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AIR QUALITY ISSUES FACT SHEET **#20**

High Cost Energy ▶ *The economics of nuclear power*

On December 9, 2005, the Ontario Power Authority (OPA) released its *Supply Mix Advice Report* which outlines its proposed blueprint for meeting Ontario's electricity needs to 2025. The *Report* also includes an analysis of the costs of obtaining additional electricity supplies from: i) a new CANDU 6 nuclear reactor; and ii) a new natural gas-fired combined-cycle power plant.

The OPA's analysis of the economics of a new CANDU 6 nuclear reactor versus a new natural gas-fired power plant is based on the following four key assumptions:

- The capital cost of a new CANDU 6 nuclear reactor would be $2,845 per kilowatt (kw);
- A new CANDU 6 nuclear reactor would be able to operate at an 85% annual capacity utilization rate for 30 years;
- The natural gas-fired electricity would be produced by a combined-cycle power plant*; and
- The annual cost of natural gas over the next 20 years will be $8 per million BTU (2005 Cdn $).

All of the OPA's key assumptions are heavily biased in favour of nuclear power:

- The assumed capital cost for a new CANDU 6 nuclear reactor ($2,845/kW) is 30% less than the actual capital cost ($4,085/kw) of the last nuclear power plant, the Darlington Nuclear Station, built in Ontario.
- During the last 25 years, the average capacity utilization rate of Ontario's fleet of nuclear reactors has never equaled or exceeded 85%. Rather their annual capacity utilization rates declined from 80% between 1980-83 to 51% in 2003. In 2005 the average capacity utilization rate of Ontario's fleet of nuclear reactors was 65%.
- The OPA's analysis of the economics of nuclear versus natural gas-fired generation was based on the cost of a natural gas-fired *combined-cycle* power plant despite the fact that natural gas-fired *combined heat and power* plants* are a much more efficient option to produce electricity. Specifically, *combined heat and power* plants can achieve energy efficiencies of 80-90% versus the 60% energy efficiency of a *combined-cycle* power plant. As a result, a combined heat and power plant's natural gas consumption and costs can be 30% less than those of a combined-cycle power plant.
- The OPA's analysis assumes that the real (i.e., net of inflation) cost of natural gas will average $8 per million BTU (2005 Cdn $) between now and 2025, despite the fact that *all* of the nine independent natural gas price forecasts summarized in the Canadian Energy Research Institute report commissioned by the OPA predict that the annual average gas prices will be less than $8 per million BTU during this time period.

The OPA used these assumptions to calculate the cost per kilowatt-hour (kWh) of nuclear and natural gas-fired electricity under three different scenarios with respect to the required rate of return on capital for a power plant. (The required rate of return on capital depends on a project's risk. The greater the risk, the greater its required rate of return. In other words, investors will only put up capital for high-risk projects if there is an equivalent potential for generous financial returns. Needless to say, building a nuclear power plant is a high-risk project.)

The results of the OPA's analysis are shown in Table 1 below.

Table 1: Cost Comparison: CANDU 6 vs. Natural Gas-Fired Combined-Cycle

	CANDU 6	Natural Gas-Fired Combined-Cycle
Real Pre-Tax Rate of Return on Capital = 5%[1]	5.2 cents/kWh	6.3 cents/kWh
Real Pre-Tax Rate of Return on Capital = 8.5%	6.8 cents/kWh	6.7 cents/kWh
Real Pre-Tax Rate of Return on Capital = 11%	7.9 cents/kWh	7.0 cents/kWh

1. Assuming the power plant is 100% debt-financed

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As Table 1 reveals, given the OPA's assumptions, a natural gas combined-cycle power plant is the lowest cost option under 2 of its 3 scenarios. Nuclear power is the least cost-option *if and only if* one assumes that a power company could 100% debt finance a multi-billion nuclear power plant. This is simply not realistic.

On October 17, 2005, CIBC World Markets Inc. provided Ontario's Deputy Minister of Energy with its estimate of Bruce Power's required rate of return on capital for its Bruce restart and refurbishment project (Bruce Power is Canada's only investor-owned nuclear power company). According to CIBC World Markets, Bruce Power's actual cost of capital is 30-70% higher than the highest required rate of return on capital (a real pre-tax rate of return of 11%) used by the OPA in its analysis (see Table 1). Specifically, according to CIBC World Markets, Bruce Power's *nominal after-tax* required rate of return on capital is 10.6 to 13.8%.

We asked the OPA to recalculate its costs using CIBC World Markets' required rate of return on capital estimates together with all of the OPA's original assumptions. The result raises the cost of CANDU 6 nuclear electricity to 9.7 to 11.9 cents per kWh. That is, the cost of nuclear power (9.7 to 11.9 cents per kWh) is *at least* 39-70% more expensive than natural gas-fired power (combined cycle).

If we further assume that:

- the capital cost of a new nuclear power plant will equal the actual capital cost of the Darlington Nuclear Station ($4,058/kW);
- the new nuclear power plant will have an average annual capacity utilization rate of 65% (the actual average capacity utilization rate of Ontario's fleet of nuclear reactors in 2005); and
- the required nominal after-tax rate of return on capital for a new nuclear power plant is up to 13.8% as per CIBC World Markets' analysis;

then the cost of a new CANDU 6 nuclear power plant is 20.9 cents per kWh — a cost almost three-times greater than that of a new combined cycle natural gas-fired power plant (7 cents per kWh) and almost 2.5 times the cost of renewable power (8.6 cents per kWh) from the eight wind farms and one water power project contracted by the OPA in 2005.

Table 2: Cost comparison based on actual nuclear cost and performance factors

CANDU 6	Natural Gas-Fired Combined-Cycle	2005 wind and water power contracts
20.9 cents/kWh	7.0 cents/kWh	8.6 cents/kWh

Applying real numbers to the OPA's hypothetical analysis makes it clear that nuclear power is, by far, one of the highest-cost options for meeting Ontario's incremental electricity needs. It also demonstrates how pouring billions of public dollars into nuclear power is likely to pull significant financial resources away from more viable options, including efficiency and conservation initiatives and renewable power development. In fact, it would be the equivalent of pouring money into public transit improvements while continuing to allow unchecked urban sprawl — a recipe that we know simply doesn't work.

* A combined-cycle system captures waste heat from the gas turbine and uses it in a steam turbine to boost the plant's power production. A combined heat and power system captures waste heat to make steam for space or water heating or an industrial production process while also producing electricity.

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