

OVERVIEW OF CANADA'S NUCLEAR INDUSTRY

The Canadian nuclear industry is a substantial contributor to the Canadian economy, generating over \$6.6 billion a year in economic activity. The industry also provides over \$1.5 billion in federal and provincial revenues and drives over \$1.2 billion in exports.

Canada's nuclear industry is a major employer, offering stable and well-compensated jobs to 71,000 Canadians, exploring and mining uranium, generating power, advancing nuclear medicine, and promoting Canada's nuclear advantage.

According to a study completed by the Canadian Energy Research Institute (CERI), the nuclear industry is responsible for about 66,000 jobs in the nuclear power sector and another 5,000 jobs in the uranium mining sector.

In July 2010, the Canadian Manufacturers & Exporters released a report stating that the refurbishment of nuclear facilities at Bruce and Darlington will create 25,000 jobs in the next decade, injecting \$5 billion annually into Ontario's economy. Nuclear energy is an important part of Canada's diversified electricity supply mix. It provides 24-hour base load power and produces 15% of Canada's electricity – and over 50% of Ontario's – in a safe and reliable manner.

The major advantage of nuclear power is that it produces massive amounts of energy with virtually zero greenhouse gas emissions over a very long period of time. With continuous advances in engineering and learning, our nuclear power plants can stay in operation for up to 60 years.

Nuclear can also become an enabler for renewable energy as we explore how our various energy systems can work together.

With Canada's energy demand projected to increase by 34% by 2025, we will require increased capacity to produce reliable, clean electricity 24 hours a day, seven days a week.

NUCLEAR REACTORS IN CANADA

There are 22 nuclear power producing facilities in Canada located in Ontario, Quebec and New Brunswick. Three units are currently being refurbished (Bruce, ON; Point Lepreau, NB). Two units have been placed in safe storage (Pickering, ON).

In 2009, 17 nuclear reactors provided nearly 15% of Canada's electricity and over 50 per cent of the total electricity production in Ontario.

The top two performing nuclear reactors in 2009 were Bruce unit 5 and Pickering unit 7.

There are also 8 research reactors at facilities across Canada such as Triumf in British Columbia, University of Alberta, McMaster University and Chalk River Labs in Ontario, and Ecole Polytechnique in Quebec – to name a few. These reactors are used for education and research, medical isotope production, and industrial imaging (material science).

CANDU REACTORS IN THE WORLD

There are 34 CANDU nuclear reactors worldwide: Canada (22), Argentina (1), Romania (2), South Korea (4), China (2), Pakistan (1) and India (2).

COST OF NUCLEAR ENERGY IS COMPETITIVE

Nuclear energy is an affordable, low cost energy source. Its costs are competitive with coal and natural gas, and lower than the two most promising renewables, wind and solar energy.

Nuclear does have high capital costs, but it is important to remember that these projects – new builds or refurbishments - generate large and positive economic impacts across the country and that long-term fuel and operating costs are low.

The price of nuclear energy is also stable. The fuel for nuclear power is uranium – mined in Canada. And even if the price of uranium rises, it has a minimal impact on the cost of power because fuel is a very small proportion of nuclear power's total cost. The cost of electricity generated by fossil fuels can be volatile, depending on the markets for gas, oil or coal.

Nuclear power has the advantage of not having any carbon or air pollution emissions, minimizing environmental costs. The future cost of carbon dioxide reduction adds to the cost of fossil-fuelled generation to society.

The costs of the eventual decommissioning of nuclear plants and long-term used fuel and waste management are included in the nuclear energy price, so these will not leave an unpredictable cost legacy for future generations as carbon emissions are likely to do.

When all costs are considered over the long term, Canadians pay the same or less for electricity from nuclear power compared to all other forms of electricity.

According to studies conducted by the Canadian Energy Research Institute, the overall cost of nuclear power over the life of a nuclear power plant, is similar to that of large hydro, natural gas and coal, and much lower than the two most promising renewables, namely wind and solar.

NUCLEAR'S FUTURE IN CANADA

The Governments of Ontario, New Brunswick and Saskatchewan have both reiterated their commitments to nuclear energy and research since the Japanese earthquake and tsunami struck the Sendai region.

Nuclear has a role to play in Canada as part of our energy mix because of its very small carbon footprint, and its important role in medical research and applications, and food safety, and its contributions to other industries, and the Canadian economy. Nuclear also enables renewable energy sources (wind, solar) by being a safe and reliable base load electricity provider.

Medical isotopes produced in Canada are used in over 50,000 medical procedures each day in over 65 countries; Cobalt 60 is used to sterilize medical supplies and devices; and nuclear R&D supports materials testing and product improvements.

