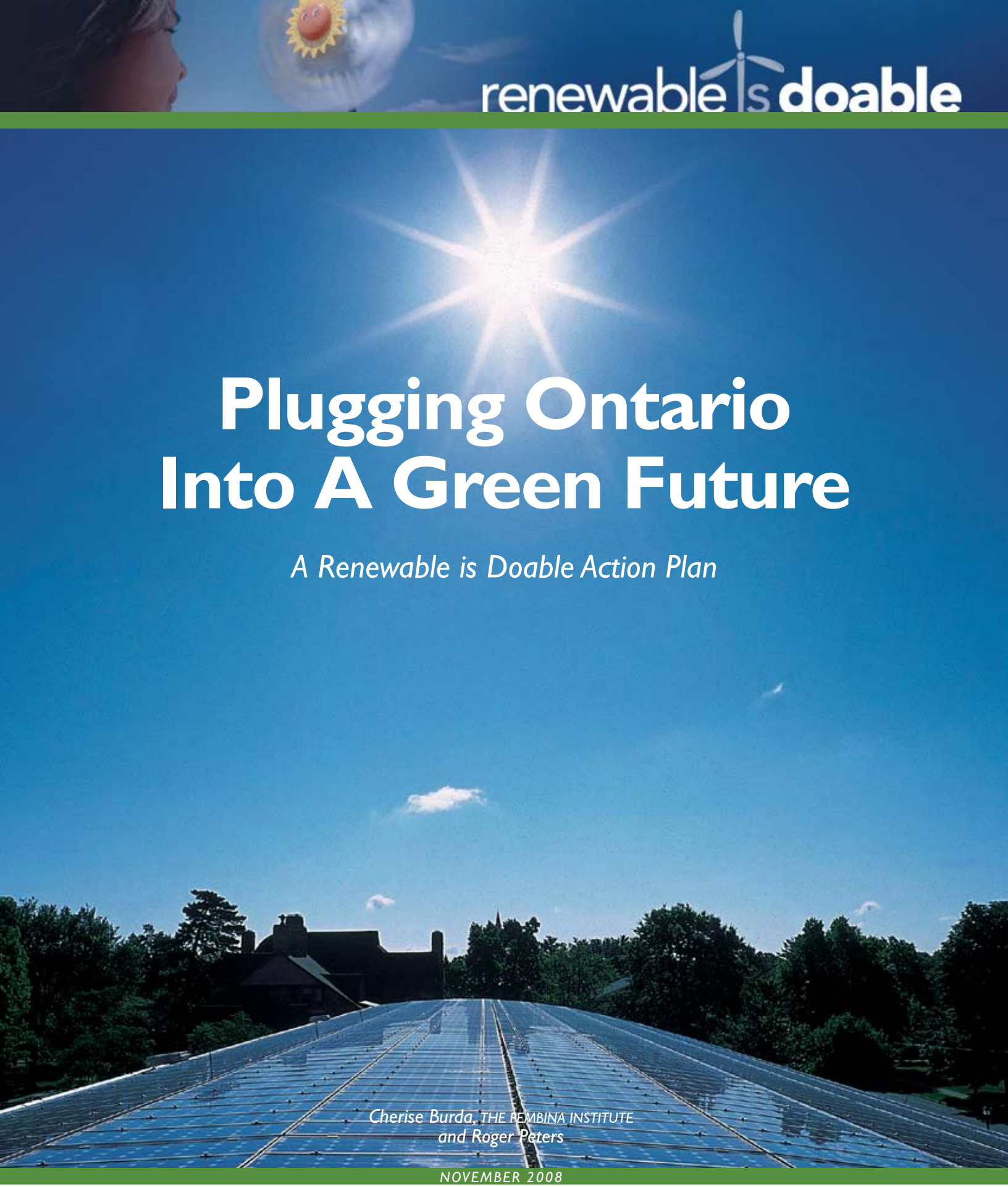
renewable is doable

Plugging Ontario Into A Green Future

A Renewable is Doable Action Plan



Cherise Burda, THE PEMBINA INSTITUTE
and Roger Peters

NOVEMBER 2008

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WWF

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GREENPEACE

Canadian Environmental Law Association
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Sierra Club Ontario

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About Renewable Is Doable

Renewable Is Doable is a joint inititative of the Pembina Institute and World Wildlife Fund. It has now grown to include the David Suzuki Foundation, Greenpeace, Sierra Club and the Canadian Environmental Law Association. For more information about this publication and the Renewable is Doable campaign visit www.renewableisdoable.com.

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Plugging Ontario Into A Green Future

A *RENEWABLE IS DOABLE* ACTION PLAN

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Plugging Ontario Into A Green Future

A *RENEWABLE IS DOABLE* ACTION PLAN

Executive Summary

Ontario's potential for renewable energy is much greater than our energy needs. **The Renewable Is Doable *portfolio is feasible and requires no significant upgrades to the current transmission system.***

On September 17, Ontario Energy Minister George Smitherman directed the Ontario Power Authority (OPA) to "revisit" its 20-year electricity plan to see how the contributions of renewable energy, conservation and distributed generation could be "enhanced". [1]

Plugging Ontario Into A Green Future lays out an action plan for achieving this goal and shows how doing so will assist Ontario in meeting its climate targets and create new green jobs. It also identifies the major barrier to achieving these goals: the province's commitment to nuclear power.

Despite the intent of the McGuinty government's original supply mix directive which set a minimum target for renewable energy, the OPA's electricity plan effectively "caps" the development of renewable energy because of its focus on large, centralized generation stations, particularly nuclear generators.

PHOTO: NATIONAL RENEWABLE ENERGY LABORATORY

The Opportunity

There is a better option: Replace end-of-life nuclear reactors with quick to deploy green energy sources and conservation.

PHOTO: SAULT STE. MARIE WIND FARM. COURTESY WWF-CANADA

INSET PHOTO: PICKERING NUCLEAR STATION. COURTESY OF GREENPEACE

The best opportunity to 'get more green' into Ontario's electricity supply mix is to allow clean, sustainable sources of power to replace ageing nuclear reactors when they reach the end of their operational lives.

According to the OPA, the Ontario government must decide early in 2009 whether to rebuild or replace the Pickering B nuclear station scheduled to come offline in 2013. A similar decision about the Bruce B nuclear station must be made within the mandate of this government as well. [2] However, by framing these two decisions as "either rebuild or replace" nuclear stations, the OPA has failed to consider the option of expanding renewable energy beyond the minimum in the supply mix directive.

Instead, the OPA has given the government an unpalatable choice: rebuild old reactors at high cost and high risk or build new nuclear plants by 2020. Both options increase fossil generation until reactors are refurbished or built, resulting in the risk of higher greenhouse gas emissions.

There is a better option: Replace these aged nuclear reactors with quick-to-deploy green energy sources and conservation.

The **Renewable is Doable** Portfolio

Renewable is Doable presents a portfolio of green energy options which can replace the generating capacity of both the Pickering B and the Bruce B stations as they retire beginning in 2013.

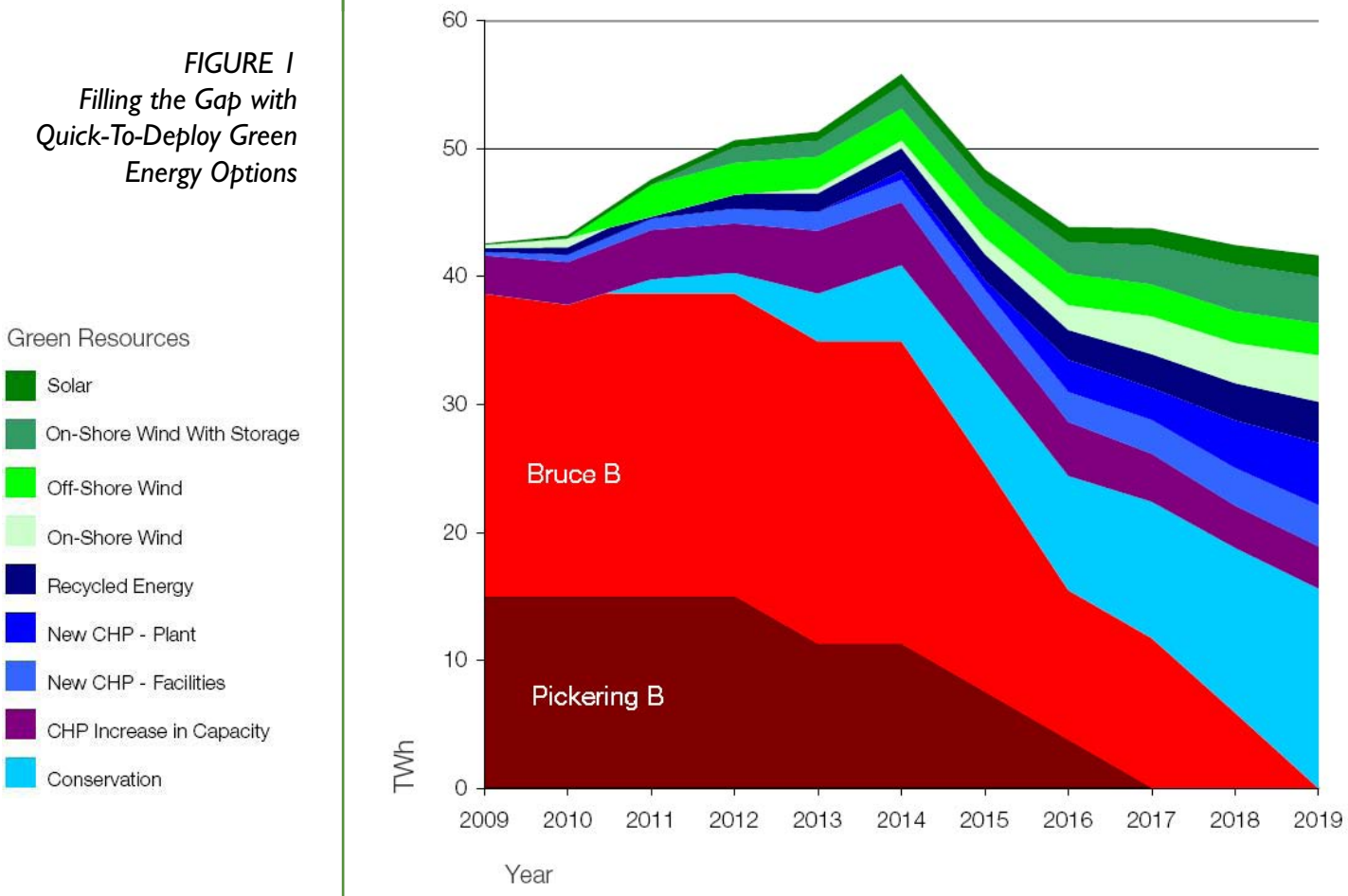
By immediately ramping up clean energy options, Ontario can reduce reliance on natural gas generation and coal-fired imports and avoid the well established pattern in refurbishing old nuclear reactors: cost overruns and lengthy delays.

Figure 1 below shows the schedule for retiring the units at the Pickering B and Bruce B (red and orange wedges) and presents a suite of green resources that can fill this gap. These green resources are in addition to the clean options currently in the OPA plan, demonstrating that Ontario can go far above and beyond what the OPA is proposing for conservation, renewables, Combined Heat and Power (CHP) and other clean, quick to deploy sources.

The portfolio of green resources provides more than enough generation to replace effective baseload capacity.

The portfolio of green resources provides more than enough generation to replace effective baseload capacity.

FIGURE 1
Filling the Gap with Quick-To-Deploy Green Energy Options



A Seven-Step Action Plan for Green Energy

The McGuinty government is serious about expanding green energy in Ontario. To do so, however, it must take the following seven steps over the next 24 months:

REPLACE

Make room for renewables by choosing green power over dirty energy

1 Replace Pickering B and Bruce B nuclear reactors with green power, as these reactors come to the end of their lives over the next decade.

REDUCE

Start first with all cost effective conservation to reduce baseload

2 Direct the OPA to acquire all cost effective Conservation and Demand management (CDM) resources as per the intent of the Supply Mix Directive, rather than treating the minimum target for CDM as a cap. And direct the OPA to change its approach to conservation from going after the "low hanging fruit" to acquiring deep energy efficiency savings as per the recommendations submitted to the Ontario Energy Board hearing on behalf of the Green Energy Coalition.

RENEW

Then increase renewable energy sources

3 Transform the Renewable Energy Standard Offer Program (RESOP) into an effective Advanced Renewable Tariff system (ARTs) to include: prices differentiated by technologies, tiered pricing within technologies, prices set according project costs and reasonable return on investment, 20 year contracts, no caps on project size or the program, and guaranteed access to the grid.

4 Use ARTs as the primary procurement mechanism for renewable energy, empowering all Ontarians to become generators and conservers at a fair price.

5 Direct Hydro One to develop and implement a Smart Green Grid Upgrade Plan which gives renewable energy priority in Ontario's transmission and distribution system. In parallel, enable a regulatory regime that encourages local distribution companies to acquire the technical and financial resources to upgrade their systems to accommodate distributed energy from clean and renewable sources.

