Ministry of Energy

Electricity Sector—Renewable Energy Initiatives

Background

The government is responsible for setting the legislative and policy framework over the production, transmission, and sale of electricity in Ontario. The three key factors that impact its electricity policy-setting role are price, reliability, and sustainability.

The Ministry of Energy (Ministry) is responsible for providing the regulatory framework and implementing the government's electricity policies, and does this in part through its oversight of several government entities, including:

- the Ontario Power Authority (OPA), which plans and procures electricity supply to meet the province's power needs;
- the Ontario Energy Board (OEB), which regulates Ontario's electricity and natural-gas sectors;
- the Independent Electricity System Operator (IESO), which is responsible for the day-to-day operation of Ontario's electrical system;
- Ontario Power Generation (OPG), which generates electricity through its nuclear, thermal, and hydroelectric stations; and
- Hydro One, which distributes electricity across the province.

One cornerstone of the current government's energy policy is the development of a significantly greater role for renewable energy in Ontario's electricity-supply mix. Renewable electricity refers to those sources of energy generated by natural processes. The four major forms of renewable energy are:

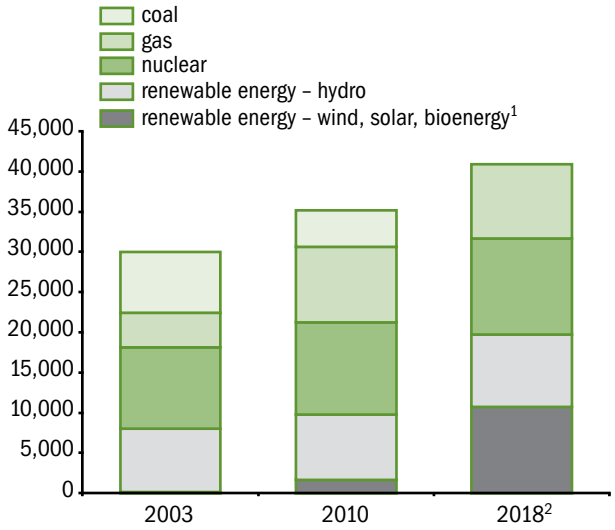
- hydro, generated from the movement of water;
- wind, generated by turbines from air currents;
- solar, generated by photovoltaic cells that capture energy from the sun; and
- bioenergy, generated by burning organic forestry residues and agricultural wastes.

The Ontario government has proposed an increased reliance on renewable energy sources, especially wind, solar, and bioenergy, partly to replace coal-fired generating plants by the end of 2014. The installed capacity from different energy sources between 2003 and 2018, as projected in the Ministry's Long-Term Energy Plan of November 2010, is shown in Figure 1.

In keeping with this priority, the government enacted the *Green Energy and Green Economy Act* (Act) in May 2009. The intent of the Act, which included new legislation and amendments to existing laws, was to attract investment in renewable energy, promote a culture of energy conservation, create a competitive business environment, increase job opportunities, and reduce greenhouse gas emissions.

Figure 1: Installed Capacity of Electricity Supply from Different Energy Sources (MW), 2003–2018

Source of data: Ministry of Energy



1. The expected electricity outputs from wind and solar are much lower than their installed capacity (see Figure 10).
2. Projected.

Both the Ministry and the OPA have played an active role in implementing the government's renewable energy policies. The Ministry's responsibilities have focused on the development of programs and policies to advance implementation of the Act, while the OPA has played a key role in planning and procuring renewable energy by contracting to buy power from developers of renewable energy projects.

Audit Objective and Scope

The objective of our audit was to assess whether the Ministry of Energy (Ministry) and the Ontario Power Authority (OPA) had adequate systems and procedures in place to:

- ensure that renewable energy resources are obtained in a cost-effective manner and within the context of applicable legislation and government policy; and
- implement a balanced and responsible plan with respect to renewable energy that provides Ontarians with a clean, reliable, affordable, and sustainable electricity system.

Senior management at the Ministry and the OPA reviewed and agreed to our audit objective and associated audit criteria.

We conducted our audit work at the Ministry and the OPA. We also visited the system control centre of the Independent Electricity System Operator (IESO) to help us better understand the operation of Ontario's electricity market.

In conducting our audit work, we reviewed relevant legislation, regulations, policies, and procedures; analyzed historical and projected electricity-related data collected by the OPA and the IESO; reviewed analyses conducted by the Ministry and the OPA; interviewed ministry and OPA staff; met with representatives from the IESO, the Ontario Energy Board, and Hydro One; and reviewed relevant literature and best practices in other jurisdictions. In addition, we engaged independent consultants with expert knowledge of Ontario's energy sector on an advisory basis.

We did not rely on the Ministry's internal audit service team to reduce the extent of our audit work because it had not recently conducted any audit work on renewable energy initiatives.

Summary

Historically in Ontario, electricity generation and transmission to residential and commercial users was largely the responsibility of Ontario Hydro, a Crown corporation, and after 1999, its successor companies. The responsibility for ensuring that these entities provided consumers with electricity that was both sustainable over the long term and reasonably priced fell to the Ministry of Energy (Ministry) and the Ontario Energy Board, an independent regulator. The *Green Energy and Green Economy Act, 2009* delegated a certain part

of the responsibility for dramatically increasing the province's renewable energy supply directly to the Minister of Energy. Under this legislation, the government created a new process to expedite the development of renewable energy by providing the Minister with the authority to supersede many of the government's usual planning and regulatory oversight processes.

As a result, the government has been able to further its renewable energy policy agenda without the delays that these processes can sometimes cause. This agenda has included generating significantly more energy from renewable sources to replace coal-sourced energy, given its environmental and health risks. It has also included creating jobs in a new "green" energy sector.

The government's renewable energy initiatives have been successful in rapidly increasing the amount of renewable power available over the next few years. At the same time, however, wind and solar renewable power will add significant additional costs to ratepayers' electricity bills. Renewable energy sources such as wind and solar are also not as reliable and require backup from alternative energy-supply methods such as gas-fired generation. The government was well aware that its renewable energy initiatives meant higher costs but felt that this was a more-than-acceptable trade-off given the environmental and health benefits, as well as the anticipated job-creation benefits.

Some of our observations relating to the implementation of the government's renewable energy policy were as follows:

- Ontario is on track to shut down its more than 7,500 megawatts (MW)—the capacity as of 2003—of coal-fired generation by the end of 2014. Coal-generated power is being replaced by nuclear power from refurbished plants and by an increase of about 5,000 MW of gas-fired generation, with the remainder resulting largely from bringing more renewable energy online. More significantly, actions taken by the OPA and the Ministry to implement the Minister's Directives are projected to increase renewable energy, mainly wind and solar power, to 10,700 MW by 2018.
- Because the ministerial directions were quite specific about what was to be done, both the Ministry and the OPA directed their energies to implementing the Minister's requested actions as quickly as possible. As a result, no comprehensive business-case evaluation was done to objectively evaluate the impacts of the billion-dollar commitment. Such an evaluation would typically include assessing the prospective economic and environmental effects of such a massive investment in renewable energy on future electricity prices, direct and indirect job creation or losses, greenhouse gas emissions, and other variables.
- In May 2009, when the *Green Energy and Green Economy Act* (Act) was passed, the Ministry said the Act would lead to modest incremental increases in electricity bills of about 1% annually—the result of adding 1,500 MW of renewable energy under a renewable procurement program called the Feed-in Tariff program and implementing conservation initiatives. In November 2010, the Ministry forecast that a typical residential electricity bill would rise about 7.9% annually over the next five years, with 56% of the increase due to investments in renewable energy that would increase the supply to 10,700 MW by 2018, as well as the associated capital investments to connect all the renewable power sources to the electricity transmission grid.
- The OPA was designated as the province's energy planner, responsible for submitting long-term plans to the Ontario Energy Board (OEB) for approval. However, the first long-term energy plan put forward by the OPA since its creation in December 2004 has not been approved by the OEB. Although the OPA did spend $10.7 million to develop its first energy plan, which it submitted to the OEB for review in 2007, the government suspended the OEB's review of the plan in 2008. In 2010,

the Ministry released its own Long-Term Energy Plan to provide the OPA with sufficient context on the government's policy priorities and targets to guide it in its planning. From the public's perspective, this could lead to some ambiguity as to which entity is responsible for electricity planning in Ontario.

- Earlier procurement programs for renewable energy included competitive bidding and the Renewable Energy Standard Offer Program (RESOP), which were both very successful and achieved renewable generation targets in record time. In particular, RESOP received overwhelming responses. It was expected to develop 1,000 MW over 10 years, but it exceeded this target in a little more than one year. Although continuing the successful RESOP initiative was one option, the Minister directed the OPA to replace RESOP with a new Feed-in Tariff (FIT) program that was wider in scope, required made-in-Ontario components, and provided renewable energy generators with significantly more attractive contract prices than RESOP. These higher prices added about $4.4 billion in costs over the 20-year contract terms as compared to what would have been incurred had RESOP prices for wind and solar power been maintained. The Ministry indicated that replacing RESOP with FIT successfully expedited its renewable energy program and promoted Ontario's domestic industry.
- Many other jurisdictions set lower FIT prices than Ontario and have mechanisms to limit the total costs arising from FIT programs. The OPA made a number of recommendations to lower Ontario's pricing structure. We were advised that the government opted for price stability to maintain the investor confidence required to attract capital investment to Ontario until the planned two-year review of the FIT program could be undertaken. Examples of proposed changes included the following:
  - In March 2009, before the passage of the *Green Energy and Green Economy Act,* the OPA proposed a reduction of 9% to FIT prices for electricity generated from ground-mounted solar projects, in line with similar practices in some other jurisdictions. This could have reduced the cost of the program by about $2.6 billion over the 20-year contract terms. The government did not apply this reduction. The Ministry informed us that such a predetermined price reduction ran counter to the government's goals of maintaining policy and price stability for the initial two-year period.
  - In February 2010, the OPA recommended cutting the FIT price paid for power from microFIT ground-mounted solar projects after the unexpected popularity of these projects at the price of 80.2¢ per kilowatt hour (kWh), the same price as was being paid for rooftop solar projects, became apparent. This price would provide these ground-mounted solar project developers with a 23% to 24% after-tax return on equity instead of the 11% intended by the OPA. The recommended price cut was not implemented until August 2010. In the five months from the time the OPA recommended the price cut in February 2010 to the actual announcement in July 2010, the OPA received more than 11,000 applications from developers. Because the government decided to grandfather the price in order to maintain investor confidence, all of these applications, if approved, would qualify for the higher price rather than the reduced one. We estimated that, had the revised price been implemented when first recommended by the OPA, the cost of the program could have been reduced by about $950 million over the 20-year contract terms.
- The Ministry negotiated a contract with a consortium of Korean companies to build renewable energy projects. The consortium

will receive two additional incentives over the life of the contract if it meets its job-creation targets: a payment of $437 million (reduced to $110 million, as announced by the Ministry in July 2011 after the completion of our audit fieldwork) in addition to the already attractive FIT prices; and priority access to Ontario's electricity transmission system, whose capacity to connect renewable energy projects is already limited. However, no economic analysis or business case was done to determine whether the agreement with the consortium was economically prudent and cost-effective, and neither the OEB nor the OPA was consulted about the agreement. On September 29, 2009, the ongoing negotiations with the consortium were publicly announced, and Cabinet was briefed on the details of the negotiations and the prospective agreement in October 2009. The formal agreement was signed in January 2010.

- Surplus generating capacity is necessary to meet periods of peak demand, which, in Ontario, occur in the summer. Therefore, to ensure system reliability, all jurisdictions will have surplus power from time to time. Ontario deals with surplus-power situations mainly by exporting electricity to other jurisdictions at a price that is lower than the cost of generating that power. Given that demand growth for electricity is expected to remain modest at the same time as more renewable energy is being added to the system, electricity ratepayers may have to pay renewable energy generators under the FIT program between $150 million and $225 million a year not to generate electricity.
- Ontario's electricity transmission and distribution systems already operate at or near capacity. A higher-than-anticipated number of renewable energy projects under the FIT program are awaiting connection to the distribution grid. As of April 1, 2011, about 10,400 MW, representing more than 3,000 FIT applications, cannot be accommodated into the existing power grid.
- Recent public announcements stated that the *Green Energy and Green Economy Act, 2009* was expected to support over 50,000 jobs, about 40,000 of which would be related to renewable energy. However, about 30,000, or 75%, of these jobs were expected to be construction jobs lasting only from one to three years. We also noted that studies in other jurisdictions have shown that for each job created through renewable energy programs, about two to four jobs are often lost in other sectors of the economy because of higher electricity prices.
- Renewable energy sources such as wind and solar provide intermittent energy and require backup power from coal- or gas-fired generators to maintain a steady, reliable output. According to the study used by the Ministry and the OPA, 10,000 MW of electricity from wind would require an additional 47% of non-wind power, typically produced by natural-gas-fired generation plants, to ensure continuous supply.

