Analysis of New Nuclear: Darlington Environmental Impact Statement

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for

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1. Introduction

1.1 Project Background

In September 2009, Ontario Power Generation (OPG) released an Environmental Impact Statement (EIS) evaluating the option of building a new nuclear power plant at its existing site in Darlington. This plant could have a capacity of up to 4,800 megawatts (MW) and deliver up to 34.9 terawatt-hours (TWh) per year.

This EIS considers nuclear power as the only option and does not look at any alternative ways to meet the demand, an approach that stems from provincial directives issued in 2006. Since 2006 the assumptions surrounding nuclear power have changed significantly. It is increasingly clear that a portfolio of renewable energy, energy efficiency and combined heat and power (CHP) systems can provide a similar contribution to Ontario's electricity needs, and should be considered as a functionally different way to meet the project need and achieve the intended purpose.

1.2 Stated Project Need

The Environmental Impact Statement filed by the OPG states that the purpose of the project is based on the June 16, 2006, directive,[1] which states:

> *"The Ontario Government announcement directed the (Ontario Power Authority) OPA to ensure adequate baseload electricity supply, while maintaining the nuclear generation component of that baseload at today's level of 14,000 MW of installed capacity… I am directing OPG to begin a federal approvals process, including an environmental assessment, for new nuclear units at an existing site."*

This directive follows from a directive previously issued to the OPA on June 13, 2006,[2] stating:

> *"Plan for nuclear capacity to meet base-load electricity requirements but limit the installed in-service capacity of nuclear power over the life of the plan to 14,000 MW."*

1.3 Updated Directives

Since issuing the initial directives used as the basis of the EIS to the OPA and OPG in 2006, the government of Ontario has issued a number of directives which supersede the initial directives. Relevant aspects of these directives are discussed below.

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[1] Dwight Duncan, *Directive to OPG, June 16, 2009*, http://www.opg.com/pdf/directive_nuclear.pdf (accessed June 7, 2010).

[2] Dwight Duncan, *Directive – June 13, 2006*, http://www.powerauthority.on.ca/Storage/23/1870_IPSP-June13%2C2006.pdf (accessed June 7, 2010).

September 17, 2008[3]

This directive amends the *Supply Mix Directive* dated June 13, 2006. It requires the OPA to revisit the Integrated Power System Plan (IPSP) with a view to establishing new targets in a number of areas, including with respect to renewable energy sources and conservation. The directive also asks the OPA to undertake an enhanced process of consultation with First Nations and Métis communities in light of potential duty to consult obligations. The OPA is to provide the revised IPSP to the Ontario Energy Board (OEB) within six months.

As of the writing of this analysis (June 2010), the OPA has not yet produced an IPSP stemming from the September 17, 2008, directive. Without the new plan, the role of nuclear moving forward is not defined. As such, an EIS should consider alternative options to the proposed project. This is not the case in the EIS put forward by OPG.

Highlights of the updated directive include:

- Emphasis on increasing the amount and diversity of renewable energy sources in the supply mix.
- Improvement in transmission capacity to create opportunities for renewable energy.
- The availability of distributed generation.
- The viability of using pumped storage to help meet peak demand.
- Ability to accelerate conservation targets in the original IPSP.

The updated directive dated September 17 does not set a target for nuclear power, however it does require an increased role for renewable power. Whether or not this increase is possible with the old nuclear targets needs to be examined.

September 24, 2009[4]

> *"The OPA is directed to develop a feed-in tariff (FIT) program that is designed to procure energy from a wide range of renewable energy sources. The development of this program is a key element of the Green Energy and Green Economy Act, 2009 (the "Green Energy Act") and is critical to Ontario's success in becoming a leading renewable energy jurisdiction."*

December 8, 2009[5]

> *"Supplementary Initiative to July 13, 2006 Direction re Coordination and Funding of Local Distribution Companies (LDC) activities to deliver Conservation and Demand-Side Management [CDM] Programs – the OPA is directed to increase funding for LDC*

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[3] George Smitherman, September 17, 2008 Directive to the Ontario Power Authority from the Minister of Energy and Infrastructure, RE: Amendments to Supply Mix Directive Issued June 13, 2006 http://www.powerauthority.on.ca/sop/Storage/83/7831_Ministry_Directive_PSP_Sept_18_08.pdf (accessed May 6, 2010).

[4] George Smitherman, *Directive to OPA, September 24, 2009,* http://www.powerauthority.on.ca/Storage/106/15420_FIT_Directive_Sept_24_09.pdf (accessed June 7, 2010).

[5] Gerry Philips, *Directive to OPA, December 8, 2009,* http://www.powerauthority.on.ca/Storage/112/15999_December_8_2009_-_MEI_Directive_Supplement_to_July_13_06.pdf (accessed June 7, 2010).

CDM activities by $50 million and extend the timeframe for available funding under the existing CDM Direction to December 31, 2010."

