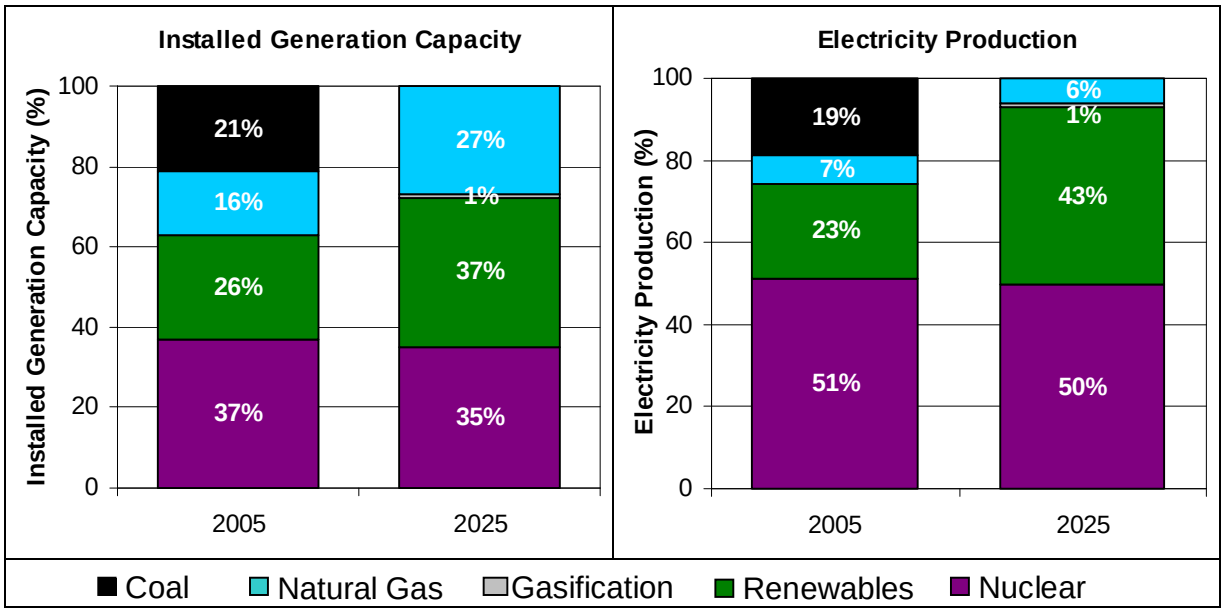
1.1 Supply Mix Summary

This report presents recommendations of the Ontario Power Authority (OPA) to the Minister of Energy on options for the future development of Ontario's electricity system. It responds to a request from the Minister on May 2, 2005 for advice on the appropriate mix of electricity supply sources to satisfy the expected demand in Ontario, taking into account conservation targets and new sources of renewable energy out to 2025.

Figure 1.1.1 shows the mix of installed generation capacity and the contribution of each source to meeting electricity production requirements at present and by 2025, based on the recommendations of this report. (Definitions of capacity and other technical terms appear in the glossary in Part 1.6.)

Figure 1.1.1: Direction for Ontario's Electricity System Development



Source: OPA; Note: Figures shown take into account the reduction in demand due to conservation activities

The recommendations would increase the share of renewable sources in Ontario's supply mix, maintain the share of nuclear generation, and replace coal by increasing the share of gas-fired generation and renewable resources.