OVERALL MINISTRY RESPONSE

The Ministry of Energy (Ministry) welcomes the Auditor General's recommendations and remains committed to providing quality policy advice and implementing the government's decisions in a manner that is cost-effective and promotes system reliability and sustainability.

The *Green Energy and Green Economy Act, 2009*, enacted by the Ontario Legislature and authorizing the creation of a Feed-in Tariff (FIT) program, represents a fundamental shift in Ontario's electricity policy direction. This directional shift is consistent with some 88 jurisdictions worldwide that have also implemented FIT programs.

Ontario's FIT program was designed to meet three key policy objectives:

- Reduce our environmental footprint (greenhouse gas emissions) by bringing more renewable energy online and supporting the phase-out of coal by 2014.
- Better protect the health of Ontarians by eliminating the harmful emissions from burning coal. In fact, an Ontario independent study in 2005 found that coal-fired generation costs $4.4 billion annually when health and environmental costs are taken into consideration.
- Create green energy jobs and attract scarce investment capital to Ontario amidst a global recession.

The uptake of Ontario's FIT program has been successful largely due to the government's decision to set attractive FIT prices and instill investor confidence by not reducing prices or making major policy or program changes prior to the mandatory two-year review.

Planning for a stable supply of electricity is a complex exercise requiring compliance with North American standards. Prudent planning requires providing significantly more generating capacity than peak demand. By 2016, energy supply and demand are projected to match closely as nuclear units are taken offline for refurbishment.

The Ministry will continue to work closely with the Ontario Power Authority to balance energy supply and demand in the next Integrated Power System Plan and make adjustments as necessary to ensure reliability.

OVERALL OPA RESPONSE

The OPA supports the Auditor General's recommendations with respect to the ongoing development and administration of renewable energy programs in the province. The Ontario FIT program—the first of its kind in North America in scope, comprehensiveness, and magnitude—was designed and launched in 2009 in a particular set of economic and policy circumstances. The OPA worked to diligently and effectively implement the program within short timelines. Consistent with the OPA's own internal audit, the Auditor General did not find any significant issues with the administration of the FIT program. From the outset, a mandatory review was built in, at the two-year mark, to provide a period of program stability as well as to recognize that the program would need to evolve as both technology and markets matured over time. This review, under way in fall 2011, provides an opportunity to consider many of the issues raised in the audit.

The Auditor General also identifies the importance of sector-wide collaboration and coordination for renewable energy development. The OPA works closely with the Ministry of Energy, Hydro One, the Independent Electricity System Operator, local distribution companies, and the Ontario Energy Board on renewable energy development—for example, through the Renewable Energy Supply Integration Team—and will continue to do so. This includes finding ways to more effectively communicate with the public on the costs of renewable energy and other types of electricity generation. Finally, the OPA is encouraged that the Auditor General recognizes the contribution that renewable energy is making to support the reduction of greenhouse gases in Ontario's electricity system.

Detailed Audit Observations

SIGNIFICANT RENEWABLE ENERGY COMING ON-LINE

Building clean, affordable, reliable, and sustainable sources of electricity is a top priority for the Ontario government. As part of its goals of protecting the environment and the health of Ontarians, the government has committed to closing all coal-fired

plants by the end of 2014. Ontario is on track to meet this commitment. Of the 19 units operated at five coal-fired plants across Ontario in 2003, the Ministry indicated that eight units had been closed since that year and two more were to be shut down later in 2011. As a result of these closures, the installed capacity of coal-fired generation in Ontario has been decreasing. It is anticipated that more than 7,500 MW of coal-fired installed capacity in 2003 will be replaced by nuclear power from refurbished plants and an increase of about 5,000 MW of gas-fired generation, with the balance coming from new renewable energy sources (see Figure 1).

Specifically, with the passage of the *Green Energy and Green Economy Act, 2009*, Ontario has made progress in bringing more renewable energy on-line. According to the Ministry, the installed capacity of cleaner renewable energy such as wind, solar, and bioenergy has increased from about 160 MW in 2003 to about 1,700 MW in 2010, and is expected to increase further to 10,700 MW by 2018 (see Figure 1).

COST IMPACT OF RENEWABLE ENERGY ON CONSUMERS

Rising electricity costs have in the last few years been a concern for Ontarians, who saw their power bills rise an average of 26% between 2008 and 2010, mainly as a result of capital investments, refurbishment of generating infrastructure, and the imposition of the Harmonized Sale Tax (HST). The government responded with a 10% reduction, called the Ontario Clean Energy Benefit, on the monthly electricity bills of households and small businesses that took effect on January 1, 2011, and that is to last for five years.

At the same time, mounting concerns about the impact of conventional power generation on the environment and public health have led many to give serious consideration to environmentally friendly renewable energy as an alternative. On the other hand, renewable energy sources, particularly wind and solar, cost much more than conventional energy sources. Accordingly, electricity bills are projected to rise even further as more renewable energy projects start commercial operations in the next few years. The following section deals with some of the key factors affecting the cost of electricity in Ontario.

Hourly Ontario Electricity Price (HOEP) and Global Adjustment (GA)

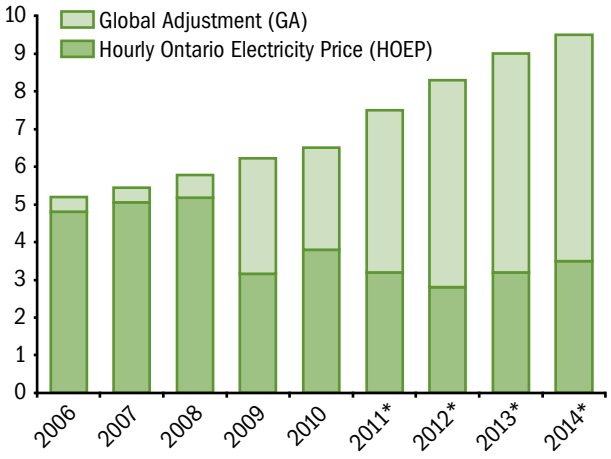
There are five parts to the typical electricity bill: electricity charge, delivery charge, regulatory charge, debt retirement charge, and HST. The electricity charge accounts for the biggest single portion of the bill, and it consists of two key components:

- The Hourly Ontario Energy Price (HOEP) is an hourly market price based on supply and demand for electricity as determined by a competitive process in which generators bid to supply electricity into the market.
- The Global Adjustment (GA) is the difference between the market price (HOEP) and the guaranteed prices paid to regulated and contracted generators. It also accounts for the cost of the OPA's conservation programs. Guaranteed prices are paid to generators, including, but not limited to, nuclear and hydroelectric generators administered by the Ontario Power Generation (OPG), non-utility generators administered by the Ontario Electricity Financial Corporation, and gas-fired and renewable energy generators contracted by the OPA.

The OPA has entered into a number of fixed-price contracts, resulting in higher-than-market electricity prices. Following passage of the *Green Energy and Green Economy Act* in 2009, the OPA was directed to significantly expand renewable energy by offering very attractive contract prices to developers of renewable energy projects. These contracts are expected to lead to significantly higher electricity charges through the GA portion of the electricity bill. Figure 2 shows that:

- The sum of the HOEP and the GA, representing the biggest part of electricity bills,

Figure 2: Electricity Charge, 2006–2014 (¢/kWh)
Source of data: OPA and IESO



* Projected.

increased by 25% between 2006 and 2010, and is expected to rise another 43% by 2014 due to rapid growth in the GA.

- By 2014, the GA is expected to be 6¢ per kilowatt hour (kWh)—almost two-thirds of the electricity charge—and will be almost two times more than that year's projected HOEP.

Based on our analysis of OPA data, renewable energy contracts will contribute significantly to increases to the Global Adjustment. As illustrated in Figure 3, the total GA is expected to increase tenfold province-wide, from about $700 million in 2006 to $8.1 billion in 2014, when the last coal-fired plants are phased out. Almost one-third of this $8.1 billion is attributable to renewable energy contracts.

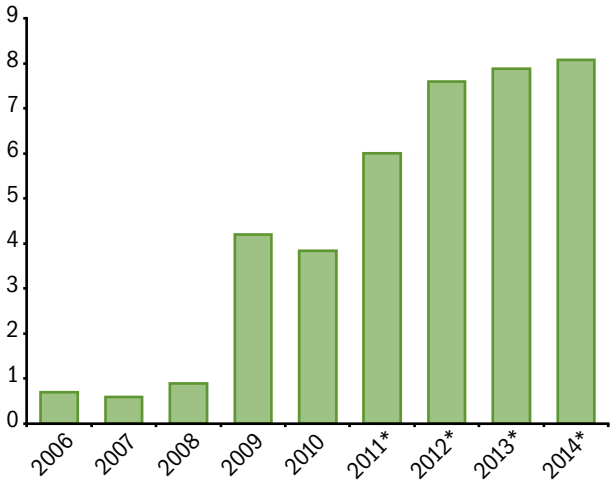
Public Awareness of the Cost Impact of Renewable Energy

The OPA indicated that consumers have to be advised, through appropriate channels, of the expected electricity-price increases arising from a large number of contracts to buy green energy at fixed rates that are significantly higher than market prices. However, a number of consumer surveys conducted by the government in spring and fall 2010 indicated that although consumers generally supported renewable energy, they were for the most part unaware of its impact on prices. Specifically:

- An OPA survey showed that only 14% of respondents thought renewable energy would lead to electricity price increases, while 60% disagreed that "green energy sources like wind and solar are too expensive and unreliable."
- Ministry surveys found that only a minority of respondents linked recent price increases to the cost of renewable energy, although many respondents did say that they were prepared to pay "modest" increases for renewable electricity.
- Hydro One surveys found that consumers supported spending to connect renewable energy to the power grid, but were less inclined to support electricity bill increases associated with these investments. About half said they were willing to pay for such investments, but only 27% would agree to an increase in their electricity bills of more than 5%.

In May 2009, when the *Green Energy and Green Economy Act* was passed, the Ministry said it would lead to modest incremental increases in electricity bills of about 1% annually as a result of adding 1,500 MW of renewable energy under a renewable energy program called Feed-in Tariff (FIT) and implementing conservation initiatives. In November

Figure 3: Total Global Adjustment, 2006–2014 ($ billion)
Source of data: OPA and IESO



* Projected.

2010, the Ministry's Long-Term Energy Plan (LTEP) included electricity-price forecasts based on the effects of all investments in Ontario's electricity system. According to the LTEP, a typical residential electricity bill would rise about 7.9% annually over the next five years, with 56% of the increase due to investment in new, cleaner renewable energy that would increase the supply to 10,700 MW by 2018 as well as the associated capital investments to connect renewable power sources to the transmission grids.

Because the forecasts in the LTEP were not specific to renewable energy, we asked the Ministry for a detailed breakdown and analysis showing the impact of all renewable energy initiatives on various components of residential, industrial, and commercial electricity bills. As Figure 4 illustrates, the impact of renewable energy on monthly electricity charges is expected to increase for all sectors between 2010 and 2018, especially the large commercial and industrial sectors. However, the Ministry did not have a similar breakdown for the impact of renewable energy on monthly delivery and regulatory charges. We also noted that although the LTEP and the related pamphlet did inform the public that renewable energy would increase their electricity bills, the cost impact of renewable energy by sector was not disclosed in detail. The Ministry informed us that the forecasts in the LTEP were based on all-in total costs, which are more important to the public than cost data relating to the different sources of energy, such as renewable energy.

In addition to the forecasts in the Ministry's LTEP and contained in Figure 4, in April 2010, the OEB completed an analysis predicting that a typical household's annual electricity bill will increase by about $570, or 46%, from about $1,250 in 2009 to more than $1,820 by 2014. More than half of this increase would be because of renewable energy contracts.