April 23, 2010[6]

"Conservation and Demand Management Initiatives under the GEA Conservation Framework *- The OPA has received this direction to advance conservation, being one of the most cost effective means of dealing with electricity supply issues. The direction is categorized into three areas: (i) strategic co-ordination of OPA contracted province wide programs; (ii) energy efficiency and demand response programs for First Nation and Métis communities; and (iii) support and funding of CDM research and innovation."*

1.4 The Green Energy Act

The Green Energy Act (GEA) developed in 2009 has two primary thrusts:

"making it easier to bring renewable energy projects to life and creating a culture of conservation so that people can go about their daily lives using less energy."[7]

Combined with other initiatives such as solar rooftop programs, the feed-in-tariff, and a variety of rural energy programs targeting sustainable energy (i.e. Northern Energy Program), there is a distinct focus on the development of CDM and renewable resources over both nuclear power and fossil fuel generation moving forward.

This focus is reflected by the initiative of energy producers. A recent survey by the OPA found that there are 150 energy developers with 381 projects in various stages of development. Those projects, it calculated, represent 15,128 megawatts of renewable energy supply that has near-term development potential.[8]

The OPA itself suggests that the GEA (Bill 150) will bring significant changes to the energy sector and that the OPA must incorporate the policy directions embodied within Bill-150:

"Bill 150 will, if passed by the Legislature, bring about far-reaching changes in the energy sector and set a bold new direction for energy policy in the Province. In order for the OPA's planning work to be relevant and useful, it must incorporate into its thinking the new policy direction that is embodied in Bill 150. The OPA intends to respond to the Minister's directive in the summer, if the Legislature has completed its consideration of Bill 150 by that time."[9]

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[6] Brad Duguid, *Directive to OPA, April 23, 2010*, http://www.powerauthority.on.ca/Storage/118/16600_MEI_Directive_CDM_Initiatives_under_GEA_Apr_23_10.pdf (accessed June 7, 2010).

[7] Green Energy Act Website, *Green Energy Act — What is it About?*. Available online at: http://www.ontariogreenenergyact.ca/about.html (accessed May 27, 2009).

[8] Tyler Hamilton, "Renewable electricity seen filling half of grid", *The Toronto Star*, April 22, 2009.

[9] Michael Lyle, *Letter to Kristen Walli, March 12, 2009*, http://www.powerauthority.on.ca/Storage/96/9159_OPA_Letter_EB-2007-0707_20090312.pdf (accessed June 7, 2010).

Since issuing the original 2006 directive to the OPA, the Ontario Government has developed the Green Energy Act and continued to issue directives to the OPA consistent with increasing renewable energy and conservation.

The OPA itself has recognized that this shift in policy will affect its planning work moving forward. The EIS should examine how the proposed 4,800 MW nuclear generating station fits within the new context and policy framework.

