



# 10-Year Outlook Highlights

From January 2005 to December 2014



# EXECUTIVE SUMMARY

Ontario requires substantial additional electricity supply and demand-side measures to maintain supply adequacy into the future.



Ontario's electricity system faces significant challenges over the next 10 years. The uncertainty surrounding the return to service of Pickering A nuclear units, the lack of new generation investment and the commitment to shut down 7,500 MW of coal fired generation by December 31, 2007, all contribute to a potentially severe shortfall. New transmission, supply and demand side initiatives are urgently needed to address this gap and secure Ontario's energy future.

The need is most pressing in the Toronto area, to deal with the immediate impact of the April 30, 2005 shutdown of the Lakeview Thermal Generating Station. Plans are being implemented to address this in the short term. In the longer term, additional generation is also required in the Toronto area to replace the Lakeview generating capacity and to meet load growth in the Greater Toronto Area (GTA).

Each year the Independent Electricity Market Operator (IMO) publishes an integrated assessment of the security and adequacy of the Ontario electricity system over the next 10 years. This report presents the IMO assessment for the 10-year period from 2005 to 2014. It is based on the IMO's forecast of electricity demand, information provided by Ontario generators on the supply that will be available and the latest information on the configuration and capability of the transmission system.

## ELECTRICITY SUPPLY OUTLOOK

Additional Ontario electricity supply and demand-side measures are required to maintain supply adequacy into the future and to reduce Ontario's dependency on supply from other jurisdictions.

The reactivation of 2,000 MW of nuclear capability and the addition of 500 MW of new gas-fired generation over the last 18 months, and the addition of 755 MW of gas-fired generation expected by this summer has eased concerns over the next 18 months. However, more resources are required in

every year of the 10-Year Outlook period, some with a high degree of urgency. With the lead times and the quantities of supply and demand resources needed over this period, commitments are required now.

Given the government's commitment to shut down coal-fired generation -- which accounts for some 25 per cent of Ontario's current generating capacity -- a substantial amount of new supply, refurbished generation and demand side resources could be required by 2014. Allowing for typical resource unavailability of 10%, approximately 12,850 MW of supply or demand measures would need to be in place to reliably cover the 2014 peak capacity deficiency of 11,600 MW. The exact amount and timing of the new resources hinges on a variety of factors including demand growth and the performance of Ontario's aging generation infrastructure. The provincial government has indicated that it is developing plans to address this situation.

