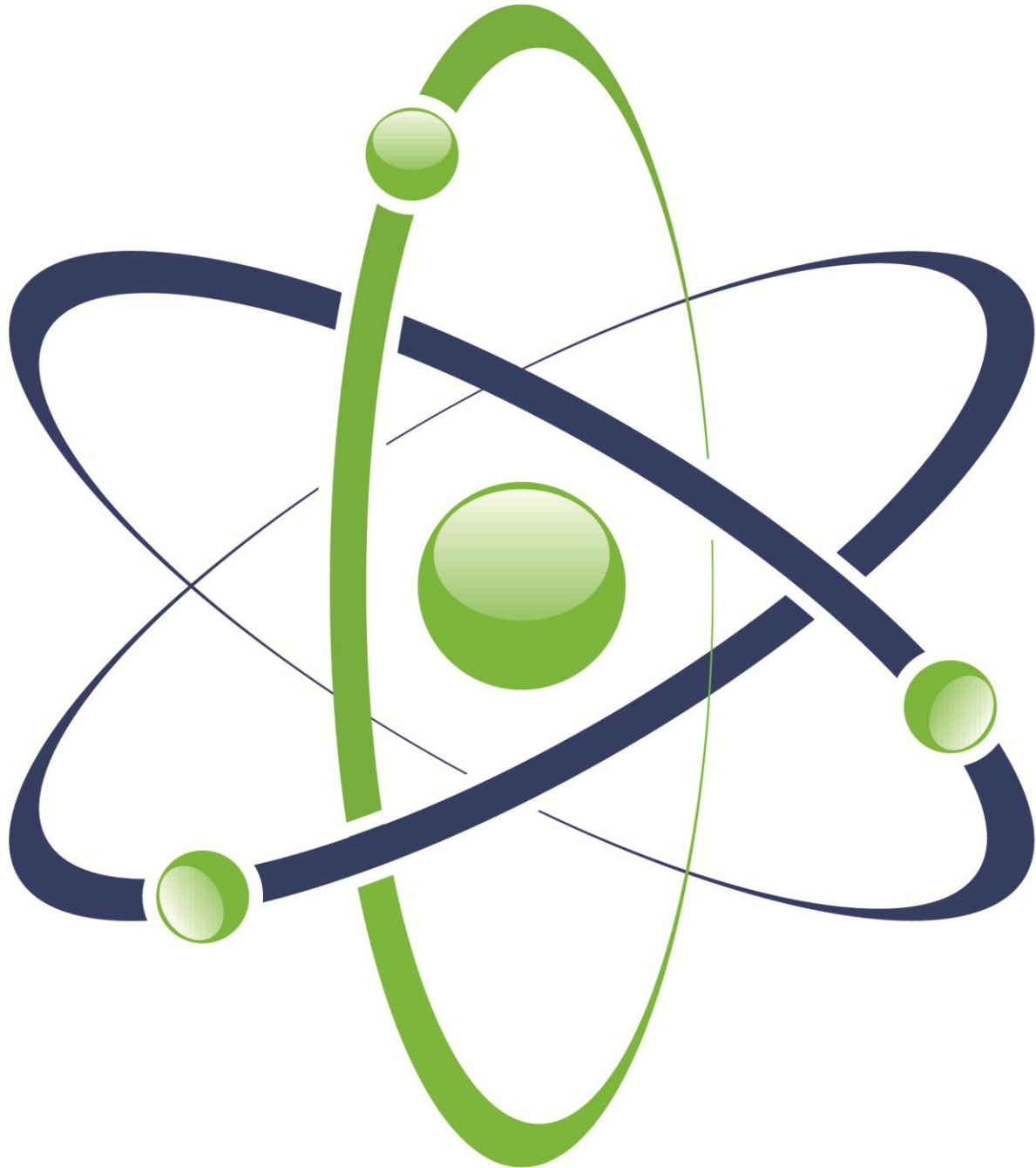


THE FUTURE OF CANADA'S NUCLEAR ENERGY SECTOR

Saskatoon Workshop Summary Report



CANADA'S
PUBLIC POLICY

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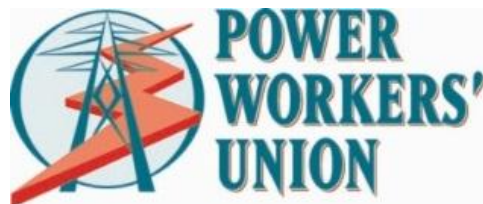
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Project overview

On May 14, 2013, Canada's Public Policy Forum convened leaders from the private, public, academic and research sectors in Saskatoon to explore the future of the Canadian nuclear sector. The day focused on whether and how Canada's nuclear energy industry can take better advantage of domestic and international market opportunities over the next 20 years. The purpose of the workshop was to engage subject-matter experts across the industry to identify the opportunities, challenges and potential long-term outlook for nuclear energy in our country. Workshop participants were asked to explore key policy questions, including: what is the potential for Canada to take advantage of these opportunities? Where are the sector's strengths and vulnerabilities? What are the main challenges that must be considered, and how can they be addressed? This report summarizes some of the key discussions at the workshop.

