ontario Electricity Financial Corporation, *Annual Report 2007*, pages 5 and 12; and Ontario Energy Board, *2007 Yearbook of Electricity Distributors*, (August 26, 2008), page 10.
46. Infrastructure Ontario, *News Release*, "Nuclear Procurement Project Announces Additional Bilateral Meetings", (July 25, 2008) and "Phase 2 of Nuclear RFP Latest Step in Ontario's 20-Year Plan to Bring Clean, Affordable and Reliable Electricity to Ontarians", (June 16, 2008).
47. *IPSP*, Exhibit L, Tab 8, Schedule 4: Jim Harding, Overnight Costs of New Nuclear Reactors, page 5
48. Tyler Hamilton, "AECL rapped for touting design", *Toronto Star*, (August 8, 2008).
49. *IPSP*, Exhibit I, Tab 31, Schedule 6, Attachment 1.
50. Ontario Ministry of Energy, *News Release*, "Expanding Opportunities for Renewable Energy in Ontario", (March 21, 2006).
51. OPA, *A Progress Report on Renewable Standard Offer Program*, (May 2008).
52. Letter from Premier Dalton McGuinty to Priorities Ontario Coalition, c/o Jennifer Foulds, September 25, 2007.
53. *IPSP*, Exhibit I, Tab 22, Schedule 87; and Moody's Investors Service, *Moody's Corporate Finance: Special Comment*, "New Nuclear Generating Capacity: Potential Credit Implications for U.S. Investor Owned Utilities", (May 2008), page 15..
54. *IPSP*, Exhibit D, Tab 1, Schedule 1, Attachment 2, page 1; Exhibit D, Tab 4, Schedule 1, Attachment 3; and Exhibit D, Tab 9, Schedule 1, page 23.
55. As previously noted, New York State's electricity productivity in 2007 was \$9.11 (Canadian \$) per kWh. In 2007 Ontario's Gross Domestic Product was \$582 billion. According to the Ontario Ministry of Finance's forecasts, Ontario's annual real GDP growth rates will be 2.9% to 2009; 3.0% between 2010 and 2014; 2.6% between 2015 and 2019; and 2.3% between 2020 and 2025. Assuming annual growth rates of 2.3% for 2026 and 2027, Ontario's real GDP in 2027 will be \$974 billion (2007\$). Therefore if our electricity productivity in 2027 equals \$9.11 per kWh, our total electricity consumption will be 106.9 billion kWh. Ontario Ministry of Finance, *Ontario Toward 2025: Assessing Ontario's Long-Term Outlook*, (2005), page 44.
56. According to the Government of Ontario, the province's total demand for grid-supplied electricity in 2027 will be 164.2 billion kWh. Assuming an 85% capacity factor, an additional 14,210 MW of CHP capacity would produce 105.8 billion kWh of electricity per year (14,210 MW x 8760 hours x 85%) which would reduce Ontario's demand for grid-supplied electricity to 58.4 billion kWh (164.2 - 105.8 billion kWh). The Government is forecasting that our total renewable electricity supplies in 2027 will be 63 billion kWh.
57. If Ontario achieves New York State's level of electricity productivity by 2027, our total demand for grid-supplied electricity will be 106.9 billion kWh. Furthermore, the Government is forecasting that our renewable generation in 2027 will be 63 billion kWh. Therefore, under these assumptions the demand for grid-supplied electricity will be 43.9 billion kWh greater than our renewable supplies. This excess demand could be eliminated by an extra 43.9 billion kWh of CHP which would be equivalent to 41% of Ontario's additional CHP potential, namely 105.8 billion kWh. See endnote # 38.
58. *IPSP*, Exhibit L, Tab 8, Schedule 4.: Jim Harding, "Overnight Costs of New Nuclear Reactors", (August 1, 2008), page 7.

OCAA membership list

Municipalities

City of Guelph
City of Hamilton
City of Kitchener
Town of Markham
City of Peterborough
City of Stratford
City of Toronto
City of Windsor
Regional Municipality of Durham
Regional Municipality of Peel
Regional Municipality of Waterloo

Companies

AIM PowerGen Corporation
Bullfrog Power
Energent Incorporated
Enviro-Energy Technologies Inc.
Enwave Energy Corporation
Hydro 2000
Indigo Wind Energy Systems
Mississippi River Power Corporation
Oshawa Power and Utilities Corporation
Prince Edward County Wind Co-op Inc.
Sky Generation
Sudbury Hydro
Toronto Hydro

Organizations and Associations

Algoma Manitoulin Environmental Awareness
Algoma Manitoulin Nuclear Awareness
Allergy/Asthma Information Association
Association of Local Public Health Agencies
Canadian Association of Physicians for the Environment
Canadian Institute of Child Health
Canadian Institute for Environmental Law and Policy
Cashmere Avenue Public School EnviroClub
CAW CANADA
CAW Durham Regional Environment Council
CAW Windsor Regional Environment Council
Citizens Advocating Renewable Energy
Citizens Environment Alliance of Southwestern Ontario
Citizens' Environment Watch
Citizens for Renewable Energy
Citizens Clearinghouse on Waste Management
Community Action Parkdale East
Community Environmental Alliance
Community Renewable Energy Waterloo

Conservation Council of Ontario
Conservator Society of Hamilton and District,
Hamilton Chapter
Earth Day Canada
EarthWorks
Echo Lake Association
Energy Action Council of Toronto** (EnerACT)
Environment North
Environmental Defence Canada
The Evergreen Foundation
Federation of Ontario Cottagers' Associations
GASP (Good Air, Safe Power)
Glanbrook Conservation Committee
Globespotter.com
Greenest City
Hearthmakers Energy Cooperative
The Humane Society of Canada
Lakeshore Area Multi Services Project
The Lakewatch Society (Canada)
Learning Disabilities Association of Ontario
MegaWHAT?
North East Sutton Ratepayers Association Inc.
One Change - Project Porchlight
Ontario College of Family Physicians
Ontario English Catholic Teachers' Association
Ontario Forestry Association
Ontario Highlands Friends of Wind Power
Ontario Lung Association
Ontario Public Health Association
Ontario Public Interest Research Group - University of Guelph
Ontario Public Interest Research Group - McMaster University
Ontario Public Interest Research Group - Queen's University
Ontario Public Interest Research Group - University of Toronto
Ontario Society for Environmental Education
Peel Environment Network
Pesticide Action Group/Waterloo
Pollution Probe
South Riverdale Community Health Centre
Thames Region Ecological Association
Toronto Green Community
Tree Canada
Unitarian Fellowship of Sarnia-Port Huron
Unitarian Congregation of South Peel
The United Church of Canada
Wastewise
Wildlands League
Women's Healthy Environments Network
World Wildlife Fund of Canada
York Region Environmental Alliance



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