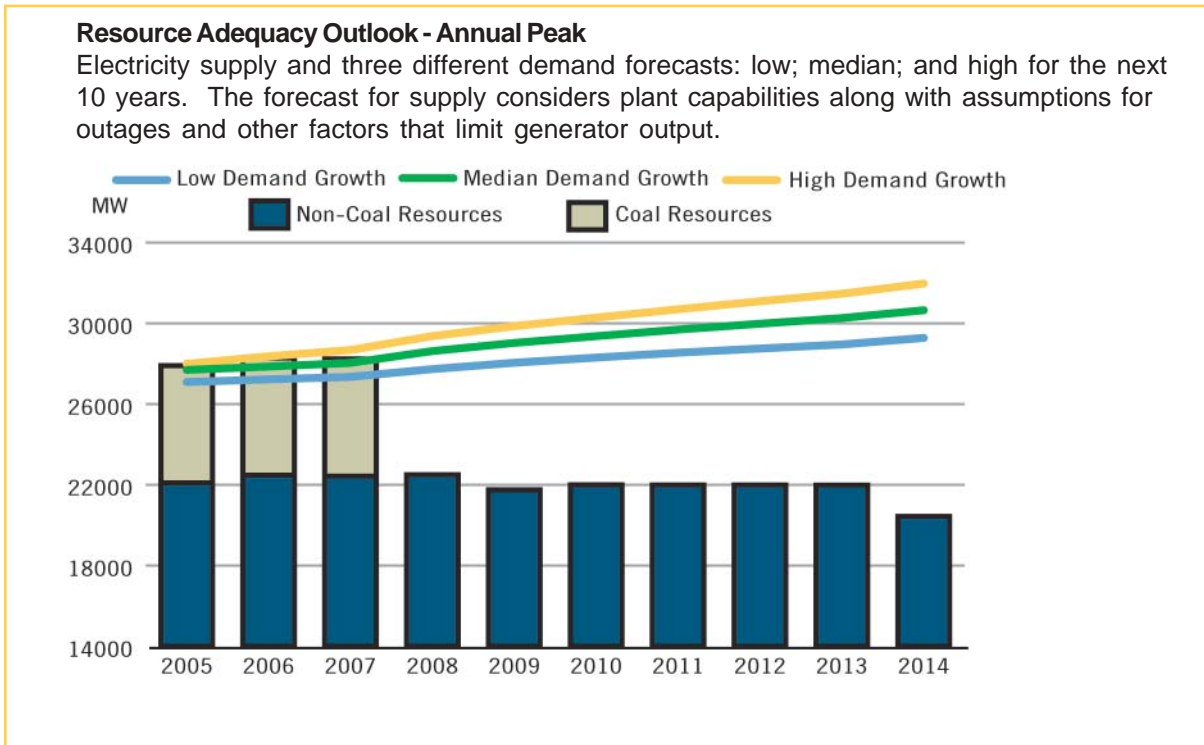
Proposals for over 30 future generating facilities totaling more than 6,000 MW have been submitted to the IMO. From this total, the capacity available to meet system needs at peak times is estimated to be only 4,000 MW, based on the various capacity factors associated with each generation type. This much capacity, or its equivalent, and more, is needed to meet Ontario's requirements. However, construction of only three of the proposed facilities has started. The provincial government has initiated a Request for Proposals process seeking up to 2,500 MW of new generating capacity and/or demand side initiatives to be developed as early as 2005. The government will also be seeking up to 300 MW of renewable energy capacity to be in service as soon as possible. As in previous Outlooks, the IMO does not include in its assessment those projects for which construction has not begun. Only one of the remaining three Pickering A units is included.



TransAlta's gas-fired cogeneration plant in Sarnia, completed in 2003, is one of the newest generating stations in Ontario.

The increasing age of Ontario generation was identified in last year's Outlook as an emerging issue toward the end of the study period and beyond as much of the existing generation infrastructure reaches or exceeds its nominal life.

A significant amount of new generation needs to be situated close to Toronto. To meet power system needs, the Lakeview coal-fired generating station in Mississauga, scheduled to be removed from service on April 30, 2005 in accordance with Ontario Regulation 396/01, should be replaced and augmented by generation or demand initiatives in the GTA, east of Milton, by 2006. All the proposed new generation projects for the Toronto zone address this local requirement, and their



timely completion would alleviate supply concerns in downtown Toronto and the western GTA. These projects will complement, but not replace, the need for transmission reinforcements.

With respect to the retirement of coal-fired generation announced by the government, with few exceptions, replacement capacity must be located in the same electrical zone and have the same overall operational characteristics as the station being retired, in order to avoid grid adequacy and operability issues.

**TRANSMISSION**

The need for additional supply and transmission reinforcement to maintain the reliability of the GTA was thoroughly documented in the 2003 10-Year Outlook. The plans to address GTA concerns have evolved substantially over the past 12 months. However it is critically important that sufficient projects are implemented in a timely manner to maintain the required level of reliability.

Several transmission infrastructure additions are required before 2005 summer peak conditions in order to prevent overloading of autotransformers and to provide adequate reactive power to maintain acceptable voltages throughout the western portion of the GTA. Hydro One will be adding a new Transformer Station in Markham, extending an existing 230 kV double circuit line between

Richmond Hill and Markham, and installing new equipment in a number of stations within the GTA.

The IMO has directed Ontario Power Generation to retain the option to convert two Lakeview generating units to synchronous condensers should the reactive power needed to support voltages in the GTA not be available from other sources. No coal burn is required for this mode of operation.

For implementation further along in the decade, Hydro One has proposed two alternative transmission projects to address the need for a third supply to downtown Toronto – a Direct Current (DC) Option and an Alternating Current (AC) Option. Both options meet IMO criteria and improve the reliability of supply to downtown Toronto. However the DC option is preferred as it requires fewer system upgrades.

