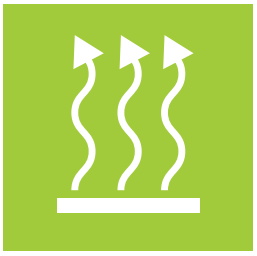
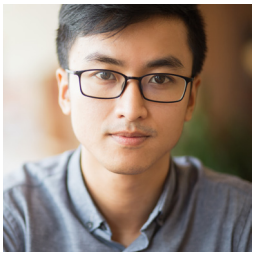
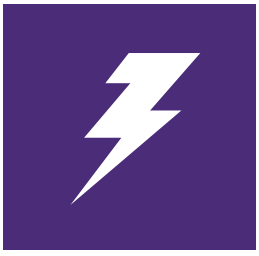
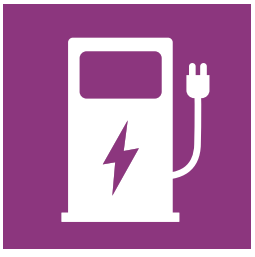
A Call to Action:

A Canadian Roadmap for Small Modular Reactors









A Call to Action:

A Canadian Roadmap for Small Modular Reactors

November 2018

This report was prepared by the Canadian Small Modular Reactor (SMR) Roadmap Steering Committee. The Steering Committee is a group of Canadian provincial governments, territorial governments, and power utilities interested in the potential for development, demonstration, and deployment of SMRs in Canada. The findings and recommendations of this report reflect the views of the voting members of the Steering Committee. Natural Resources Canada supports the Steering Committee in a convening role and participates as a non-voting member. Atomic Energy of Canada Limited participates in the SMR Roadmap Steering Committee as a non-voting member.

Recommended Citation:

> Canadian Small Modular Reactor Roadmap Steering Committee (2018). *A Call to Action: A Canadian Roadmap for Small Modular Reactors*. Ottawa, Ontario, Canada.

Voting Members

Non-voting Members

Natural Resources Canada

Ressources naturelles Canada

Executive Summary: A Call to Action

Nuclear energy in Canada is a strategic asset. Canada is a Tier 1 nuclear nation, with a full-spectrum industry that we leverage for significant economic, geopolitical, and social and environmental benefits.

A Roadmap for Small Modular Reactors (SMRs) is our answer to the question: "What's next?" It is the result of a 10-month effort that was unlike any other initiative the sector has ever undertaken. Through the SMR Roadmap, representatives from industry, governments, utilities and enabling partners have come together to chart a vision for the next wave of nuclear innovation. This vision was informed by expert analysis as well as dialogues across the country, including initial engagement with Northern and Indigenous communities and organizations.

The opportunity

Why did we do this? Because SMRs could help Canadians achieve a low-carbon future. And with SMRs, we could witness the emergence of a new industrial subsector that will create jobs and economic opportunities across Canada. Because SMRs can help Canadians achieve a low carbon future. Because Canada is well-positioned to lead.

Markets around the globe are signalling a need for smaller, simpler, and cheaper nuclear energy in a world that will need to aggressively pursue low-carbon and clean energy technologies to meet climate change goals.

SMRs respond to these needs: they are smaller nuclear reactors that involve lower capital investment and modular designs to control costs; they can compete with other low-cost forms of electricity generation; they incorporate enhanced safety features; and they could enable new applications, such as hybrid nuclear-renewable energy systems, low-carbon heat and power for industry, and offset diesel use in remote communities and mine sites.

First-movers in this area of high-tech innovation will lock in significant benefits. For Canada, this could mean anchoring jobs, Intellectual Property, and supply chains here; positioning Canada as a policy leader and international standard-setter for strategic influence; and delivering on our climate change and clean energy commitments while opening opportunities for regional development, and enabling a constructive dialogue with northern and Indigenous communities on remote energy issues.

And Canada has what we need to seize this opportunity: a ramped-up supply chain leveraging the Province of Ontario's $26 billion investment in nuclear reactor refurbishments; leadership in nuclear science and technology—bolstered by a federal investment of $1.2 billion in infrastructure at Canadian Nuclear Laboratories and investments by New Brunswick to establish an SMR nuclear research cluster; and a regulatory approach that is open to innovation.