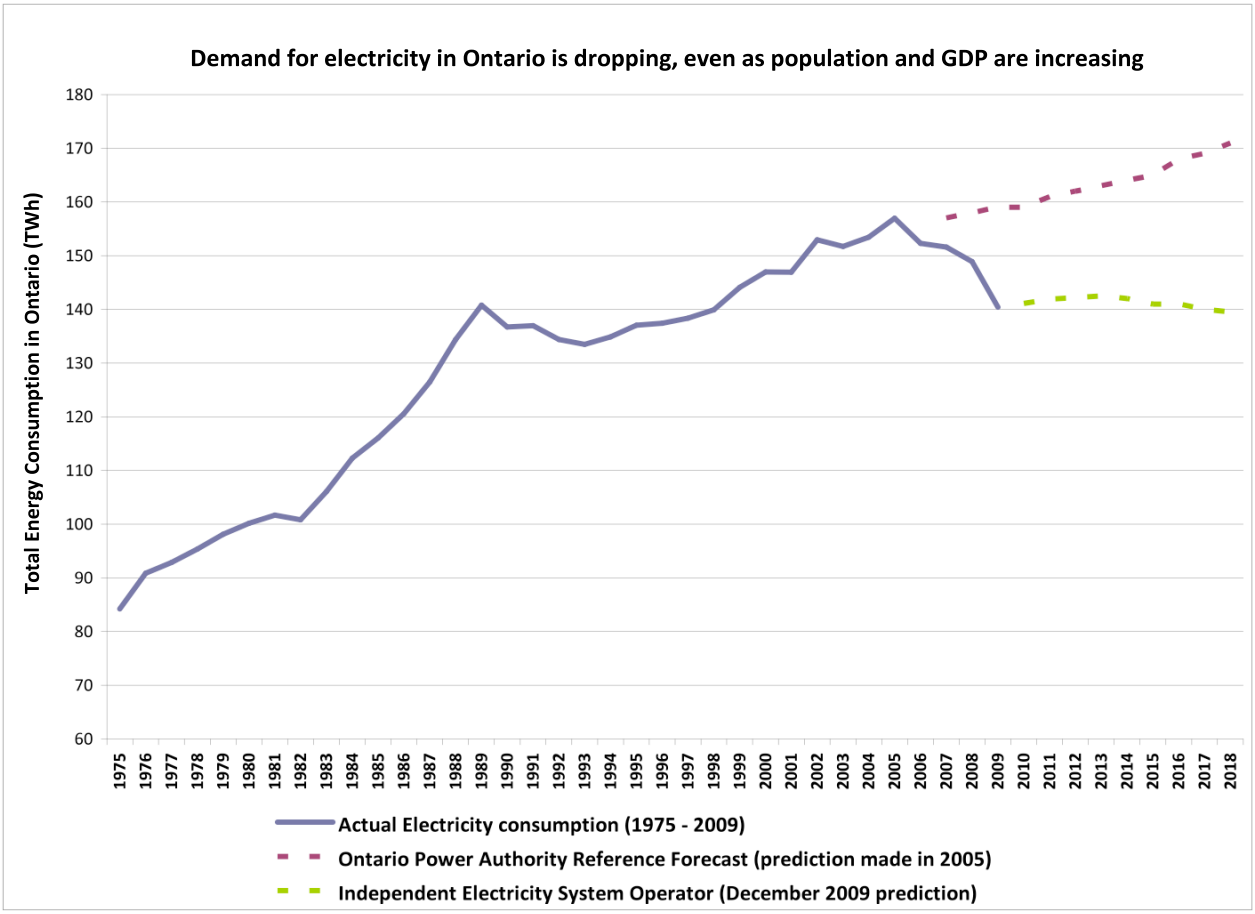
2. Key Issues

2.1 Decreasing Demand Forecast

At the time the IPSP was published in 2007, data from 1995 to 2005 was used to forecast future energy use. An increase in energy use was forecasted based on this time frame. However, since 2005 demand in Ontario has steadily declined, and in October 2009 the North American Electric Reliability Corporation (NERC) predicted that Ontario's demand will continue to fall by an average of 0.7% a year between 2009 and 2018.

Figure 1 below shows historical energy consumption, the demand forecast used in the IPSP, and the updated IESO demand forecast from December 2009. As Figure 1 shows, between 1995 and 2005 there was a trend of increasing energy use, leading to the demand forecast used for the IPSP. However, since then demand has decreased by approximately 15 TWh, leading to the IESO's revised forecast.

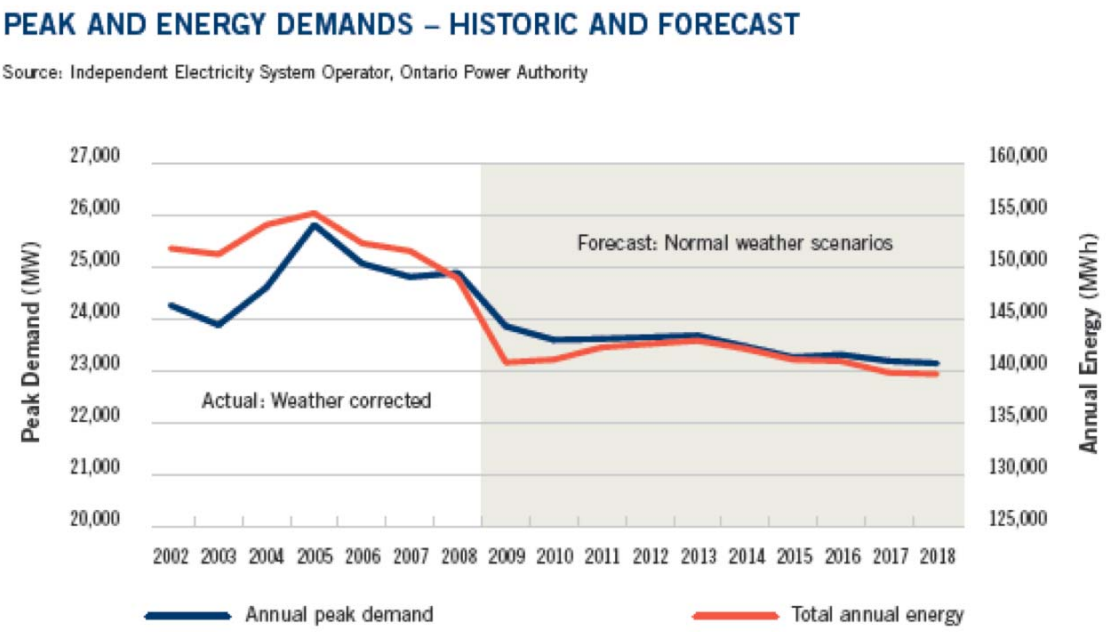
Figure 1: Comparison of IPSP demand forecast and current IESO forecast



The decline between 2005 and 2010 is the product of both conservation and the economic downturn.[10] A detailed study presented at OEB hearings shows that the trend towards decreasing demand was developing even before the economic downturn and suggests it will be ongoing. [11]

While the IESO does not suggest any further significant decreases in consumption, its projections show no growth in demand (Figure 2). The IESO argues that ongoing, long-term structural changes in the economy away from energy-intensive activities and continued conservation will keep demand down. Furthermore, as more communities produce electricity to meet their own needs, demand will shift off of the provincial electricity grid.[12]

Figure 2: IESO demand forecast



Source: Independent Electric System Operator, The Ontario Reliability Outlook, (IESO, 2009). http://www.ieso.ca/imoweb/pubs/marketReports/ORO_Report-Dec2009.pdf (accessed May 10, 2010).

Comparing the most recent IESO forecast to the forecast used by the OPA in developing the IPSP shows a significant reduction in demand. Current energy demand is approximately 20 TWh below the projection made in 2005. By 2018 the gap is projected to be over 30 TWh. This decrease is equivalent to 4,000 MW of nuclear generation capacity.

[10] Independent Electric System Operator, *The Ontario Reliability Outlook* (IESO, 2009), http://www.ieso.ca/imoweb/pubs/marketReports/ORO_Report-Dec2009.pdf (accessed May 10, 2010).