Additional transmission facilities have also been proposed for the areas west and north of Toronto to increase the supply capability to southern Mississauga, southern Oakville, Markham, Richmond Hill, Vaughan, Newmarket and Aurora. However, the supply delivery capability to the rest of Mississauga, and to Brampton, Milton and northern Oakville remains a concern. Due to the high rate of load growth in these areas, there is a need to increase transmission capability.

New transmission reinforcements are also required for other parts of Ontario including Kitchener-Waterloo, Cambridge, Guelph and Windsor as discussed in the recent Hydro One report “Transmission Solutions – A 10-Year Transmission Plan for the Province of Ontario 2004-2013”.



Bruce Nuclear Station. The return to service of Bruce Power's Units 3 and 4 and OPG's Pickering Unit 4 have significantly improved Ontario's electricity supply.

## ONTARIO DEMAND FORECAST

Without significant conservation efforts, energy consumption is forecast to grow from about 156 terawatt-hours (TWh) in 2005 to about 169 TWh in 2014, an average annual growth rate of energy of 0.9%.

Normal weather peak demands are expected to increase from about 24,160 MW in 2005 to 26,610 MW in the summer of 2014, an increase of 2,450 MW. Under extreme weather conditions, the summer peak is projected to approach the 30,000 MW level by the end of the forecast period.

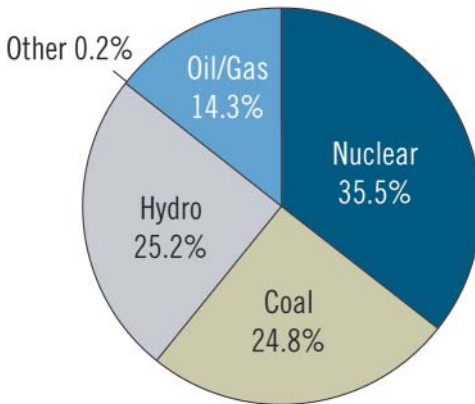
# REPORT HIGHLIGHTS

Ontario must meet its future electricity needs through demand-side measures, new large generating stations, distributed generation, increased renewable energy, continued access to imports, and transmission upgrades and additions.



## Existing Installed Generation Resources

The existing installed generation includes nuclear, coal, oil, gas, hydroelectric, wood and waste-fuelled generation, which adds to a total installed capacity of 30,501 MW.