THE SALE OF ATOMIC ENERGY OF CANADA LIMITED (AECL)

We have been clear that we support a structure that will advance the industry and the hundreds of Canadian companies that are part of the nuclear technology supply chain, to make it more competitive.

We also must emphasize that research is at the heart of our industry. For Canada to remain a competitive player in the global nuclear industry we need investments in R&D to maintain our expertise which is known around the world.

NEW REACTORS BEING CONSIDERED IN CANADA

By 2020, Ontario will need to replace approximately 80% of its electricity Generation (25,000 MW) because of growth in demand and aging plants, about half of which are nuclear.

In February 2010, Ontario Power Generation (OPG) announced the planning phase to refurbish the Darlington Nuclear Generating Station to extend its lifetime. The work could begin in 2016. OPG also announced that beginning in 2020, Pickering B Nuclear Generating Station would begin the decommissioning process.

In November 2010, the Government of Ontario committed to clean, reliable nuclear power remaining at approximately 50 per cent of the province's electricity supply as a key part of the province's Long-Term Energy Plan.

The Joint Review Panel for the Darlington New Nuclear Project commenced hearings on March 21, 2011 as a next step in the process to build two new units at Darlington station in Clarington, Ont.

The employment and economic contribution to the Ontario economy will grow with refurbishment and new nuclear projects. In July 2010, the Canadian Manufacturers & Exporters released a report stating that the refurbishment of nuclear facilities at Bruce and Darlington will create 25,000 jobs in the next decade, injecting \$5 billion annually into Ontario's economy.

NUCLEAR RESEARCH REACTOR

Research reactors are smaller than those that produce power. They are used to test fuels and other components of a power reactor which leads to continuous improvements in production and safety of the industry.

Research reactors are also used to test the strength of materials including plastics, metals, composites, ceramics and engineered wood products. Advanced materials are essential for modern manufacturing, and they can only be tested using neutron beam facilities that are provided by research reactors.

In Canada, there are eight operational research reactors located in Alberta, Saskatchewan, Ontario, Quebec, and Nova Scotia.

With over 50 years of studying improved materials, Canada has made major scientific and economic advances and has maintained a highly advanced manufacturing sector that leads in technology-intensive areas like electronics, telecommunications, aerospace, pharmaceuticals and medical devices.

ROLE OF NUCLEAR R&D IN CANADA'S INNOVATION SYSTEM

Nuclear R&D produces advances across Canada's economy. Nearly all advanced economies have nuclear (and other) research and development facilities that receive at least some public funding. Investing in R&D keeps us competitive.

Canada has a network of institutions and experts involved in nuclear R&D. While AECL plays an important role, nuclear research and development also takes place at the National Research Council, nuclear medicine companies and hospitals, several universities, Laval's Canadian Irradiation Centre, Vancouver's TRIUMF subatomic research facility, the Saskatchewan cyclotron, nuclear mining companies and fuel fabricators and other organizations.

Nuclear R&D supports materials testing and product improvements (mainly through nondestructive neutron beam testing, which is essential for advanced parts and materials development). It also supports medical products and services, training and development of scientists and engineers, and other activities that are of value across more than one industry. It also supports Canada's ability to manage radioactive materials, meet our international non-proliferation commitments, and safely operate our existing fleet of nuclear facilities.

Nuclear research and development facilities, located in public and corporate facilities, at joint-venture laboratories and at universities, provide *learning environments for scientists and engineers* – not just those from the nuclear industries, but in many specialties from chemistry and physics to medicine and the environment. This means high-knowledge opportunities, not just for young Canadians, but for our partners around the world.

SAFETY IN CANADA'S NUCLEAR INDUSTRY

Canada's nuclear power operations are among the safest in the world because they are highly monitored, appropriately regulated and continuously improved through the daily efforts of qualified professionals.

In almost 50 years of using nuclear energy in Canada, there have been no significant incidents resulting from accidents or radiation exposure at one of our power plants or a waste storage facility.

The CNSC regulates the use of nuclear energy and materials to protect the health, safety, security of Canadians and the environment.

Canadian nuclear power plants are among the most robust designs in the world – they have layers of multiple, **redundant** safety systems to prevent damage in the event of an earthquake or major incident. Both the actual structures that form containment and the systems important to safety have been designed to meet strict seismic standards.

Nuclear power plants in Canada are located in areas without a history of major earthquakes or tsunamis. The Canadian Nuclear Safety Commission (CNSC) has reviewed and inspected these installations and confirms their robustness with regards to potential earthquakes.

As well, all of Canada's nuclear power plant operators have well-established and practiced emergency procedures that include emergency shutdown of the reactors.

CNSC staff is located on-site at each of Canada's nuclear power plants and elsewhere across Canada to ensure that nuclear materials are safe and that facility operators are prepared in the event of an emergency.