RECOMMENDATION 1

To ensure that electricity ratepayers understand why their electricity bills are rising at a much higher rate than inflation, the Ministry of Energy (Ministry) and the Ontario Power Authority (OPA) should work together to increase consumer awareness of the concept of the Global Adjustment and make more information available on the cost impact of its major components.

MINISTRY RESPONSE

The Ministry agrees that consumer awareness of electricity costs, and the factors that affect those costs, is vital.

The Ministry will seek to build on its extensive public education and awareness actions to

Figure 4: Monthly Electricity Charge Related to Renewable Energy in Different Sectors
Source of data: Ministry of Energy

Economic Sector	Examples	Assumed Electricity Consumption (kWh/month)	Renewable Energy-related Electricity Charge ($) 2010 (Actual)	2018 (Projected)
residential	n/a	800	2	31
small commercial	convenience store, small dry cleaner, restaurant, small retail store	12,000	38	500
large commercial	supermarket, shopping mall, large office building, hotel	130,000	385	5,000
industrial	paper and pulp, automobile, mining, cement, iron and steel manufacturing, chemical products, petroleum (i.e., refineries)	61,200,000	200,000	2,400,000

date. In 2011, these actions included providing the following focused information about changes to electricity prices to all of Ontario's electricity consumers:

- the "Electricity Prices Are Changing" pamphlet, sent to all Ontario households; and
- a quarterly electricity bill insert titled "Ontario Clean Energy Benefit," detailing changes to electricity bills.

The Ministry will continue to work with the Ontario Energy Board, local distribution companies, the OPA, and its other partners to seek opportunities to further increase public awareness about energy prices. The Ministry will also explore options for an integrated media campaign, which could include web postings and fact sheets and other opportunities.

OPA RESPONSE

The OPA agrees with this recommendation. Information about the Global Adjustment (GA) and the relationship between the OPA's contracts and the GA is currently available on the OPA website. The OPA has started work to simplify this information and co-ordinate with other electricity organizations to provide comprehensive, consistent information about the total cost of electricity. The OPA maintains updated cost forecasts and has substantially completed an update of the Integrated Power System Plan, which will contain a detailed cost and bill-impact analysis. As the province's electricity planner, the OPA could be the logical source of independent and credible information on costs.

DEVELOPMENT OF ENERGY PLAN AND RENEWABLE ENERGY POLICY

The OPA was created in December 2004 by the *Electricity Restructuring Act*. One of its key objectives is to ensure the adequacy and reliability of Ontario's electricity supply through planning and procurement. Under the legislation, the Ministry and the OPA would continue to provide the government with advice on the development of renewable energy, but the Minister essentially had the authority to direct the OPA, which minimized the need for an analysis of different policy options and an assessment of the cost-effectiveness of alternative approaches.

Integrated Power System Plan (IPSP)

The OPA has since its inception had the statutory responsibility to develop an Integrated Power System Plan (IPSP) and procurement processes for electricity. The IPSP is to represent Ontario's 20-year plan to achieve the province's energy goals. The OPA is required to submit the IPSP and the related procurement processes every three years to the Ontario Energy Board (OEB), which then must review the proposed IPSP to ensure that it is economically prudent and cost-effective. However, the OEB has never approved the first IPSP put forward by the OPA after the OPA's creation in December 2004 because of frequent changes to government policy and planning requirements, as illustrated in Figure 5.

The OEB's review and approval process of the OPA's first IPSP, submitted in August 2007, was suspended the following year at the direction of the Minister, who asked the OPA to revise the IPSP. The suspension of the independent regulator's review meant that there would be no independent assessment to ensure that decisions were made in an economically prudent and cost-effective manner.

In November 2010, the Ministry released a document called the Long-Term Energy Plan (LTEP) that specified Ontario's energy goals and supply-mix to 2030. The Ministry indicated that the LTEP, along with a February 2011 supply-mix directive, provided sufficient context to guide the OPA in planning and developing a revised IPSP. However, OPA staff acknowledged that the existence of two plans—the Ministry's and its own—could lead some

Figure 5: Key Developments in Ontario's Long-term Energy Planning, 2006–2011
Source of data: Ministry of Energy and OPA

Date	Events
June 2006	Minister issues first supply-mix directive, which calls for renewable energy capacity of 15,700 MW by 2025, and instructs OPA to develop Integrated Power System Plan (IPSP) and maximize the contribution from renewable energy sources.
Aug. 2007	OPA submits first IPSP, designed to help achieve goals set in the June 2006 supply-mix directive, to OEB for review and approval.
Sept. 2008	Minister issues a new supply-mix directive, suspending OEB review and approval process of current IPSP and requiring OPA to submit a revised IPSP to OEB within six months.
Mar. 2009	OPA does not revise IPSP as per the September 2008 supply-mix directive, saying in a letter to OEB that it would wait before issuing revised IPSP due to "significant evolution" in the policy environment.
May 2009	*Green Energy and Green Economy Act, 2009* is passed to accelerate significant additions of renewable energy through creation of a Feed-in Tariff (FIT) program to promote renewable energy, in particular wind and solar power.
Sept. 2009	Minister issues a directive requiring OPA to develop the FIT program.
May 2010	OPA Board of Directors notes that a new IPSP is likely needed due to significant changes that have occurred since original IPSP was filed in 2007.
Nov. 2010	Ministry releases Long-Term Energy Plan (LTEP), a high-level document highlighting Ontario's energy goals and supply-mix to 2030.
Feb. 2011	Minister issues a new supply-mix directive, which calls for renewable energy capacity of 19,700 MW by 2018, and instructs OPA to develop a new IPSP based on the Ministry's LTEP.

to conclude that the OPA has only limited authority as an energy planner and that the Ministry's LTEP is Ontario's "true" plan for the future.

Renewable Energy Initiatives

In June 2006, the Minister issued the first supply-mix directive to increase the province's renewable energy capacity to 15,700 megawatts (MW) by 2025, representing an increase of about 90% over the actual installed capacity of 8,200 MW in 2006. In February 2011, the Minister issued a new supply-mix directive that further increased the renewable energy target to 19,700 MW, but stipulated that it be achieved seven years earlier than the date set in the 2006 directive. In order to achieve these aggressive new targets, both the Ministry and the OPA expeditiously implemented the actions the Minister requested in his ministerial directives. Several renewable energy initiatives were introduced, as illustrated in Figure 6.

Although the Ministry consulted with stakeholders in developing the supply-mix directives, the LTEP, and the *Green Energy and Green Economy Act*, billions of dollars were committed to renewable energy without fully evaluating the impact, the trade-offs, and the alternatives through a comprehensive business-case analysis. Specifically, the OPA, the OEB, and the IESO acknowledged that:

- no independent, objective, expert investigation had been done to examine the potential effects of renewable-energy policies on prices, job creation, and greenhouse gas emissions; and
- no thorough and professional cost/benefit analysis had been conducted to identify potentially cleaner, more economically productive, and cost-effective alternatives to renewable energy, such as energy imports and increased conservation.

Figure 6: Summary of Renewable Energy Initiatives in Ontario

Source of data: Ministry of Energy and OPA

Launch Date	Program/ Initiative	Acquisition Method	Description	Capacity as of April 1, 2011 (MW)		
				Committed [1]	Non-committed [2]	Total Capacity
OPA-contracted Renewable Energy Sources						
June 2004 June 2005 Aug. 2008	Renewable Energy Supply (RES I, II, and III)	request for proposals (competitive)	based on confidential pricing proposals from bidders	1,570	–	1,570
Nov. 2006	Renewable Energy Standard Offer Program (RESOP)	standard offer (pre-set price)	initiated by ministerial direction to remove obstacles for small renewable projects by setting fixed contract prices and simplifying contract rules and processes	916	–	916
Dec. 2007	Hydroelectric Energy Supply Agreement (HESA)	negotiation (non-competitive)	initiated by ministerial directions that required OPA to enter into hydroelectric contracts	2,062	–	2,062
May 2009	Hydroelectric Contract Initiative (HCI)					
Oct. 2009	Feed-in Tariff (FIT) and microFIT	standard offer (pre-set price)	initiated by ministerial direction to replace RESOP by setting higher contract prices, with a focus on creating jobs and green economy	3,675	10,408	14,083
Jan. 2010	Korean consortium [3]	negotiation (investment arrangement)	privately negotiated contract between the Ministry and the Korean consortium	2,500	–	2,500
Uncontracted Renewable Energy Sources						
	uncontracted hydroelectric facilities [4]	n/a	managed by private developers and/or OPG	5,938	–	5,938
Total				**16,661**	**10,408**	**27,069**

1. Includes all projects that were offered contracts or have executed contracts, either under construction or in commercial operation.
2. Includes all projects that have submitted applications, either under review or waiting for review. Does not include projects that have been rejected or withdrawn.
3. Considered as committed since the Green Energy Investment Agreement was signed in January 2010.
4. Estimated by subtracting 2,062 MW (HESA and HCI) from approximately 8,000 MW (total hydroelectric capacity) because no complete listing exists of uncontracted hydroelectric facilities.

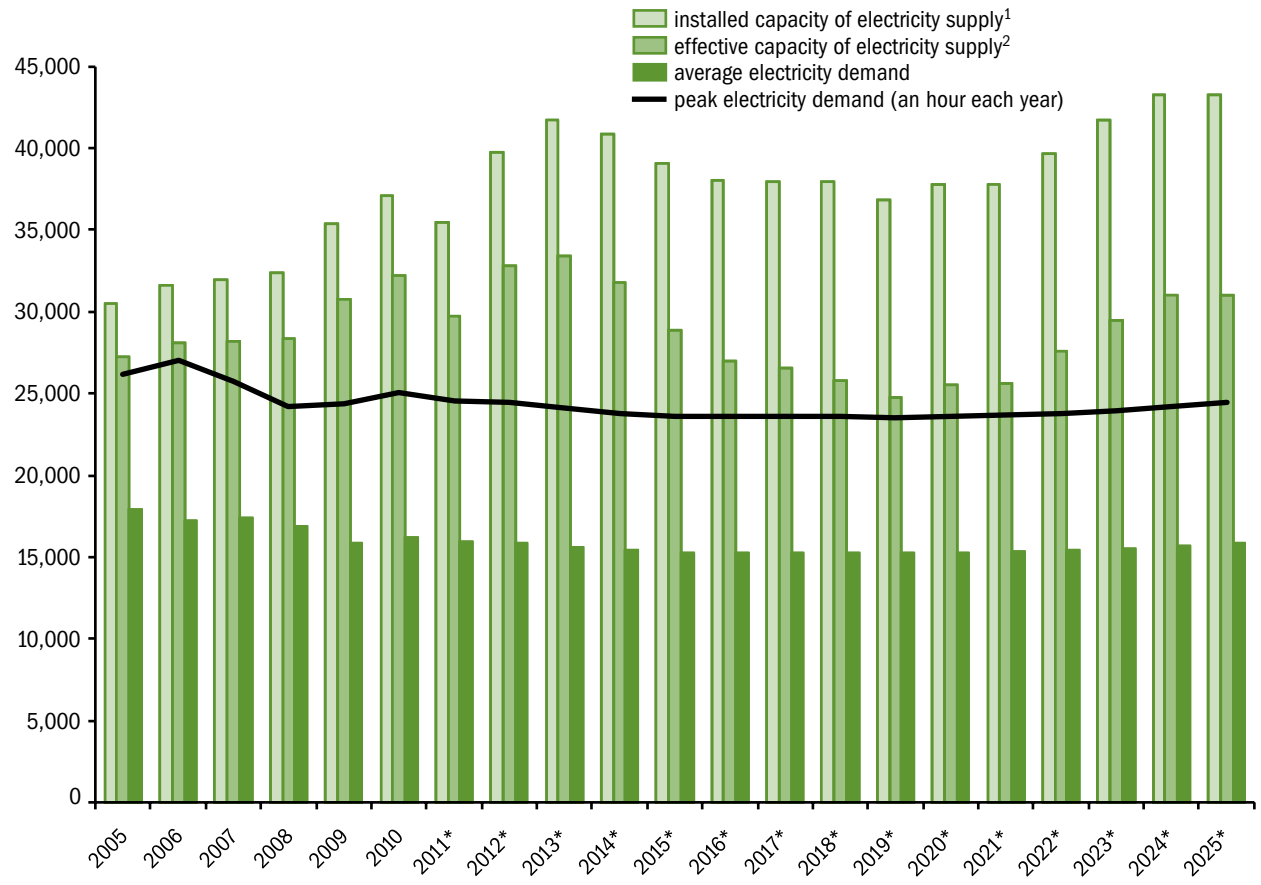
Electricity Supply and Demand in Ontario

According to the OPA, Ontario's electricity generation capacity has been much higher than demand in recent years. Electricity demand has declined since 2005 due to the economic downturn, conservation, and declines in the auto, pulp, and paper industries, while supply increased mainly because of the addition of renewable energy and gas-fired resources. The OPA noted that demand is expected to remain flat or decline due to continued conservation efforts and uncertain or slow economic recovery, while supply is expected to increase as a result of significantly more renewable energy coming on-line.