[11] Ralph Torrie and Doug Morrow, *Review of the Ontario Load Forecast in the Integrated Power System Plan* (IPSP, 2008).

[12] Independent Electric System Operator, *The Ontario Reliability Outlook* (IESO, 2009), http://www.ieso.ca/imoweb/pubs/marketReports/ORO_Report-Dec2009.pdf (accessed May 10, 2010).

With energy demand decreasing, additional nuclear energy could lead to too much base load generation, which creates system stability problems.[13] This was the case for 214 hours during March and April of 2009 when Ontario's wholesale electricity price was negative (i.e. large users were paid to consume electricity) as a result of over-generation.[14,15]

Since the development of the IPSP targets in 2005, Ontario's electricity demand forecast for 2018 has decreased by over 30 TWh, the equivalent of 4,000 MW of nuclear generation.

2.2 Conservation and Demand Management (CDM)

The OPA has found that CDM programs are exceeding their targets; this will help keep demand down. For example, the OPA's 2008 conservation programs achieved a net savings of more than 386 gigawatt-hours (GWh) — more than double the expected savings of 181 GWh.[16] The lifetime savings from these programs is expected to be 4,621 GWh, nearly quadrupling the forecasted savings of 1,197 GWh. Additional conservation initiatives can be added each year, further reducing demand. If CDM programs continue to exceed expectations, the demand forecast could decrease below IESO forecasted levels.

2.3 Development of Generating Capacity

While the demand forecast has decreased significantly, development of new generation has exceeded projections in the IPSP, particularly generation from wind power and other renewables.

The Green Energy Act does not legislate a cap on renewable energy. However, there is currently limited space on the electricity grid. To accommodate new renewable generation capacity beyond current targets, either existing transmission capacity must be opened up and/or new transmission must be built, while ensuring that the balance of the system is capable of handling new variable sources of power.

Wind Power

When the IPSP was developed in 2005 there were no commercial wind farms in Ontario. The IPSP called for a total of 4,055 MW of wind power by 2018. Development has already surpassed these numbers. In total, 5,418 MW have been contracted to date with an additional 5,533 MW awaiting Economic Connection Testing (ECT) and final approval. If all projects awaiting ECT go forward it would lead to a total of 10,951 MW. In particular:

[13] Green Resource Portfolios, *Development, Integration, and Evaluation* by Paul Chernick, Jonathan Wallach and Richard Mazzin. Resource Insight Inc., filed August 1, 2008. Available at: http://pubs.pembina.org/reports/oeb-green-resource-portfolios.pdf).

[14] Clean Air Alliance (April 2009), *Ontario wholesale electricity prices go negative*, http://www.cleanairalliance.org/node/696 (accessed June 7, 2010).

[15] AMPCO, *Negative Electricity Prices*, http://www.ampco.org/assets/AMPCO%20Negative%20pricing%2020090403.pdf

[16] Ontario Power Authority, *2008 Final Conservation Results*, (Toronto, ON: OPA, 2010), http://www.powerauthority.on.ca/Storage/113/16044_2008_Final_Conservation_Results_report_20100125_final.pdf (accessed May 10, 2010).

- 1,198 MW of wind power are currently in operation.[17]
- 690 MW of wind power were contracted for prior to the FIT program.[18]
- 1,229 MW of onshore wind power have been contracted through the FIT program.[19]
- 300 MW of offshore wind have been contracted through the FIT program.[20]
- 0.3 MW of wind power applications have been received through the microFIT program.[21]
- 2,000 MW of wind power have been contracted directly to Samsung.[22]
- An additional 5,503 MW of onshore wind and 30 MW of offshore wind are awaiting ECT prior to approval for the FIT program.[23]

Solar Power

The IPSP called for 88 MW of solar power by 2018. Development of solar projects has significantly outpaced this projection.

- 50 MW are in commercial operation.[24]
- 553 MW were contracted prior to the FIT program (includes 54 MW via microFITs).[25]
- 651 MW have been contracted to date through the FIT program.[26]
- 500 MW have been contracted directly to Samsung.[27]
- 610 MW await ECT prior to approval for the FIT program.[28]

This places the total contracted solar capacity at 1,254 MW with another 610 MW awaiting ECT, for a potential total of 1,864 MW.

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[17] Ontario Power Authority, *Wind Power*, http://www.powerauthority.on.ca/Page.asp?PageID=924&SiteNodeID=234 (accessed June 7, 2010).

[18] Ibid.

[19] Ontario Power Authority, *List of Contracts Offered: April 8 2010*, http://fit.powerauthority.on.ca/Storage/100/10989_FIT_Contracts_Offered_April_8_10_-_Applicant_Legal_Name_Order3.pdf (accessed June 7, 2010).

[20] Ibid.

[21] Ontario Power Authority, *Ontario's Feed-In Tariff Program Backgrounder*, http://fit.powerauthority.on.ca/Storage/100/10899_FIT_-_CAE_Event_-_Backgrounder_-_FINAL.pdf (accessed June 7, 2010).

[22] Samsung (January 25, 2010), "Samsung C&T, Korea Electric Power Company to Build World's Largest Wind, Solar Panel Cluster in Ontario," http://www.samsung.com/ca/news/newsRead.do?news_seq=17081&page=1 (accessed June 7, 2010).