6 Embed these items in legislation via a Green Energy Act that includes an obligation for grid connections for green energy.

RECYCLE

Use conventional fuels more efficiently with more CHP and waste heat recovery

7 Implement the Clean Energy Standard Offer Program for cogeneration and recycled energy but without capacity limits and with a feed in tariff that provides a reasonable return for investors.

Part One I

Keeping Ontario's Green Promises

The OPA's current plan relegates new renewable energy to a marginal role.

PHOTO: TEACHANDLEARN ON FLICKR

Introduction

Ontario's Ministry of Energy and Infrastructure recently made a commitment to enhance renewable energy and conservation efforts in the province and directed the OPA to adopt more ambitious targets in these areas.[3]

However, it is not clear at this time how aggressive these new targets for renewable energy will be or where the "space" for more green energy is going to come from within the proposed electricity plan currently before the Ontario Energy Board.

Ontario's existing and projected electricity supply mix is dedicated almost fully to large, centralized power plants such as nuclear, coal and gas plants (as well as hydro).[4] The OPA's current plan relegates new renewable energy to a marginal role in meeting Ontario's electricity needs and leaves no room for green energy, including conservation, to grow beyond the minimum level required by the government's directive.

The Opportunity

The best opportunity to develop a green energy economy in Ontario is to allow these sustainable sources of power to replace ageing nuclear reactors when they are scheduled to shut down beginning in 2013.

To take advantage of this opportunity, however, the Ontario government must forgo the advice of its electricity-planning agency. The OPA has given the government an unpalatable choice: rebuild old reactors at high cost and high risk or build new nuclear plants by 2020. Both options increase fossil generation until reactors are refurbished or built, resulting in the risk of higher greenhouse gas emissions.

The imminent closure of the Pickering B and Bruce B nuclear stations provides space for green energy economy to grow in Ontario. A decision to rebuild or replace these nuclear stations with additional nuclear stations post-2020 will foreclose any significant expansion of green power in the province. OPA's own evidence demonstrates that a higher commitment to energy efficiency requires a reduced commitment to nuclear generation on line in 2018.[5]

To meaningfully and fully develop a green energy economy in Ontario, the provincial government should take advantage of the near-term closure of Ontario's nuclear stations to make space for renewable energy to grow, creating a ready market for new green economic development.

Ontario could fall short of meeting its GHG reduction targets if it continues to depend on ageing nuclear power plants in the hope that they will operate better than they have in the past.
PHOTO: CLIPART

Averting GHG Pollution

This approach would also ensure that Ontario maintains its targets to reduce greenhouse gas (GHG) pollution. The province could fall short of meeting its GHG reduction targets if it continues to depend on ageing nuclear power plants operating better than they have in the past.

Should the operational problems and delayed refurbishments that have plagued nuclear reactors in the past fifteen years persist over the next decade, the result will be more – not less – GHG pollution. The problem stems from the OPA's plan to replace any shortfall in nuclear generating capacity by burning more natural gas in inefficient centralized plants and importing more coal-based power from the U.S.[6] The Province's promise to phase out coal could be compromised even if the nuclear fleet is able to match its less than stellar performance of the last 15 years when it was plagued by operational problems, delays and cost overruns.

This report presents a short-term suite of feasible green energy options to effectively replace the generating capacity of both the Pickering B and the Bruce B stations. By immediately ramping up clean energy options, Ontario can ensure enough power online by 2014 to ensure the phase-out of coal, reduce reliance on centralized gas generation and imports, and avert the delays and cost overruns of refurbishing old reactors.

The Case of Pickering B

The four reactors at the Pickering B nuclear station are scheduled to come offline between 2013 and 2016. In 2009, the government must decide whether or not it risks rebuilding the four Pickering reactors or closes them permanently.

In its long-term electricity plan, the OPA provides contingencies if Pickering B cannot be refurbished: increasing fossil generation or trying to run the ageing reactors longer until new replacement reactors can be built by 2020.

Figure 2 illustrates how GHG emissions fall dramatically in 2014 due to the anticipated coal phase-out but rise again in the event that Pickering B is not refurbished. This is because of a heavily fossil-dependent plan created for that scenario whereby increased natural gas generation and fossil-based imports replace the capacity of Pickering B.[7]

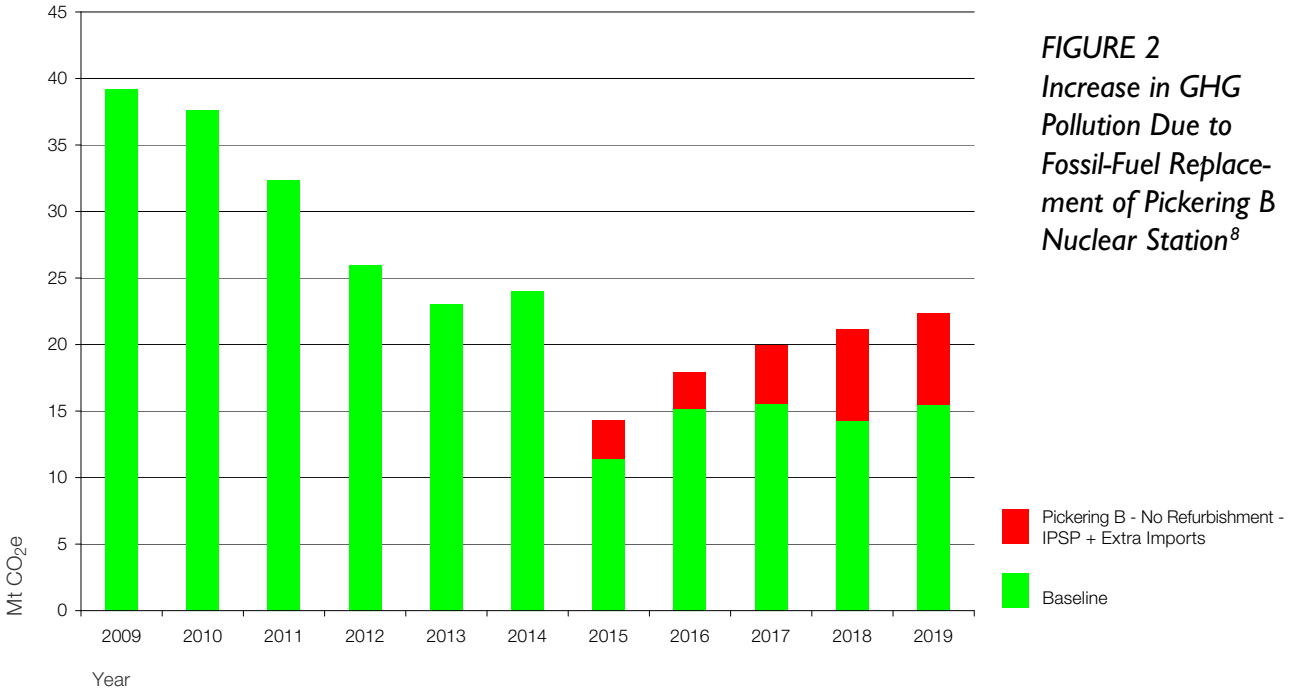


FIGURE 2
Increase in GHG Pollution Due to Fossil-Fuel Replacement of Pickering B Nuclear Station[8]

The Case of Bruce B

The four reactors at Bruce B nuclear station are scheduled to begin shutting down for life-extension repairs or permanent closure in 2015, the year after the coal phase-out date.

The OPA's plan does not include a contingency if life extension repair is not an option and Bruce B is shut down. Yet, if this is the case, developing replacement generation would need to begin now.

In 2006, Bruce Power claimed it could build new reactors quickly enough to replace the ageing Bruce B reactors beginning in 2014.[9] In 2007, however, the OPA plan assumes: "... the earliest in-service date for new nuclear generation is 2018."[10]

An early decision to close all the four Bruce B reactors at the end of their life provides an opportunity to immediately take the cap off of renewable energy development in the Bruce area, which is currently limited to 700 MW[11] because of the priority given to Bruce Power on transmission lines. The Bruce region has one of the greatest potentials for cost-effective wind development in the province.[12]

The OPA's assumption that Ontario's ageing nuclear fleet will perform better in the future is unrealistic.

Increasing GHG Emissions

The OPA's optimistic assumption that Ontario's nuclear fleet will perform significantly better in the future than it has in the past is shown in Figure 3 below. This is very optimistic given that there will be no new reactors built for at least a decade. Therefore, the OPA is assuming that the performance of existing reactors will improve significantly as they age, in spite of their past history.

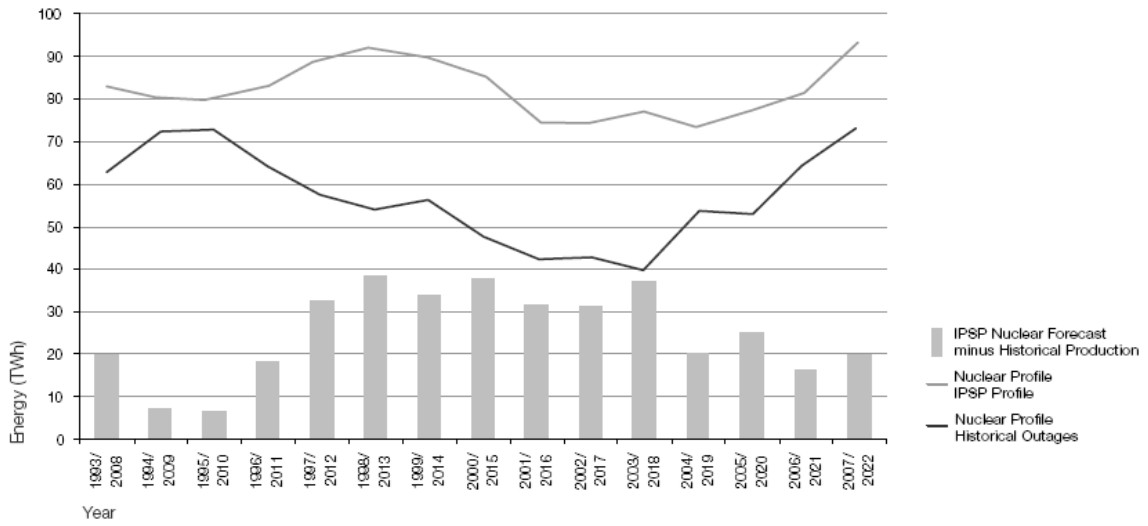


FIGURE 3
Comparison of the Historical Nuclear Production with the IPSP Nuclear Forecast[13]

In response to questions from interveners in the Integrated Power System Plan hearing currently before the Ontario Energy Board, the OPA modelled what would happen if future nuclear performance matches past performance. The result was that the amount of energy generated from Ontario's reactors would be roughly 30% lower than predicted between 2009 and 2019.

Consequently, any nuclear generation shortfalls over this period – whether it be from refurbishment delays or operational shortcomings – will be replaced by increases in both gas-fired generation and coal-based imports from the U.S. The resulting GHG emissions due to applied historical nuclear performance are presented in Figure 4 below.