CANADIAN NUCLEAR INDUSTRY AND THE NUCLEAR SITUATION IN FUKUSHIMA, JAPAN

As we review our own safety systems, our thoughts remain with the people of Japan and the workers at the Fukushima station who have demonstrated heroic efforts these past weeks.

Our industry has a culture of cooperation and openness that transcends national boundaries and commercial interests in a way that is unique among industries worldwide. We consider an event at *any* nuclear plant to be an event at *every* plant.

As an industry, we have come together to share ideas, review our own plants and consider lessons learned from the tragic events in Japan

We are actively responding to the Canadian Nuclear Safety Commission (CNSC) Requests for Action as well as to other reviews as required. All information will be submitted by the requested date - April 29. The CNSC will then provide an update on next steps and key dates.

One of the true strengths of the nuclear industry is its commitment to openly share any information that could improve nuclear safety.

Every piece of equipment, human performance and emergency response action around this incident in Japan will be scrutinized and analyzed by the world's nuclear community. When we fully understand the facts surrounding these events, we will use those insights to make nuclear energy even safer.

It is important to remember that the Fukushima reactors withstood the largest earthquake in recorded Japanese history. The current problems were caused by a failure of the backup power system due to damages from a tsunami of unprecedented magnitude.

Please visit the Canadian Nuclear Association website at www.cna.ca for links to more information related to the safety of the nuclear reactor system in Canada.

Canada's nuclear industry has a strong safety record that spans almost 50 years. There have been no significant incidents in Canada and our nuclear power plants are among the most robust designs in the world with multiple, redundant safety systems.

The 71,000 workers in the nuclear industry are highly trained and qualified professionals in their fields, and the industry is closely monitored.

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SAFETY SYSTEMS AT CANADA'S NUCLEAR POWER PLANTS

Canadian nuclear power plants are among the most robust designs in the world – they have layers of multiple safety systems to prevent damage in the event of an earthquake. Both the actual structures that form containment and the systems important to safety have been designed to meet strict seismic standards.

Nuclear power plants in Canada are located in areas without a history of major earthquakes or tsunamis. The Canadian Nuclear Safety Commission (CNSC) has reviewed and inspected these installations and confirmed their robustness with regards to potential earthquakes.

As well, all of Canada's nuclear power plant operators have well-established and practiced emergency procedures that include emergency shutdown of the reactors.

Several changes to safety rules in the last decade have added even more redundancies to Canadian reactor safety systems. Now, two onsite backup power systems are mandatory, each self-sufficient and separate from the other. (The Japanese plants had only one.)

Larger inventories of on-site water must be maintained as an emergency coolant. And before any Canadian plant can be licensed or re-licensed, the CNSC requires it to have "two fully capable, independent shutdown systems that will assure that reactors are placed in a safe shutdown state in case of an earthquake."

It must also be noted that Canada's nuclear reactors use a technology very different from that employed in Japan and most other Western countries. Our reactors use natural - rather than enriched uranium, and are cooled with heavy water. This may make Canadian reactors more expensive to start, but much safer in the long run.

We encourage people to contact the CNSC for details about the industry's regulatory oversight related to safety.

NUCLEAR'S CONTRIBUTION TO THE ENVIRONMENT

Nuclear energy provides a clean energy solution for the reduction of greenhouse gas emissions. By clean, we mean virtually no GHG emissions.

The Canadian Energy Research Institute, an independent, non-profit research institute, analyzed green house gas emissions from various power generation sources. They concluded that energy generated from nuclear power plants results in emission levels that are much lower than coal, oil, and natural gas; and are similar to those of wind, solar and hydro.

This fact was verified by the Canadian Energy Research Institute, a highly-respected, independent and non-profit organization. It analyzed greenhouse gas emissions from various power generation sources and concluded that energy generated from nuclear power plants results in emission levels that are much lower than coal, oil, and natural gas.

In fact, the emissions profile of nuclear energy is similar to those of wind, solar and hydro.

For example, if we did not have the nuclear power plants in Canada today, and instead relied on fossil-based electricity for that output, our country would generate an additional 90 million tonnes of greenhouse gases every year. That's equal to about 12 percent of our annual total greenhouse gas emissions.

Nuclear can also be considered an enabler for renewable energy as it provides 24/7 baseload power over a very long term at a low-operating cost.

NUCLEAR IS MANAGED

Nuclear waste is currently managed on-site at the nuclear facilities. The total amount of used fuel we have today is equivalent to the size of six hockey rinks up to the top of the boards.

Canada's safe and secure plan for the long-term management of all of Canada's nuclear fuel waste – now and in the future – is the Adaptive Phased Management approach.

This plan is being implemented by the Nuclear Waste Management Organization. It involves safely and securely containing, isolating, and monitoring the nuclear fuel waste in a deep geological repository.