[23] Ontario Power Authority, *List of Projects Awaiting Economic Connection: Test April 8 2010*, http://fit.powerauthority.on.ca/Storage/100/10988_FIT_Awaiting_ECT_April_8_10_-_Applicant_Legal_Name_Order3.pdf (accessed June 7, 2010).

[24] Ontario Power Authority (May 2010), *A progress report on Electricity Supply*, http://www.powerauthority.on.ca/Storage/120/16787_2010_Q1_Progress_Report_On_Electricity_Supply_final_May_27-10.pdf (accessed June 7, 2010).

[25] Ibid.

[26] Ontario Power Authority, *List of Contracts Offered: April 8 2010*.

[27] Samsung (January 25, 2010), Samsung C&T, Korea Electric Power Company to Build World's Largest Wind, Solar Panel Cluster in Ontario, http://www.samsung.com/ca/news/newsRead.do?news_seq=17081&page=1 (accessed June 7, 2010).

[28] Ontario Power Authority, *List of Projects Awaiting Economic Connection Test: April 8 2010*.

Bio-Energy

The IPSP called for 539 MW of bio-energy such as bio-mass, bio-gas and landfill gas by 2018. Current bio-energy development stands at 1,150 MW with the potential for 1,235 MW. In particular:

- 36.8 MW are in commercial operation.[29]
- 65.4 MW were contracted prior to FIT.[30]
- 48.6 MW have been contracted through the FIT program.[31]
- 1,000 MW will be generated via conversion of existing coal plants to bio-mass.[32]
- 84.8 MW are awaiting ECT prior to approval for the FIT program.[33]

Summary

Table 1 compares the new renewable energy capacity planned for in the IPSP with the new renewable energy capacity contracted to date.

Table 1: Non-hydro renewables contracted vs. IPSP planned levels

	New (Non-Hydro) Renewables Planned for in IPSP Until 2018	New (Non-Hydro) Renewables Contracted for as of March 2010
Solar Capacity	88 MW	1,754 MW
Onshore Wind Capacity	4,685 MW	5,118 MW
Offshore Wind Capacity	0 MW	300 MW
Bio-energy Capacity	539 MW	1,151 MW
Total Annual Generation	**14.5 TWh**	**21.5 TWh**

Additional development of renewable resources has already reached 7 TWh. If all of the projects awaiting ECT go ahead, an additional 14.2 TWh will be generated, bringing the additional annual generation up to 21.2 TWh. This additional generation would be equivalent to approximately 2,900 MW of nuclear generation, and can be expected to grow as the FIT program continues to attract more renewable energy projects.

Renewable energy contracted to date has far exceeded the amount planned for in the IPSP. Further capacity exists, but modification of the IPSP will be required to accommodate expansion of green power beyond current targets.

[29] Ontario Power Authority (May 2010), A progress report on Electricity Supply, http://www.powerauthority.on.ca/Storage/120/16787_2010_Q1_Progress_Report_On_Electricity_Supply_final_May_27-10.pdf (accessed June 7, 2010).

[30] Ibid.

[31] Ontario Power Authority, *List of Contracts Offered: April 8 2010*.

[32] Ontario Power Generation (November 2009), *Biomass Generation*, http://www.opg.com/investor/BioEnergy%20Chris%20Young%20091124.pdf (accessed June 10, 2010).

[33] Ontario Power Authority, *List of Projects Awaiting Economic Connection Test: April 8 2010*.

2.4 Price of Nuclear Power

Since 2005, the estimated cost of building new nuclear plants has more than doubled, while reactor refurbishment projects, such as Point Lepreau and Bruce A, have gone substantially over budget and suffered significant delays. In 2005, energy planners estimated that new nuclear reactors cost on the order of $2,900/kW or about $6 billion for a 2,000 MW station. The most recent projection completed by Moody's Investors Service prices nuclear power at $7,500/kW[34].

After the government suspended its procurement of new reactors in 2009, it was reported that what would have been the "winning bid," AECL's Advanced CANDU reactor, cost over 10,000/kW or $26 billion for a 2,400 MW station. The OPA later suggested that building new reactors at these levels would not be cost effective.[35]