Our analysis of actual and projected data from the IESO and the OPA shows that from 2005 to 2025, installed and effective capacity will continue to exceed both average demand and peak demand. The OPA did advise us that Ontario will face significant energy uncertainty beyond 2015 as a result of the increasing supply of renewable energy, the phasing out of coal by the end of 2014, and the refurbishment of nuclear units. Figure 7 shows that Ontario will experience a temporary supply reduction from 2016 to 2020, when all coal-fired plants will be closed and some nuclear units will be taken out of service for refurbishment. The expected increase in renewable energy sources such as wind and solar will not effectively address the temporary supply reduction. According to the OPA, renewable energy sources are not always available during peak demand periods due to their intermittency and low effective capacity.

As illustrated in Figure 7, average demand is expected to drop from about 18,000 MW to 16,000 MW and peak demand from about 26,000 MW to 24,000 MW. In the same period, installed capacity (the maximum amount of electricity that can be produced by generators) is expected to rise from about 30,000 MW to 43,000 MW, and effective capacity (the portion of installed capacity that can be depended upon to produce electricity) is expected to grow from about 27,000 MW to 31,000 MW. An OEB analysis completed in April 2010 also concluded that, by 2016, electricity supply will far exceed demand. Despite these anticipated

Figure 7: Ontario's Installed and Effective Capacity, and Average and Peak Electricity Demand, 2005–2025 (MW)
Source of data: OPA and IESO



* Projected. Significant uncertainty is expected beyond 2015.

1. Installed capacity is the maximum amount of electricity that can be produced by generators.
2. Effective capacity is the portion of installed capacity that can be depended on to produce electricity.

surpluses, renewable energy generators who have contracts with the OPA will get paid even though Ontario does not need their electricity.

It is critically important that peak demand (the highest demand, generally occurring once a year for about one hour in July or August) is met reliably. Otherwise, the OPA said, the shortfall between available supply and peak demand could lead to blackouts. Although Ontario has sufficient generation capacity to meet even peak summer demand, the OPA indicated that it is required to plan for a 17% reserve margin in excess of peak demand to ensure system safety and reliability and to offset unexpected events such as changes in demand and equipment failure. The North American Electric Reliability Corporation monitors whether this requirement is being met.

We noted that the August 14, 2003, blackout in Ontario and the U.S. Northeast—the biggest ever in North American history—was not caused by any electricity shortfall in Ontario. According to a joint Canada–U.S. task force, it was actually triggered by an unexpected electricity shutdown in Ohio that led to a cascade of shutdowns.

Figure 7 shows that Ontario's effective capacity is expected to grow from about 27,000 MW to 31,000 MW between 2005 and 2025. However, we noted that Ontario rarely needs that much effective capacity to meet peak demand throughout the year. For example, the last time that demand in Ontario reached 27,000 MW was in August 2006—and then only for two hours in a single day. Since 2007, Ontario has not experienced a single day in which demand exceeded 26,000 MW, and it experienced only two days of demand greater than 25,000 MW in 2010. Even on July 21, 2011, one of the hottest days on record in the Greater Toronto Area and many other Ontario cities, demand was about 25,000 MW—well below the all-time high of 27,000 MW reached in August 2006.

Roles of the OPA and the OEB

Even after the breakup of the former Ontario Hydro, Ontario's electricity sector continued to have a system of checks and balances in place with two expert agencies playing key roles—the OPA as energy planner and the OEB as regulator. This arrangement was intended to ensure that decisions are made transparently and objectively; that consumers get reliable, affordable, and sustainable power; and that any energy plan is economically prudent and cost-effective. With the *Green Energy and Green Economy Act, 2009* (Act) giving the Minister the authority to direct certain aspects of planning and procurement of electricity supply through ministerial "directives" and "directions," the frequent exercise of this authority has created some ambiguity regarding the original mandates of the OPA and the OEB from the planning and oversight perspective.

The OPA: Planning and Procurement

The OPA is designated as Ontario's energy planner, with the authority to procure electricity supply. However, the Minister has the authority to issue "directives" (which require Cabinet approval) to the OPA regarding the supply mix. The Minister can also issue "directions" (which do not require Cabinet approval) on specific electricity-related initiatives, such as renewable energy projects. Since the creation of the OPA in December 2004, 22 of the 48 directives and directions issued to it by the Minister were partly or fully related to renewable energy.

The introduction of the Act has affected the OPA's role as Ontario's energy planner. Specifically:

- Before the Act was passed, the Minister had the authority to issue directions without Cabinet approval to the OPA to procure electricity supply. However, this direction-making authority was to expire once the OEB approved the OPA's first long-term plan, or IPSP, which would have specified the procurement processes that the OPA would use. In essence, the OPA currently has no

independent authority to procure electricity supply until the OEB approves its IPSP, except pursuant to the authority given to the OPA through ministerial directions. However, as noted earlier, the first IPSP developed by the OPA has never been approved by the OEB.

- Under the Act, the Minister has the authority to issue directions related to renewable energy without Cabinet approval, and this direction-making authority will not expire after an IPSP has been approved. Under this authority, the Minister can direct certain aspects of the OPA's procurement of renewable energy, including price and whether to use competitive or non-competitive procurement.

The OPA did acknowledge that, as Ontario's energy planner, it requires some level of independence to allow it to objectively and proactively develop alternative options and ideas instead of relying exclusively on ministerial directions.

The OEB: Regulatory and Oversight

The OEB is an independent regulatory agency mandated to protect the interests of consumers with respect to the price, adequacy, reliability, and quality of electricity service. It is also responsible for promoting economic efficiency and cost-effectiveness in the generation, transmission, and distribution of electricity. Under the *Green Energy and Green Economy Act , 2009* (Act), the OEB was also given a new objective: the promotion of renewable energy, including the timely connection of renewable energy projects to transmission and distribution systems.

The ministerial direction-making authority has limited the OEB's ability to carry out its regulatory and oversight role on behalf of consumers with respect to renewable energy. The OEB advised us that other than the review of the IPSP, it has no oversight responsibility over any procurement of renewable energy, which has become an increasingly important part of Ontario's electricity-supply mix. Because the OEB has not yet approved any IPSP, it has had no oversight role with respect to renewable energy since the creation of the OPA in 2004. Had the OEB's review and approval responsibilities with respect to the OPA's first IPSP not been suspended, the impact of any ministerial directions would have been analyzed as part of the OEB's review of the IPSP. Many directions related to the procurement and pricing of renewable energy have been issued since 2008 in the absence of an approved IPSP, and the OEB has had no oversight role whatsoever. A report in 2009 by the Environmental Commissioner of Ontario raised concerns that the OEB will not be able to examine the economic prudence and cost-effectiveness of any electricity-related initiatives introduced through ministerial directions in the absence of an approved IPSP.

Although the OEB has played an oversight role in the connection of renewable energy to the grid by evaluating construction, expansion, and reinforcement projects of transmission and distribution systems, its limited involvement in reviewing the procurement and pricing of renewable energy has limited the effectiveness of its normal role in protecting the interests of consumers with respect to prices and overall cost-effectiveness in the electricity sector. For example, in December 2007 the Minister directed the OPA to enter into contracts for certain hydro projects that would have the "potential to add a new supply of clean, renewable power at an acceptable price to Ontario ratepayers." In January 2010, the OPA was advised that the estimated cost for one of these projects had increased substantially, from $1.5 billion to $2.6 billion, and there was no guarantee that the cost would not continue to rise. Given the estimated $1.1-billion cost increase, the OPA expressed concerns about whether the project would provide value for ratepayers. In February 2010, at the OPA's request, a direction was issued by the Minister, who acknowledged the cost overrun but instructed the OPA to proceed anyway. The direction noted that the Minister was satisfied that the project remained consistent with government priorities. The Ministry informed us that under the existing regulatory and legislative framework, the

OEB would not have had any oversight role with respect to this particular project.

RECOMMENDATION 2

To ensure that senior policy decision-makers are provided with sound information on which to base their decisions on renewable energy policy, the Ministry of Energy and the Ontario Power Authority should work collaboratively to conduct adequate analyses of the various renewable energy implementation alternatives so that decision-makers are able to give due consideration to cost, reliability, and sustainability.

MINISTRY RESPONSE

The Ministry will continue to build on its effective collaborative working relationship with the OPA to provide decision-makers with the best advice, giving due consideration to cost, reliability, and sustainability. In developing the Feed-in Tariff (FIT) program, the Ministry worked closely with technical experts in the electricity sector to harness the best policy and technical advice. The expert group met regularly from fall 2008 to summer 2009 to design the implementation of FIT.

The Ministry will continue to build upon its existing policy advisory practices, including seeking advice and working in co-operation with the OPA, as well as the Independent Electricity System Operator, Hydro One, and Ontario Power Generation; developing policy options and costs; and considering international practice, experience, and the perspectives brought by non-governmental organizations.

OPA RESPONSE

The OPA agrees with this recommendation and will continue to provide the Ministry with expert professional advice on the development of renewable energy as well as other types of generation. The OPA has substantially completed an update of the Integrated Power System Plan (IPSP) and plans to file the document with the Ontario Energy Board in fall 2011. Cost, reliability, and sustainability of renewable energy and other sources of generation are assessed in the updated IPSP.

PROCUREMENT OF RENEWABLE ENERGY

Procurement Methods

There have been three forms of procurement processes for renewable energy: competitive (request for proposals), non-competitive (negotiations), and standard offer (pre-set price), as illustrated in Figure 6. Initially, Ontario solicited renewable energy projects mainly through competitive requests for proposals from private developers. In recent years, renewable energy has often been procured through standard-offer and non-competitive processes in response to ministerial directions. Prices for renewable energy, especially under the FIT program, have been between two and 10 times higher than those of conventional energy sources, such as nuclear, natural gas, and coal. Generators of renewable energy will be paid guaranteed prices over the contract terms, which range from 20 years for electricity from wind, solar, and bioenergy, to 40 years for hydroelectricity.

Request for Proposals and Standard-Offer Program

The first competitive procurement initiative adopted by the government to acquire renewable energy was several requests for proposals (RFPs) inviting potential developers to bid on renewable energy projects. The OPA indicated that the competitive process usually provides the best value and is the preferred option, barring other policy priorities, to ensure that contracted prices are cost-effective and reflect current market costs. Three RFPs for Renewable Energy Supply (RES)

Figure 8: Prices of Renewable Energy Sources under Different Procurement Methods, as of April 2011 (¢/kWh)
Source of data: Ministry of Energy and OPA

	Renewable Energy Supply (RES I, II, III) [1]	Renewable Energy Standard Offer Program (RESOP)	Feed-in Tariff (FIT) and microFIT [2]	Korean Consortium [3]
	June 2004, June 2005, Aug. 2008	Nov. 2006	Oct. 2009	Jan. 2010
solar (rooftop)		42.00	53.90–80.20	
solar (ground-mounted)		42.00	44.30–64.20	44.30 + 2.60
wind (offshore)		11.00	19.00	
wind (onshore)	9.51	11.00	13.50	13.50 + 0.50
hydroelectric	7.85	11.00	12.20–13.10	
bioenergy	8.23	11.00	10.30–19.50	

1. Weighted averages of all projects.
2. Prices vary depending on project size, with smaller projects typically qualifying for higher prices.
3. Standard FIT prices apply to phase 1 and phase 2 projects, plus additional payment called Economic Development Adder (EDA) as stated in the original Green Energy Investment Agreement (GEIA). Subsequent to our audit fieldwork, the GEIA was amended in July 2011, and the EDA was reduced to 1.43¢/kWh for solar power and 0.27¢/kWh for wind power.

programs were issued: RES I in June 2004, RES II in June 2005, and RES III in August 2008.