Designs have been developed for this repository which will be hosted by an informed and willing community. The project will not be imposed on any municipality alone. This plan is flexible and adaptive and will incorporate changes in technological developments, including changes in the types of nuclear fuel waste.

Any facility for the long-term management of nuclear fuel waste will be regulated by Canadian Nuclear Safety Commission.

CANADIAN NUCLEAR AND CANADIAN HEALTHCARE

Canada is a leading provider of innovative technologies for medical imaging and radiotherapeutics, and sterilization technologies benefiting the lives of millions of people in more than 65 countries around the world.

Canada's nuclear technology is the basis for vital cancer-fighting medical technologies, including diagnosis and treatment. It also provides the technology needed for medical sterilization and food irradiation, desalination of water, and other established and emerging health technologies.

Nuclear medicine got its worldwide start in Canada in 1951 with the first uses of cobalt-60 radioisotopes to treat cancer. Canada has continued to lead in this area for six decades.

Canadian-produced medical isotopes are used in over 50,000 procedures every day, worldwide, with 5,000 of those in Canada.

Medical isotopes are used in targeted cancer treatments, for medical imaging, and Canada supplies over half of that market worldwide. These images enable physicians to diagnose and treat all kinds of diseases including cardiac conditions and several types of cancers.

Canada also supplies three-quarters of the world's Cobalt-60, which is a sterilizing agent. Cobalt-60 is used to sterilize nearly half of the world's single-use medical supplies and devices—things like bandages, catheters and syringes. There are clear benefits from nuclear technology in terms of lives saved or extended, illnesses and infections avoided. And Canada is connected to a worldwide system of Expertise that delivers those benefits consistently and with excellence.

CANADIAN NUCLEAR LIABILITY

Canada's Nuclear Liability Act makes provision for compensation for injury or property damage. Nuclear power plant operators must obtain liability insurance for damages up to a maximum of \$75 million.

In the event that damages exceed \$75 million, the federal government must appoint an independent tribunal that would receive claims, assess damages and recommend the level of compensation that should be paid. The Act does not set a limit on what the government would pay.

The Canadian Nuclear industry is proud of the fact that there has not been any claim triggered under the Nuclear Liability Act.

The Canadian nuclear industry is focused on constantly improving and enhancing safety in the work place as well as performance.

To date there have been four legislative efforts to update the Canadian Nuclear Liability Act to increase the liability limit to \$650 Million. The proposed \$650 Million liability would represent a 6 fold increase in insurance premiums for the Canadian nuclear industry.

The proposed legislation would have benefited the public and the Canadian nuclear industry by providing a defined regime in place to address the contingency of third party liability in connection with a nuclear incident.

Other Amendments to the Act included:

- An initial review of the liability limit in the first 18 months and a commitment to consult with industry and have insurance accessible in reasonable rates before any liability limit decisions are made.
- The clear responsibility to the operators in the case of any claims arising from the very unlikely nuclear incident would be with the operator of the facility where the incident occurred.
- The requirements for Consultations. The proposed legislation grants the Governor in Council the ability to change the legislation by regulations. The industry would call on the Government to include consultations prior to making regulatory changes.

- Operators are required to hold financial security in respect of their liability. This amount will be reviewed regularly and may be increased by regulation. The enactment also provides for the establishment, in certain circumstances, of an administrative tribunal to hear and decide claims. Finally, this enactment repeals the Nuclear Liability Act and makes consequential amendments.

Canada's nuclear industry encourages a new Government and all parties to reintroduce and pass a legislative initiative that updates the current Act to international standards including meeting the ratification needs of the international Convention of Supplementary Compensation.

CANADIAN NUCLEAR INDUSTRY AND PUBLIC CONFIDENCE

We must be mindful of the fact that the Canadian nuclear industry has an excellent record of providing a broad spectrum of products and services that benefit all Canadians. We are committed to ensuring safety throughout all aspects of our industry and being responsible environmental stewards.

Nuclear energy provides a clean and reliable source of power and is an important part of Canada's clean energy portfolio. Because there are virtually no greenhouse gas emissions from our power generating plants, it does not contribute to global climate change or smog.

The application of nuclear science improves the health and well-being of Canadians through nuclear medicine and food safety technologies. Innovation in nuclear science is also being applied to address a number of societal challenges such as public health and transportation.

The Canadian nuclear industry is made up of over 71,000 Canadians employed directly or indirectly in exploring and mining uranium, generating electricity, advancing nuclear medicine, and promoting Canada's worldwide leadership in science and technology innovation.

Through the efforts of our people, the Canadian nuclear industry is a \$6.6 billion per year industry, contributing \$1.5 billion in tax revenues and \$1.2 billion in export revenues.