Canada is well positioned to take advantage of domestic and international opportunities in nuclear energy

Canada has an ideal market to support small modular reactor technology

Many participants agreed that Canada is the ideal market for small modular reactor technology (SMR). Given the government support for the nuclear sector in Saskatchewan and Ontario, as well as the country's infrastructure and historical industry knowledge, Canada is well positioned to use SMRs to provide energy to rural and northern populations. It is also important to note that for many of these remote communities, the nuclear energy industry, and SMRs in particular, may provide a sustainable source of jobs, training and stable income, providing long-term economic and social benefit..

Our country has the ability and resources to offer services throughout the entire nuclear life cycle

There was also support to consider "closing the fuel cycle" by offering to accept spent fuel from countries which originally purchased uranium from Saskatchewan. Given the Nuclear Waste Management Organization's (NWMO) long-term strategy for the safe storage of spent fuel, Canada could provide a much sought-after "cradle to grave" service to its international customers. Canada could also offer expertise in decommissioning reactors used by other countries. Rather than shipping Canadian reactors to Europe to be decommissioned, we could foster a domestic industry in this area, creating Canadian jobs and expertise in the process.

In Saskatchewan, Ontario and elsewhere, a potential greater demand for energy in the medium to longer terms means that policymakers will need to commit capital and other resources to redesign their electrical grids. According to some participants, this challenge presents an important opportunity for

both nuclear and wind power to play a bigger role in energy supply. Given public concern over greenhouse gas (GHG) emissions, there could be greater support for these lower carbon and carbon-free alternatives as politicians make key long-term decisions about energy sources and infrastructure. It was suggested that in Saskatchewan and Alberta, the adoption of SMRs could be used to help offset the oil sands' GHG emissions by providing a lower-GHG energy source.

Canada has an opportunity to expand its exports of nuclear fuel to new and emerging markets

Canada's 70+ years of expertise in nuclear energy gives our country a sizeable competitive advantage over many of our competitors. Our country is already a leader in uranium mining, reactor technology, plant operation, nuclear research, and environmental and safety standards. Today, there are important opportunities for Canada's industry leaders to supply our expertise and resources to countries looking to expand their own nuclear energy sources. Established public-private partnerships, reactor designs, regulations, expertise, and a respected global reputation all place our country in a good position to take advantage of global opportunities.

Some participants suggested that China, India, Russia, the UK, Middle East and even South Korea could provide additional opportunities for Canada to export its nuclear fuel. Although Canada is sitting on top of the world's largest uranium resources, it is unclear how Canadian industry leaders can capitalize on their expertise and position. What relationships need to be developed or expanded to realize important opportunities? Over the medium- to long-term, does Canada need to move towards fuel enrichment to "close out the nuclear fuel spectrum?" According to one participant, how stakeholders respond to these questions will help determine whether Canada will remain a leading energy provider to global markets.

Taking advantage of our strengths will require a concerted effort by industry and government to develop international partnerships. Prior to the Nuclear Cooperation Agreements recently signed with China and India, Canadian business had few opportunities to enter these quickly-expanding economies. As more developing countries consider nuclear energy to meet their growing energy needs and to reduce their carbon footprint, it will be essential for Canada to establish closer relations and trade arrangements that provide export opportunities for the Canadian industry.

The nuclear energy sector may wish to consider developing greater technical and business capacity.

Although more skilled tradespeople are needed for Canada's nuclear energy industry to flourish, participants suggested that leaders should also focus on training their employees in leadership, business, communications and management. As demonstrated by the petroleum and clean coal industries, business is often generated through effective marketing campaigns and developing a practical business

case for the product. Participants suggested that the nuclear industry could potentially learn from and improve upon some of these approaches by training, attracting and leveraging the expertise of business leaders.

One important example where greater business acumen could assist the industry is in helping to develop new ways to use nuclear energy processes to benefit third parties. For example, Bruce Power in Ontario, and some European nuclear power plants have used reactor steam to provide electricity to greenhouses and paper mills.