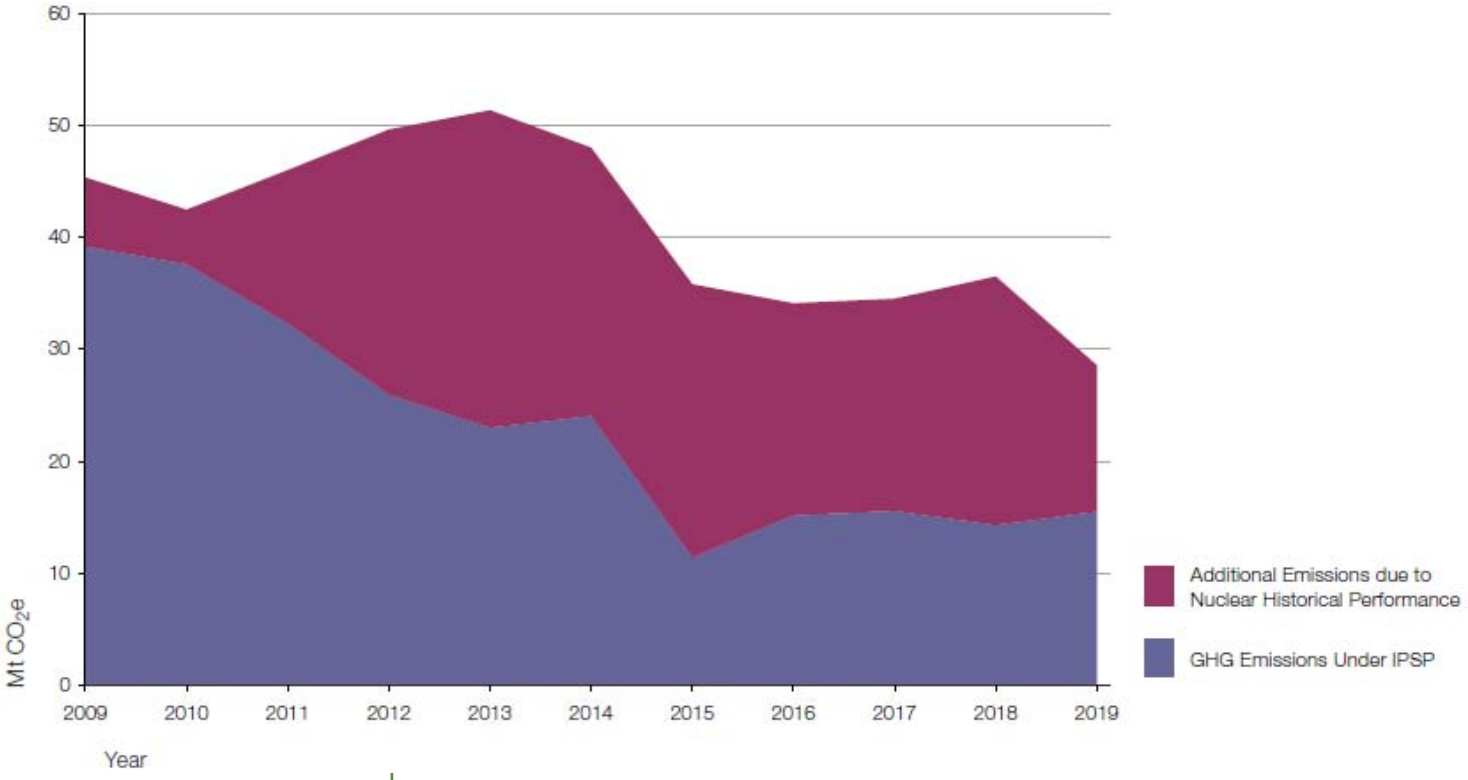


FIGURE 4
Increase in GHG Emissions in Ontario Under the OPA Electricity Plan with Applied Historical Performance of Nuclear Reactors[14]

Falling Short of Ontario's GHG Emission Reduction Targets

The OPA's plan forms the basis of the province's greenhouse gas emission forecasts as presented in Ontario's *Go Green Climate Action Plan*. If these overly optimistic assumptions are wrong, Ontario will fail to meet its GHG targets.

In fact, according to this modelling, GHG emissions from the electricity sector in 2014 would increase by 26MT – that's one-third of Ontario's entire Go Green GHG emission reduction target of 61MT and an amount equivalent to all the GHGs produced by Ontario's residential and agricultural sector in 2004.

Even though Ontario has passed a regulation to phase out coal, this effort may be undermined by "outsourcing" coal generation elsewhere (importing coal-based imports from the U.S.) and by burning more natural gas here at home. An additional 26MT of GHGs would also negate the positive benefits of phasing out coal, which is expected to eliminate 28MT by 2014.

At worst, significant delays and cost overruns in rebuilding old nuclear reactors could put the coal phase-out date in jeopardy. In 2005, for example, the refurbishment of Pickering A was finally abandoned after the costs reached four times the original estimates;[16] in 2005, the Province broke its promise to phase out coal in 2007. The subsequent promise to phase out coal in 2009 was broken in 2006.[17]

Crowding Out Green Options

The Ontario government's *Supply Mix Directive* has set minimum targets for conservation and renewable energy.[18] The OPA's plan clearly interprets the directives as maximums and places limits on both CDM and renewable energy.[19]

In addition, the OPA plan and its current slate of CDM programs are focused on reducing peak demand in the summer rather than addressing the potential to reducing baseload requirements. Reducing baseload has significant additional customer and environmental benefits through lower overall energy consumption, but it also reduces peak demand.

The OPA also interpreted the directive's maximum of 14,000 MW of nuclear capacity as a target resulting in a plan for Ontario's grid – transmission and distribution – designed around these minimal roles for CDM, renewable power, and combined heat and power, and a maximum role for nuclear power. Analysis of grid development in other countries confirms any power system based on nuclear power is so highly centralized that it effectively precludes distributed energy sources from ever becoming major power sources.[20]

The OPA imposes a "nuclear ceiling" over green energy and conservation industries in Ontario.

Thus, the OPA's plan effectively imposes a "nuclear ceiling" over the renewable energy industry in Ontario, sending a message to the market that opportunities for renewable and conservation industries in Ontario are limited. Already, renewable energy developers have left Ontario to invest elsewhere.[21] CHP projects in Ontario have been abandoned and significant investment has been lost due to the delay and continuing uncertainty surrounding the Clean Energy Standard Offer Program (CESOP) that the Minister of Energy asked the OPA to develop in August of 2005.

The Minister of Energy and Infrastructure's most recent directive asks the OPA to increase the amount and diversity of renewable energy sources in the supply mix. The only way to do this is to make room for significant expansion of renewable energy via the permanent retirement of these old reactors and allowing them to be replaced with green energy.

The amendment also asks the OPA to consider the viability of accelerating the achievement of stated conservation targets, but not increasing conservation and energy efficiency to its maximum potential.

Getting More Green in the Mix

The Independent Electricity System Operator has already noted that the OPA's current plan already has a problem of too much "baseload" production at times of low demand.[22] This creates a further disincentive for comprehensive conservation because the existing plan may already require nuclear plants to be turned off at various points during the year, which is difficult and risky to do quickly. The only way to lift the cap on conservation is to make room for its expansion as a baseload energy source by reducing baseload, i.e. nuclear sources elsewhere.

The province must choose between green energy and nuclear.

So ultimately, the province must choose between green energy (conservation/ renewables/ CHP) and nuclear. Given the cost overruns, performance problems, refurbishment delays and consequent GHG emission increases, and life extension risks associated with nuclear power, the greener choice is the better choice.

This report presents a portfolio of clean, reliable quick-to-deploy energy options that the province of Ontario should aim to have in place by 2014 in time for both the retirement of these nuclear reactors and the phase-out of coal and up to 2019 – effectively filling the gap period between the retirement of old reactors and the proposed building of new reactors.

Ontario can ensure enough green power online by 2014 to guarantee the phase-out of coal, reduce GHG emissions, and avert the delays and cost overruns of refurbishing old reactors.

It's a smart, sensible solution. And it's doable.

This *Renewable Is Doable* portfolio shows how green energy sources can address Ontario's electricity needs and obligations to fight climate change where nuclear energy cannot.

We do not want to find ourselves in a situation where the province cannot meet its climate commitments or has to break its promise to phase out coal for a third time.[23] Clearly, Ontario needs a better short-term energy strategy to ensure the following:

- Provide the base for long term development of renewable power sources
- Decrease dependence on natural gas and coal-based imports;
- Ensure that Ontario meets its climate commitments.
- Guarantee the phase-out of coal; and,
- Guard against uncertainties;

Choosing to "get more green" into the energy supply mix will foster serious investment in, and development of, the renewable energy and energy efficiency industry and help diversify Ontario's energy mix.

By immediately ramping up clean energy options, Ontario can ensure enough power online by 2014 to guarantee the phase-out of coal, reduce reliance on inefficient centralized gas generation and imports, and avert the delays and cost overruns of refurbishing old reactors.

It's a smart, sensible solution. And it is doable.

Part Two 2

The Renewable Is Doable Portfolio: Reduce. Renew. Recycle.

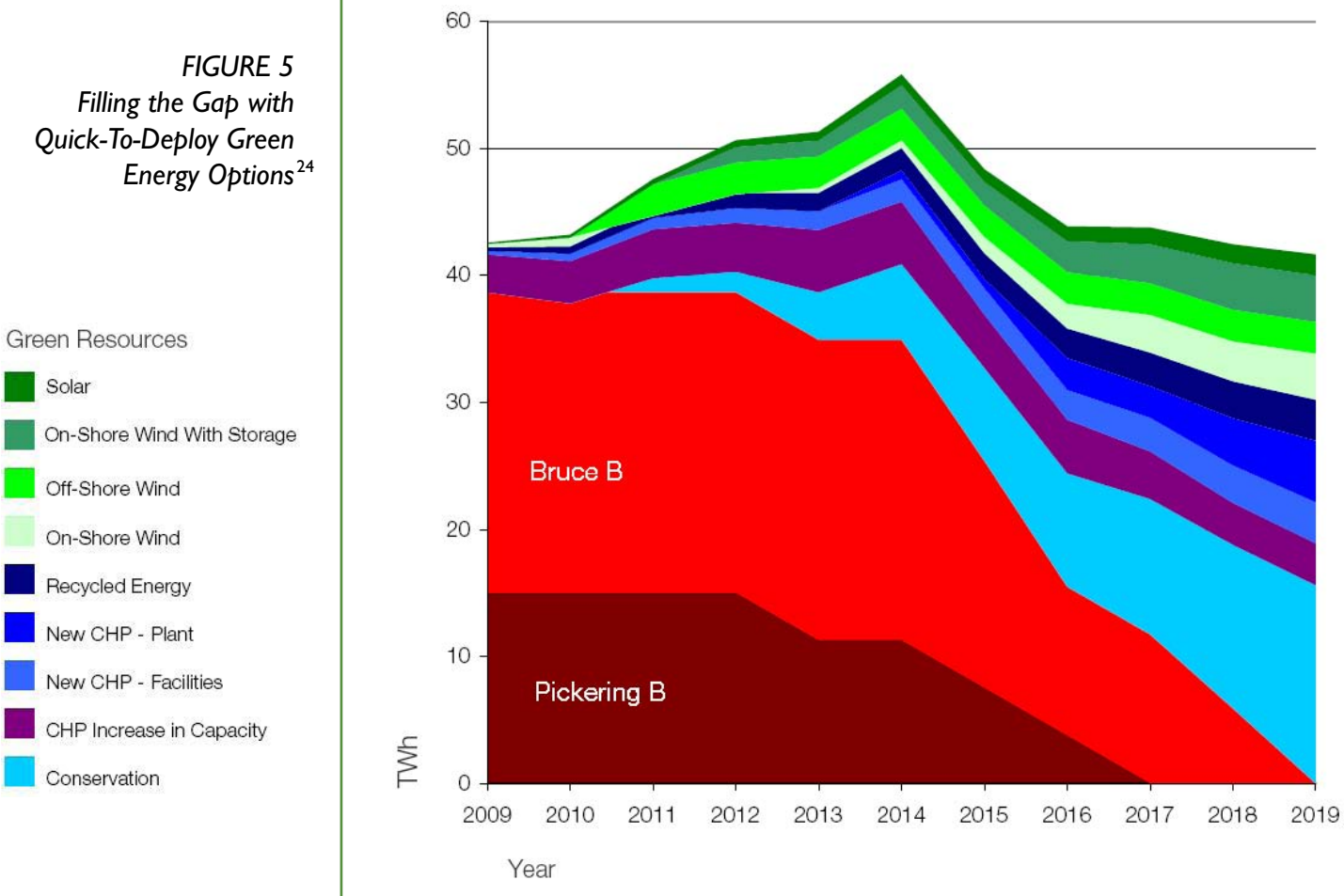
Introduction

The following scenario shows that it is possible to replace ageing baseload nuclear facilities with a diversified mix of low-carbon and safe energy options.

The benefits of such a portfolio are broad: developing a green energy industry, developing green jobs in communities across the province and diversifying supply.

Figure 5 illustrates the gap in power production created as Pickering B and Bruce B (in red and orange) come offline beginning in 2013 and presents how clean options fill this gap. The graph shows that the portfolio provides more than enough generation capacity to replace effective baseload capacity.

FIGURE 5
Filling the Gap with Quick-To-Deploy Green Energy Options[24]



The McGuinty government has set relatively ambitious conservation and green energy capacity targets until 2010 but the OPA's electricity plan reigns in the development of conservation and renewables after 2010 to leave space for nuclear projects with long lead times.

Renewable Is Doable, however, builds on the government's achievements and ramps up clean energy options.

This portfolio of clean options is in *addition* to the clean options currently in the OPA plan, demonstrating that Ontario can go far above and beyond what the OPA is proposing for conservation, renewables, combined heat and power and other clean, quick to deploy sources. In fact, *Renewable Is Doable* provides an extra small cushion of green power to provide options to avoid some of the expensive natural gas generation in OPA's plan.[25]

A number of recent expert studies suggest far greater economic potential for energy efficiency, combined heat and power and renewable energy can be realized, allowing even more of the Province's future power demands to be met from these sources.[26] In fact, the *Renewable Is Doable* portfolio may be considered moderate in comparison to what is actually possible.

For example, the Alliance for Clean Technology (ACT) identified a potential for 11,400MW of CHP in Ontario.[27] The *Renewable Is Doable* portfolio, while proposing to increase over that planned by the OPA, calls for a total 2831MW of installed CHP – less than 25% of the identified potential.

Table 1 summarizes the total amount of *additional* clean options that can be online by 2014 and 2019 according to *Renewable Is Doable*.