However, the complexity and cost of developing competitive RFPs was seen as favouring larger projects at the expense of smaller ones. To remove these barriers to small projects, the Minister issued a direction in 2006 to the OPA to develop a Renewable Energy Standard Offer Program (RESOP) that would offer smaller renewable energy projects a standard pricing regime while providing for simplified regulations, including eligibility and contracting.

Prices under RESOP were about 16% to 40% higher than the competitive prices under the RFPs, as illustrated in Figure 8. The OPA indicated that RESOP would not be successful if the standard prices were not set high enough to attract investment in renewable energy projects. On the other hand, the OPA did acknowledge that the standard-offer process might have had some unintended consequences arising from an absence of the competitive tension that encourages innovative solutions, and it did ultimately result in high prices and oversubscription.

The Ministry and the OPA indicated that both RES and RESOP were successful. For example, RES I substantially increased the number of wind turbines, from 10 in 2003 to more than 200 in 2006, an increase in capacity of about 300 MW. RES II, which had been intended to attract 1,000 MW of renewable energy, had twice as many applications as expected because of developers' interest in the guaranteed high prices.

Feed-in Tariff (FIT) Program

Both RES and RESOP proved to be immediate successes, with high response rates and generation targets being met in record time. In particular, RESOP, which offered very attractive contract prices to renewable energy generators, received overwhelming responses. When RESOP was launched in November 2006, it was expected to develop 1,000 MW over 10 years. In May 2008, the OPA indicated that RESOP had exceeded all expectations and achieved more than 1,000 MW of contracted projects in a little more than a year. Although continuing the successful RESOP initiative was one option, the Minister directed the OPA in September 2009 to replace RESOP with a new standard-offer program

called Feed-in Tariff (FIT), which was wider in scope, required made-in-Ontario components, and provided renewable energy generators with significantly more attractive contract prices than RESOP, as illustrated in Figure 8. These higher prices added about $4.4 billion in costs over the 20-year contract terms as compared to what would have been incurred had RESOP prices for wind and solar power been maintained. The Ministry indicated that replacing RESOP with FIT successfully expedited its renewable energy program and promoted Ontario's domestic industry.

According to the Ministry, RES and RESOP were replaced with FIT following a government policy decision to expand more rapidly the procurement of renewable energy in order to create jobs and protect the environment.

Determination of FIT Prices

The FIT program aims to encourage development of renewable energy projects by a diverse range of developers, including homeowners, farmers, small businesses, and community groups, by offering long-term, fixed prices for the electricity they generate. Launched in October 2009, FIT garnered an overwhelming response, receiving applications for a total capacity of about 14,000 MW at the end of the first quarter of 2011. The FIT program has two streams: the comprehensive FIT stream for projects over 10 kW and the simplified microFIT stream for those under 10 kW. Both offer prices that vary depending on energy sources (wind, solar, hydro, and bioenergy), project sizes (microFIT projects below 10 kW qualify for higher prices), and deployment methods (rooftop or ground-mounted solar, onshore or offshore wind), as illustrated in Figure 8.

FIT prices were based on several factors, including prior experience in Ontario and other jurisdictions, feedback from stakeholders, and cost assumptions for capital, operations and maintenance, connection, term of contract, generating capacity, and construction lead time. Ontario's FIT prices were originally designed with the intention of allowing a reasonable rate of return, defined as 11% after-tax return on equity, for developers of all types of renewable energy projects. However, we noted that:

- There was minimal documentation to support how FIT prices were calculated to achieve the targeted return on equity, because of the numerous changes to the financial model and assumptions used by the OPA.
- There has been a lack of independent oversight on the reasonableness of FIT prices. Although the OEB has historically been mandated to oversee and approve electricity prices, it has no role or legislative responsibility to review or approve FIT prices. The OPA informed us that the first review of FIT prices will be conducted in-house by OPA staff, supported by consultants as needed, during fall 2011. However, the Ministry indicated that the government has not decided whether to involve an independent third party in the review.

The OPA said it initially developed Ontario's FIT prices based on the long-established and successful FIT programs in Germany and Spain. We noted that the internal rates of return offered to the developers in these countries varied depending on project risks and ranged from just 5% to 7% in Germany to between 7% and 10% in Spain. When Ontario's FIT prices were first developed in spring 2009, they were already higher than those of Germany and Spain, which have both significantly dropped their FIT prices since then due to lower component costs arising from technological advances. However, Ontario's prices have remained unchanged, except for a drop in the rate for small ground-mounted solar projects. According to the Ministry and the OPA, it was a deliberate decision by the government to maintain price stability in order to retain investor confidence and offer very attractive prices to investors in order to encourage the start-up of a "green" industry in Ontario.

Revision of FIT Prices

By July 2010, less than a year after the launch of FIT, the OPA had received more than 16,000 applications, about 13,500 of which were for ground-mounted solar projects. According to the OPA, this overwhelming response highlighted the unexpected popularity of microFIT ground-mounted solar projects at the price of 80.2¢/kWh, the same price that was being paid for rooftop solar projects. The original FIT price of 80.2¢/kWh would provide developers of these ground-mounted solar projects with a 23% to 24% after-tax return on equity instead of the 11% intended by the OPA. Therefore, in July 2010 OPA proposed cutting the price by about 27%, from 80.2¢/kWh to 58.8¢/kWh.

The proposed price cut brought a strong response during a 30-day round of consultations. Many developers objected to the proposed 58.8¢/kWh price and demanded that the OPA grandfather the 80.2¢/kWh price for those applications already filed. In August 2010, the OPA issued a more modest price cut of about 20%—to 64.2¢/kWh instead of 58.8¢/kWh—and agreed to pay 80.2¢/kWh for all applications received by the OPA up to then, including those still awaiting approval. The OPA applied the price cut only to new applications in order to ensure price and policy stability and prevent any potential lawsuits. We also noted that the price cut had limited impact because it was not done in a timely way. Specifically:

- The OPA had proposed since February 2010 that immediate action be taken to reduce the FIT price for ground-mounted solar projects. The OPA informed us that the price cut was not announced until July 2010, five months later, because the government needed time to analyze the situation. Due to this delay, the OPA received more than 11,000 applications from February to June 2010, all of which qualified for the full price rather than the reduced one because of the decision to grandfather the price in order to maintain investor confidence.
- The number of applications for ground-mounted solar generation dropped significantly, from more than 2,000 in June 2010 to fewer than 200 in August 2010, and remained stable at that level thereafter. Because the OPA grandfathered the original price of 80.2¢/kWh for all applications already filed, the reduced price of 64.2¢/kWh applied only to new applications received after the announcement of the price cut in August 2010 (about 200 per month).

In addition, we noted that the revised price of 58.8¢/kWh originally proposed by the OPA would have provided developers with an 11% after-tax return on equity intended for all renewable energy projects. However, the revised price went from 58.8¢/kWh to 64.2¢/kWh without adequate documentation to support how the OPA arrived at the higher price. The OPA indicated that 64.2¢/kWh was a reasonable price based on justifications provided by developers and other stakeholders. We estimated that, had the OPA been successful in making the price cut to 58.8¢/kWh when it was initially recommended, electricity ratepayers would have saved about $950 million over the 20-year contract terms, while developers would still have received their 11% after-tax return.

Cross-jurisdictional Comparison of FIT Prices

Our research found that Ontario's FIT prices were generally higher than those of other jurisdictions, especially for solar projects, as illustrated in Figure 9. According to the Ministry, Ontario's prices were set higher than elsewhere to create investor confidence and more quickly attract investment capital amidst a global recession. A unique feature of Ontario's FIT program, the domestic content requirement, also led to higher prices because the cost of Ontario-made generation components is higher than that of comparable equipment made in lower-cost jurisdictions such as China.

Our research also noted that many jurisdictions have mechanisms in place to control the increase of FIT prices. For example, Germany reduces prices automatically by a certain percentage every year for new projects, while Spain regularly revises its prices

Figure 9: Comparison of FIT Prices as of April 2011 (¢/kWh in Canadian $) [1]

Prepared by the Office of the Auditor General of Ontario

	Solar (Rooftop)	Solar (Ground-mounted)	Wind (Offshore)	Wind (Onshore)	Hydroelectric	Bioenergy
Canada						
Ontario	53.90–80.20	44.30–64.20	19.00	13.50	12.20–13.10	10.30–19.50
United States						
Michigan	33.54–47.91	33.54–47.91	4.31–15.91	7.67–11.98	9.29–15.33	7.47–14.28
Vermont	28.75	28.75	13.42–19.16	13.42–19.16	–	11.50
Washington [2]	14.37–28.75	14.37–28.75	14.37	14.37	–	14.37
Wisconsin	23.96	23.96	6.32–8.82	6.32–8.82	8.82	5.83–14.85
Europe						
Denmark	–	–	10.80	10.80	–	5.40
Germany	29.24–39.80	29.24–39.80	18.01	12.62	4.81–17.55	10.68–16.00
Spain	37.31	37.31	10.14	10.14	10.80	18.09
Asia						
South Korea	63.33	63.33	9.51	9.51	6.52	5.46
Australia						
Australian Capital Territory	46.33	46.33	–	–	–	–
New South Wales	20.27	20.27	–	–	–	–
Queensland	44.60	44.60	–	–	–	–
South Australia	44.60	44.60	–	–	–	–
Victoria	60.82	60.82	–	–	–	–
Western Australia	40.55	40.55	–	–	–	–

1. Prices vary depending on project size, with smaller projects typically qualifying for higher prices. Prices were converted to Canadian currency based on the average exchange rates in April 2011.
2. These base rates are increased if the components are manufactured in Washington.

based on pre-set capacity targets. Washington State has imposed an annual maximum payment per contractor, while several American and Australian states set caps on capacity that, when reached, result in termination of a FIT program.

In Ontario, the government chose to maintain price stability until the two-year program review could be undertaken rather than incorporating any price or capacity adjustment mechanisms such as the following:

- The initial FIT prices proposed by the OPA in March 2009, prior to the passage of the *Green Energy and Green Economy Act*, included an automatic 9% drop in the contract price for every 100 MW of power contracted from ground-mounted solar projects. However, the OPA informed us that the Minister removed this adjustment, fearing that it would discourage manufacturing investments and hamper the development of renewable energy. We estimated that if this adjustment had been implemented as first proposed, the cost of the FIT program could have been reduced by about $2.6 billion over the 20-year contract terms.
- The absence of caps or limits to the number of contracts signed under Ontario's FIT program led to the current oversubscription. The OPA informed us that it designed the FIT program at a time when no long-term energy plan was in place and it was unsure about the quantities

of power the FIT program was intended to procure. The OEB indicated that ceilings, caps, or other measures must be in place to minimize the risk of higher consumer prices and less-than-optimal deployment of resources.

Both the Ministry and the OPA were aware of the high FIT prices in Ontario and of the price reduction and program-control mechanisms in other jurisdictions. However, the Ministry indicated that the government's decision was not to change prices before the first planned review of the FIT program—targeted to take place in fall 2011, two years after the program's introduction—so as to create stability and instill investor confidence.

However, we noted that in October 2010, the OPA did recommend that instead of reviewing the FIT program in fall 2011 and making incremental changes as issues arise, an "immediate program review" should be conducted to ensure that priority issues are addressed more fully and that ad hoc changes are avoided to preserve the credibility and stability of the FIT program. One of the top-priority issues identified by the OPA was the significant reduction in the cost of solar technologies—about 50% since 2009—as the technology matured and improved. The OPA specifically recommended reducing FIT prices for solar projects to reflect current market conditions and introducing a plan to signal further price reductions in future. However, the OPA informed us that no decision had been forthcoming regarding its concern about the very generous prices being offered to investors in renewable energy projects.

FIT Contract Term: Additional Contract Payment

A situation called curtailment occurs when the Independent Electricity System Operator (IESO) instructs generators to reduce all or part of their output in order to mitigate an oversupply of electricity. Compared to other renewable energy contracts such as RES and RESOP, the FIT contract has a unique feature that offers renewable energy generators an "Additional Contract Payment" to compensate them for any revenue lost as a result of curtailment instruction. Accordingly, electricity ratepayers still have to pay renewable energy developers even when those generators are not producing electricity during periods of curtailment.

