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ECONOMIC GROWTH AND INNOVATION

The Nuclear Option:

How to Make Nuclear Energy Viable in Canada

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In this issue...

The nuclear industry could be a viable component of Canada's energy future; hurdles remain.

The Study in Brief

Canada is at an energy and environmental crossroad. Fossil fuels cause environmental damage and the growth potential of large-scale hydroelectricity is limited. Policymakers are reconsidering the merits of nuclear power as both a low-carbon emitting and low-cost base load electricity source.

While nuclear power may look like an attractive option, nuclear power must overcome problems such as the high and uncertain cost of construction, dealing with nuclear waste, reactor licensing and regulation, and the future of Canada's nuclear reactor builder, Atomic Energy of Canada Limited (AECL), a federal Crown corporation.

We examine three key policy questions facing the nuclear industry: cost, privatization of AECL, and regulation.

First, nuclear power is likely cost competitive with fossil fuels once the social costs of all energy are accounted for. Nuclear power already internalizes far more of its social costs and potential liabilities than fossil fuels and the introduction of a carbon price will place the two on a level playing field.

Second, AECL should be partially privatized to bring stable funding, new international partnerships, and market capacity and discipline. However, a privatization deal should include continuing support, public or private, for pure research and development at the Chalk River, Ontario laboratories.

Third, Ottawa should review the array of nuclear regulatory regimes across different nuclear risks, from isotope manufacturing to reactor licensing to long-term waste storage. The commercial nuclear reactor licensing process will also need revision if a nuclear electricity renaissance is to occur in Canada.

The future of nuclear power in Canada is positive – if policymakers can resolve these key issues.

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Canada faces a unique set of nuclear issues in the context of its broader energy and environmental policy.

The country has ample supplies of fossil fuels, but they contribute to a less-than-stellar record on climate change (see, for example, Jaccard 2007; Eberlein and Doern forthcoming).

It is, however, the world's leading producer and exporter of uranium, and it has developed its own unique reactor design, the CANDU, in the hands of a federal Crown corporation, Atomic Energy of Canada Limited (AECL). CANDU reactors already supply 52 percent of the electricity in Ontario, and the federal and Ontario governments now face important policy decisions about the future of the nuclear industry and, more specifically, about the funding and organization of AECL, including its laboratories at Chalk River, Ontario.

In this *Commentary*, we examine three questions and the appropriate policy responses to those questions. First, given the need to meet rising electricity demand while reducing greenhouse gas (GHG) and other emissions, is nuclear power a competitive option in the current policy framework? We conclude that nuclear energy is amply justified as a part of Canada's future electricity energy mix on both energy and environmental grounds. This is based partly on nuclear energy's advantage of low GHG and other emissions, and partly on the ability of nuclear power to provide base load power, in tandem with a range of alternative energy sources for variable intermediate and peak power needs. We also argue that policymakers should ensure that the environmental costs of fossil fuel energy sources are internalized in energy prices to the same extent as they already are for nuclear energy. Fossil-fuel-based energies currently do not need to pay for emitting their CO_2 waste, while nuclear facilities pay for most of the direct and contingency costs of dealing with radioactive waste.

Second, should AECL be privatized? We argue that it should be, at least partially. Partial privatization would bring the needed funding, ownership and partnership structures, and capacities required for the corporation to compete globally. Federal support for Chalk River and other related investments would still be needed, so full privatization likely is not a viable option. However, any approach to partial privatization – whether through the establishment of a new mixed enterprise corporation or through the sale of AECL's commercial assets and activity to a private company or companies – would have to deal effectively with the needed public goods research and development (R&D) functions of the Chalk River laboratories. Indeed, any final partial privatization package should include Chalk River's development and restructuring as a joint publicly and privately funded national laboratory.

Third, is there a need for new approaches to nuclear regulation? We argue that federal policymakers should establish regulatory review mechanisms across the array of nuclear regulatory bodies and agencies and the complete range of nuclear risks. These mechanisms should assess periodically the changing relative risks and ways to manage them, including funding needs related to regulatory capacity. The *Nuclear Safety and Control Act* also needs to be amended to ensure public safety while recognizing the obligations of both the regulator and the federal government for effective and efficient reactor licensing. In addition, policymakers need to demonstrate concrete progress, including with respect to the regulatory and approval process, on site selection for a nuclear waste management facility, since this is an important factor in public approval and would remain a crucial and continuing federal policy need even if the nuclear industry were to be closed down.

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Electricity Supply, Climate Change, and Costs

Given Canada's rising demand for electricity and the need to reduce GHG and other emissions, is nuclear power a competitive option in the current policy framework? We argue that the use of nuclear energy is amply justified as part of Canada's future electricity energy mix on both environmental grounds (its low-to-zero GHG and other emissions) and energy grounds (its ability to provide base load power, in tandem with alternative energy sources for variable intermediate and peak power needs). We begin with the situation in Ontario and, briefly, in other provinces. We then deal with the environmental, climate change, and related cost and subsidy factors of nuclear energy compared with other sources of electricity supply.

Ontario's Demand for Nuclear Energy as a Source of Base Load Power

Whatever the merits of nuclear energy, its future in Canada will be decided by actual orders, both foreign and domestic, for AECL's new advanced CANDU reactor (ACR). Ontario has been and will continue to be Canada's major domestic market for nuclear power, although the annual growth of demand for energy in the province has been negative for the past several years due to slow economic growth, restructuring toward less electricity-intensive activities, and improvements in efficiency. With the current economic crisis, moreover, demand is forecast to continue to decline over the next few years (IESO 2009).