TABLE 1
*The Renewable Is Doable Portfolio of Additional Green Resources***

Supply Source Online	By 2014		By 2019	
	TWh	Peak MW	TWh	Peak MW
Reducing Consumption and Demand with Conservation and Energy Efficiency	7.2	1367	17.9	3859
Recycled Energy and Waste Heat Recovery	1.8	285	3.2	523
Industrial and Plant CHP	5.5*	122	8.3*	828
Building Scale CHP	0.6	120	0.9	243
Wind – Onshore	0.6	-67	3.6	159
Wind – Offshore	2.5	188	2.5	188
Wind with Storage	1.8	195	3.7	390
Solar	0.9	722	1.6	1397
TOTAL	21.0	2932	41.7	7586

* *Industrial and Plant CHP includes TWh gained from building additional CHP plants and from increasing the capacity factor of CHP plants (existing, contracted and planned) from 41% to 67%.*

** *The complete Renewable is Doable data and spreadsheets can be found at www.renewableisdoable.com.*

Renewable Is Doable involves tapping into efficiency, fuel switching and conservation resources already identified as cost-effective by the OPA. It also involves using natural gas more efficiently in combined heat and power plants, rather than in large peaking plants and taking advantage of high temperature "recycled" heat from industry to produce power that requires no extra fuel costs or GHG emissions.

The *Renewable Is Doable* portfolio meets the following criteria:

COST-EFFECTIVE

Economic modelling done for the Ontario Energy Board hearing on the IPSP found that a green portfolio would be up to 24% less expensive than the nuclear-dominated IPSP.[28]

QUICK TO DEPLOY

More than 20 TWh/yr of additional demand reduction and supply can be online by 2014 to fill the gap, ramping up to at least 41 TWh by 2019.

CLEAN

The portfolio reduces GHG emissions and other pollution, as well as environmental and health costs associated with fuel acquisition from traditional sources.

MARKET READY

Developers and other stakeholders are interested and ready to produce and market supply.

Start first with all cost effective conservation to reduce baseload

REDUCE

Even before investing in new green energy supplies, it is essential that energy is used wisely and efficiently. Energy efficiency, conservation, fuel switching and demand response not only reduce peak demand but can also permanently reduce baseload demand, essentially generating "new supply."

Energy efficiency means using more efficient products like Energy Star refrigerators and fluorescent lamps so that it takes less energy to do the same job. Conservation means being more careful with energy e.g., making sure lights are off when not needed or making sure energy-using equipment is well maintained.

Fuel switching is using an alternative fuel such as natural gas or solar energy to meet our heating needs instead of electricity. Utilities and governments can use a combination of incentives, regulations and other measures to help customers make the right choice.

Demand response is the use of pricing, incentives and other measures to encourage customers to switch power-using activities to off peak times. Smart meters are used to provide the necessary information to customers, or customers agree to have the power load limited at peak times.

Conservation and Demand Management	2014		2019	
Efficiency/Conservation	**TWh/yr**	**Peak MW**	**TWh/yr**	**Peak MW**
Renewable Is Doable Portfolio	14.0	2613	26.2	5314
OPA	8.8	1675	12.3	2424
Additional	5.2	938	13.9	2890
Fuel Switching	**TWh/yr**	**Peak MW**	**TWh/yr**	**Peak MW**
Renewable Is Doable Portfolio	6.2	206	9.2	397
OPA	4.2	139	5.2	194
Additional	2.0	67	4.0	203
Demand Response	**TWh/yr**	**Peak MW**	**TWh/yr**	**Peak MW**
Renewable Is Doable Portfolio	0.1	1090	0.2	1640
OPA	0.1	728	0.2	874
Additional	0.0	362	0.0	766
TOTAL	7.2	1367	17.9	3859

TABLE 2
Conservation and Demand Management (CDM) for 2014 and 2019

PHOTO: ALEXIS BIRKILL ON FLICKR

Renewable Is Doable proposes to mobilize 75% more energy efficiency, conservation, fuel switching and demand response by 2019 than the OPA's current plan. This is well within the cost-effective range estimated by consultants.

First, OPA's own studies shows the achievable and cost-effective potential for 10,000 MW of savings in 2020 via CDM (including on site generation[29]), yet only 6300MW (by 2027) has been accounted for in the IPSP – as that was the minimum required to meet the government's directive.[30] No technical or market reasons are given for limiting CDM to 6300 MW, and there is strong evidence supporting the achievability of this full potential,[31] so Renewable Is Doable starts with utilizing that full potential.

In addition, the OPA's Robustness Study, Case 3A and 3B, shows that by adding 50% of additional conservation resources up to 3200 MW of new supply could be eliminated.[32] The option clearly exists to maximize attainable demand management resources that are cheaper than all other supply options.

Finally, separate analyses of energy efficiency and fuel switching potential by ICF (2006)[33], Marbek (2006)[34], MKJA (2006)[35 36] and The Pembina Institute (2004)[37] show that with the right policies and an objective to achieve as much cost-effective CDM as possible, even higher potential savings could be achieved. The savings can also be achieved much faster than the OPA is proposing and would address both baseload and peak demand reductions.

Renewable Is Doable's proposal to achieve 17.9 TWh/yr of additional CDM by 2019 through energy efficiency, fuel switching and demand response has received additional confirmation from a new report from the Vermont Energy Investment Corporation (VEIC) that this is definitely doable.[38] VEIC has analyzed the broader market and sector growth potential for CDM in Ontario and concludes that we can go much further than the OPA's 6300 MW cap.

The VEIC report studies CDM potential and success in other jurisdictions and concludes that Ontario is in an excellent position to achieve comparable (if not better) results.[39] Ontario has an established conservation bureau, a RESOP program and a favourable market and investment climate. Their study concludes that with a relatively unaggressive approach, Ontario can achieve an additional 22 TWh of CDM (including small-scale on-site generation) savings by 2019 over what is currently planned by the OPA. This is approximately twice the CDM than the OPA has planned and 23% more than the OPA identified as potential.

By including the *Renewable Is Doable* recommended additional on-site generation of 0.9 TWh from micro-turbines by 2019 (see Section 3.2.3) to the proposed additional 17.9 TWh for efficiency, fuel switching and demand response, Renewable Is Doable's comparable CDM portfolio provides 18.8 TWh of additional demand side savings – very close to the VEIC medium estimate on the conservative side.

CDM Is Cost-Effective

The OPA's plan estimates that spending $7 billion on conservation programs over the next 20 years will eliminate a cost of $15.9 billion to build and run generators and transmission capacity that otherwise would have been used – a savings of $2.27 for every dollar spent on conservation.[40] Conservation savings are achieved at an average cost of less than 3 cents/kWh.[41] Increasing the contribution of conservation programs up to their cost-effective limits would therefore not only reduce demand but also save Ontarians billions of dollars.

The cost-effectiveness of demand-side resources improves with any increase in supply-side costs such as nuclear and natural gas. Recent evidence points to much higher construction and fuel costs for nuclear power[42] leading to costs for new nuclear of 14.2 cents/kWh, compared to 11.7 cents/kWh for combined cycle gas turbines and 10.1 and 10.5 cents/kWh for onshore and offshore wind (respectively).[43] The potential for cost savings via efficiency, fuel switching and demand management are therefore even greater by comparison.

Many jurisdictions set their targets to achieve all cost-effective demand side resources through market transformation – taking steps to make sure that all inefficient equipment and practices are replaced.[44] To achieve this market transformation, the Government of Ontario should direct the OPA to achieve greater savings. In Vermont, similar actions led to enough electricity savings sufficient to turn load growth negative.[45]

Moreover, energy efficiency and conservation will significantly improve the province's economic competitiveness as well as create many jobs across the province. In 2006, the United States energy efficiency industry had nearly $1 trillion in revenues and provided 3.5 million direct jobs and another 8 million indirect jobs.[46] A recent study by the American Council for an Energy-Efficient Economy (ACEEE) reports that by adopting energy efficient strategies, Florida will save $28 billion, offset the state's entire future growth in electric demand by 2023 and create more than 14,000 jobs in 2023.[47]

CDM Is Quick to Deploy

Energy efficiency improvements do not require the building of new electricity generation sources, transmission lines and natural gas facilities. They can be deployed in all parts of the province by a wide variety of professions and trades, creating employment in all regions (see below).

The only limit to the deployment of efficiency and fuel-switching measures is the stock turnover rate (how often something needs to be changed). The life of most equipment is less than 20 years and, on average, homes and commercial buildings are renovated every 10 years. Even after that, new technologies, processes and codes and standards will continue to deliver additional energy savings not conceived of today. California has been implementing conservation programs since 1975 and continues to still lead the way.[48]

Conservation Is Clean

Energy efficiency improvements are the lowest cost option to reduce greenhouse gases (GHG) and meet the province's climate protection goals.

CDM Is Market Ready

The OPA laid out its plans for CDM (Conservation Demand Management) in IPSP Discussion Paper No. 3 in 2006. The stated objective was to acquire the maximum cost-effective CDM resources through programs that focused on market transformation, building CDM capacity and direct resource acquisition. However, as noted above, the OPA is only pursuing 65% of the CDM potential it has identified as cost-effective and market ready.

As noted above, many other jurisdictions in North America and Europe have set significant "stretch" targets for energy efficiency and are implementing market transformation programs that demonstrate international confidence in an energy efficiency market that is both large and ready to be tapped. California has and is still leading the way.[49]

Making It Happen

Energy efficiency, conservation and demand management are the most cost-effective energy supply option. However, a number of factors impede the OPA from reducing energy demand and generating maximum "new supply" via conservation and efficiency.

The Supply Mix Directives to the OPA set quite modest targets for CDM and encouraged OPA to focus on reducing peak demand. The current OPA target for CDM is therefore interpreted by the OPA as a ceiling and precludes the full potential for long-term energy efficiency and conservation programs that result in significant permanent reductions in baseload demand. Moreover, the focus on peak reduction decreases the opportunity to reduce greenhouse gas emissions, which are produced by hours of use, not peak use; put another way, they decrease the required peak capacity, but not the overall power produced. Focusing on one dimension of energy benefits – peak reduction – misses opportunities to transform markets and build capacity.[50]

The Supply Mix Directive for CDM needs to be interpreted as a minimum target, rather than as a cap to maximize the acquisition of all cost-effective CDM resources. These minimum targets need to be increased to the achievable and effective long-range potential identified by current studies.

The Government of Ontario must play a major role in ensuring that all cost-effective energy efficiency, fuel switching and demand response opportunities are taken. It must develop a comprehensive action plan to transform all energy end use markets in Ontario and build the capacity to deliver this plan through the OPA and a wide variety of other channels.

While the OPA describes the importance of building capability to deliver efficiency and having long-term market transformation plans in place to ensure all cost-effective efficiency is realized, this is not reflected either in its Plan or the current CDM portfolio. In particular, the OPA plan ramps up CDM quite aggressively to 2010 and then shows a steady decline, thereby prohibiting the opportunity for real and effective market transformation to take place.[51]

The *Renewable Is Doable* portfolio and the VEIC study referenced above propose a sustained level of CDM development and acquisition, which results in greater, not fewer, savings after 2010. Therefore, market transformation programs are necessary, along with the hiring of necessary staff and expertise from other jurisdictions to implement these programs.

Another factor limiting the use of efficiency resources is the lack of coordination of conservation efforts in the province among the various energy forms and players in the market place: governments of all levels, agencies, utilities, training organizations and trade associations.

By choice, the OPA and the Chief Energy Conservation Officer focus on electricity CDM although end-uses employing other fuels or water systems all consume electricity as well.

A complete list of recommendations for CDM development in Ontario is presented in Appendix 2.

RENEW

Increase renewable energy resources

Wind Power

The *Renewable Is Doable* portfolio proposes accelerating the deployment of wind power so that a **total** of 8000 MW are in place by 2019. This is within the bounds of the Ontario Wind Integration study cited by the OPA, which states:

> *The results of the regulation analysis show that the incremental regulation required to maintain the current performance is small.... [W]e believe that the impact on regulation of 10,000 MW of wind generation by the year 2020 is modest and can be accommodated with little or no changes to existing operating practices. (OPA Exhibit D-5-1, Attachment 2, p. 74)*

Renewable Energy	2014		2019	
Onshore Wind	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio	3250	8.0	5750	12.9
OPA	3005	7.4	4270	10.5
Additional	245	0.6	1480	3.6
Offshore Wind	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio	750	2.5	750	2.5
OPA	0	0	0	0
Additional	750	2.5	750	2.5
Wind with Storage	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio	750	1.8	1500	3.7
OPA	0	0	0	0
Additional	750	1.8	1500	3.7
Solar PV	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio	900	0.9	1650	1.7
OPA	88	0.1	88	0.1
Additional	812	0.9	1562	1.6

TABLE 3
Renewable Power Sources for 2014 and 2019

This wind farm near Sault Ste. Marie was built on-time and on-budget, and now produces enough power for 40,000 homes.