2.5 Price of Clean Energy Alternatives

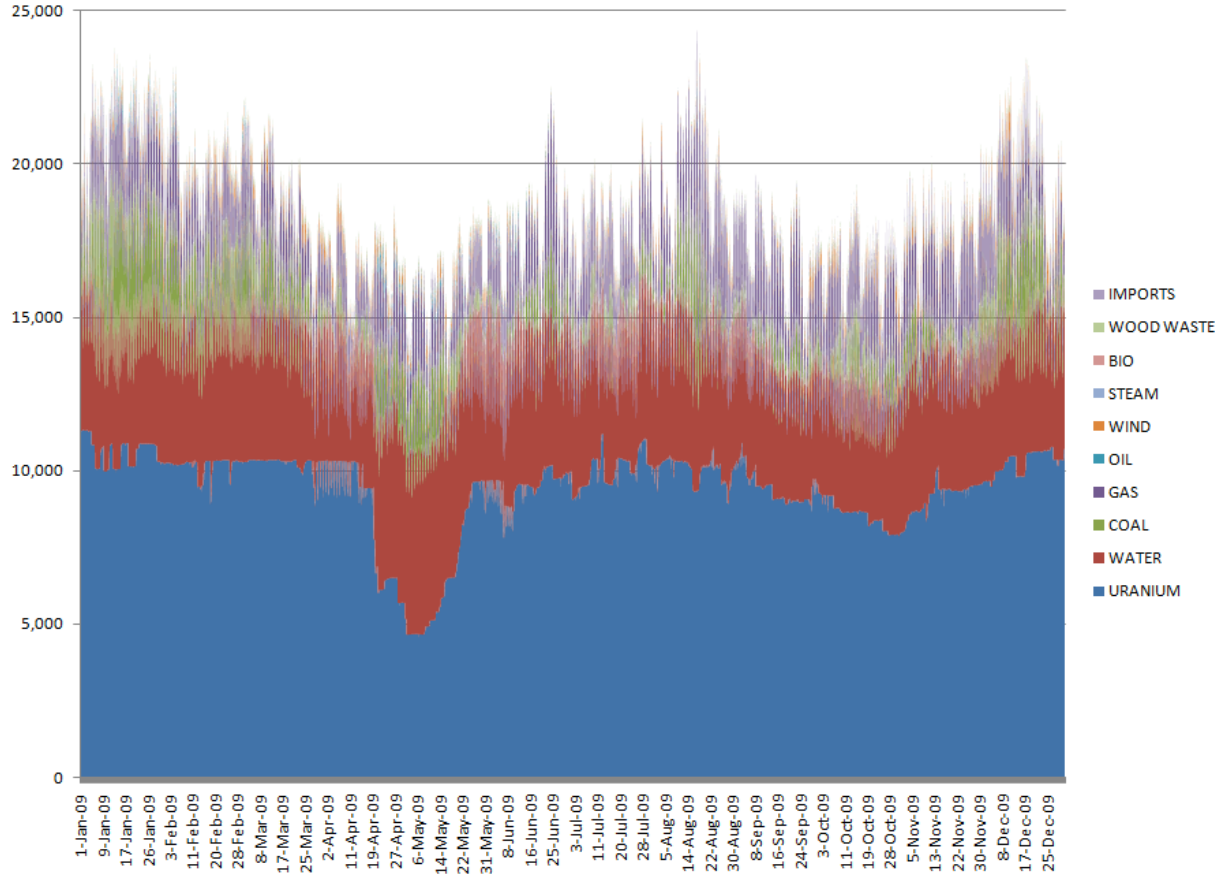
Ontario's FIT makes the procurement costs of clean energy alternatives fairly transparent. The majority of costs for renewable energy projects are up-front capital costs, and the 20 year contracts that are signed under the FIT amount to relatively stable long-term costs. The FIT is also scheduled for semi-annual price reviews. As prices for renewable power projects continue to decline, it is expected that future contracts for renewables will be cheaper than they are currently. This has been the case in many other countries with feed-in tariff legislation, which are designed to decrease tariffs to reflect and encourage technological advances.

The Ontario power system is already capable of handling large shut-downs of nuclear plants. For example, 5,000 MW of capacity were taken off line in April and May 2009 for operations and maintenance, as can be seen below. In fact, even at the peak demand of 24,380 MW at 2 p.m. on August 17, 2009, the nuclear output was 9,308 MW, down over almost 20% or 2,000 MW from its maximum output of 11,331 MW that year.

[34] Moody's Investors Service, "New Nuclear Generating Capacity: Potential Credit Implications for US Investor Owned Utilities," May 2008.

[35] In response to questioning at the Ontario Energy Board, the OPA admitted that at an overnight capital cost of $3,600 with an additional 2 cents in operating and maintenance costs and an 8% discount rate, nuclear stations would be uneconomical. See: Ontario Power Authority, EB-2007-0707, Exhibit, Tab 43, Schedule 3.

Figure 3: Ontario 2009 electricity production (source: IESO)



The Ontario Wind Integration Study performed by General Electric for the OPA, the IESO and CanWEA in 2006 by General Electric concluded that Ontario could integrate up to 10,000 MW of wind power by 2020 without significant changes to the grid or additions of more load following capacity. Therefore a portfolio of clean energy options that deliver generation equivalent to the proposed nuclear project can be used to compare costs. An example of a portfolio of alternatives that could provide the same annual production as the proposed nuclear project is shown below in Table 2.

Table 2: Portfolio to replace 3,000 MW of nuclear

	MW	Cost (¢/kWh)	TWh/yr
Hydro	950	12.5	4.6
Onshore Wind	2,100	13.8	5.1
Offshore Wind	700	19.0	2.1
Solar	950	60.0	1.0
Biomass/Biogas/Landfill	450	12.0	2.4
Combined Heat and Power	500	8.5	3.5
Additional Efficiency/Conservation	350	2.7	3.1
Total		13.5	21.8
Being Replaced			
Moody Investment Service Nuclear Estimate ($7,500/kW Installed)	3,000	15.1	21.8
AECL 2009 Nuclear RFP "Winning" Bid ($10,800/kW Installed)	3,000	20.0	21.8

2.6 Summary

Since the IPSP directives were developed in 2006, the electricity demand forecast for 2018 has dropped significantly, renewable energy generation has exceeded targets, and the price of new nuclear has increased substantially. Given these major issues it is critical to examine how nuclear power fits into Ontario's supply mix moving forward. Such an exercise should take place in a needs assessment of the Darlington new build nuclear project.