Nuclear: 10,831 MW/ 5 Stations

Coal: 7,564 MW/ 5 Stations

Hydro: 7,676 MW/ 61 Stations

Oil/Gas: 4,364 MW/ 22 Stations

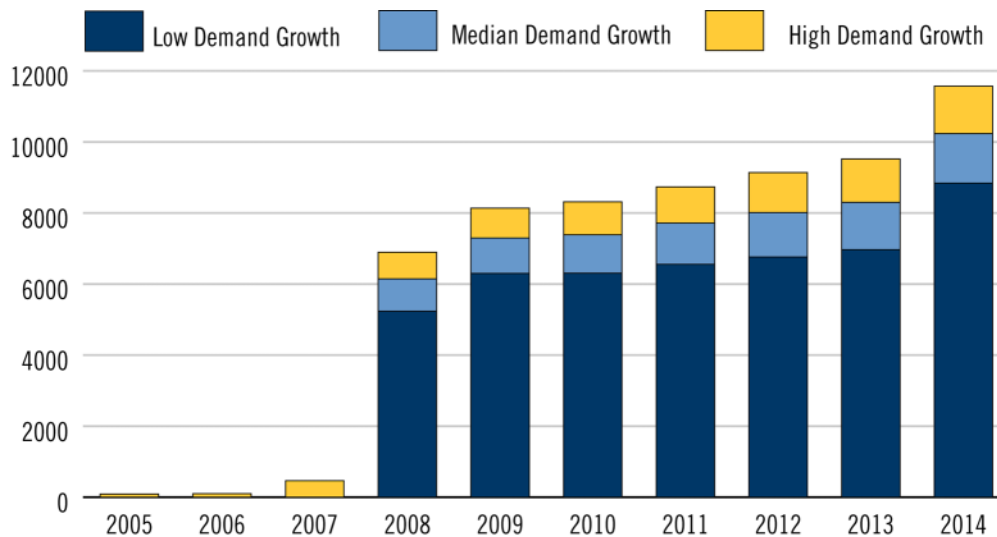
Other: 66 MW/ 2 Stations

## GENERATION ADDITIONS

Two important aspects to be considered regarding generation additions are location and mix. Proper location and a diverse mix of generation resources is crucial for ensuring overall reliability and market efficiency, through dispatch flexibility, reduced vulnerability to fuel supply contingencies and fuel price fluctuations, and through avoiding or alleviating transmission congestion.

### Net Requirement for Additional Resources

The range of additional resources (either generation or conservation efforts) required to meet system needs at peak times under three different forecast scenarios: low; median; and high demand.



### Locating Coal-Replacement Generation

In order to preserve reliability while the coal phase-out program is implemented, replacement capacity should be in place for each coal-fired generating station by the time it is shutdown. With few exceptions, the replacement capacity must be located in the same electrical zone and have the same overall operational characteristics as the station being retired, in order to avoid transmission adequacy and system operability issues.

### Generation Proposals by Zone

The zone with the most immediate need for additional generation resources is the Toronto zone, especially the **Greater Toronto Area**, where demand growth over previous years exceeded, and is forecast to continue to exceed, most of the other zones in Ontario.

### Baseload Generation

Baseload generation largely consists of nuclear and run-of-the-river hydroelectric resources which cannot routinely be cycled on and off in response to demand fluctuations. These types of generators have limited dispatch flexibility, and, when available to operate, must be run almost continuously at a fixed output, often at or near their full capability. If too much baseload generation is present in the supply mix, the amount of generation can have the potential to exceed the market demand, thereby creating a situation known as unutilized baseload generation (UBG). An analysis

of the minimum peak demands in the latter years of the study period suggests that up to approximately 4,000 MW of nuclear and run-of-the-river generation resources could be added to the existing in-service baseload facilities towards the end of the ten-year period without causing undue risk of UBG. This amount will be affected by load growth and any load shifting patterns between on-peak periods and off-peak periods.

### **Intermediate and Peaking Generation**

Existing intermediate and peaking generation in Ontario consists mainly of generation fuelled by coal, gas, oil, and hydroelectric generation with storage capability. New intermediate and peaking generation must be added to the Ontario resource mix in order to implement the coal phase-out plan. The only projects of this nature in the IMO queue are gas-fired. The completion of all the gas-fired generation projects in Ontario would add between 3,500 and 3,800 MW of gas-fired capacity and would more than double the present annual volume of gas consumed in Ontario to produce electricity. Approximately 20% of all the gas consumed in Ontario would then be devoted to electricity generation. The prospects of long-term gas supply at reasonable prices is uncertain. Consideration of other fuel-types with more stable long-term supply potential should be considered in lieu of or in conjunction with gas-fired generation, provided equivalent or lower emission rates can be achieved.

### **Renewable Generation Resources**

Renewable resources consist primarily of hydroelectric, wind, biomass, solar, and geothermal energy sources. These are considered the cleanest and least environmentally impactful of all generation resources. Only wind and a small amount of hydroelectric generation have been proposed to the IMO. Wind generation, by its nature has very little dispatch flexibility; only when the wind blows, can energy be produced. The diversity among projects identified to the IMO will tend to moderate local fluctuations. Further utilization of wind energy can be achieved through partnering with suitable hydroelectric facilities to co-optimize both types of resources. The Energy Conservation and Supply Task Force (ECSTF) Report states that potential exists for large amounts of renewable generation resources to be developed, and that the Province is targeting additions of about 1,350 MW by 2007 and 2,700 MW by 2010 in renewable resources. This potential is substantiated by the approximately 2,350 MW of wind generation proposals submitted to the IMO for Connection Assessment and Approval.



Wind generation is considered one of the cleanest electricity resources.