Current Ontario policy limits the production of nuclear power in the province to its historical maximum of 14,000 megawatts (MW). At present, CANDU reactors supply most of Ontario's base load, with some help from hydro and coal. Current nuclear capacity is 11,300 MW, based on 16 operating CANDU units at the Pickering and Darlington power stations, owned by the Ontario government through its Crown corporation Ontario Power Generation, and at the Bruce power station, which is leased to Bruce Power, a private consortium. When two units at Bruce currently being refurbished are returned to service, nuclear capacity will increase to 13,000 MW.

Ontario's more variable intermediate and peak load requirements for electricity are now supplied mainly by coal and natural gas. Under the Ontario Integrated Power System Plan, however, coal-fired power is to be phased out by 2014, to be replaced by a combination of natural gas and wind and an increase in nuclear power through the refurbishment of current plants and the building of two new nuclear plants at Darlington. Conservation and the use of renewable energy sources will also be strongly encouraged.

Ontario's new reactors will be purchased on a competitive basis. AECL, with its ACR, is competing for this business with new light water reactor (LWR) designs by both Westinghouse-Toshiba and Areva, a reactor and fuel cycle corporation that is majority owned by the French government and already has four projects under construction. In the export market, AECL also faces tough competition from these and other vendors, including a partnership between General Electric and Hitachi. Ontario will base its purchasing decision on the criteria of low lifetime power cost, the ability to meet Ontario's schedules, and the level of investment in Ontario. On this last factor, at least, unless other vendors also use Ontario labour and subcontractors, AECL should have an edge over its competitors, since all of Ontario's current nuclear power comes from CANDU reactors, most of the CANDU suppliers are in Ontario, and AECL itself is Ontario based. Yet, although nuclear energy is important to Ontario, not just for the electricity it supplies but for the jobs in research and development, design, and manufacturing, the province sees the economic benefit of the first two factors, cost and timing, as much greater than the economic benefit gained through investment and local spending (Infrastructure Ontario 2008). Moreover, vendors other than AECL might offer access to new technologies and markets, as well as offset business for Ontario to compensate for the loss of CANDU activities should the province not choose AECL. Clearly, Ontario's purchase decision will have a profound influence on the future of AECL and the nuclear industry in Canada and, hence, on federal nuclear energy policy.

Nuclear Developments in Other Provinces

The future of AECL's ACR reactor program depends to some extent on whether provinces other than Ontario express an interest in it and adopt it as a part of their energy strategy. New Brunswick and Quebec already have one CANDU reactor each; Alberta and Saskatchewan have not used nuclear power to date but are in the very early stages of considering its adoption.

New Brunswick is actively looking for funding for a new reactor to complement the existing CANDU reactor at Point Lepreau, where AECL is carrying out a $1.4 billion refurbishment project. The bid to install an ACR has been put forward by Team CANDU, a consortium of AECL and private firms, which is proposing a merchant model whereby the consortium, rather than the provincial government, would undertake the project risk.[1] Half of the new reactor's output would be exported to the United States. Since New Brunswick does not want to own a one-of-a-kind reactor, it is looking for the federal government either to invest in AECL to ensure that the company can compete globally or privatize it and let investors make it competitive (New Brunswick 2008). A first order from New Brunswick for a new reactor would be a strong endorsement from an old CANDU customer.

Quebec will refurbish its existing CANDU unit, but is not in the market for more reactors. Rather, its electricity policies are centred more on new hydroelectric power, including projects with long-term northeastern US markets in mind.

Alberta's current electricity supply is largely based on coal and natural gas, and the province will need 5,000 MW of new electricity capacity by 2017. It is under pressure, however, to reduce its GHG emissions, especially from the oil sands (Bratt 2008). Bruce Power is considering the possibility of building nuclear reactors to supply power to the oil sands, displacing natural gas. In March 2008, it announced that it had bought an Alberta company active in promoting nuclear power, and filed an application with the Canadian Nuclear Safety Commission (CNSC) for approval to prepare a site that would generate 4,000 MW from two to four reactors. Alberta is also looking at carbon capture and storage (Cattaneo, 2008), which could be seen as the main cost competition for nuclear power in dealing with emissions from the oil sands provided considerable technological obstacles and regulatory uncertainties can be overcome.

Bruce Power is also studying the possibility of building a nuclear power plant in Saskatchewan (Jones 2008), whose premier sees it as a way of adding value to the province's uranium resources (Bratt 2008).

Provincial support for AECL's new reactor model could provide a domestic base for exports, a benefit that would accrue both to the federal government through an increased market value for AECL and to Ontario through additional jobs in the nuclear industry. Without provincial support, however, the federal government would have less motivation to maintain the technology and the market value of AECL would decline.

Nuclear Energy's Role in Climate Change and Improved Air Quality

Central to governmental decisions about future nuclear power use in Canada is whether the low level of GHG and other emissions from nuclear power can tip the balance in favour of its increased role in the electricity supply mix. A reduction of emissions also would have direct implications for nuclear energy's costs vis-à-vis those of its competitors.

Canada's current GHG emissions total 721 megatonnes per year of CO_2-equivalent, of which fossil-fired electricity, mainly coal, contributes 115 megatonnes per year, or 16 percent of the total (Canadian Electricity Association 2006, 8). To meet its commitments under the Kyoto Protocol, which clearly will not happen on schedule, Canada would need to reduce its emissions by about 160 megatonnes of CO_2-equivalent per year from current levels (Environment Canada 2006). A 1,000 MW CANDU reactor running 80 percent of

1 See "Team Candu ready to proceed with second Point Lepreau reactor without government funding," Daily Commercial News and Construction Record, February 12, 2008.

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