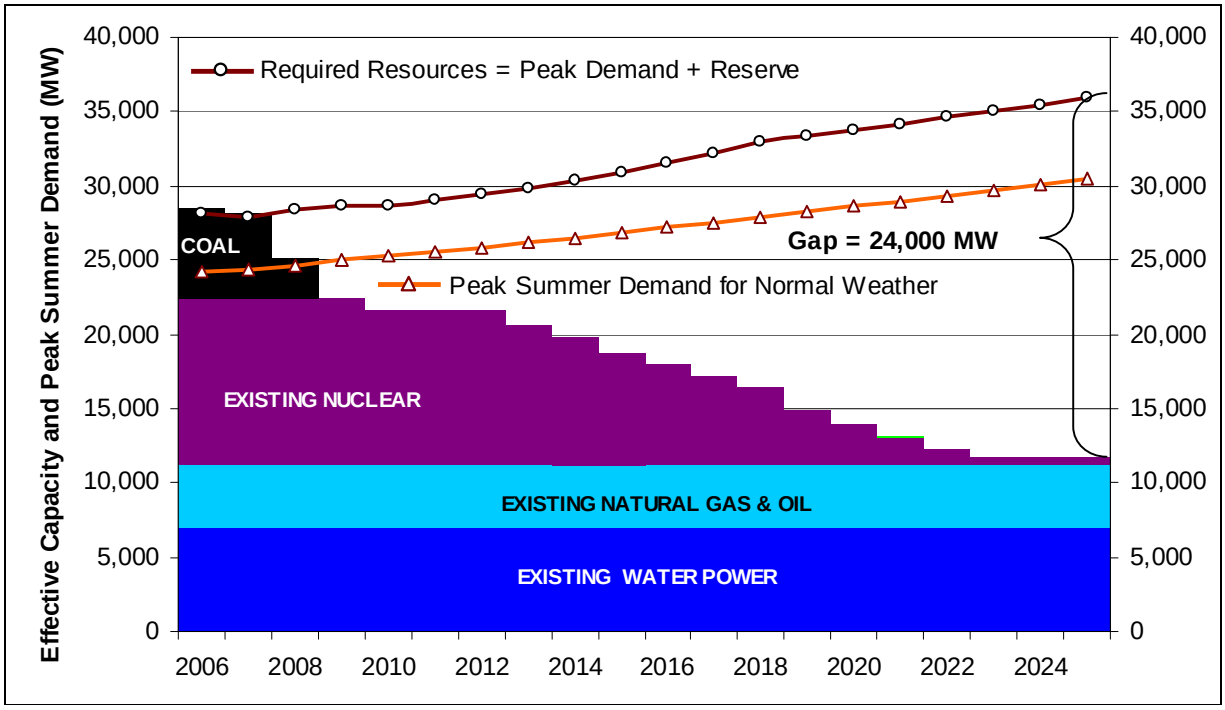
Ontario's electricity sector is at one of the most challenging points in its history. The system has less capacity today than it did 12 years ago, while demand has increased because of population

and economic growth. This is particularly true in downtown Toronto and the Greater Toronto Area, where facilities were shut down and load has grown faster than the provincial average.

As Figure 1.1.2 shows, a projected province-wide shortfall in supply capacity emerges later in this decade and grows rapidly over time. The shortfall stems primarily from Ontario's shrinking supply, with growth in demand as an important secondary factor.

The nature of the problem is clear: a lack of investment to expand electricity capacity in Ontario in the past decade. With supply already tight as a result of this under-investment, the sector faces the loss of a major part of its current supply mix as most units of its nuclear fleet reach the end of their design life over the next several years. The loss of nuclear generation would come immediately on the heels of replacement of coal-fired stations, scheduled for completion by 2009. Together, the combination of demand growth and generation retirements would create a gap of roughly 24,000 megawatts (MW) by 2025, equivalent to about 80% of Ontario's current capacity.