In an increasingly competitive global environment, Canada's nuclear energy industry continues to face key challenges that limit its potential

Upfront capital costs and project overruns significantly inhibit the public's support for refurbishments and new builds

According to workshop participants, the cost of building and refurbishing nuclear power plants is the single greatest deterrent to their construction. High capital costs, despite being balanced by the low electricity prices that nuclear energy provides, are often difficult for politicians and utilities providers to justify to tax- and rate-payers. Furthermore, the penalties and interest rates that accrue when a project misses deadlines increase costs and can attract negative media coverage. Participants suggested that additional costs, such as enhanced safety requirements and a higher nuclear liability cap, could also make nuclear energy a more expensive option.

Project scoping and management are the main challenges related to the cost issues. According to participants, planners are often unaware of the challenges and true costs until after they have broken ground. It is important to note that high capital costs and risks with new builds and refurbishments are common not only in Canada, but around the world. In Finland, for example, it wasn't until after engineers began building a reactor that they discovered fundamental design flaws and risks, which resulted in significant cost overruns.

Notwithstanding these concerns, participants pointed to the Bruce A3 & A4 projects, which were refurbished on time and budget, as proof that effective planning and management can limit many of these additional costs.

Cheap natural gas prices, and the speed with which gas plants can be constructed, make it difficult to justify building new nuclear plants

With the shale gas revolution in North America, the cost of using natural gas to generate electricity is at an all-time low. As a result, low gas prices make it difficult for politicians and other stakeholders to

justify the costs and risks associated with building, refurbishing and operating nuclear power plants. A similar challenge arose in the 1980s where the discovery of gas fields in the North Sea pushed down oil prices and effectively eliminated the nuclear energy industry in the United Kingdom. As gas prices eventually rose, the UK was later forced to use French organizations to build nuclear power plants.

Unlike nuclear power plants, which require large upfront capital expenditures, gas plants are relatively inexpensive and quick to build, creating a significant competitive advantage for the gas industry. However, given that there is no way to predict the price of gas in the medium- to long-term, electricity generated from gas continues to be a somewhat risky investment for governments.

Expanding the nuclear energy industry will require a greater focus on public engagement

If Canada's nuclear energy industry is to overcome many of the challenges it currently faces, it will be essential to develop a better relationship with the broader public. Communities where uranium mines and nuclear power plants currently operate have very good relations with and a much higher level of acceptance of the nuclear energy industry, in comparison with broader civil society. Although most people intuitively understand that diversity is important to Canada's energy security, many still believe that our country should eventually transition to renewable power sources as its primary baseload, not realizing the current limitations of such a scenario. Participants suggested that initiating a fact-based, public dialogue may be necessary to explain the benefits of a more diversified energy mix for Canada, and to help break down ongoing myths

Furthermore, some participants noted that the industry could provide opportunities to develop best practices around public engagement, knowledge management and communications to better communicate with Canadians. For example, although reactor refurbishments in Ontario allowed the province to reduce fossil fuel emissions through the closure of coal plants, this important benefit was never effectively communicated to the public.

The absence of public support for nuclear energy makes it more difficult for politicians and other stakeholders to pursue new builds and refurbishments

The often vitriolic public reaction to nuclear power is a significant challenge for industry leaders to overcome. With the prevalence of media coverage of the Fukushima Daiichi disaster in Japan, memories of Chernobyl and Three Mile Island, and common misunderstandings around the risks of radiation, the public is often reluctant to embrace power plants or view nuclear as a viable energy source.

Participants suggested that one way to address public concern is to engage high school and university students in a factual dialogue before they become exposed to misinformation. In addition, credible, independent organizations from outside of the nuclear industry – such as Industry Canada, Health

Canada and others – could help break down some of the common misconceptions that often lead to fears around nuclear energy and shed light on the benefits of a diverse energy mix.

According to workshop participants, one way to deal with anti-nuclear organizations is to try to engage them with the goal of making the dialogue less polarized. Over the past 20 years, the Forest Products Association of Canada (FPAC) adopted this approach by working with their anti-forestry counterparts on a personal level in order to overcome animosities and common challenges. After 10 years, FPAC's leading critic, Greenpeace, had become active partner in helping FPAC meet its objectives in an environmentally-friendly way.

Canada's National Research Universal (NRU) reactor is set to shut down in 2016.