Table 3: Change in major assumptions between 2006 and 2010

	2006	2010
Demand Forecast (2018)	172 TWh	140 TWh
Price of New Nuclear	8.6 ¢/kWh[36]	20 ¢/kWh
Renewable Energy Generation	14.5 TWh by 2018	21.7 TWh contracted Additional 14.2 TWh awaiting ECT.

[36] Median price forecast according to Ontario Power Authority, *Methodology and Assumptions for the Cost to Customer Model* (Table 10), available at http://www.powerauthority.on.ca/Storage/53/4886_G-2-1_Att_1_corrected_071019.pdf

3. Project Alternative

3.1 Introduction

This section details a proposed alternative means of achieving the 34.9 TWh expected to be generated annually by a 4,800 MW nuclear station. The proposed portfolio is comprised of a variety of power options, which creates flexibility and can be easily scaled up or down to meet changes in demand.

Table 4: Proposed alternative

Portfolio to Replace 4,800 MW of Nuclear	MW	TWh/yr
Onshore Wind	6,500	15.9
Offshore Wind	750	2.2
Solar	1,000	1.1
Hydro	1,000	4.8
Biomass/Biogas/Landfill	500	2.7
Combined Heat and Power*	1,453	3.3
Additional Conservation and Demand Management	560	5.0
Total		35.0

*Increase in CHP capacity assumed in IPSP from 41% to 67%.

The right combination of sources can help meet Ontario's base load power demand. With the right grid integration, transmission, regulation, and acquisition policies, these options can provide a reliable power source that is more flexible, less risky and cleaner than nuclear power.[37]

Per sections 1 and 2, the advantages of this portfolio include:

- It is in line with current provincial policy.
- It can be easily scaled back to adapt to decreases in demand.
- The timeline for deployment is quicker.
- It is cheaper than nuclear power.

For each power source in the proposed alternative portfolio, current deployment levels and the potential for the resource within the province are examined below to determine achievability.

[37] Roger Peters and Cherise Burda (2007), *The Basics on Base Load*, The Pembina Institute.

3.2 Wind Power

As discussed in section 2.3, contracting of wind generation has already exceeded the projection in the IPSP by over 400 MW, with an additional 5,650 MW awaiting ECT. The alternative portfolio requires a small amount of additional onshore generation beyond projects awaiting ECT (approximately 400 MW); this is likely to be sourced though continued applications to the FIT and microFIT program.

Offshore wind contracts currently total 300 MW with 30 MW awaiting ECT. To meet the portfolio target of 750 MW, another 420 MW will be required. A project of this size is already being planned by Trillium Energy.[38]

Even greater potential extends beyond targets for our scenario. A recent survey completed by the OPA found that over 13,000 MW of wind power projects are ready to be built following the announcement of the Green Energy Act.[39] The OPA's own assessment of onshore wind potential within close proximity to existing transmission corridors is 22,000 MW.[40] Even at a 30% capacity factor this is equivalent to approximately 7,300 MW of nuclear generation. Over 35,000 MW of additional capacity for wind power is available offshore in the Great Lakes.[41] This offshore potential would operate at a higher capacity in the range of 34.7% to 40.8%.[42]

3.3 Bio-Energy

Bio-energy is a valuable resource in any portfolio since it can be used to generate electricity on-demand. For example, it can be used to complement wind power: when wind turbines are producing little electricity the output from bio-energy plants can be scaled up, and when wind turbines are producing heavily the output from bio-energy plants can be scaled back or turned off.

With the planned conversions of Nanticoke and Atikokan in addition to existing contracts, the portfolio's target for bio-energy generation is easily exceeded. Further potential exists for bio-energy, with 750 MW identified from the agricultural sector (from crop residue and animal manures)[43] and 297 MW from the forestry sector 297 MW.[44]

3.4 Small Hydro

Prior to the FIT program the OPA had sourced 33 MW of small-scale hydro power. The FIT program has contracted an additional 192 MW of water power with a further 153 MW awaiting ECT. This adds up to 378 MW, exceeding the portfolio target of 300 MW.

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[38] Trillium Power, *Trillium Power Wind 1*, http://www.trilliumpower.com/energy/project-wind-1/ (accessed June 8, 2010).

[39] Tyler Hamilton, "Renewable electricity seen filling half of grid", *The Toronto Star*, April 22, 2009.

[40] Helimax Energy Inc (2005), *Analysis of Wind Power Potential in Ontario* 2005.

[41] Helimax Energy Inc (2008), *Analysis of Future Offshore Wind Farm Development in Ontario*.

[42] Ibid.

[43] Ontario Power Authority, *Bioenergy Resources*, IPSP Exhibit D, Tab 5, Schedule 1, Attachment 5.

[44] Ibid.

There is potential for even further development. Studies by the Ontario Water Power Association,[45] Canadian Hydro Association[46] and Hatch Acres[47] have all shown that there is significantly more capacity for hydro power than the OPA is pursuing.[48] In addition, the Ministry of Natural Resources estimates that there is the potential for 2,000 MW of additional hydro power in Ontario.[49]

3.5 Solar

In a mixed portfolio, solar power provides significant value. The output of solar cells has a high coincidence factor with peak electricity usage, meaning that installed solar cells provide an excellent complement to wind power and other distributed generation sources in load following.