## Distributed Generation

Distributed generation can play an important role in addressing local supply needs. Not only can it reduce losses and congestion on major transmission interfaces, it can also alleviate local area transmission and distribution reliability concerns. In most cases distributed generation projects can be completed faster than large projects. Distributed generation can be situated anywhere it is not precluded by local transmission concerns; in particular it should be considered for large load centres such as Kitchener/Waterloo, Ottawa, and Windsor, as well as smaller, transmission limited areas, such as Peterborough.

## Demand-Side Measures

The IMO has been identifying the suitability of demand-side initiatives as part of the supply picture for several years and believes demand reductions and demand shifting should be vigorously pursued in Ontario, as clean and potentially less expensive ways to reduce future supply requirements. The application of such demand initiatives is virtually unrestricted in location.

Programs would improve the supply-demand balance in three main ways:

- Price-responsive demand which reacts to market price signals and needs not only technical infrastructure for conveying price signals and implementing dispatch but also an appropriately structured market.
- Demand reduction through technological or process efficiency improvements would have beneficial effects on the environment and reduce the need for generation capacity additions.
- Shifting the time of use from peak to off-peak periods through demand-response programs would achieve peak demand reductions, influencing electricity prices downward and improving utilization rates of generation resources.

The Electricity and Conservation Supply Task Force (ECSTF) explored the possible ways to achieve energy conservation and demand response in Ontario. The ECSTF report states that conservation programs could contribute up to 1,350 MW to alleviate future supply requirements.



There are many ways households and businesses can conserve energy. Programmable thermostats are a cost effective way to save energy.

## **Interconnections**

Ontario has a coincident import capability of approximately 4,000 MW through its existing interconnections.

In real-time system operation, reliance on external supply through interconnections is mutually beneficial to all interconnected systems, for both reliability and market efficiency reasons. During off-peak periods, attractively priced external supply can provide cost savings to the electricity market. During peak hours, due mainly to the non-coincidence of the peak demands with one or more neighbouring systems, external supply can contribute to meeting peak demand.

## **External Supply Availability**

An analysis of historical power flows on Ontario's interconnections for the five years prior to 2002 suggests that, outside of summer peak demand periods, up to 1,800 MW of external generation resources can be expected to be available to Ontario. During Ontario's summer peak demand periods of July and August opportunities for imports still exist and imports are still expected to be available despite the fact that many neighbouring systems are often experiencing their peak demand. This is due, in part, to the frequent non coincidence of the daily peak hours between Ontario and its neighbours and the availability of spare capacity from systems that are not summer peaking. From the same analysis, up to 1,400 MW would be expected to be available based on observations during summer peak months in recent years prior to 2002.

The actual hourly import levels experienced from market opening in May 2002 up to February 24, 2004 indicates an average import level of 1,164 MW for all hours. During the 3,044 hours when Ontario demand exceeded 20,000 MW the average import level was 1,544 MW. During the 338 hours when Ontario demand exceeded 23,000 MW the average import level was 2,293 MW, and occasionally reached the Ontario coincident import capability of approximately 4,000 MW.

Future levels of imports into Ontario will vary depending on several factors, including the availability and willingness of resources in external jurisdictions to supply the Ontario market, and the availability of required transmission capacity. For interconnected supply to contribute to the capacity needs of Ontario, the dependability of supply contracts will need to have an equivalent level of certainty to that of Ontario-based generation.

### Potential Generation Resource Additions in Ontario

New generation projects that will be connected to the high voltage transmission lines must be approved by the IMO. Although approximately 6,000 MW of generation additions remain in the IMO queue, only projects that are under construction are included in the resource scenario presented.

