

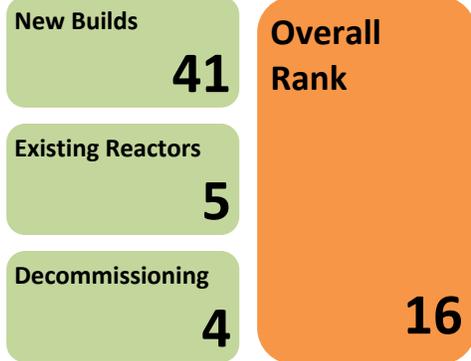


2016 Top Markets Report **Civil Nuclear** Country Case Study

Canada

Market Type: Mature and Maintaining

While Canada has delayed plans to build additional domestic reactors, it is a competitor of the United States in international markets. Canada’s ongoing decommissioning and refurbishing projects offer some opportunities for U.S. exporters, although a robust Canadian nuclear industry and lower electricity demand will limit U.S. participation in new builds.



U.S. Ambassador to Canada: Bruce A. Heyman
U.S. Commerce Attaché to Canada: Lucy Latka

Canada has 19 operational and six shut down or decommissioned nuclear reactors. Four nuclear generation stations house Canada’s 19 reactors, which provide 16.15 percent of Canada’s total electricity. Nuclear power ranked second in Canada’s 2014 energy mix behind hydro (63.32 percent) and ahead of coal (14.65 percent).

The four main reactor sites are Bruce Power Nuclear Generating Station (NGS) on Lake Huron (190 km from Toronto), Darlington NGS on Lake Ontario (60 km from Toronto), Pickering A NGS on Lake Ontario (30 km from Toronto) and Point Lepreau NGS in New Brunswick (30 km southwest of Saint John).

All of Canada’s operational reactors are CANDU (Canadian Deuterium Uranium) PHWR-type reactors designed by Atomic Energy Canada Ltd (AECL) of Mississauga, ON, in cooperation with GE. GE also supplies reactor systems, including the radioactive combustible loading/unloading in the reactor. In

October 2011, the commercial reactor business of AECL was sold to SNC-Lavalin, which established Candu Energy Inc. as a subsidiary. The federal government continues to own and operate other parts of AECL, including the research reactors, mainly the Chalk River facilities, under the name of Canadian Nuclear Laboratories (CNL), which are managed by a consortium called Canadian Nuclear Energy Alliance (CNEA). The Canadian nuclear industry is a \$6.6 billion industry and is a global leader in uranium mining and fuel supply, reactor exports and medical isotope production.

Canadian reactors are undergoing an extensive refurbishment program aimed at enhancing safety, uprating and extending operational lifetime. To date, seven reactors have completed refurbishment. Large cost overruns and schedule delays with several of these projects have caused operators and investors to reevaluate plans for other reactors, resulting, in some cases, in scaling down the extent of refurbishment or shutting down plants rather than refurbishing them. Plans for refurbishing reactors at Pickering B, Bruce B and Darlington are under review and may extend over

the next 10 years. In December 2015, the Ontario Energy Ministry announced the approval of the long-term contract that will allow Bruce NGS to refurbish six reactor units. Bruce Power will invest CD\$13 billion to refurbish the plants. In January 2016, the Ontario Energy Ministry approved Ontario Power Generation's plans to refurbish two nuclear reactor units at Darlington NGS.

Three reactors are undergoing decommissioning. The extent of other opportunities for decommissioning contracts will depend on plans for refurbishing Canada's remaining three currently shut down reactors. In 2016, the decommissioning of Gentilly 2 will be decided, as it remains in a safe storage mode since ceasing operations in 2012. Of those units that have already undergone refurbishment, the first planned closure will occur in 2018.

Canada has largely deferred its new reactor builds. In November 2013, the Ontario government indefinitely deferred plans for constructing two new reactors at Darlington, citing a slowdown in electricity demand growth. The leading contenders for the new reactors were Westinghouse (AP1000) and SNC-Lavalin/Candu Energy Inc. (Enhanced Candu-6 (EC6)); both had submitted detailed construction plans, schedules and cost estimates before the decision to defer construction plans was made.