The IESO has not yet curtailed renewable energy generators under the FIT program because no FIT projects have been on-line, and therefore no "Additional Contract Payment" has been triggered or included in electricity bills to date. However, the OPA and the IESO acknowledged that when more renewable energy projects under the FIT program are added to the grid, the power surplus will grow and such curtailments will be likely (see "Operational Challenge: Surplus Power" later in this report).

There has been inadequate assessment of the potential costs of curtailing renewable energy, even though there is a strong likelihood of curtailment in the future for these energy sources. For example, the OPA has performed several scenario analyses, but none included the impact of curtailing renewable energy. The OPA indicated that its plans are based on situations where supply equals demand, but not where there are surpluses and where the curtailment of renewable energy may be required.

The OPA also noted that the calculation of curtailment costs depends on a number of factors and assumptions that could be very volatile. The only analysis on curtailment we found was done by the IESO in 2009. It estimated that the substantial addition of renewable energy would result in curtailment of between 2,000 and 2,500 hours per year and that the cost of paying renewable generators for not producing electricity could range from $150 million to $225 million a year. However, these projections were based on 2008 data and we were advised that no updated projections had been done since then.

Agreement with the Korean Consortium

While the FIT program was intended to provide a channel for renewable energy investments by homeowners, farmers, small businesses, and community groups, the Ministry was also negotiating with a

consortium of Korean companies under separate terms to build more renewable energy projects.

The consortium, led by two large Korean companies, approached the Ministry in June 2008 and proposed to make a major investment in Ontario's renewable energy sector. This led to ongoing talks between the Ministry and the consortium and the signing of a memorandum of understanding in December 2008. In June 2009, the Minister travelled to Korea for more discussions; six months later, the Minister, on behalf of the government, signed the $7-billion Green Energy Investment Agreement (GEIA) with the consortium. The consortium committed to build 2,000 MW of wind projects and 500 MW of solar projects in Ontario in five phases by 2016, with the equipment to be manufactured in this province.

Neither the OEB nor the OPA was consulted about the agreement. The OPA was not involved until summer 2009, when the Ministry inquired about available transmission capacity to accommodate consortium projects. On September 29, 2009, the ongoing negotiations with the consortium were publicly announced, and Cabinet was briefed on the negotiations and prospective agreement shortly thereafter. We were advised that Cabinet had subsequent briefings prior to finalization of the agreement in January 2010. In April 2010, the Ministry directed the OPA to negotiate with the consortium on the Power Purchase Agreements (PPAs), which outline contractual obligations and payment terms for each renewable energy project to be developed by the consortium. As of April 2011, details of the PPAs had not yet been finalized. Subsequent to our audit fieldwork, six PPAs were signed in August 2011.

The draft PPAs with the consortium are substantially similar to FIT contracts, but the consortium will receive two additional incentives: priority access to Ontario's transmission system; and, originally, an additional $437 million on top of the standard FIT prices, contingent on the fulfillment of the consortium commitment to build four manufacturing plants in Ontario. Subsequent to our audit fieldwork, the Ministry renegotiated the GEIA with the consortium, which had requested a one-year commercial operation date extension for phases one and two of its projects because of challenges in completing its regulatory and environmental studies. In July 2011, as a result of the date extension and other changes, the Ministry amended the GEIA to reduce the additional $437 million payment to $110 million.

According to the Ministry, the consortium agreement is neither a non-competitive procurement nor a sole-source deal. Instead, it is an "investment arrangement" with an objective of establishing a sound green energy sector in Ontario since no other company has proposed to invest in Ontario's renewable energy sector at the size and scale of the consortium and its partners. However, we noted that the normal due diligence process for an expenditure of this magnitude had not been followed. For large projects such as the consortium agreement, we expected but did not find that a comprehensive and detailed economic analysis or business case had been prepared. According to the Ministry, the decision to enter into the agreement with the consortium was made by the government. Although the Cabinet was briefed about the agreement, the Ministry indicated that there had been no formal Cabinet approval because it was not required.

RECOMMENDATION 3

To ensure that the price of renewable energy achieves the government's dual goals of cost-effectiveness and encouraging a green industry, the Ministry of Energy and the Ontario Power Authority should:

- work collaboratively to give adequate and timely consideration to the experiences of other jurisdictions and lessons learned from previous procurements in Ontario when setting and adjusting the renewable contract prices;
- work with the Independent Electricity System Operator to assess the impact of

curtailing renewables as part of its energy planning in order to identify ways to optimize the electricity market; and

- ensure that adequate due diligence is undertaken, commensurate with the size of electricity-sector investments.

MINISTRY RESPONSE

The Ministry will continue to take into consideration the experiences of other jurisdictions while ensuring that the program remains stable and sustainable. As planned, the Ministry will undertake a mandatory two-year review of the Feed-in Tariff (FIT) program (as required in the Minister's FIT direction) in conjunction with the OPA. The review will examine potential FIT price reductions, as well as FIT support programs, contract rules, and how the program is meeting the government's policy objectives. Recommendations for improving the FIT program will be made to the Minister.

The Ministry will continue to work with the Independent Electricity System Operator (IESO) during the development of new rules and tools to better integrate renewable energy sources into the market. This ongoing work includes more precise forecasting of load and intermittent generation and the ability to dispatch (turn down or off) renewable energy facilities such as wind that until now have been able to run whenever they were available to.

In order to fulfill the Ministry's key objectives of electricity reliability, sustainability, and cost-effectiveness, the Ministry agrees to continue to provide a full analysis of new investments, including through the Integrated Power System Plan, which is to be updated every three years. This will ensure that system planning continues to reflect the most up-to-date and accurate information and challenges affecting the system. The Ministry will continue to work collaboratively with the IESO, OPA, and all partners in the sector to ensure the system is capable of meeting new challenges.

OPA RESPONSE

A mandatory two-year review of the FIT program will be carried out in the near future. Experience from other jurisdictions and previous Ontario procurements will be considered as part of the review.

A reliable and sustainable electricity system will from time to time have surplus power. A key objective of the OPA, the Ministry, and the IESO is to strike the right balance between ensuring that clean, reliable electricity facilities are built and are available when required, and ensuring that ratepayer value is maximized. For the last two years, the OPA has been working with the IESO and other stakeholders on the issue of potential surplus energy and curtailment for renewable energy and other types of generation. This process has included looking at the appropriate contractual options available to curtail resources when necessary at the lowest possible cost to ratepayers. The FIT contracts do contain curtailment provisions. The OPA and IESO have been actively collaborating on aligning other renewable energy contracts to make operators more responsive to market rules.

The OPA will continue to perform due diligence with respect to the design of plans and the execution of contracts on behalf of electricity ratepayers, and will continue to provide the Ministry and other sector stakeholders with updated plans and status and outlook reports.

Co-ordination and Planning for the Procurement of Renewable Energy

The development of renewable energy initiatives involves planning and co-ordination with other parties, including the Ministry of the Environment, the Ministry of Natural Resources, federal agencies,

and municipalities. We noted several instances where renewable energy initiatives led to potentially unnecessary compensation and potential lawsuits because of conflicts with environmental impact and planning decisions. Among them:

- In June 2009, the Ministry of the Environment changed the regulations governing the placement of wind turbines, affecting some onshore wind contracts already awarded by the OPA. One developer filed a claim against the OPA and, in order to avoid litigation, the OPA agreed to settle by paying the developer up to $2.4 million.
- In June 2010, the Ministry of the Environment proposed a policy relating to offshore wind turbines. In February 2011, the government decided to suspend all offshore wind projects pending completion of independent scientific research. Although this decision affected all offshore wind projects under FIT, the OPA was not informed of the decision until three days before the public announcement. Affected developers felt that they had been incurring costs in good faith even though the government was planning to suspend offshore projects, resulting in ongoing negotiations since then between the developers and the OPA.
- In October 2010, the Ministry cancelled a signed contract with a private-sector developer to build a 900 MW gas-fired project in the GTA because decreased electricity demand, the supply of more than 8,000 MW of new and cleaner power, and increased conservation efforts had made it unnecessary. The OPA has been negotiating with the developer to reach agreement over the amount of possible compensation to be paid for the cancellation of the signed contract.

RECOMMENDATION 4

To avoid unintended costs arising out of changes to regulatory requirements and changes to supply and demand situations, the Ontario Power Authority and the Ministry of Energy should work collaboratively with other ministries and agencies to ensure that they are made aware on a timely basis of anticipated policy and regulatory changes.

MINISTRY RESPONSE

The Ministry agrees that close collaboration with other ministries and agencies on proposed policy and regulatory changes is vitally important.

The government carefully considered, supported by scientific research, its policy decision to create uniform provincial standards for placement of wind turbines away from homes. The government considered this policy choice to be better than having each municipality decide the setback distances in an ad hoc way.

With respect to the offshore wind development, the Ontario government and the U.S. Department of Energy have worked collaboratively on developing wind resources in the Great Lakes. The collaboration involves joint scientific research to inform the creation of a uniform regulatory framework and policies. It is necessary to suspend further offshore projects until the scientific research is completed.

The Ministry will continue to build on its existing practice of ensuring strong and regular staff connections between relevant ministries, recognizing that it can inform agencies or other parties of new policy direction only after a duly authorized decision is made.

OPA RESPONSE

The OPA agrees with this recommendation and continues to work closely with Hydro One and the Independent Electricity System Operator to assess and manage the impacts of new generation on the electricity system.

RELIABILITY OF RENEWABLE ENERGY

Solar and wind energy are by their nature intermittent, and the growing contribution of these unpredictable resources to the energy-supply mix has increased uncertainty and created challenges for the Independent Electricity System Operator (IESO). It has to balance supply and demand to ensure that renewable energy can be efficiently integrated into the operation of Ontario's power system without compromising the reliability, stability, and efficiency of the system.

The power-generating capacity of a power plant can be measured in two ways: "capacity factor" (the ratio of the actual output of a power plant in a given period to the theoretical maximum output of the plant operating at full capacity) and "capacity contribution" (the amount of capacity available to generate power at a time of peak electricity demand, which is usually in July and August).

The power-generating capacity of current wind and solar technology is much lower than other energy sources, as illustrated in Figure 10. Wind generators operate at 28% capacity factor but have only 11% availability at peak demand due to lower wind output in the summer. Solar generators operate at just 13% to 14% capacity factor on average for the year but have 40% availability at peak demand in the summer.

We analyzed the performance of all wind farms in Ontario in 2010 based on IESO data. Although the average capacity factor of wind throughout the year was 28%, it fluctuated seasonally, from 17% in the summer to 32% in the winter. It also fluctuated daily, from 0% on summer days, when electricity demand was high, to 94% on winter days, when demand was lower.

Our analysis also indicated that wind output was out of phase with electricity demand during certain times of day. For example, during the morning hours, around 6:00 a.m., wind output usually decreased just as demand was ramping up. Throughout the day, demand remained high but wind output typically dropped to its lowest level for the day. During the evening hours, around 8:00 p.m., when demand was ramping down, wind output was rising, and it remained high overnight until early morning. This somewhat inverse relationship between daily average wind output and daily average demand was particularly pronounced in the summer and winter months.

Figure 10: Capacity Factors (Expected Output) and Capacity Contributions (Output during Peak Electricity Demand), by Energy Source (%)

Source of data: OPA and IESO

	Capacity Factor	Capacity Contribution
nuclear	84	95–100
coal	66	90–100
hydroelectric	90	71
bioenergy	75–85	65–100
natural gas	85	50–100
solar	13–14	40
wind	28	11

The OPA has recognized that the lack of correlation between electricity demand and intermittent renewable energy has created operational challenges, including power surpluses and the need for backup power generated from other energy sources. The IESO has been working through its Renewable Integration Project to mitigate these challenges by engaging stakeholders and establishing technical working groups to discuss design principles, forecasting, and future markets for renewable energy.

Operational Challenge: Surplus Power

The IESO informed us that increasing the proportion of renewable energy in the supply mix has exacerbated a challenge called surplus base-load generation (SBG), a power oversupply that occurs when the quantity of electricity from base-load generators is greater than demand for electricity. Base-load generators are designed to run at a steady output 24 hours a day to meet the constant

need or minimum demand for electricity. Ontario's base-load fleet includes nuclear units, certain hydro stations, and intermittent renewable energy sources such as wind. The IESO informed us that Ontario did not have any SBG days from 2005 to 2007, but experienced four such days in 2008, 115 days in 2009, and 55 days in 2010. The jump in SBG days was attributed to several factors, including an increase in wind power and a drop in electricity demand.