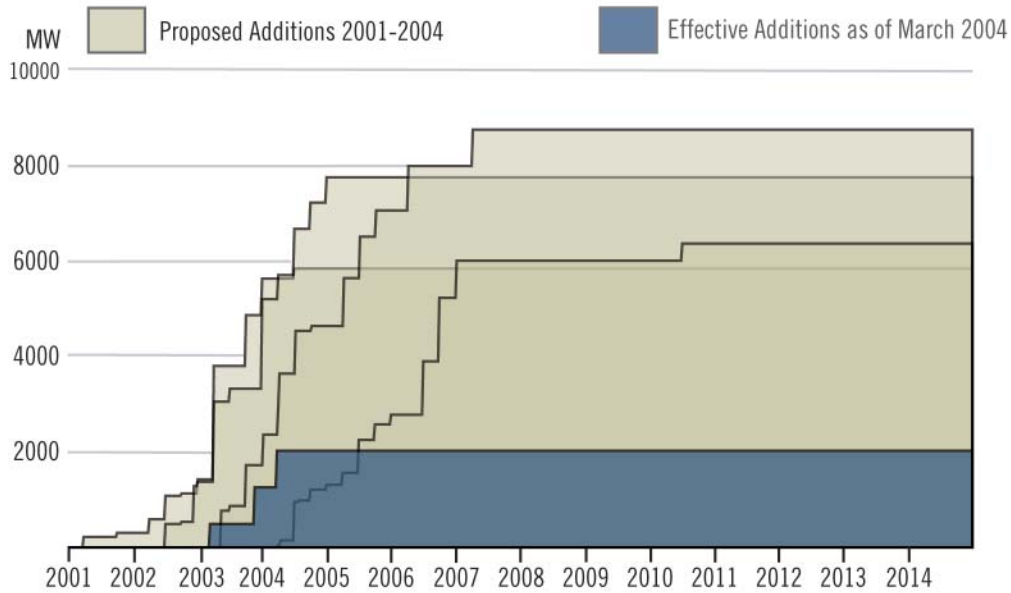
Proponent/Project Name	Zone	Fuel Type	Capacity MW	Estimated I/S Date	Under Construction*
ATCO Power Ltd. - Windsor	West	Gas	625	2004 - Q2	Yes
Imperial Oil Ltd. - Sarria	West	Gas	98	2004 - Q2	Yes
Northern Cross Energy - Goderich	Southwest	Gas	50	2004 - Q2	No
Northland Power Inc. - Kirkland Lake	Northeast	Gas	32	2004 - Q3	Yes
Toronto Hydro ES Inc. - Portlands	Toronto	Gas	180	2004 - Q3	No
Hydro One for Vision Quest - Kincardine	Bruce	Wind	15	2004 - Q4	No
Hydro One for Vision Quest - Pictou	East	Wind	22	2004 - Q4	No
CPG - Beck GS#2 - Generation Rehabilitation	Nagara	Hydro	192	2004 - Q4	No
Superior Wind Energy Inc. - Manitoulin Island	Northeast	Wind	100	2005 - Q1	No
AIM POWERGEN - Lake Erie Northshore	West	Wind	150	2005 - Q2	No
Superior Wind Energy Inc. - Sault St. Marie	Northeast	Wind	100	2005 - Q2	No
Chinodini Enterprises - Grey Highland Wind Project	Southwest	Wind	240	2005 - Q3	No
Energysource Hydro Mississauga - Pearson Int. Airport	Toronto	Gas	117	2005 - Q3	No
GAIA Power Inc. - Wolfe Island	East	Wind	35	2005 - Q3	No
Superior Wind Energy Inc. - Bruce Peninsula	Southwest	Wind	100	2005 - Q3	No
Superior Wind Energy Inc. - Leamington	West	Wind	200	2005 - Q3	No
AGSTAR Power Inc. - Tilbury	West	Gas	88	2005 - Q4	No
Port Albert Wind Farms - Goderich	Southwest	Wind	57	2005 - Q4	No
Repower Wind Corp. - Manitoulin Island	Northeast	Wind	57	2005 - Q4	No
Boralex Inc. - Mississauga	Toronto	Gas	125	2005 - Q4	No
Superior Wind Energy Inc. - Collingwood	Southwest	Wind	200	2006 - Q1	No
Northland Power Inc. - Thorold	Nagara	Gas	273	2006 - Q3	No
Ontario Power Generation Inc. - Portlands Energy Centre (formerly "Hearn")	Toronto	Gas	550	2006 - Q3	No
Superior Wind Energy Inc. - Bruce Peninsula	Southwest	Wind	100	2006 - Q3	No
Superior Wind Energy Inc. - Marathon	Northwest	Wind	200	2006 - Q3	No
Port Albert Wind Farms - PAWF Phase IV	Southwest	Wind	300	2006 - Q4	No
Stthe Canadian Holdings Inc. - Goreway Brampton	Toronto	Gas	932	2006 - Q4	No
Stthe Canadian Holdings Inc. - Goreway Brampton	Toronto	Gas	1009	2006 - Q4	No
Superior Wind Energy Inc. - Sault St. Marie	Northeast	Wind	100	2006 - Q4	No
CPG - Lac Seul GS	Northwest	Hydro	13.6	2007 - Q1	No
Stthe Canadian Holdings Inc. - Southdown Mississauga	Toronto	Gas	763	2007 - Q1	No
Stthe Canadian Holdings Inc. - Southdown Mississauga	Toronto	Gas	336	2007 - Q1	No
Canadian Renewable Energy Corporation - Wolfe Island	East	Wind	360	2010 - Q3	No
<b>Total</b>	<b>6,025 - 6,375</b>				