Additional plans for reactor projects have been pursued by the governments of New Brunswick and Alberta over the last 10 years, but since 2011, all plans have been put on hold.

Canada continues to market CANDU reactors abroad in both newly emerging and mature markets; such potential new builds present opportunities for U.S. industry engagement.

Planned Nuclear Energy Projects

New Build

Owner: Ontario Power Generation (OPG) (government-owned crown corporation)

Reactor Type: undetermined

Capacity: up to 4800 MWe

Value of Project: N/A

Construction Period: indefinitely deferred in November 2013

Operation (tentative): N/A

Notes: The project has been deferred in favor of refurbishing existing plants through 2026. Reactor projects at Point Lepreau in New Brunswick and Peace River in Alberta have been proposed but have not moved forward.

Refurbishments

Owner: OPG

Reactor Type: two CANDU reactors and related facilities at Darlington NGS

Value of Project: CD\$13 billion

Construction Period: start 2016

Owner: Bruce Power

Reactor Type: six CANDU reactors at Darlington NGS

Value of Project: CD\$13 billion

Construction Period: start 2020

Commercial Opportunities

Services (front- and back-end): Opportunities for decommissioning.

Legal and Consulting Services: Limited.

Licensing Support: Limited.

Design, Construction, and Operation:

Opportunities exist for U.S. content in CANDU new build abroad, but there are no new build plans in Canada.

Components: Significant opportunities will exist for the announced refurbishments of existing plants in Canada and moderate opportunities for CANDU reactors abroad.

Challenges and Barriers to Exports

The main barrier for new build contracts in Canada is the stagnant demand for electricity and more than sufficient existing capacity. That, combined with a very safe and clean generation mix relying on over 60 percent hydro, is driving government policies, which have recently deferred all plans for new reactor construction. Even if new construction is pursued, it would be difficult for a supplier other than Candu Energy to win new build contracts because of the confidence and synergies resulting from having practically the same supplier for all of Canada's existing reactors, in addition to the very large integration and local contribution in the design, manufacturing,

installation, commissioning, operation and maintenance, which cannot be matched by other suppliers. Candu Energy and its parent, SNC-Lavalin, have access to high-level decision makers in the provincial and federal governments and is the largest EPC company in Canada.

The same obstacle exists for U.S. exports to Canada's existing fleet, though much less so. There is a high degree of integration between the U.S. and Canadian civil nuclear industries for goods and services to Canada's reactor fleet and nuclear facilities. There are also opportunities for U.S. content in CANDU reactors abroad, including upgrades to operating plants and new builds.

Energy drivers are another challenge. Low projected electricity demand was the reason cited by the Ontario government for deferring plans for the Darlington expansion project. Canada's vast reserves of natural gas and current low natural gas prices may further dampen its perceived need for new nuclear capacity.

Canada remained on USTR's Special 301 Watch List in 2015, mainly due to border enforcement issues of pirated and counterfeit goods and for patent regulation issues chiefly related to the pharmaceutical industry. Canada scores highly in all financial and infrastructure factors, and its commitment to accede to the CSC is welcome news.

Nuclear Infrastructure

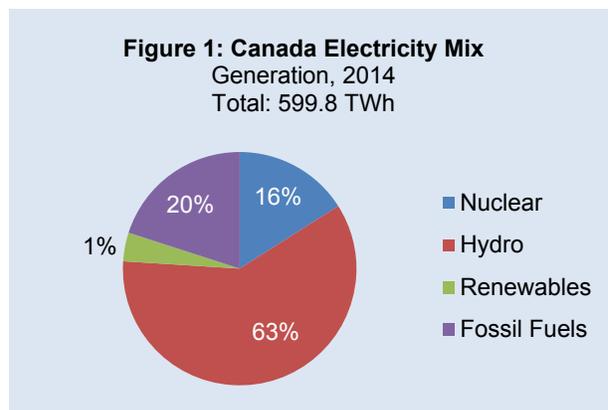
Research Reactor: A 60 MWe WR-1 research reactor was built by GE at Whiteshell Laboratories and started up in 1965. The original purpose of the unit was as a test reactor for a proposed organic-cooled CANDU power reactor. When that program ceased in 1972, it was used for other R&D until it was shut down in 1985. Six other research reactors were built and continue to operate on university campuses. Five of these are SLOWPOKE-2 units, low-energy pool-type reactors designed by AECL with passive cooling and safety systems.