PHOTO: WWF-CANADA

The portfolio proposes that the installed total of all wind resources grow by a rate of 500 to 750MW per year from 2011 onwards. This is in line with the OPA's current installation rate for wind[52] but continues well beyond OPA's planned "ceiling" of 5000 MW. To provide a diversity of wind resources that has the flexibility to meet varying demand, we propose the following mix by 2019:

- **Onshore Wind Farms**: A total of 5750MW of regular onshore wind is acquired at current annual acquisition rates.
- **Offshore Wind Farms**: A total of 750MW of offshore wind is acquired, in-line with current proposals.
- **Wind Farms with Storage**: An additional 1500MW of onshore wind are installed with storage to all the energy to be dispatched as needed.

This amount of wind resource is feasible and prudent and can be achieved by building on the current Ontario market and emulating successes in other countries. As of 2007, both Germany and Denmark generate close to 15% of their annual electricity from wind. On a particularly windy day in March 2008, Spain reached a point where 40% of its power was coming from the wind.[53]

OPA's own assessments of onshore wind potential within close proximity to existing transmission corridors is 22,000 MW.[54] Recent studies of offshore wind in the Great Lakes indicate that there is another 35,000 MW of potential at capacity factor 50% better than onshore sites.[55] There is also considerable interest in Great Lakes wind in the U.S. States south of the lakes,[56] and there are already plans for an offshore wind farm off of Prince Edward County.[57]

Currently Ontario has 1650 MW of wind generation in place or under contract with an additional 5000 MW of capacity in the Hydro One queue for a connection impact assessment.[58] However, OPA's Plan only includes the purchase an additional 3000 MW of new wind over the next 20 years at a relative slow rate with very few additions beyond 2018. Its very modest plan is based on its assumption that no more than this level is needed to meet the government's Renewable Energy Directive, and any more is not cost-effective compared to its comparison of the long run levelized unit cost of wind with its overly optimistic assumptions of the cost of new natural gas and nuclear energy.[59]

Adding 2 MW of storage with five to eight hours of capacity to every 10 MW of wind can turn a wind farm's variable output into firm delivered power. Storage technologies will add up to 40%[60] of the cost of wind, but storage can be installed in small increments providing flexibility and manageable cash flow.

Storage has three benefits:

1. Overcoming the problem of predicting the temporal behaviour of wind farms allowing day-ahead contracts;[61]
2. Improving quality of power fed into the grid; and
3. Sizing grid connections to average rather than peak output.

Other innovations that are making integration easier include the following:

- New wind power generators that are more "grid friendly" and produce higher quality power;[62] [63]
- Improved weather forecasting and prediction of power output from renewable power sources; and
- Regulatory reform based on the use of new smart grid control technologies.

Solar Power

Renewable Is Doable proposes as a minimum adding 150 MW of solar power per year, both roof mounted and green field projects, or an installed capacity of 1650 MW in 2019.[64] CANSIA has presented evidence in the OEB Hearing on the Integrated Power System Plan that 3,754 MW to 5,343 MW of solar capacity could be reached in Ontario by 2019.[65]

Solar power is poised to be the future for electricity.[66] In 2006, global investment in solar PV was $20 billion with Germany and the U.S. leading the way. Analysts predict that cost reductions will result from mass production and innovation and make solar PV cost competitive with grid electricity in many parts of the world by 2014.[67]

The OPA's Plan proposes to acquire only 88 MW of large scale solar PV and another 100 MW of on-site (roof top) generation by 2027 – far less than the 1000 MW Germany installed in one year (2006) and less than the 700 MW of solar PV contracts already signed in Ontario under RESOP.[68] Rapid deployment of Solar PV will play a major role in meeting Ontario's increasing summer peak.

Private solar collection site in Toronto. The Renewable is Doable plan keeps solar installation rates in line with those achieved through the RESOP program.

PHOTO: HOLLY PAGNA ON FLICKR

Wind and Solar Can Be Cost-Effective

If more realistic estimates of the cost of natural gas and nuclear power are taken in to account, much more that the 5000 MW of onshore wind capacity proposed by OPA would be cost-effective – particularly in the future.

And while the cost of offshore wind and wind with storage will be higher than conventional wind, higher capacity and peak effectiveness factors will more than compensate.

Solar PV technology costs are expected to show a rapid decline in cost by 2014. It can play a major role in meeting Ontario's peak demand if a strong industry is built in Ontario, and policies are put in place to build the distribution infrastructure to accommodate significant solar capacity.

Wind and Solar Are Quick to Deploy

Wind and solar power systems can be deployed in sizes from a few kW to hundreds of MW. In all cases, installation can be achieved in months.

Wind and Solar Are Clean

Wind and solar power systems produce no emissions during operations and have low life-cycle impacts. Siting issues must be dealt with effectively and fairly, but there are many sites where large wind and solar capacity are acceptable, particularly in smaller or offshore applications.

Wind and Solar Are Market Ready

Onshore wind technology is market ready and already into its second or third generation of blade, mechanical systems and grid friendly power generation technologies. Offshore wind has been demonstrated in several key areas and will be fully market ready very soon. Power storage is now being commercialized and promises to be fully market ready in a few years. Solar PV technology and grid interconnection systems are well developed and market ready. Major cost reductions will come through market expansion and economies of scale.

Community solar rooftop installations such as WISE in Toronto provide a smaller-scale community based approach to increasing the installed solar base.

PHOTO: WWF-CANADA

Making It Happen

It has been shown that Ontario's potential for renewable energy is much greater than our energy needs and certainly exceeds the 10-year portfolio proposed in Renewable Is Doable. The Renewable Is Doable portfolio is more than feasible and requires no significant upgrades to the current transmission system; however, it does require some policy modification to improve access to the grid for distributed renewable energy.

To realize the full potential of renewable energy, Ontario's Renewable Energy Standard Offer Program (RESOP) needs to be reformed to allow for maximum uptake. The RESOP should become the primary acquisition vehicle for all renewable power in Ontario. This involves removing all caps and restrictions from RESOP and implementing advanced renewable tariffs (ARTs) – a pricing system that differentiates technology, scale, location and type of generation[69] in particular removing bottlenecks and improving access to the grid.

Germany installed 5 times more solar in 2006 than Ontario plans to install over the next 20 years.

PHOTO: MISSISSAUGA WATER TREATMENT PLANT, COURTESY REGION OF PEEL

Lack of access to the grid for renewable energy developers needs to be addressed in order for the province to meet its own renewable targets – and to go beyond these targets and achieve what is actually doable. Germany's EEC (Green Energy Act) provides a model for legislation that mandates priority access to the grid for renewable and distributed energy, with an obligation to connect and interconnect costs put in the rate base.[70]

Moreover, the retirement of Bruce B presents and opportunity for the Ontario government to develop and commit to a green energy plan for replacing the ageing Bruce B nuclear station, which starts going offline in 2015, by unlocking priority access to nuclear stations to the transmission corridor. The Bruce region has the best potential for wind development in southern Ontario; however wind development is severely limited in the region since transmission in the region is already at capacity.[71] Studies show that there is tremendous potential for wind development in the Bruce region (1421MW[72]), and this potential could be realized without the need for new transmission lines. The closure of Bruce B would make space for over 3000MW of transmission available for renewable energy.

Renewable Is Doable offers a suite of green energy options that

Needed: A Smart Green Grid

require only minimum modifications to the grid in the short term. However, a longer-term strategy for both green energy and a green economy requires a roadmap for a smart green grid that can accommodate greater levels of renewable energy distributed throughout the province.

Recent reports by the California Independent System Operator and California Energy Commission provide excellent models of a Green Grid Road map.[73] A Green Grid has the following features – all of which are already being used in other jurisdictions:

- better coordination of variable power sources with flexible power sources such as combined heat and power and hydro;
- increase in the operational flexibility of the generation portfolio – quick start, fast ramp up and down, turn down, and load following;
- improved forecasting of power outputs from renewable power sources;
- new grid operating strategies and "smart grid" control systems;
- management of demand to better match supply variations through "demand response" techniques;
- geographic diversity of renewable power systems;
- use of "grid friendly" renewable power sources that provide high quality power – frequency, power factor, etc.;
- extensive use of energy storage – at renewable power generation sites, within the grid, or at a customer's site; and
- a conducive policy and regulatory framework.

Use conventional fuels more efficiently with more CHP and waste heat recovery

RECYCLE AND RECOVER

Significant opportunity exists to capture waste heat from industrial processes.

PHOTO: STEFAN GARA ON FLICKR

Generating "Free" Power with Waste Heat Recycling

Waste Heat Recycling

Currently Ontario is not taking advantage of the high temperature waste heat that is produced at Ontario's industrial facilities; it simply goes up the stack. There is tremendous potential to capture pressure and recycle hot exhaust into clean local power and burn no incremental fossil fuel or emit any incremental CO_2.

Industry experts estimate the total potential power from wasted energy streams at approximately 3,000 MW, if industries with stacks less than 50 metres tall are included.[75] Not all industry with waste heat available would be interested in providing power; the *Renewable Is Doable* portfolio assumes that a conservative 500 MW – one sixth of the total identified potential – would be available by 2019.[76]

Waste Heat Recycling	2014		2019	
	Installed MW	TWh/yr	Installed MW	TWh/yr
Renewable Is Doable Portfolio	285	1.8[74]	523	3.2
OPA	0	0	0	0

TABLE 4
Waste Heat Recycling (CDM) for 2014 and 2019

There is 500 MW potential in using expansion turbines on Ontario's gas distribution system.[77] Additional high temperature waste heat sources are available at industrial sites with shorter exhaust stacks but no estimate of the potential electricity is available. See Figure 6 below:

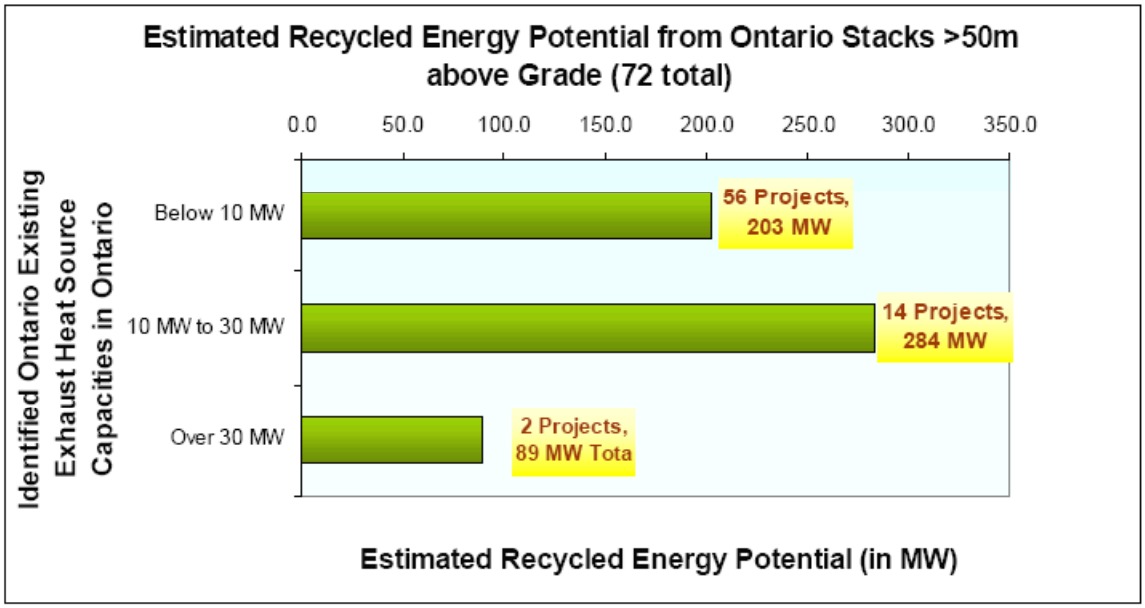


FIGURE 6 Estimated Recycled Energy Potential from Ontario Stacks >50m above grade[78]

However, there are many other potential high temperature waste heat sources at industrial sites that have shorter exhaust stacks.

Since we cannot assume that all industry with waste heat available would be interested in providing power, the *Renewable Is Doable* portfolio assumes that a conservative 500 MW – one sixth of the total identified potential – would be available by 2019. The OPA does not acknowledge Ontario's waste energy recycling potential in its plan.

Waste Heat Recycling Is Cost-effective, Quick to Deploy, Clean and Market Ready

In terms of cost-effectiveness, the fuel is already being burned so there are no incremental fuel costs or emissions. The incremental costs of the turbine generator and grid connection are estimated to be about $1500/kW. At a capacity factor of 67% this translates into about 3 cents/kWh, less than any other supply resource.[79]

Enbridge Gas estimates that it would take 10–15 years to deploy all of the expansion turbine power plants. Renewable Is Doable conservatively assumes only half will be deployed; it is also conservative to give more than half the estimated time for total deployment, allowing 50% of the total to be deployed by 2018.

Recycling hot exhaust into local clean power or capturing wasted pressure requires no additional fuel and creates no extra GHG or other pollutants. It also requires no special new equipment.

Making It Happen

One of the most effective ways to save energy, create energy and not produce GHG pollution is to harness the thousands of megawatts of energy going up in smoke. The 10MW limit should be removed from the CESOP procurement policy, and the offer would have to be kept open long enough for developers to complete the 12-to-30-month process of developing complicated energy recycling projects.