Given that electricity demand is expected to remain relatively flat for at least the next few years as more renewable energy comes on-line, there will almost certainly be more SBG days in the years to come, creating operational challenges and costs that will ultimately be borne by electricity ratepayers.

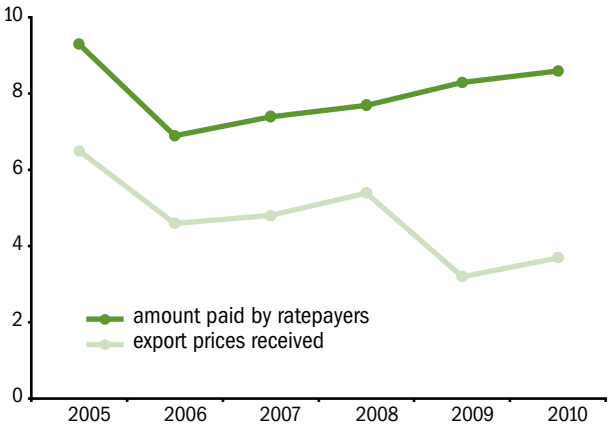
In 2008, the IESO forecast that, because most generators cannot ramp wind power up or down in response to demand, SBG hours will increase significantly over the next decade. The vast majority of new renewable energy in the next few years is expected to come from wind generators, which typically have their highest output overnight and early morning, when SBG events are more prevalent.

Since the prevalence of SBG events could threaten the reliability of the electricity system, the IESO has been taking action to ease the power surplus. However, there are technical difficulties and cost implications of these actions. Among them:

- Storing surplus power is difficult because of the seasonal nature of renewable energy and the need for unrealistically large storage capacity.
- Exporting surplus power is, according to the OPA and the IESO, a common and preferred way to mitigate power surpluses. Since 2006, Ontario has been a net exporter. The IESO indicated that although it is difficult to quantify, the increase in renewable energy has led to an increase in exports and put downward pressure on export prices. We noted that:
  - In 2010, 86% of wind power was produced on days when Ontario was already in a net export position.
  - The price Ontarians pay for electricity and the price Ontario charges its export customers—which are determined by the interaction of supply and demand in the electricity market—have in recent years been moving in opposite directions. Although export customers paid only about 3¢/kWh to 4¢/kWh for Ontario power, electricity ratepayers of Ontario paid more than 8¢/kWh for this power to be generated, as illustrated in Figure 11.
  - Based on our analysis of net exports and pricing data from the IESO, we estimated that from 2005 to the end of our audit in 2011, Ontario received $1.8 billion less for its electricity exports than what it actually cost electricity ratepayers of Ontario.
  - A study in September 2009 also noted that Denmark, which relies heavily on wind power, has been faced with a similar situation and exported large amounts of surplus power to Norway and Sweden in order to balance domestic supply with demand.
- Reducing hydro power can be done by diverting, or spilling, water from hydro generators. The IESO informed us that although the magnitude and timing of spill activities have not been well documented, Ontario

Figure 11: Electricity Charge Paid by Ratepayers in Ontario vs. Export Price Received by Ontario from Other Jurisdictions (¢/kWh)

Source of data: IESO



spilled water to reduce electricity supply on 96 days in 2009 and 10 days in 2010. Because the overall cost to produce hydro power is often lower than that of all other types of power, reducing hydro power to "make room" for wind and solar power is an expensive mitigation strategy to reduce surplus power, particularly as hydro, wind, and solar power are all considered renewable energy sources.

- Reducing nuclear power is viewed as a last resort because nuclear units are designed to run constantly and produce at maximum capacity. Ramping nuclear units up and down involves significant costs and can lead to equipment damage. If a nuclear unit is shut down, it typically takes 48 to 72 hours to restart it. With nuclear energy accounting for the majority of Ontario's electricity, such downtime is risky and costly. The IESO requested that nuclear generators shut down or reduce electricity supply 205 times in 2009 and 13 times in 2010.
- Reducing renewable power can be an efficient way to reduce supply. Wind generators can be brought on-line or off-line quickly—an ideal characteristic to address surpluses. Although this helps to address the degree to which the electricity system is overloaded, it may not result in cost savings because if the IESO instructs wind generators to shut down under a surplus-power situation, the generators still get paid under the FIT program (see the section titled "FIT Contract Term: Additional Contract Payment" earlier in this report).

Operational Challenge: Backup Power Requirement

To maintain reliability, there is always a need for backup power generation in the event that a generator must shut down unexpectedly. However, intermittent renewable energy sources such as wind and solar require fast-responding backup power and/or storage capacity to keep the supply of electricity steady when the skies are cloudy or the wind dies down. The OPA informed us that because viable large-scale energy storage is not available in Ontario, wind and solar power must be backed up by other forms of generation. This backup power is generated mainly from natural gas, because coal will be phased out by the end of 2014. The backup requirements have cost and environmental implications. For example:

- The IESO confirmed that consumers have to pay twice for intermittent renewable energy—once for the cost of constructing renewable energy generators and again for the cost of constructing backup generation facilities, which usually have to keep running at all times to be able to quickly ramp up in cases of sudden declines in sunlight levels or in wind speed. The IESO confirmed that such backups add to ongoing operational costs, although no cost analysis has been done.
- The use of gas-fired backup generation will reduce the net contribution of renewable energy to environmental protection, as indicated by studies from other jurisdictions (see the "Environmental and Health Impacts" section later in this report).

Despite these concerns, the cost and environmental impacts of such backup generation capacity were not formally analyzed to ensure that this information would be available to policy decision-makers. We noted that:

- Prior to the passage of the *Green Energy and Green Economy Act* in 2009, the Ministry did not quantify how much backup power would be required. It was not until February 2011 that the Minister issued a new supply-mix directive that asked the OPA to consider backup options, such as converting coal-fired plants to gas-fired operation, importing power from other jurisdictions, and developing storage systems. The OPA has not yet made any recommendations to the Ministry.
- The only analysis on backup power that the Ministry cited was a study done by a third

party engaged by the OPA as part of its 2007 IPSP development. The study noted that 10,000 MW of wind would require an extra 47% of non-wind sources to handle extreme drops in wind. We noted that the third party who carried out this study also operated an Ontario wind farm, raising questions about the study's objectivity. In spite of this, the OPA and the Ministry did not confirm or update this study's projections and did not determine how much backup power would be required.

According to the OPA, a new IPSP will assess the operational challenges of surplus power and backup requirements. At the time of our audit, the new IPSP was still under development.

RECOMMENDATION 5

To ensure that the stability and reliability of Ontario's electricity system is not significantly affected by the substantial increase in renewable energy generation over the next few years, the Ontario Power Authority should continue to work with the Independent Electricity System Operator to assess the operational challenges and the feasibility of adding more intermittent renewable energy into the system, and advise the government to adjust the supply mix and energy plan accordingly.

MINISTRY RESPONSE

The Ministry agrees that system reliability and stability is a key element in energy system planning. The Ministry will work collaboratively with the IESO, the OPA, and all partners in the sector to ensure that the system is capable of meeting new challenges.

Ontario, as part of the North America–wide interconnected network, is required to plan for an agreed-to level of reliability, which is developed and monitored by the North American Electric Reliability Corporation. A focus of this requirement is on the ability to reliably meet annual peak electricity demand. A system that fails to do so would create reliability risks with other interconnected systems.

We note that the increases in renewable energy generation do not increase greenhouse gas emissions. Without renewable energy generation, the gas-fired generation would have to run more frequently, resulting in higher greenhouse gas emissions.

OPA RESPONSE

The OPA agrees with the recommendation and is working with the IESO to improve the integration of renewable energy and to explore how changes to the supply mix and to contractual requirements could maximize the benefits of intermittent generators for the Ontario electricity grid and ratepayers. The OPA will continue to provide advice for the government's consideration in determining the supply mix. Ongoing planning has already contributed to greater understanding of the issues and solutions required to integrate renewable energy.

DELIVERY OF RENEWABLE ENERGY

As a result of the *Green Energy and Green Economy Act, 2009* and the FIT program, there has been enormous demand for connecting renewable energy to Ontario's electricity grid. As a result, additional transmission and distribution developments are required to facilitate the connection and delivery of renewable energy resources.

Impact of Renewable Energy on Transmission and Distribution Systems

Because the FIT program has created many new points of generation, especially in northern Ontario, significant investments are required to update and expand transmission and distribution systems to get the electricity from numerous remote and widely dispersed renewable energy generators

to population centres in southern Ontario. Costs associated with these investments are paid by electricity ratepayers through increases in the delivery charges on electricity bills. Specifically:

- The Ministry's Long-Term Energy Plan identified five priority transmission projects, including three designed to accommodate renewable energy, at an estimated total cost of about $2 billion. According to the OPA, the three priority projects were intended to accommodate 1,900 MW of renewable energy at an estimated cost of between $450 million and $850 million, and also to contribute to system reliability and increase transmission capability. Hydro One indicated that the actual timing and cost of these priority projects is uncertain, because they depend on complex and often lengthy approval processes by the OEB, the Ministry of the Environment, and others. There may also be unexpected capital expenditures due to unforeseen technical problems, because new technology is required for transmission and distribution systems to support renewable energy.
- In addition to the three priority projects, the Bruce–Milton line is expected to go into service in December 2012 to deliver 1,500 MW of nuclear power and 1,700 MW of renewable energy in southern Ontario. The cost of this line was initially estimated at $635 million, but the estimate was raised in March 2011 to $755 million. Hydro One attributed the $120-million cost overrun to delays in project approvals and higher-than-anticipated labour and material costs. The overrun could increase further by the time Bruce–Milton is complete. The three other priority projects could face similar cost overruns if similar labour and material cost pressures arise.
- Hydro One files applications with the OEB to seek approval to recover the costs of transmission and distribution charges on electricity bills. Its most recent distribution rate application estimated that investments of $169 million in 2010 and $296 million in 2011 would need to be recovered from electricity ratepayers for the cost of connecting renewable energy to the distribution systems and modernizing the electricity grid.

Apart from the cost implications, the OPA was aware that only limited capacity was readily available to FIT when the program was launched. To date, Ontario's existing transmission and distribution systems have already been operating at or near capacity, but there has been a higher-than-anticipated number of FIT projects attempting to connect into the system. The capacity limitation has hindered the timely connection of renewable energy to the grid and kept the FIT program from achieving its full potential.

As of April 1, 2011, more than 3,000 FIT applications with a total capacity of about 10,400 MW could not be accommodated by the existing transmission infrastructure and were awaiting connection. Of the 10,400 MW awaiting connection, only about 2,400 MW will be accommodated by the future transmission capacity of the Bruce–Milton line and the three other priority projects. The remaining 8,000 MW will not be connected unless new lines are built or existing ones upgraded. Most of this is from FIT applications prior to June 2010, and these have been awaiting an Economic Connection Test (ECT) to determine whether it is economical to build additional transmission infrastructure. Therefore, connecting renewable energy projects to the grid is subject to both technical and economic considerations, and there is no guarantee that every project will be connected. However, the Ministry informed us that the requirement to conduct the ECT process was superseded by the Long-Term Energy Plan (LTEP) in November 2010. Therefore, as of April 2011, the OPA had not yet started the first ECT, which was to have been conducted in August 2010 and every six months thereafter on a rotating basis.

Allocation of Capacity to Korean Consortium

As noted earlier, the Ministry signed an agreement with a consortium of Korean companies that agreed to develop 2,500 MW of renewable energy resources in Ontario in five phases by 2016. Besides paying the consortium contract prices higher than the standard FIT prices if it meets its job-creation targets, another aspect of the consortium agreement is its impact on transmission capacity for other renewable energy projects. In April 2010, the Minister directed the OPA to give priority to connecting the consortium projects to the grid when assessing the availability of already-limited transmission capacity. This commitment to the consortium affected the FIT contract allocation process and the timely connection of renewable energy from other generators. Specifically:

- When the OPA evaluated the FIT applications and the availability of transmission capacity, it had to consider the locations and sizes of the consortium projects and their transmission requirements. According to the OPA, the required Economic Connection Test was delayed because the OPA could not start to assess the transmission availability until the consortium finalized the connection points for phases two and three of its projects.
- Two of the three priority transmission projects were selected partly because they were expected to meet the timing requirements of the consortium agreement. Specifically, the OPA's forecasts of the likely locations of the consortium projects indicated that 1,323 MW of the existing transmission capacity and about 1,177 MW of the future transmission capacity from the Bruce–Milton line and the other three priority projects will be made available to the consortium.