As discussed in section 2.3, over 1,754 MW of solar have already been contracted, with another 610 MW awaiting ECT. Even if all of the projects awaiting ECT are cancelled, our target of 1,000 MW on top of development called for in the original IPSP (88 MW) is easily met.

3.6 Conservation and Demand Management

The additional 5.0 TWh proposed in the alternative portfolio is largely achievable based on the additional capacity identified by the OPA itself. In developing the IPSP the OPA identified over 33.6 TWh of potential cost-effective savings from CDM measures by 2020; however, the IPSP plan calls for only 21.5 TWh of CDM by 2020.[50]

Given the underestimation of savings from the OPA's 2008 program, it is possible that the potential for savings is much greater than even 33.6 TWh. This is supported by analysis carried out by ICF (2006),[51] Marbek (2006),[52] MKJA (2006),[53, 54] the Pembina Institute (2004)[55] and the Vermont Energy Investment Corporation (VEIC).

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[45] Ontario Waterpower Association, OWA – About (website), www.owa.ca/about.html (accessed April 28, 2009),

[46] The Pembina Institute (2007), *Renewable Is Doable: Analysis of Resource Potential and Scenario Assumptions*. See table 11,Various Estimates of Hydroelectric Potential in Ontario.

[47] Hatch Acres (2005), *Evaluation and Assessment of Ontario's Waterpower Potential*. Prepared for Ontario Waterpower Association and Ontario Ministry of Natural Resources.

[48] The Pembina Institute (2007), *Renewable Is Doable: Analysis of Resource Potential and Scenario Assumptions*. In this report the Pembina Institute recommends pursuing an additional 700 MW.

[49] Ontario Ministry of Energy and Infrastructure, *Hydro Power*, online resource last updated November 24, 2009, http://www.mei.gov.on.ca/en/energy/renewable/index.php?page=water_about (accessed June 10, 2010).

[50] Ontario Power Authority, *Integrated Power System Plan; Exhibit D Tab 4, Schedule 1*.

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

[52] Marbek Resource Consultants and Altech Environmental Consulting (2006), *Potential for Fuel Switching to Reduce Ontario's Peak Electricity Demand*.

[53] MK Jaccard and Associates & Marbek Resource Consultant Ltd. (2006), *Demand Side Management Potential in Canada: Energy Efficiency Study*, prepared for Canadian Gas Association.

[54] MK Jaccard and Associates (2006), *Modelling and Scenario Documentation*, prepared for Ontario Power Authority.

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3.7 Combined Heat and Power

Combined heat and power (CHP) plants offer significant efficiency gains over traditional natural gas generating stations. Local CHP generation that recycles otherwise wasted thermal energy achieves 200 to 250% higher energy efficiency than the average large plant.[56]

A number of opportunities exist to increase the CHP capacity in Ontario moving forward.

1. Non-utility generators (NUGs): Ontario has a number of contracts with NUGs that are expiring between now and 2016. If Ontario renewed contracts with those who operate CHP plants, an additional 122 MW would be available by 2014 and 828 MW would be available by 2019.
2. Increasing the capacity factor of existing and planned CHP plants: The OPA plans to operate CHP plants at 41% in 2018. By increasing the capacity factor to 67%, an additional 1,453 MW could be generated by 2019. This capacity increase would also make Ontario's CHP plants more economically viable.

The alternative portfolio recommends the second option. Since no new construction is required for this increase in generation, it is very cost-effective and helps provide a reliable source of base load power.

3.8 Conclusions

Options that are more sustainable than nuclear exist for the expansion of Ontario's generating capacity. The EIS must examine these options and consider how effective they would be at meeting future provincial generating requirements compared to nuclear power.

Our analysis shows that renewable energy, conservation and demand management combined with increased use of existing CHP plants can provide the equivalent generating capacity of a 4,800 MW nuclear generating station.

[56] Cherise Burda and Roger Peters (2008), *Plugging Ontario into a Green Future*, The Pembina Institute.

4. Conclusion

Since the province originally directed OPG to plan for a new nuclear station at the Darlington site significant changes to provincial policy have occurred which cloud the picture concerning this project. Firstly the IPSP, upon which the call for this station was based, has been cancelled, with the province calling for an altogether new plan. Without this plan the need for this station is called into question. Additionally since cancelling the IPSP the province has moved decidedly towards increasing cleaner sources of power such as renewable energy by the passing of Bill 150; the Green Energy and Economy Act. Finally, based on the submitted costs the province rejected all bids for the construction of a new nuclear power plant.

Beyond a shift in provincial policy between the time this project was initially called for by the province and today, significant changes have occurred to the electricity sector in Ontario which raise significant questions around the need for this project. First instead of an increasing demand forecast, demand is now projected to decrease in the coming years, with modest growth forecast beyond that, significantly below the previously cancelled IPSP. Additionally, renewable generation is significantly outpacing initial targets set in 2006. Both the decrease in the demand forecast and the increase in renewable generation are nearly sufficient to replace this project.

Finally, if it is determined that additional generation is required, this EIS should consider all options of generating that electricity. Based on our analysis there is sufficient capacity from clean generation technologies and conservation to provide a lower cost and more sustainable alternatives to nuclear power at this time.