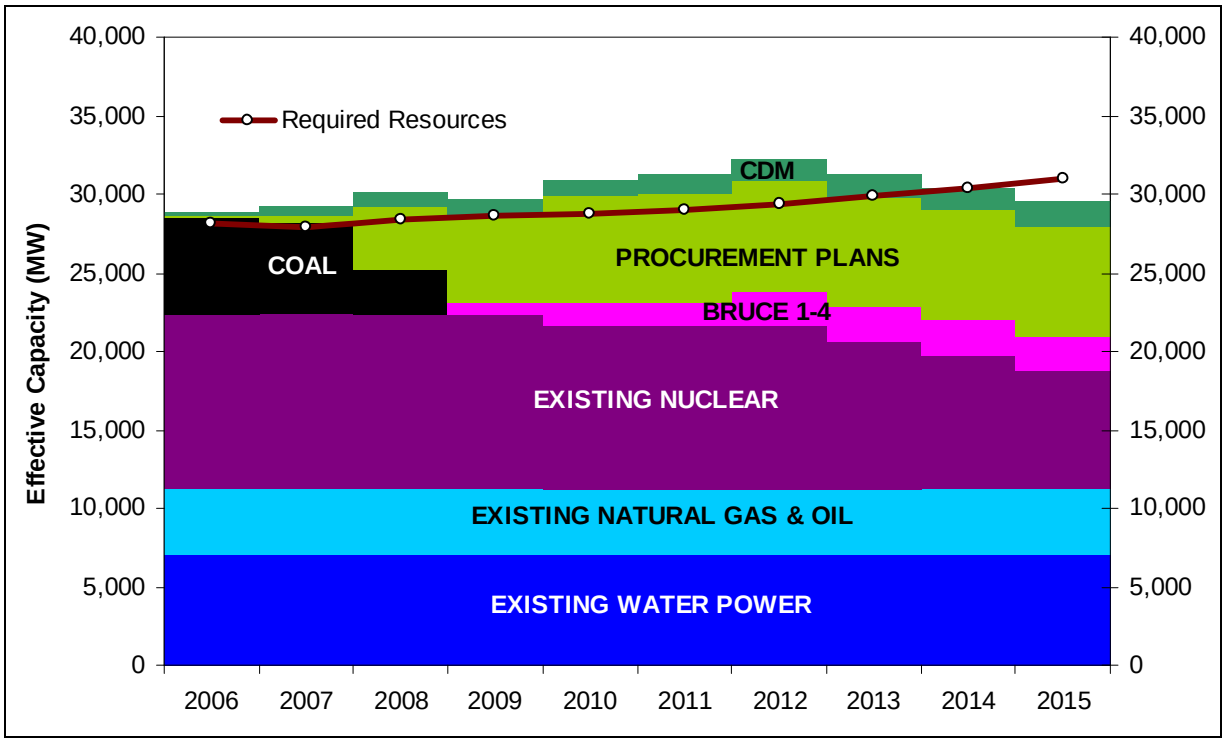
Figure 1.1.2: Demand Growth and Generation Retirements Define Challenge



Source: OPA

Procurements and other initiatives, as shown in Figure 1.1.3, are under way to balance supply and demand in the mid term. By roughly 2013, however, increasing demand and loss of nuclear capacity will once again overwhelm the ability of the system to meet needs.

Figure 1.1.3: Current Procurement Initiatives and CDM Cover Needs to 2014



Source: OPA

The focus of this advice, then, is on the best way to meet needs over the long term, specifically by 2015, 2020 and 2025. Analysis has shown that, because the most attractive options needed in the longer term involve long lead times, decisions are needed soon to ensure that electricity consumers in Ontario benefit from a reliable and affordable mix of supply sources.

Planning supply mix would be simple if a single resource were superior to others in all areas – environmental impact, reliability and costs – and could meet equally well the needs of base, intermediate and peak load. The reality is that no such single resource exists – a combination of resources and technologies is needed, and tradeoffs and synergies among them must be considered.

The Starting Point

In approaching the task of advising on how to meet this challenge, we recognized three Ontario Government policies already established as priorities:

- Creation of a conservation culture
- Preference for renewable sources of energy, and

- Replacement of coal-fired generation for environmental and health reasons

These policies are consistent with evidence that responsible stewardship of the environment requires more intelligent use of carbon-based energy sources. The Government has stated that its first concern is reliability of supply and that its policy objectives are subject to maintaining reliable supply.

With this public policy framework as a starting point, a number of principles further guided the development of this advice.

- *Listening*: Any plan for Ontario's energy future must reflect the values and concerns of its citizens.

- *Sustainability*: Choices and directions need to be put on a path to sustainability – for Ontario's environment, economy and people – over the long term.

- *Flexibility*: Advice must consider the need to adapt to changing circumstances.

- *Embracing the Future*: Advice and plans must be forward-looking, open to new possibilities and technologies, and willing to tackle difficult choices.

- *Managing Risks:* The economic, environmental and reliability risks of potential supply sources must be explicitly recognized, and options combined in ways to mitigate or avoid these risks.