\* For projects which are not under construction, the IMO assumes no commitment on the part of the market participant to complete the project.

**Evolution of Proposed New Generation Additions**

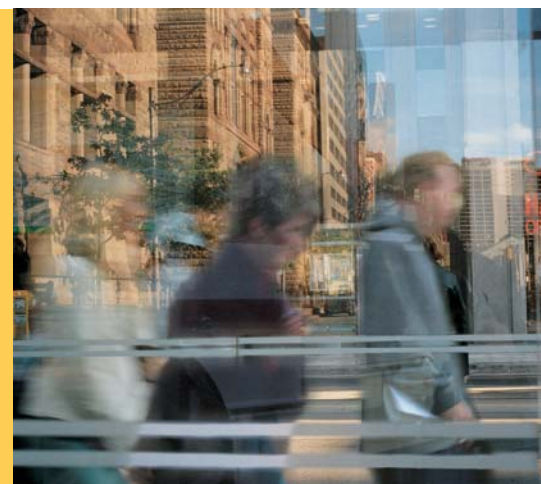
Over the last four years few of the proposed projects have come into service. The in-service dates for most projects have been delayed over the years, and some of the proponents have already withdrawn their projects.

The amount of generation additions that will materialize over the next few years is critical for the long-term resource adequacy of Ontario. The only generation projects completed to date are the TransAlta-Sarnia Cogeneration Project and two reactivated Bruce A units, for a total of approximately 2,000 MW of additional generation. One Pickering A unit was also returned to service in 2003, increasing the available Ontario capacity by about 500 MW (this unit is not included in the figure below). The ATCO-Brighton Beach, Imperial Oil and Northland Power-Kirkland Lake projects have been identified to the IMO as being under construction and are expected to come into service through 2004.



# OBSERVATIONS, FINDINGS AND CONCLUSIONS

The IMO has identified a number of areas in Ontario where generation, demand-side measures and transmission projects are required.



The full 10-Year Outlook report contains more detailed observations, findings and conclusions with respect to the transmission system.

- Additional Ontario electricity supply and demand-side measures are required to maintain supply adequacy into the future and to reduce Ontario's dependency on supply from other jurisdictions. The reactivation of 2,000 MW of nuclear capability over the last 12 months and the addition of 755 MW of gas-fired generation expected by this summer have eased some of the near-term concerns. However, more resources are required in every year of the Outlook period, some with a high degree of urgency.
- By 2014, up to 11,600 MW of Ontario's electricity requirement will need to be met with new supply, refurbished generation or demand-side measures. Of this amount, up to 5,400 MW is associated with economic demand growth and other known generation retirements, with the remainder required to replace existing coal-fired generation in the province.
- Some of the new generation, built to meet supply requirements, should be situated close to or within Toronto. Lakeview generation can be replaced by generation in the GTA, east of Milton. All the proposed new generation projects for the Toronto zone meet this local requirement, and their timely completion would bring benefit to the overall reliability of the Ontario power system and would alleviate supply concerns in downtown Toronto and the western GTA. These projects will complement, but not replace, the need for transmission reinforcements. The coal-fired generation retirement program will require that an equivalent amount of capacity is located in the same electrical zone as the station being shutdown, in order to avoid transmission adequacy and system operability issues.