Requiring documentation of all industrial stacks of all sizes would help to identify the greater potential for recycled energy.

Increasing the "Smart Use" of Natural Gas through Combined Heat and Power

Combined Heat and Power

Renewable Is Doable proposes maintaining and renewing all CHP "Non Utility Generator (NUG) contracts.[80] These units should be upgraded to match the level of new CHP plants. *Renewable Is Doable* assumes these upgraded plants come on-line one year after each NUG contract expires to replace the generation. It also assumes that the 1000 MW of new committed and planned CHP go ahead as per the IPSP but at a better capacity factor. A conservative 67% capacity is assumed for both new and upgraded plants.

It is also "doable" to increase the amount of self-generation through micro-turbine facilities to 50 MW installed per year for a total of 550 MW by 2019 – almost twice the OPA Plan for self-generation. The OPA includes a small amount of small scale CHP facility generation in its CDM portfolio.

Recent studies estimate the total CHP potential in Ontario at 11,400 MW of which 4,000MW could be from plants with less than 100 MW of capacity (i.e., Facility/Building Scale).[81] This is 19 times the OPA's assumed capacity from local clean energy capacity. Denmark embarked on a program to promote local generation and now produces 54% of its power by recycling otherwise wasted energy. A comparable 54% of Ontario's generation would be 16,200 MW.

More Fuel Efficient

Natural gas is used in Ontario to produce power in several ways:

1. Single cycle gas turbine (SCGT) generators are used mostly for meeting peak demand. These units operate at less than 30% efficiency, and the rest of the energy (70%) is wasted as heat.
2. In combined cycle gas turbine (CCGT) generators, some of the waste from a gas turbine generator is used to generate more power using a second steam-driven turbine. The combined efficiency from the two turbines is up to 50% with the remaining 50% wasted as heat.

3. In industrial combined heat and power (CHP) plants – also known as cogeneration – the waste heat from a single or combined cycle generation plant is used to make process steam and hot water for use in industrial process, with the power being sold to the grid. This "heating credit" can reduce the cost of delivering power to the grid.
4. Small scale CHP plants are located at a customer's site and normally use micro-turbines or engines. They supply power into the local distribution system rather than the transmission grid. Small scale CHP plants are now being used in buildings to supply the building's heating needs and sell power to grid (or use it on site).

On average, large central generating plants (coal, gas or nuclear, etc.) waste over 65% of the input energy through vented heat and transmission losses. Local CHP generation that recycles otherwise wasted thermal energy, achieves 200 to 250% higher energy efficiency than the average large plant.

Currently Ontario has 1280 MW of industrial CHP, but there are plans to phase out much of this CHP capacity after 2015 as contracts with power generators expire. The OPA's plan includes only 1000 MW of new industrial CHP over the next 20 years. In addition, OPA assumes that the capacity factors of CHP plants are only 41-58% – far lower than the actual industry average. This has skewed the economic analysis in the plan and serves to make the cost per MWh from CHP much higher than it is.[82]

TABLE 5
Combined Heat and Power (CHP) for 2014 and 2019

CHP	2014		2019	
Existing, Committed and Planned CHP	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio*	2,159	12.7	1,453	8.5
OPA	2,159	7.8	1,453	5.2
Additional	0	4.9	0	3.3
New CHP**	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio	122	0.7	828	4.9
OPA	0	0	0	0
Additional	122	0.7	828	4.9
Facility CHP	**Installed MW**	**TWh**	**Installed MW**	**TWh**
Renewable Is Doable Portfolio	300	1.8	550	3.2
OPA***	180	1.2	307	2.3
Additional	120	0.6	243	0.9

* *Renewable is Doable numbers reflect the upgrade in capacity factor from 41% to 67% as evidenced by the increase in TWh for this category.*

** *Renewing all CHP NUG contracts or replacing these plants with new-build CHP. All renewed units should be upgraded to match emission levels of new CHP plants.*

*** *These resources are those proposed by OPA for all on-site self generation – the majority of which are from micro-turbine cogeneration.*

In contrast, the OPA's current plan includes 7853 MW of new, but much lower efficiency, combined cycle power over the next 20 years including its contingency should Pickering B not be refurbished. Currently, Ontario has 3280 MW of conventional single and combined cycle gas, which includes the 2100 MW Lennox dual oil/gas fuel SCGT plant.

Increased Reliability

A system of large generators also means that a lot of excess energy is needed on hand in case a large generator fails. A recent study found that Ontario's system of large generators requires 18% to 21% of redundant generation and transmission capacity to be reliable. By comparison, a system of small local generators can provide the same reliability with only 3% to 5% excess:[83] "When a 1000MW power plant fails there must be a spare 1000 megawatts of idle generation to fill the gap (with 30 such generators chances are two to three will be down at one time) By contrast, a system of many small generators all close to load is significantly more robust".[84]

Increased Operability and Reducing Line Losses

Since CHP generates power locally and energy is consumed close to the load, no energy is lost in the long distance transmission system. Distributed generation can increase overall grid operability and provide benefits to the electricity system by reducing line losses and reducing load on transmission facilities. The IESO has stated:

"With the appropriate procedural and technological changes, embedded generation has the potential to enhance operability during periods of surplus baseload generation as well during normal conditions." [85]

Local CHP generation achieves up to 250% higher efficiency than large central generating plants which waste over 65% of the input energy.

By contrast, the OPA has committed to purchase 7853 MW of new lower efficiency combined cycle power over the next 20 years. 1700 MW of this capacity is to compensate for not refurbishing the Pickering B nuclear station. Currently, Ontario already has 3280 MW of conventional single and combined cycle gas, which includes the 2100 MW Lennox dual oil/gas fuel SCGT plant.

It is very wasteful to use so much natural gas in generating facilities. If the IPSP is followed and existing CHP contracts are not renewed, only 1000 MW out of 12,000 MW total gas generating capacity will have heat recovery by 2019. Ontario will use 25% of its total gas consumption for power generation yet waste more than half of it – billions of dollars up the stack.

CHP Is Cost-Effective

- Because of the credit from the use of heat and the savings in transmission losses from being closer to load centres, CHP plants – both industrial and buildings facilities – can deliver power at 50-60% the cost of a combined cycle gas plant and less than half the cost of a new nuclear plant.[86]

CHP Is Quick to Deploy

- CHP plants are smaller and more quickly deployed than large-scale combined cycle plants. Most plants would be on existing sites and do not require lengthy approval processes.

CHP Is Clean

- On an emissions per kWh basis, CHP is almost twice as clean as combine cycle plants. Local generation, by reducing the total amount of fossil fuel per delivered kilowatt-hour, results in substantially lower air pollution, GHG emissions and overall demand for fossil fuel.[87]

CHP Is Market Ready

- Industrial CHP systems are off the shelf and have been in use in many countries for over 20 years. Technical studies have shown that the potential for CHP in Ontario is between 10,000 and 16,000 MW so our proposal is very conservative. Small scale micro-turbines for buildings are just entering the market now.

Making It Happen

- The IPSP calls for utilizing only 5.1% of the CHP and recycled energy potential that has been identified. Most identified potential could be achieved through a modified CESOP program. The 10 MW capacity limit per project would need to be removed and an appropriate tariff provided for facility micro-turbines as the market develops and costs come down that provide a good return for investors.

This cogeneration plant near Kingston uses waste energy recycling process to produce both electricity and industrial steam for adjacent industry.
PHOTO: WWF-CANADA

Part Three 3

A Seven-Step Action Plan for Green Energy

PHOTO: NATIONAL RENEWABLE ENERGY LABORATORY

The McGuinty government is serious about expanding green energy in Ontario. To do so, however, it must take the following seven steps over the next 24 months:

REPLACE

Make room for renewables by choosing green power over dirty energy

1 Replace Pickering B and Bruce B nuclear reactors with green power, as these reactors come to the end of their lives over the next decade.

REDUCE

Start first with all cost effective conservation to reduce baseload

2 Direct the OPA to acquire all cost effective Conservation and Demand management (CDM) resources as per the intent of the Supply Mix Directive, rather than treating the minimum target for CDM as a cap. And direct the OPA to change its approach to conservation from going after the "low hanging fruit" to acquiring deep energy efficiency savings as per the recommendations submitted to the Ontario Energy Board hearing on behalf of the Green Energy Coalition.

RENEW

Then increase renewable energy sources

3 Transform the Renewable Energy Standard Offer Program (RESOP) into an effective advanced renewable tariff system (ARTs) to include: prices differentiated by technologies, tiered pricing within technologies, prices set according project costs and reasonable return on investment, 20 year contracts, no caps on project size or the program, and guaranteed access to the grid.

4 Use ARTs as the primary procurement mechanism for renewable energy, empowering all Ontarians to become generators and conservers at a fair price.

5 Direct Hydro One to develop and implement a Smart Green Grid Upgrade Plan which gives renewable energy priority in Ontario's transmission and distribution system. In parallel, enable a regulatory regime that encourages local distribution companies to acquire the technical and financial resources to upgrade their systems to accommodate distributed energy from clean and renewable sources.

6 Embed these items in legislation via a Green Energy Act that includes an obligation for grid connections for green energy.

RECYCLE

Use conventional fuels more efficiently with more CHP and waste heat recovery

7 Implement the Clean Energy Standard Offer Program for cogeneration and recycled energy but without capacity limits and with a feed in tariff that provides a reasonable return for investors.

APPENDIX 1 Spreadsheets, Tables and Graphs

Appendix 1.A – Emissions Factors

Table A1: Coal-Fired Plants – Data from Ontario Sustainability Report 2007

Atikokan	2007	2006	2005	2004	2003
GWh	651	737	965	1,081	946
tCO_2	751,422	849,400	1,104,000	1,177,200	996,000
tCO_2/GWh	1154.26	1152.51	1144.04	1156.39	1052.85
Average	**1132.01**				
Lambton	**2007**	**2006**	**2005**	**2004**	**2003**
GWh	8,855	6,856	9,422	7,672	10,636
tCO_2	8,458,685	6,451,000	8,692,000	7,169,900	9,499,000
tCO_2/GWh	955.24	940.93	922.52	934.55	893.10
Average	**929.27**				
Nanticoke	**2007**	**2006**	**2005**	**2004**	**2003**
GWh	18,083	16,174	17,666	14,466	20,393
tCO_2	17,867,783	16,222,800	17,580,000	14,671,800	19,737,000
tCO_2/GWh	988.10	1003.02	995.13	1014.23	967.83
Average	**993.66**				
Thunderbay	**2007**	**2006**	**2005**	**2004**	**2003**
GWh	590	959	962	965	1,474
tCO_2	705,654	1,127,620	1,149,600	1,126,000	1,581,000
tCO_2/GWh	1196.02	1175.83	1195.01	1166.84	1072.59
Average	**1161.26**				
COAL TOTAL	**2007**	**2006**	**2005**	**2004**	**2003**
GWh	28,179	24,726	29,015	24,121	33,449
tCO_2	27,783,544	24,650,820	28,525,600	24,144,900	31,813,000
tCO_2/GWh	985.97	996.96	983.13	1000.99	951.09
AVERAGE	**983.63**				

Table A2: Lennox – Data from OPG Sustainability Report 2007

Lennox	2007	2006	2005	2004	2003
GWh	789	317	965	1,263	2,775
tCO_2	582,929	281,720	953,530	613,000	1,954,900
tCO_2/GWh	738.82	888.7	754.97	1018.27	704.47
Average	**821.05**				

Table A3: Other Sources – Information from IPSP Exhibit G-3-1 Attachment 1 Table A.4

Emissions (tCO_2eq/MWh)	CO_2	CH_2	N_2O	Total
Coal (Imports)	0.862	0.000	0.004	0.866
CHP Existing	0.528	0.000	0.004	0.532
CHP New	0.240	0.000	0.002	0.242
CCGT	0.304	0.003	0.003	0.307
SCGT	Assumed to match CCGT			

Table A4: Emissions Factors Used in Calculations

Source (tCO_2eq/MWh)	$MTCO_2e$/TWh
Coal – Ontario	0.984
CHP – Existing	0.532
CHP – New	0.242
CCGT	0.307
SCGT	0.307
Lennox	0.821
Imports (90% Coal)	0.779

Appendix 1. B – Scenario Data

IPSP Baseline Emissions:

Using data from scenario 1A the baseline IPSP emissions were calculated. Table B1 displays baseline TWh data for fossil fuel sources in the IPSP plan:

Table B1: IPSP Scenario 1A Fossil Fuel Generation (TWh)[88]

Source	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coal	28	27	21	16	14	15	0.0	0.0	0.0	0.0	0.0
CCGT	5.6	5.5	5	5.2	5.0	5.2	10	12.3	13.1	14.2	15.3
CHP	0.7	1.6	1.6	1.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
SCGT	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.5	0.7	0.7	0.8
Lennox	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
NUGs	11.0	11.0	11.0	11.0	9.9	9.9	8.0	7.6	6.3	3.3	3.4
Imports	5.0	4.0	5.0	3.0	2.0	2.0	4.0	8.0	9.0	9.0	10.0

Using the emissions factors noted in Appendix 1.A the emissions were calculated to provide a baseline for comparison:

Table B2: IPSP Scenario 1A GHG Emissions (Mt CO_2e)

Source	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coal	27.5	26.6	20.7	15.7	13.8	14.8	0.0	0.0	0.0	0.0	0.0
CCGT	1.7	1.7	1.5	1.6	1.5	1.6	3.1	3.8	4.0	4.4	4.7
CHP	0.2	0.4	0.4	0.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9
SCGT	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2
Lennox	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
NUGs	5.8	5.8	5.8	5.8	5.3	5.3	4.3	4.0	3.4	1.8	1.8
Imports	3.9	3.1	3.9	2.3	1.6	1.6	3.1	6.2	7.0	7.0	7.8
TOTAL	39.2	37.6	32.3	25.9	23.0	24.0	11.4	15.2	15.6	14.3	15.5

Loss of Pickering B:

To determine the additional emissions that would result from the loss of Pickering B, IPSP scenarios 1A and 1B were compared. IPSP scenario 1B differs from scenario 1A in that it assumes Pickering B will not be refurbished while scenario 1A does.