Fuel: Canada is the world's second largest exporter of uranium, accounting for 15 percent of world output, and 15 to 20 percent of Canadian uranium production is consumed domestically. All Canadian uranium mining currently takes place in northern Saskatchewan. Cameco Corporation and AREVA Canada Resources Inc. (AREVA) are the majority owners and operators of the

uranium mines and mills now in operation. Cameco owns and operates the Rabbit Lake mill and the Eagle Point mine. It is also the joint venture operator of the McArthur River mine and the Key Lake mill. AREVA is the operator of the McClean Lake mine and mill.

At its Port Hope, Ontario facility, Cameco has about one-quarter of the western world's uranium hexafluoride (UF₆) conversion capacity and provides the only commercial supply of fuel-grade natural (unenriched) uranium dioxide (UO₂). The UF₆ is enriched outside Canada for use in light water reactors, while natural UO₂ is used to fabricate fuel bundles for CANDU reactors in Canada and abroad. Two fuel fabrication plants in Ontario process some 1,900 tons of uranium per year to UO₂ fuel pellets, mainly for domestic CANDU reactors.

Waste Management: Canada's nuclear regulator is the Nuclear Fuel Waste Bureau from Natural Resources Canada. The Nuclear Waste Management Organization (NWMO), together with Candu Energy, are responsible for storage and disposal of high-level wastes. Nuclear utilities and AECL are responsible for low and intermediate-level wastes. A deep geological repository for high-level wastes is currently under advanced approval process for Tiverton, ON with input/approval from host communities. NWMO expects the repository to begin operation in 2035. Low and intermediate-level wastes are stored above ground. A Deep Geologic Repository is in the planning stage and is subject to further approval.



U.S. Government Collaboration

123 Agreement: Canada's 123 Agreement with the United States expires on January 1, 2030 with rolling five-year extensions thereafter.

International Engagement

The GOC cooperates with many countries for R&D and commercial engagement and promotion. Most recently, in July 2014, SNC-Lavalin signed two cooperation agreements with China National Nuclear Corporation (CNNC) to jointly develop reactors using CANDU technology and to collaborate on uranium mining projects in China. The GOC is active in multilateral organizations, including the IAEA and IFNEC.

In April 2015, Cameco signed a uranium supply contract with India's Department of Atomic Energy. Its first shipment arrived in December, ending a bilateral nuclear cooperation hiatus that lasted over 41 years.

Figure 2: Additional Agreements	
Non-Proliferation Treaty	✓
IAEA Comprehensive Safeguards Agreement & Additional Protocol	✓
Joint Convention on Safety of Spent Fuel Management	✓
Convention on Nuclear Safety	✓
Convention on Early Notification of a Nuclear Accident	✓
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	✓
Paris Convention on Third Party Liability in the Field of Nuclear Energy	
Vienna Convention on Civil Liability for Nuclear Damage	
Joint Protocol Relating to the Application of the Vienna Convention and Paris Convention	
Convention on Supplementary Compensation for Nuclear Damage	
Organization Membership	
IAEA	✓
Nuclear Suppliers Group	✓
OECD/NEA	✓
IFNEC	✓
GenIV International Forum (GIF)	✓

Resources

For more information on commercial opportunities in Canada, contact: Stefan Popescu (Commercial Specialist in Toronto, stefan.popescu@trade.gov); Cindy Biggs (Principal Commercial Officer in Calgary, cindy.biggs@trade.gov); I&A Civil Nuclear Team: Jonathan Chesebro (jonathan.chesebro@trade.gov).

For more information on nuclear energy in Canada: Atomic Energy of Canada Ltd:

<http://www.aecl.ca/en/home/default.aspx>

Canadian Nuclear Safety Commission

<http://nuclearsafety.gc.ca/eng/>

Sources

CIA Factbook; United Nations; World Nuclear Association; Asian Development Bank, and our contacts at the US Embassy in Ottawa and the US Consulate in Toronto.