- Demand-side initiatives should be vigorously pursued in Ontario, as clean and less expensive ways to reduce the supply requirement. The application of conservation measures is virtually unrestricted with respect to location.
- The increasing age of Ontario generation was identified in last year's Outlook as a potential issue toward the end of the study period and beyond, as much of the existing generation infrastructure reaches or exceeds its nominal life. Other than coal shutdown, the possible shutdown of Bruce Unit 3 in 2009 is considered (subject to any future refurbishment decision which may be taken by Bruce Power), as well as the need for re-tubing of the Pickering B units 5, 6 and 7, by the end of 2013 (pending development of refurbishment plans by OPG).
- Several transmission infrastructure additions in the GTA are required to be completed before Summer 2005 peak conditions to coincide with the shutdown of Lakeview Station to prevent overloading of autotransformers and to provide adequate reactive power capability to maintain acceptable voltages. These transmission additions include the initial phase of Parkway Transformer Station with the installation of the first autotransformer and the installation of shunt capacitors banks at Burlington TS, Richview TS and John TS.
- Further reinforcement, either transmission or generation, will be required to improve the supply capability to the combined Southwest and Toronto zones as early as the summer of 2006 under extreme load conditions and certain generator outages.
- Transmission reinforcement is required in order to maintain the reliability of supply to northern Mississauga, Brampton, Milton, the Town of Halton Hills, Vaughan and northern Toronto. These municipalities are susceptible to supply interruption for a double circuit line contingency.
- Plans are in place to improve the supply to downtown Toronto. Hydro One has indicated that the initial stage of establishing a new link between John TS and Esplanade TS will be in service by 2008 at the earliest. Hydro One has proposed two alternatives for the remaining work to complete the third supply into Toronto. The IMO has found both options to be acceptable from a system reliability perspective. However the IMO favours the DC option since fewer system upgrades are required.



Electricity demand continues to grow every year. Energy consumption over the next 10 years is expected to grow on average 0.9 per cent a year.

- The operating area encompassing Kitchener-Waterloo, Cambridge and Guelph, in south-western Ontario, is susceptible to supply interruptions for double circuit line contingencies. Thermal overloads on the autotransformers in this area are also possible. Respecting minimum voltage levels is a third concern. A number of plans have been initiated by Hydro One to address the immediate concerns. Additionally, upgrades to the thermal capacity of transmission lines, a new 500/230 kV supply point and possibly a new 230/115 kV supply point eventually would be required to ensure the long-term supply to this area.
- The reliable supply to the City of Ottawa and surrounding areas will be enhanced with the current transmission projects being completed by Hydro One. However, near Bilberry Creek, concerns will still remain regarding minimum 115 kV voltages and operating flexibility to supply loads. Hydro One has identified transmission solutions to alleviate these concerns.
- Existing congestion is likely to continue on the East-West Tie transmission interface. To allow higher volume transactions with Manitoba and Minnesota and to increase the transfer capability between the Northwest and Northeast zones, transmission enhancements are needed near Wawa TS or Marathon TS.
- In the Northeast zone, the proposed transmission reinforcement by Great Lakes Power Limited represents an enhancement to the Northeast transmission system. It will result in an improvement in the reliability of the IMO-controlled grid and would bring increased efficiencies to the electricity market.

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The Independent Electricity Market Operator (IMO) is responsible for ensuring the reliable supply of electricity and operating the competitive wholesale market in Ontario. It balances the supply of and demand for electricity and directs its flow across the province's transmission lines. The IMO also monitors the power system, identifying requirements to maintain reliability in the future. This 10-year outlook provides an assessment of the security and adequacy of Ontario's electricity system.

This document contains highlights of the full 10-Year Outlook which is available on the IMO Web site at [www.theIMO.com](http://www.theIMO.com).

For more information, contact:

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The Sir Adam Beck Hydroelectric Facility, was one of Ontario's first large-scale sources of power generation capacity. Today, water power accounts for one-quarter of the province's electricity production.