Participants agreed NRU is vital for helping to drive the innovation and R&D that will lead to a vibrant nuclear energy sector in Canada. According to one participant, governments often think of research reactors like NRU as cost-centres, not assets, especially after the 2009 shutdown of the Chalk River facility led to a global isotopes crisis. Further, due to the high costs of operating and maintaining these facilities, research reactors like NRU and its counterparts are often considered stranded assets that provide a public good, but are costly and attract few private investors. Participants suggested that there needs to be an environment where costs are shared and industry makes a case to governments for keeping research reactors open. Clearly, a new partnership and cost-sharing model is required and desirable, and is currently being considered.

The dominance of light water reactors (LWR) in the world

Approximately 85-90% of reactors used in the world are light water reactors (LWR), and few countries want both LWR and heavy water reactors (HWR). Unfortunately, Canada doesn't have very much experience with LWRs, which means that shifts away from HWR could put our country's supply chain at risk. The CANDU HWR has a very entrenched supply chain, but some specialized training is lost when you move to LWR technology.

Although there are far more opportunities in the LWR field, CANDU's unique properties, such as using various fuels such as natural uranium and thorium, give it a competitive edge over many other reactor designs. Fortunately, Canada does not have to deal with LWR and HWR as an "either or discussion." The good news for the sector is that India remains a HWR dominant country with great potential, and that Canadian component manufacturers are developing LWR expertise.

Conceptualizing what a positive outlook for the nuclear energy sector might look like in 20 to 25 years

In the afternoon, participants were asked to identify what a “successful” Canadian nuclear energy industry would look like 20 to 25 years into the future. This positive future scenario conceptualized an expanded Canadian uranium extraction and export industry; a greater capacity to train and attract skilled labour; improvements in communities’ quality of life; building and refurbishing power plants domestically and globally; a strong R&D and innovation capacity; social license and political support; a competitive economic environment with global demand for energy, and, SMR development in Canada.

An expanded uranium extraction and export industry

- Canada regains its status as the number one uranium producer in the world and increases production in Saskatoon, with expansion into Nunavut.
- Canadian uranium has a greater presence around the world.
- The fuel cycle is closed and the spent fuel plan has been finalized and implemented.
- The uranium mining industry is still very active in supplying the global market, and exports have risen.
- There has been a relaxation of the investment rules, specifically with regards to Canada’s uranium mines.
- Fuel fabrication is supplying new power plant builds.
- Relaxed foreign investment rules in the Canadian uranium market.

An improved capacity to train and attract skilled labour in Canada

- Some ENGOs are actively promoting nuclear energy in Canada and around the world as a safe, sustainable energy supply.
- Highly qualified people (HQP) in Canada are able to operate both LWR and HWR.
- There are more institutions and a greater capacity to produce and attract skilled labour in Canada.

- Canada is able to provide quality apprenticeships to northern and Aboriginal communities (e.g. in order to operate regional SMRs).

Improvements in quality of life

- The nuclear energy sector enjoys robust engagement with Canadians and communities that host power plants, uranium mines, fuel fabrication facilities and R&D facilities.
- The Aboriginal community has been integrated into the nuclear energy business and plays an important role in working in and managing the nuclear energy sector.
- Communities are very supportive and actively promote nuclear energy.

Building and refurbishing power plants domestically and around the world

- Industry and government leaders take a “Team Canada approach” to existing CANDU markets and begin expanding into new markets. As well, Canadian governments, industry, regulators and other stakeholders apply this approach to meeting with international leaders on other components of the nuclear energy value chain.
- Canada has increased its competitiveness, has lowered its greenhouse gas emissions (GHGs) and has established SMRs in Saskatchewan.
- Canada has developed a national energy strategy that includes nuclear as a key energy source.
- Joint federal-provincial cooperation exists with the support of former opposition groups.
- Canada has constructed some new builds in both the domestic and international markets, including SMRs in Alberta, Saskatchewan, Ontario, New Brunswick and VSMRs (very small modular reactors) in the Canadian north.
- Canada is able to export its technology, close the fuel cycle and increase fuel cycle flexibility.
- Canada is operating a sited repository and storing Canadian and international spent fuel.

A strong R&D and innovation industry in Canada

- There is federal-provincial investment in research reactor technology, nuclear innovation and support for the Canadian nuclear industry.
- The NWMO spent fuel storage plan has been completed and implemented successfully.
- Innovation is fostered in communities of interest (such as the provinces).
- Canadian expertise is developed for the advanced fuel cycle.
- Canada is an internationally competitive nation in all aspects of the nuclear energy sector.
- Canada is able to maintain and build upon its technical capabilities in HWRs.
- There is greater innovation in the uranium mining industry.
- Canada has developed a new research reactor to replace the NRU.
- Canadian industry leaders take on a greater role in the complete fuel cycle, providing services in the United Kingdom and the People's Republic of China.