Table B1: Decrease in Generating Pickering B Output from Scenario 1A to 1B[89]

	2015	2016	2017	2018	2019
Pickering B – No Refurbishment (MW)	516	516	1032	1548	1548
Pickering B – No Refurbishment (TWh)[1]	3.75	3.75	7.50	11.26	11.26

1 Assumes an 83% capacity factor for Pickering B

Because of the loss of Pickering B scenario 1B prescribes additional natural gas and imports over scenario 1A. However, these additions do not completely fill the TWh gap created by the loss of Pickering B:

Table B2: Pickering B Replacement Profile (TWh)[90]

	2015	2016	2017	2018	2019
Natural Gas[1]	0	2	3	4	4
Imports[2]	1	1	2	4	4
Unaccounted[3]	2.75	1.75	2.5	3.26	3.26

1 Increase in natural gas generation of scenario 1B over 1A. Assumed to be CCGT for GHG accounting purposes.

2 Increase in imports of scenario 1B over 1A .[91]

3 TWh loss unaccounted for in between scenarios 1A and 1B. To ensure a proper replacement of Pickering B this gap must be filled. For GHG accounting purposes, this gap is assumed to be filled with imports.

Using the GHG emissions factors from Appendix 1.A the increase in emissions due to the loss of Pickering B were calculated:

Table B3: Pickering B replacement GHG emissions (Mt CO_2e)

	2015	2016	2017	2018	2019
Additional GHG Emissions	2.92	2.76	4.43	6.88	6.88

Nuclear Historical Performance

In response to questions from interveners in the Integrated Power System Plan hearing currently before the Ontario Energy Board, the OPA modelled what would happen if future nuclear performance matches past performance. To make up for lost generating capacity the OPA suggested the following replacement generation:

Table B4: Nuclear Historical Performance Replacement Profile (TWh)[92]

Source	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Coal	2	1	3	4	4	3	0	0	0	0	0	0	0	0
Gas	1	0	2	6	6	5	11	11	11	14	7	6	4	5
Imports	5	5	13	23	29	25	27	20	20	23	14	19	12	15

Using emission factors from Appendix 1.A, the increase in GHG emissions was calculated:

Table B5: Additional emissions associated with Nuclear Historical Performance (Mt CO_2e)

Source	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Coal	1.97	0.98	2.95	3.93	3.93	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas	0.31	0.00	0.61	1.84	1.84	1.54	3.38	3.38	3.38	4.30	2.15	1.84	1.23	1.54
Imports	3.90	3.90	10.13	17.92	22.59	19.48	21.04	15.58	15.58	17.92	10.91	14.80	9.35	11.69
TOTAL	6.17	4.88	13.69	23.70	28.37	23.96	24.41	18.96	18.96	22.22	13.06	16.65	10.58	13.22

Go Green Ontario

In 2007, Ontario developed greenhouse gas emissions targets. These targets were predicated on meeting IPSP targets. Any deviations from the plan that lead to increased GHG emissions will remove Ontario from its path to meeting these targets. The overall targets for Go Green Ontario are shown in table B6:

Table B6: Go Green Ontario Targets[93]

	1990	2004	2014	2020	2050
Emissions (Mt)	177	203	–	–	–
Target Emissions (Mt)	–	–	166	150	35

APPENDIX 2

Detailed List of Policy Recommendations

CDM

1. Direct the OPA to interpret the Supply Mix Directive for CDM as a minimum target, rather than as a cap, and a requirement to maximize the acquisition of all cost-effective CDM resources. Minimum targets need to be increased to the achievable and effective long-range potential identified by OPA study (10,000MW).
2. Develop market transformation programs and hire necessary staff and expertise from other jurisdictions to implement these programs.
3. Improve and introduce regulation to backstop and accelerate market transformation:
   - Align OPA conservation programs with CaGBC Building Performance System and adopt corresponding targets for Ontario as set nationally. Reduce energy consumption in 100,000 buildings and 1 million homes by 2015.
   - Set legally binding energy savings targets for electric and gas utilities.
   - Establish explicit linkages between OPA CDM programs and the upgrading of energy efficiency codes and standards, especially for lighting, air conditioning and new building construction.
   - Toughen standards for appliances and equipment for energy efficiency and conservation under the Energy Efficiency Act, requiring all energy efficiency standards to be reviewed and brought up to the international best practice on a three-year cycle.
   - Establish a cycle for regularly toughening codes for buildings and homes for energy efficiency and conservation.
4. Bring forward additional regulations under the "Energy Conservation Leadership Act":
   - Create Energy Management Plans for public sector buildings.
   - Remove requirement for 24/7 lighting for stairwells in high-rise buildings.
   - Accelerate implementation of the building code improvements to 2009.
   - Require homes to have an up-to-date energy assessment and rating when listed for sale.
   - Enable condominium reserve funds to include energy and water retrofits.
   - Enable condominiums to participate in the Renewable Energy Standard Offer Program (RESOP).
5. Assist electricity and gas utilities in maximizing efficiency gains through financing and capability building.

Renewable Energy

1. Maximize the effectiveness of Ontario's Renewable Energy Standard Offer Program (RESOP):
   - Remove all caps and restrictions.
   - Implement an advanced renewable tariff (ARTs) pricing system that differentiates technology, scale, location and type of generation.
   - Mandate priority grid access for renewable and distributed energy, with an obligation to connect, and interconnect costs put in the rate base (as in Germany).
   - Offer premium incentives to systems that use storage to reflect the higher value of dispatchable power from renewable energy sources.
   - Make an evolved RESOP the primary procurement method for all renewable energy in Ontario.
2. Remove transmission and distribution system bottlenecks that are preventing the connection of renewable energy projects in Ontario:
   - Remove the orange and yellow zone restrictions.
   - Mandate the right to grid access for renewables for the proposed Bruce transmission line and require Bruce Energy to make their plans with respect to refurbishment to enable wind to have space on the grid.
   - Directing Hydro 1 to develop and implement a Grid Upgrade Plan to accommodate for renewable energy. Priority access to distribution system should be made for its customers ahead of nonresident developers.
   - Increasing the use of demand response and power storage in all parts of the transmission and distribution system should be used to maximize the present capacity and
3. Adopt the Green Energy Act. Based on legislation in Germany that have effectively resulted in reducing GHG emissions, a GEA (as proposed in 2008 by OSEA) would accomplish the following:
   - Obligate grid system operators to purchase RE electricity and pay a fee for it, but do not charge excessive prices for renewable electricity.
   - Ensure that RE technologies are ecologically benign.
   - Ensure that basic elements of an effective advanced renewable tariff system (ARTs) are in place including fixed fees and tiered pricing.
   - Guarantee priority access to the grid for all renewable power sources that meet technical specifications.
   - Ensure LDCs are empowered and obligated to connect renewable energy projects and are granted the right to develop, own and expand transmission and distribution.

Renewable Energy

4. Develop a Green Grid Roadmap to determine what is needed in the way of grid management, transmission optimization and regulatory reform to meet more ambitious renewable power targets.
5. Provide assistance to LDCs to upgrade distribution systems, system modelling and staff capability to remove bottlenecks to distributed generation from waste heat recycling, small scale CHP and renewable energy from wind and solar sources

CHP and Recycled Energy

1. Remove the 10 MW capacity limit per project.
2. Ensure feed-in tariffs that provide a good return for investors, especially facility operators.
3. Use true market rates for the cost of capital for all options, factoring in costs of line losses, the capital cost of transmission, distribution and relative amounts of redundancy.
4. Make CESOP the predominant procurement mechanism, not an RFP, for clean energy and keep the offer open long enough for developers to complete the 12-to- 30-month process of developing complicated energy recycling projects.
5. Inventory industrial stacks in Ontario to identify the actual potential for recycled energy.

NOTES

1 - 22

1 George Smitherman (Ontario Minister of Energy and Infrastructure), *Amendment to the Supply Mix Directive*, Issued September 17, 2008. Available on-line at: http://www.powerauthority.on.ca/Storage/83/7831_Ministry_Directive_PSP_Sept_18_08.pdf

2 According to the Ontario Power Authority's electricity plan, the four Pickering B reactors will reach the end of their operational lives between 2013 and 2016. The four Bruce B reactors reach the end of their operational lives beginning in 2015. The OPG will make a recommendation to rebuild or close the Pickering B reactors in the first quarter of 2009. Nuclear generating schedules based on MW data provided by the OPA in IPSP document EB-2007-07-07 Exhibit D Tab 6 Schedule 1. Refer to Greenpeace Canada, *Better Never Than Late,* October 2008, Appendix A for a detailed breakdown nuclear schedules including reactor shutdowns.

3 George Smitherman (Ontario Minister of Energy and Infrastructure), Amendment to the Supply Mix Directive, Issued September 17, 2008. Available online at: http://www.powerauthority.on.ca/Storage/83/7831_Ministry_Directive_PSP_Sept_18_08.pdf

4 The current supply mix is 50% nuclear, 18% coal, 9% natural gas, 23% renewables (including hydro). In 2027 the supply mix is 55% nuclear, 10% natural gas and 35% renewable (including hydro). See EB-2007-07-07 Exhibit D Tab 9 Schedule 1 table 10.

5 IPSP document EB 2007-07-07 Exhibit G Tab 1 Schedule 1 Tables 21 and 23 that show that if more conservation is pursued a reduced commitment to both nuclear and natural gas generation is required.

6 See Figure 4 of the Integrated Power System Plan, Exhibit 1, Tab 43, Schedule 2, filed June 18, 2008 and Exhibit 1, Tab 43, Schedule 3, page 5.

7 Based on difference between IPSP scenarios 1A and 1B (EB 2007-07-07 Exhibit D Tab 9 Schedule 1 tables 22 and 24). Any TWh lost from Pickering B not replaced by the prescribed increases to gas generation or imports were assumed to be filled with additional imports. See Appendix 1.B.

8 Based on difference between IPSP scenarios 1A and 1B (EB 2007-07-07 Exhibit D Tab 9 Schedule 1 tables 22 and 24). Any TWh lost from Pickering B not replaced by the prescribed increases to gas generation or imports were assumed to be filled with additional imports. See Appendix 1.B.

9 Bruce Power, Bruce Power New Build Power Project Environmental Assessment: Project Description, January 2007. Figure 4 of this report, the project schedule, shows new build plants beginning operation in 2014, 2015, 2016 and 2017. This report is available on-line: http://www.ceaa.gc.ca/050/documents_staticpost/cearref_25738/57.pdf

10 Ontario Power Authority, EB-2007-0707, Exhibit D, Tab 6, Schedule 1, Page 17.

11 Hydro One, "Argument in Chief for Leave to Construct Application for the Bruce to Milton Transmission Line", Evidence filed with the Ontario Energy Board in EB-2007-0050 (June 23, 2008), p. 5.

12 Helimax Energy, Analysis of Windpower Potential in Ontario, November 2005. Helimax notes the constrained potential in Bruce Region is 1421MW (which equates to 4TWh) and that the unconstrained potential is 6626MW (equating to 18TWh). This report is available online: http://www.energy.gov.on.ca/opareport/Part%204%20-%20Consulting%20Reports/Part%204.6%20Helimax%20Report%20on%20Wind%20to%20OPA%20-%202005.11.24.pdf

13 Integrated Power System Plan, Exhibit 1, Tab 43, Schedule 2, (filed June 18, 2008). This graph was created by the OPA in response to the request to "Apply last fifteen years of historical nuclear unit performance to all nuclear units (existing, committed and planned) for the next fifteen years on a deterministic basis and identify resource utilization and supply adequacy implications." It does not consider outages beyond the first calendar year of the duration of the unit lay-up because this was deemed to be an extraordinary event, even though eight reactors were laid up for multiple year periods during the period under consideration.

14 Based on data from Integrated Power System Plan, Exhibit 1, Tab 43, Schedule 2, (filed June 18, 2008). Refer to Appendix 1.B, Tables B1, B2, B4 & B5 for complete data.