- *Prudence:* Finding the right balance among choices without unnecessarily exposing consumers to unacceptable risks represents the prudent course that people in Ontario expect.

Consultations with stakeholders and members of the public provided insight into specific concerns, as well as broader values. There was wide consensus that reliability of supply was the single most important concern, and that stable rates and environmental considerations also ranked as high importance.

Elements of a Solution

Taking into account the nature of the problem and given the framework for analyzing choices, certain broadly defined elements of a solution became evident:

1. Conservation and other forms of demand management must be a major part of any plan:

- We explored a range of gains from 1,800 to 4,300 MW that might be achieved through greater energy efficiency, demand reduction and demand response measures, in addition to the expected impact of current initiatives and assumptions, and in addition to 1,000 MW of natural gas-fired cogeneration.
- For the purposes of long-term planning, the 1,800 MW estimate (5% of requirements) was considered a reasonable and prudent assumption at this stage, because of the high level of certainty that it will be achieved. This is not the target of the OPA's Chief Energy Conservation Officer.
- We believe it is possible that Ontario can achieve a greater gain. As confidence about achievable conservation grows, the plan can adapt to the changes.
- OPA's Conservation Bureau has an objective of achieving the greatest possible amount of conservation, and there is flexibility in the plan to incorporate increases in conservation estimates.

2. Renewables offer considerable potential, especially in the longer term:

- Renewables, including wind, small hydro (waterpower) projects and hydro purchased from other provinces (referred to as "hydro imports" in the balance of this report), can provide a significant share of capacity and energy.
- It is clear, however, that putting in place the infrastructure needed to harvest the most promising sources, hydro imports and large-scale wind generation, will take considerable time and money.
- There are additional policy and regulatory constraints on some of these opportunities – a review to explore the potential and alternatives for facilitating development is advisable.

Together, conservation and new renewable sources would more than meet all of Ontario's growth in demand for electricity by 2025. This would not, however, replace the loss of capacity from the retirement of other supply sources. Ensuring enough supply means turning next to an analysis of conventional sources. The conclusions are:

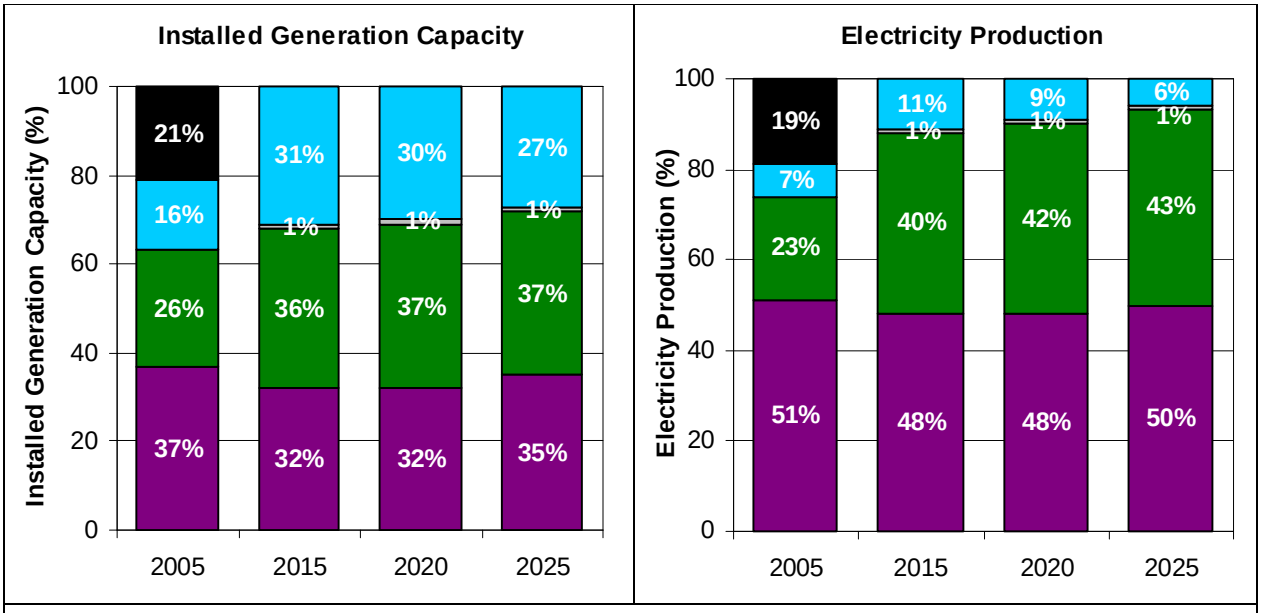
3. Gas-fired generation will play a targeted, but critical role:

- Gas-fired generation has a number of attractive features; it can be built quickly, can be located to relieve transmission bottlenecks, and can be used for district energy and cogeneration. It can complement wind generation in meeting demand, particularly in summer.
- The price of natural gas has increased four-fold in the past five years and is expected to remain high and volatile. Residential and commercial space heating and industrial processes compete for supply and several nearby jurisdictions also rely heavily on gas, all of which puts its availability at a premium or even at risk.
- Gas-fired generation is not recommended for base-load generation because in that role it

presents risks across all three dimensions of cost, environmental impact and financial risk.

Together, natural gas and renewable sources can replace coal generation.

Figure 1.1.4: Supply Mix Advice



(%)	2005	2015	2020	2025
Nuclear	37	32	32	35
Renewables	26	36	37	37
Gasification	0	1	1	1
Gas	16	31	30	27
Coal	21	0	0	0

(%)	2005 (Estimate)	2015	2020	2025
Nuclear	51	48	48	50
Renewables	23	40	42	43
Gasification	0	1	1	1
Gas	7	11	9	6
Coal	19	0	0	0

(MW)	2005	2015	2020	2025
Nuclear	11,397	11,000	12,000	15,000
Renewables	7,855	12,000	14,000	15,500
Gasification	0	125	250	250
Gas	4,976	10,500	11,000	11,000
Coal	6,434	0	0	0
Total	30,662	33,625	37,250	41,750

(TWh)	2005 (Estimate)	2015	2020	2025
Nuclear	79	76	81	89
Renewables	36	64	71	77
Gasification	0	2	2	2
Gas	11	17	15	11
Coal	29	0	0	0
Total	155	159	169	179

Source: OPA; Note: Figures shown take into account reduced demand due to conservation activities

4. Nuclear generation has a continuing role for base-load needs:

- The role of nuclear is not expected to change from its current contribution of 50% of electrical energy in Ontario
- Through their life cycle, our analysis shows that nuclear plants have less overall environmental impact than natural gas-fired generation and operate at lower cost for base-load needs.
- Changes in the Ontario electricity sector over the past few years make it possible to better manage the major risks of nuclear construction, which are cost overruns and delays.
- Significant progress has been achieved on the issue of spent nuclear fuel management.
- Refurbishing existing units, rebuilding on existing sites and undertaking "new build" plants can all contribute to maintaining the share of nuclear in Ontario's supply mix at roughly its current level.

5. Any plan must be flexible enough to act on new supply opportunities:

- Another technology that could provide base-load capacity at low environmental risk is gasification of a variety of fuels, such as municipal solid waste and coal, with containment of carbon dioxide.
- At present, this technology is not sufficiently developed to be relied upon for a major contribution, but the plan set out here has the flexibility to include it should it mature in future.

Many of the most attractive options for meeting base-load generation requirements entail long lead-times, so decisions need to be made quickly. Decisions must also be made with consideration for the longer term, because choices that focus only on immediate needs may foreclose more attractive options for the future. Figure 1.1.4 provides an overview of our recommendations to the Minister of Energy.

Conclusion

The advice in this report is intended to set Ontario on a course to:

- Maximize conservation and build on its potential in the future
- Pursue an aggressive course for renewables within current constraints, while looking at ways to reduce these constraints
- Adopt a "smart gas" strategy that takes advantage of the benefits of natural gas-fired generation but limits exposure to its price and supply risks
- Benefit from supply options that need long lead times, such as nuclear, large-scale wind generation, hydro imports and gasification

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