Social license and political support for the nuclear sector

- The sector has developed an open, honest and transparent relationship with the public, including the broader public outside of directly affected communities.
- The nuclear sector has created a “community of spokespeople” to connect with the public and share their personal experiences with nuclear energy.
- The sector has the support of government, industry, regulators, community leaders and researchers to help promote nuclear energy to new communities and markets.
- There is greater emphasis on the fact that nuclear energy is a safe, secure and ‘green’ form of energy.
- Public policy frameworks, at the federal, provincial and municipal levels, have been established to support the nuclear energy industry.

A competitive economic environment with high global demand for energy

- Industry will have worked with other stakeholders to lower the costs on new builds.
- Power Purchase Agreements (PPAs) are created for private sector organizations seeking to build nuclear power plants (similar to arrangements given to fossil fuel energy sources).

SMR development in Canada

- SMRs have a presence in smaller Canadian markets, such as Saskatchewan, Alberta and the north
- An efficient regulatory framework is set up to streamline Environmental Assessments (EA) and class construction licenses.

Conceptualizing what a negative outlook for the nuclear energy sector might look like in 25 years

Participants were also invited to conceptualize a scenario where the nuclear energy is in decline and were asked to identify some key events and issues that could lead to this situation. The purpose of this exercise was to identify areas of risk, and therefore stimulate discussion around possible mitigation strategies. The following is a summary of that decline scenario.

- Canada decides not to build any new power plants, and focuses instead on constructing gas plants.
- The NRU is closed in 2016 and is not replaced or refurbished.
- Chalk River becomes strictly a waste management facility.
- Asset value protections.
- The fuel cycle is closed.
- There is increased growth in the decommissioning of Canadian nuclear power plants.

Potential strategies for mitigating decline and realizing the positive outlook scenario

Participants compiled a list of recommendations or “considerations” to describe how key issues outlined in the decline scenario could be mitigated as well as some considerations that the sector may wish to consider acting upon in the short- to medium-term.

Multi-sector Collaboration

- A multi-sector discussion around nuclear energy’s role in a Canadian energy policy is necessary.
- Enhancing the nuclear energy sector will require bringing together industry leaders, governments and regulators to ensure that everyone understands each other’s challenges. In fact, this type of collaboration has proven successful in the recent past: For example, the Canadian Nuclear Safety Commission (CNSC) worked with Cameco and AREVA to streamline and make simple regulations for uranium mines. There was skepticism during the consultation phase, but CNSC is carrying this out now. If new nuclear reactors are introduced into Canada, CNSC could work with foreign regulators to help understand the key issues and regulatory needs around these new technologies.

- If the private, public, research and labour sectors are to engage in “Team Canada-type” missions, it will be important to first discuss their goals, roles and responsibilities before seeking out more international opportunities.
- The provinces could play an influential and critical role in supporting innovation at the community level.
- Greater peer-to-peer dialogues may need to be organized that include all industry stakeholders, including government, industry, regulators, researchers, ENGOs and local communities.

Economic and financial considerations

- Greater government involvement will be necessary to help develop clear strategies and a public policy framework for the sector. In order to do this effectively, political leaders may need to think in terms of the long-term energy interests of the provinces and the country as a whole.
- Providing flexibility in investment options for new builds, such as through PPAs and publicly-traded stocks could also be considered as options to provide upfront capital and to share risk.

Environmental considerations

- Stakeholders may wish to provide more education around greenhouse gas emissions and the potential role of nuclear energy in reducing GHGs. It may also be helpful to conduct a study that compares the complete costs and benefits nuclear energy, from cradle to grave, compared to other energy sources, including externalities such as environmental costs.
- Environmental groups will be an essential stakeholder that industry leaders may need to collaborate with.

Attaining social license and community acceptance

- Engaging the general public in an open, well-informed discussion on the value of nuclear energy could help generate greater support for, and awareness of the sector. Through a process of engagement, rather than consultation, the goal could be to:
 - Describe the processes, benefits and risks of nuclear energy in non-technical language;
 - Connect with the media to share success stories and some key facts about the industry;
 - Explain the role of certain industry actors, including regulators.
- The goal of facilitating a transparent public engagement exercise could be to “invest in trust” with the public by building connections and conversations with concerned communities.

The Future of Canada's Nuclear Energy Sector

Saskatoon workshop

May 14, 2013, 9:00 a.m. – 4:00 p.m.

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