Planning of Transmission Systems

Planning and co-ordinating the timelines of transmission development is not unique to the FIT program; its open nature, however, has created uncertainties and challenges for the OPA.

The OPA can identify the capacity and connecting points of renewable energy generators as well as the future needs and locations of transmission lines only after it receives the FIT applications. The OPA noted that this has created a new challenge, which it has dubbed "chicken and egg": transmission capacity requirements cannot be known in the absence of renewable energy generators, and renewable energy generators cannot go forward in the absence of transmission capacity. In essence, new transmission projects cannot be built unless there are proven needs and firm commitments from renewable energy developers, but renewable energy developers are not willing to invest money to build generators without the presence of adequate transmission capacity because of the risk that they will not be connected to the grid. This situation will affect the timeliness of connecting renewable energy to the system because the lead time for transmission projects, about five to seven years, is much longer than the two-to-three-year lead time for renewable energy projects.

RECOMMENDATION 6

To provide investors who have submitted applications for Feed-in Tariff (FIT) projects with timely decisions on whether their projects can be connected to the grid and to ensure that adequate transmission capacity is available for approved projects, the Ontario Power Authority should work with the Ministry of Energy and Hydro One to:

- identify practical ways to deal on a timely basis with the FIT investors who have been put on hold; and
- prioritize the connection of approved FIT projects to the grid.

MINISTRY RESPONSE

The Ministry continues to work closely with the OPA, Hydro One, and local distribution companies to improve connection access for FIT and microFIT projects.

The province's Long-Term Energy Plan identifies five priority transmission projects, which have been identified in large part on the basis of their ability to allow greater renewable connection.

Recently, the Minister of Energy asked Hydro One to expedite infrastructure upgrades for up to 15 of the most severely constrained hydro transformer stations to enable the connection of more microFIT projects. The Minister also issued a directive to the OPA in August 2011 directing the OPA to provide connection options to constrained microFIT proponents.

In addition, working to prioritize and effectively connect FIT and microFIT projects will be a key focus of the two-year review of the FIT program.

OPA RESPONSE

The OPA agrees with this recommendation. The OPA has continued to work closely with the Ministry and Hydro One to improve connection access for FIT and microFIT projects. In August 2011, for example, the OPA began to implement a ministerial directive that allows microFIT proponents to select from various options to relocate constrained projects to areas where connection is possible. Prior to developing the FIT program, the Renewable Energy Supply Integration Team was established by the OPA, the Ontario Energy Board, and Hydro One to provide advice and co-ordinate and streamline activities related to the expansion of renewable energy, including connecting renewable generators to the transmission and distribution systems. The OPA will continue to work with sector partners and the Ministry on connection issues.

SOCIO-ECONOMIC, ENVIRONMENTAL, AND HEALTH IMPACTS OF RENEWABLE ENERGY

Socio-economic Impacts

The *Green Energy and Green Economy Act, 2009* (Act) was intended to support new investment and economic growth in Ontario through the creation of a strong and viable renewable energy sector.

Job Creation in Ontario

The Ministry said the Act is expected to support over 50,000 direct and indirect jobs over three years in transmission and distribution upgrades, renewable energy, and conservation. We questioned whether the job projection information was presented as transparently as possible. For example:

- A majority of the jobs will be temporary. The Ministry projected that of the 50,000 jobs, about 40,000 would be related to renewable energy. Our review of this projection suggests that 30,000, or 75%, of these jobs would be construction jobs and would last only from one to three years, while the remaining 10,000 would be long-term jobs in manufacturing, operations, maintenance, and engineering. However, the high proportion of short-term jobs was not apparent from the Ministry's public announcement.
- The 50,000-job projection included new jobs but not those jobs that would be lost as a result of promoting renewable energy. Experience in other jurisdictions suggests that jobs created in the renewable energy sector are often offset by jobs lost as a result of the impact of higher renewable energy electricity prices on business, industry, and consumers, as indicated in Figure 4. In addition, the closure of Ontario's coal-fired plants by the end of 2014 will lead to job losses, but these were not factored into the Ministry's job projections. Ontario Power Generation, which operates the coal-fired plants, informed us

that the extent of job losses depended on the Ministry's plan: about 2,300 jobs would be lost if the Ministry closed all coal-fired plants, but 600 of these could be saved if certain coal-fired plants are converted to biomass or gas-fired operation. The Ministry's Long-Term Energy Plan noted that Ontario will continue to explore the opportunities for using biomass along with natural gas in the coal-fired plants.

Experiences in Other Jurisdictions

We noted that Ontario's job projections were not consistent with the experiences of other jurisdictions that have a longer history with renewable energy. Studies from these countries highlighted issues with renewable energy that included job losses and high costs per "green" job. We questioned whether the experiences of other jurisdictions had been taken into consideration, and the Ministry confirmed that it had not estimated the potential job losses and the cost per renewable-energy-related job in Ontario. In particular, Ontario's FIT program was modelled on the FIT programs in Germany and Spain, and their job-related experiences could well be relevant to Ontario. For example, we noted the following studies conducted over the past three years:

- A 2009 study conducted in Germany noted that job projections in the renewable energy sector conveyed impressive prospects of gross job growth but omitted such offsetting impacts as jobs lost in other energy sectors and the drain on economic activity caused by higher electricity prices. The study found that the cost of creating renewable-energy-related jobs was up to US$240,000 per job per year, far exceeding average wages in other sectors.
- A 2009 study conducted in Spain found that for each job created through renewable energy programs, about two jobs were lost in other sectors of the economy.
- A 2009 study conducted in Denmark noted that a job created in the renewable sector does not amount to a new job but, rather, usually comes at the expense of a job lost in another sector. The study also found that each job created under renewable energy policies cost between US$90,000 and US$140,000 per year in public subsidies—or about 175% to 250% of the average wage paid to manufacturing workers in Denmark.
- A 2011 study conducted in the United Kingdom (after the FIT program was launched in Ontario) reported that about four jobs were lost elsewhere in the economy for every one new job in the renewable energy sector, primarily because of higher electricity prices.

In November 2010, similar concerns were raised about the Ontario job projections in a report by the Task Force on Competitiveness, Productivity and Economic Progress of the Rotman School of Management at the University of Toronto. The report noted that it is unclear what the jobs estimate includes, because it has offered neither a definition of green jobs nor a transparent calculation of how the 50,000 figure was arrived at. The report also said that it is unclear whether the 50,000 estimate is a gross or net number of jobs. The report further noted that even if 50,000 new jobs were created, the higher energy costs attributable to renewable energy might result in job losses elsewhere in the economy, particularly in industries that use large quantities of energy. Another recent study in Canada estimated that each new job to be created as a result of renewable energy programs would cost $179,000 per year.

RECOMMENDATION 7

To ensure that the provincially reported estimate of jobs created through the implementation of the renewable energy strategy is as objective and transparent as possible, the analysis should give adequate consideration to both job-creation and job-loss impacts, as well as job-related experiences of other jurisdictions that have implemented similar renewable energy initiatives.

MINISTRY RESPONSE

The Ministry's calculation of 50,000 jobs relied on standard Ontario government methodology, including standard investment and job multipliers. The figure of 50,000 jobs has always been characterized by the Ministry as a mix of long-term and short-term jobs.

Lessons learned from other jurisdictions with respect to job-creation and job-loss impacts will be taken into account where they may be comparable or instructive to Ontario, taking into account the fact that renewable-energy-program administration rules vary, as does the composition of the economies.

Environmental and Health Impacts of Renewable Energy

Ontario's 2007 Climate Change Action Plan outlined "coal phase-out, renewables, and other electricity initiatives" as measures to help Ontario achieve its greenhouse gas reduction targets, which call for reductions below 1990 levels of 6% by 2014, 15% by 2020, and 80% by 2050.

The Ministry's 2010 Long-Term Energy Plan reiterated the commitment to improve the health of Ontarians and to fight climate change by investing in renewable energy and phasing out coal, which is the largest source of greenhouse gases and accounts for a number of health and environmental problems.

Environmental Concerns

The Ministry indicated that renewable energy will help reduce greenhouse gases by displacing gas-fired generation. However, as noted earlier, any significant increase in intermittent renewable energy requires backup power by either coal- or gas-fired plants because wind and solar power have relatively low reliability and capacity. In Ontario's case, because coal-fired plants are being phased out by the end of 2014, this backup will need to come from gas-fired plants. Although gas-fired plants emit fewer greenhouse gases than coal-fired plants, they still contribute to greenhouse gas emissions. Our review of experiences in other jurisdictions showed that the original estimated reduction in greenhouse gases had not been reduced to take into account the continuing need to run fossil-fuel backup power-generating facilities. For instance:

- A 2008 study in the United Kingdom found that power swings from intermittent wind generation need to be compensated for by natural-gas generation, which has meant less of a reduction in greenhouse gases than originally expected.
- A 2009 study in Denmark noted that although the country is the world's biggest user of wind energy, it has had to keep its coal-fired plants running to maintain system stability.
- The German government also had to build new coal-fired plants and refurbish old ones to cover electricity requirements that could not be met through intermittent wind generation.

According to the Ministry, Ontario is unique in its commitment to phase out coal by the end of 2014: other jurisdictions did not make that commitment. The Ministry has not yet quantified how much backup power will be required from other energy sources to compensate for the intermittent nature of renewable energy, and accordingly has no data on the impact of gas-fired backup power plants on greenhouse gas emissions.

Health Concerns

In recent years, there have been growing public-health concerns about wind turbines, particularly with regard to the noise experienced by people living near wind farms. In May 2010, Ontario's Chief Medical Officer of Health issued a report concluding that available scientific evidence to date did not demonstrate a direct causal link between wind turbine noise and adverse health effects. However, the report was questioned by environmental groups, physicians, engineers, and other professionals, who

noted that it was merely a literature review that presented no original research and did not reflect the situation in Ontario. We also noted that only a limited number of renewable generators were in operation in Ontario when the report was prepared in spring 2010, a few months after the launch of the FIT program.

One of the provisions of the Act was the establishment of an academic research chair to examine the potential effects of renewable energy generators on public health. In February 2010, an engineering professor from the University of Waterloo was appointed to this position but, as of July 2011, there had been no report on the results of any research conducted to date.

RECOMMENDATION 8

To ensure that renewable energy initiatives are effective in protecting the environment while having minimal adverse health effects on individuals, the Ministry of Energy should:

- develop adequate procedures for tracking and measuring the effectiveness of renewable energy initiatives, including the impact of backup generating facilities, in reducing greenhouse gases; and
- provide the public with the results of objective research on the potential health effects of renewable wind power.

MINISTRY RESPONSE

The Ministry agrees that the impacts of increasing the share of renewable energy in Ontario's energy mix should be quantified where possible and underpinned by objective research. For example, a 2005 independent study, *Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation,* found that if health and environmental impacts were accounted for, the total cost of coal-fired generation would be $4.4 billion per year. This study helped reaffirm the province's decision to phase out coal and to increase the share of renewable energy in Ontario's energy mix.

The Ministry will continue to rely on the Chief Medical Officer of Health to provide objective advice on the potential health impacts of renewable energy generators. The Chief Medical Officer of Health's recent review found that the scientific evidence does not demonstrate any direct causal link between wind turbine noise and adverse health effects.

The Ministry will continue to work with other ministries to promote further scientifically based information about the impacts of renewable energy. For example, the Ministry of the Environment has appointed an independent research chair for a five-year term to undertake research on the health impacts of renewable energy generators. Considerable work is well under way by the chair and his team to address the important technological, health, and safety aspects of the renewable energy technologies.

OPA RESPONSE

Ongoing plans, including the Integrated Power System Plan, identify the environmental emissions from planned resources, and they clearly identify a reduction in emissions over the time that the OPA has been involved in planning and procuring resources and through the planning horizon.