15 Removed from text

16 Ontario Power Generation, Annual Report 2006, pg 22.

17 Ontario Clean Air Alliance, "McGuinty breaks coal phase out promise", June 13 2006. http://www.cleanairalliance.org/node/337

18 The Ontario government's Supply Mix Directive dated June 13, 2006, sets out the following priorities and goals in order of importance:

1. Use conservation and demand management (CDM) to reduce peak demand by1,350 MW by 2010 and by another 3,600 MW by 2025.
2. Increase renewable generation to increase supply by 2,700 MW by 2010 and to a total of 15,700 MW by 2025.
3. Plan for nuclear power to meet baseload requirements but limit installed in-service capacity to 14,000 MW.
4. Use gas-fired generation as needed to meet peaking requirements and for applications that allow high efficiency use of this fuel.
5. Phase out coal-fired generation and replace it with cleaner resources at the earliest practical time.
6. Strengthen the transmission system to facilitate the development, use and integration of renewable resources.

19 In contrast, the Ontario Energy Board guidelines setting out how the directive should be interpreted require greater quantities of conservation and renewable energy to be included in the plan if they are "shown to be prudent and cost-effective against other resources." http://www.oeb.gov.on.ca/documents/cases/EB-2006-0207/IPSP_report_final_20061227.pdf , pp 5 -6

20 New Nuclear Power: Implications for a sustainable energy system . Catherine Mitchell and Bridget Woodman, University of Warwick UK, Published by Green Alliance, March 2006

21 The Globe and Mail, Lessons from Germany's Energy Renaissance (March 22, 2008); The Toronto Star, We must invest in energy, 'green collar' jobs (April 21, 2008)

22 Independent Electricity System Operator, "IESO Operability Review of OPA's Integrated Power System Plan", IESO Report 0411 2.0 (2008).

23 - 59

23 Expert testimony filed with the Ontario Energy Board's hearing on the IPSP has argued that the coal phase-out could in fact be accelerated to 2012, as in the 2012–2014 period the coal plants serve primarily as insurance against delays in acquiring other resources but are scheduled to be run to serve the export market. By curtailing exports and keeping the coal plants in a cold shut-down state but capable of being restarted should anticipated resources not be available in a timely manner, emissions could be minimized. The major potential challenge from reduced nuclear output occurs in the post-2014 period.

24 TWh schedules for Bruce B and Pickering B based on data from the Integrated Power System Plan assuming an 83% capacity factor for both stations.

25 There is an extra 3TWh hour cushion. This amount is sufficient to replace one 500MW nuclear reactor, operating at a 70% capacity factor.

26 See expert testimony filed with the Ontario Energy Board, available at www.renewableisdoable.ca.

27 Thomas R. Casten, The Role of Recycled Energy and Combined Heat and Power (CHP) in Ontario's Electricity Future, August 1 2008.

28 Paul Chernick, Jonathan Wallach and Richard Mazzini, "Green Resource Portfolios: Development, Integration and Evaluation (Resource Insights International Inc., 2008). Filed as EB-2007-0707 Exhibit L, Tab 8, Schedule 1.

29 Since on-site generation is expected to mostly come from facility scale micro-turbines, Renewable Is Doable includes on-site generation – see Section 2.3.2 Combined Heat and Power

30 IPSP OPA OEB Filing Exhibit D4.1 page 15

31 Scudder Parker, Optimizing the Conservation and Demand Management Resources in Ontario. Evidence filed on the Integrated Power System Plan (IPSP) on behalf of the David Suzuki Foundation, Eneract, Greenpeace, the Sierra Club of Canada, WWF-Canada, the Pembina Institute and the Ontario Sustainable Energy Association as Exhibit L, Tab 8, Schedule 3 (August 2008).

32 IPSP OPA OEB Filing Exhibit G1.1 page 14

33 ICF Consulting Toronto. Consulting for the Ontario Power Authority, Electricity Demand in Ontario – Assessing the Conservation and Demand Management (CDM) Potential. 2005.

34 Marbek Resource Consultants and Altech Environmental Consulting. Potential for Fuel Switching to Reduce Ontario's Peak Electricity Demand. September 2006

35 MK Jaccard and Associates & Marbek Resource Consultants Ltd. Demand Side Management Potential in Canada: Energy Efficiency Study. Prepared for Canadian Gas Association. May 2006

36 MK Jaccard and Associates. Modelling and Scenario Documentation, Prepared for Ontario Power Authority, September 2006.

37 The Pembina Institute, Canadian Environmental Law Association. Power for the Future: Towards a Sustainable Electricity System for Ontario. 2004.

38 VEIC is a dedicated energy efficiency utility and is recognized as one of the most experienced and influential energy efficiency agencies in the world. http://www.veic.org/

39 Scudder H. Parker, Optimizing the CDM Resources in Ontario (Vermont Energy Investment Corporation, 2008). This document shows that Ontario's CDM targets are lower than those made in New York, New Jersey, California and other jurisdictions.

40 Ontario Power Authority, Revised OPA Discussion Paper 3: Conservation and Demand Management (Toronto: OPA, 2007), 12.

41 Ontario Power Authority, Integrated Power System Plan, EB-2007-0707 Exhibit G, Tab 2 Schedule 1, page 30.

42 Jim Harding, "Overnight Costs of New Nuclear Reactors" (2008). Evidence filed with Ontario Energy Board as EB-2007-0707, Exhibit L, Tab 8, Schedule 4.

43 Green Energy Coalition, EB-20070-707, Exhibit I, Tab 120, Schedule 2. See also Forgetting Nuclear by Amory Lovins, Imran Sheikh, and Alex Markevich of the Rocky Mountain Institute 2008

44 Market transformation initiatives from around the world. Paul Waide, Senior Policy Analyst Energy Efficiency & Environment Division, International Energy Agency. http://www.aceee.org/conf/mt08/1a_waide.pdf

45 Scudder H. Parker, Optimizing the CDM Resources in Ontario (Vermont Energy Investment Corporation, 2008), p. 61

46 Robert Wending, MIS, Renewable Energy and Energy Efficiency: Economic & Job Drivers for the 21st Century. ACEEE Market Transformation Conference

47 EESI Jobs and Energy Efficiency Fact Sheet

48 Meeting Stretch Goals for Energy Efficiency- California's 2009-2020 Strategic Plan. Cathy Fogel, California Energy Commission. http://www.aceee.org/conf/mt08/1a_fogel.pdf

49 Meeting Stretch Goals for Energy Efficiency- California's 2009-2020 Strategic Plan. Cathy Fogel, California Energy Commission. http://www.aceee.org/conf/mt08/1a_fogel.pdf

50 Scudder H. Parker, Optimizing the CDM Resources in Ontario (Vermont Energy Investment Corporation, 2008), 66.

51 Ibid.

52 The average rate for wind acquisition under OPA's RFP and RESOP since the program's first installation is 728MW – 1078MW in 2008-2009 and 379MW in 2009-2010.

53 Agence France-Press, http://afp.google.com/article/ALeqM5jb_CIjlaxmm-5LbeW4Hb0taAY8VA

54 Helimax study 2005 Analysis of Wind Power Potential in Ontario

55 Helimax April 2008 Analysis Of Future Offshore Wind Farm Development in Ontario

56 http://www.greengold.org/wind/documents/113.pdf

57 Tyler Hamilton and Rob Ferguson, "Premier Reveals Support for Offshore Energy Plan", Toronto Star, January 16 2008.

58 Joanne Butler, Vice President of Human Resources, Speech to Distributed Energy Conference, Calgary, September 15, 2008.

59 IPSP. Exhibit D Tab 5 Schedule 1 Page 41 of 64

60 - 93

60 Storing Renewable Power. A Pembina Institute Primer June 2008 p19, http://re.pembina.org

61 Storing Renewable Power. A Pembina Institute Primer June 2008 p18, http://re.pembina.org

62 Impact on Past, Present, and Future Wind Turbine Technologies on California Grid. BEW Engineering, California Energy Commission 500-2006-060, May 2006

63 Patently Innovative: Imagination in Wind Turbine Technology Continues to Flourish. George March and Drew Robb, REFocus Magazine March/April 2007

64 According to a September 22, 2008 presentation by the Ontario Power Authority at the Distributed Generation conference in Toronto, there are currently 500 MW of solar contracts signed under the Renewable Energy Standard Offer Program, and another 1,500 MW are in the queue; the RESOP program was suspended in may 2008.

65 DENA – German Energy Agency, Supplementary Report on Ontario IPSP, August 18 2008. Page 30, table 2.

66 REN 21 Renewable 2007 Global Status Report http://www.ren21.net/default.asp

67 Investing in Solar Now. RBC Capital Markets Corp. April 30,2007

68 http://www.wind-works.org/FeedLaws/Canada/OntarioStandardOfferContractsAwarded.html

69 Michigan recently recommended an advanced renewable tariffs scheme that is currently being reviewed by state legislature. Details of the bill are available online: http://www.legislature.mi.gov/documents/2007-2008/billintroduced/House/pdf/2007-HIB-5218.pdf

70 German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Renewable Energy Source Act (EEG) 2007, November 2007. Available from: http://www.erneuerbare-energien.de/files/pdfs/allgemein/application/pdf/erfahrungsbericht_eeg_2007_zf_en.pdf

71 Ontario Power Authority, Local Area Supply – Bruce Transmission. The OPA notes here that the Bruce area is at or near transmission capacity and that additional generating capacity will require new transmission lines. See online at: http://www.powerauthority.on.ca/Page.asp?PageID=1224&SiteNodeID=305

72 Helimax Energy, Analysis of Windpower Potential in Ontario, November 2005. Helimax notes the constrained potential in Bruce Region is 1421MW (which equates to 4TWh) and that the unconstrained potential is 6626MW (equating to 18TWh). This report is available online: http://www.energy.gov.on.ca/opareport/Part%204%20-%20Consulting%20Reports/Part%204.6%20Helimax%20Report%20on%20Wind%20to%20OPA%20-%202005.11.24.pdf

73 Intermittency Analysis Report. California Energy Commission Public Interest Energy Research Program. July 2007 CEC-500-2007-081. Integration of Renewable Resources. California Independent System Operator, November 2007.

74 A 67% capacity factor is assumed for recycled energy.

75 Thomas R. Casten, The Role of Recycled Energy and Combined Heat and Power (CHP) in Ontario's Electricity Future (Recycled Energy Development LLC, 2008), p.15

76 Industrial Exhaust Recycled Energy Potential for Stacks >50 Meters (77 in total) Prepared By: Recycled Energy Development, LLC July 27th, 2007

77 Personal communication from Dave Teichroeb of Enbridge Gas Distribution Inc. to Keith Stewart, March 17, 2008.

78 Thomas R. Casten, The Role of Recycled Energy and Combined Heat and Power (CHP) in Ontario's Electricity Future (Recycled Energy Development LLC, 2008), p.18

79 Ibid

80 These contracts are currently held by the Ontario Electricity Financial Corporation and would require negotiation and agreement with the OPA.

81 Thomas R. Casten, The Role of Recycled Energy and Combined Heat and Power (CHP) in Ontario's Electricity Future (Recycled Energy Development LLC, 2008), p.5

82 Evidence of Tom Casten, OEB hearing into IPSP, 2008. "Most of the 250 CHP plants built by organizations that I have led achieve 90% to 96% availability, while those that follow thermal load in district heating and cooling operate at 75% to 85% load factor. The OPA 58% capacity factor is lower than any CHP plant I have ever developed in 32 years. By using these low efficiency and capacity factors, OPA "calculates" that local generation will cost more than power from its chosen nuclear plants."

83 Ibid

84 Ibid

85 IESO Operability Assessment of the OPA's Integrated Power System Plan. Issue 2.0. April 21, 2008.

86 Forgetting Nuclear by Amory Lovins, Imran Sheikh, and Alex Markevich of the Rocky Mountain Institute 2008

87 Thomas R. Casten, The Role of Recycled Energy and Combined Heat and Power (CHP) in Ontario's Electricity Future (Recycled Energy Development LLC, 2008)

88 Data from IPSP documents EB 2007-0707 Exhibit D Tab 8 Schedule 1 and EB 2007-0707 Exhibit D Tab 9 Schedule 1

89 IPSP Document EB 2007-0707 Exhibit D Tab 9 Schedule 1 - Table 22

90 IPSP Document EB 2007-0707 Exhibit D Tab 9 Schedule 1 - Table 24

91 All imports were assumed to be 10% clean-energy and 90% coal-fired generation on EB 2007-0707 Exhibit I, Tab 43, Schedule 3 that states "The dotted lines include emissions associated with both Ontario generators and imports, assuming that 90% of the imports come from non-renewable resources, largely from coal-fired generation resources."

92 Integrated Power System Plan, Exhibit I, Tab 43, Schedule 2, (filed June 18, 2008)

93 Ontario Greenhouse Gas Emissions Targets: A Technical Brief. June 18, 2007. Available online: http://www.ene.gov.on.ca/publications/6793e.pdf

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