The approach

Through *Generation Energy*—a national dialogue on Canada's energy future - the federal government heard that a pan-Canadian approach to SMRs would reduce uncertainty and help guide decisions by investors and policymakers, and inform decisions by regulators. Leveraging its convening power, the federal government, challenged all interested provinces, territories, and power utilities from across the country to co-create a Roadmap for SMRs. This involved expert analysis, extensive engagement with industry and end users, and initial engagement with Indigenous communities and organizations.

Over 10 months, more than 180 individuals representing 55 organizations across 10 sectors and subsectors were engaged in workshops and Indigenous engagement sessions. Five expert groups comprising 18 organizations looked at questions related to technology; economics and finance; Indigenous and public engagement; waste management; and regulatory readiness. All told, the Roadmap comprehensively addressed key areas of analysis surrounding SMR deployment in Canada.

The vision

What emerged is a collective vision statement for bringing this innovative technology to fruition in Canada:

Small Modular Reactors as a source of safe, clean, affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians.

The path forward

Throughout the process, it has become clear that success will rely on strategic partnerships – across the sector and internationally. No single organization can do this alone. What also emerged is a concrete set of recommendations across four thematic pillars to guide future actions needed by governments, industry, and other nuclear stakeholders to capitalize on Canada's SMR opportunity. These include:

Pillar 1: Demonstration and Deployment

Priority Recommendations:

Funding for SMR demonstration projects. The federal government and provincial governments interested in SMRs should provide funding to cost-share with industry in one or more SMR demonstration projects for advanced reactor designs.

Risk-sharing measures for first commercial SMRs. Federal and provincial governments should implement measures to share risk with private investors to incentivize first commercial deployment of SMRs in Canada, with the potential of exporting SMR technologies and related innovations developed in Canada to international markets.

Pillar 2: Policy, Legislation, and Regulation

Priority Recommendations:

Federal impact assessment. The federal government should work to align the modernization of Canada's federal impact assessment process with other initiatives to develop and deploy SMRs.

Nuclear liability. The federal government should review liability regulations under the *Nuclear Liability and Compensation Act*, in order to ensure that nuclear liability limits for SMRs are aligned with the risks they pose, using a graded scale based on risk-informed criteria.

Regulatory efficiency and nuclear security. The Canadian Nuclear Safety Commission (CNSC) should engage with industry, public, and Indigenous representatives on amendments to the *Nuclear Security Regulations* to ensure a graded approach based on risk-informed criteria.

Waste management.

- **Used fuel.** SMR technology vendors should engage with Canada's Nuclear Waste Management Organization (NWMO) to ensure that planning for NWMO's deep geological repository is well-informed by the technical specifications of these novel technologies.
- **Low- and intermediate-level waste.** Canada's Radioactive Waste Leadership Forum should take steps to ensure consideration of SMR waste streams in its integrated radioactive waste management plan.
- **Demonstration projects.** The federal government should consider risk-sharing in some of the costs of management and disposal of radioactive waste.

Pillar 3: Capacity, Engagement, and Public Confidence

Priority Recommendations:

Indigenous engagement. Building on the constructive dialogues that were launched under the Roadmap, federal, provincial and territorial governments and utilities interested in SMRs should continue with meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific project proposals.

Pillar 4: International Partnerships and Markets

Priority Recommendations:

International enabling frameworks. The federal government, with support from industry, labs, and academia, should continue strong and effective international engagement on SMRs. In particular, to influence the development of international enabling frameworks for these technologies.

Alongside these priority recommendations, the Roadmap identified additional, detailed recommendations for essential enablers in Canada. These comprehensive recommendations for actions by all essential enablers are set out in Annex A.

The time to act

Early-mover advantage will be critical to capturing global market share. Demonstration projects and early deployments in Canada will be important to anchor benefits—science and technology, intellectual property, supply chain, jobs—in Canada. All other major nuclear nations are making strategic investments in order to position their domestic industries to capitalize on the opportunity. Early action on demonstration and deployment in Canada will be important to keep innovation opportunities and investment from moving abroad.

From Roadmap to Action

What's next? The Roadmap is our answer: it sets out priority recommendations for early action, as well as comprehensive recommendations for all essential enablers, which we call "Team Canada." It calls for essential enablers to respond to the recommendations with commitments for concrete action.

Three next steps for turning the Roadmap into action:

Step 1. Essential enablers to take early action on priority recommendations.

Step 2. Team Canada to respond to comprehensive recommendations with commitments for further concrete action in a Canadian SMR Action Plan.

Step 3. Industry and governments to co-create Canada's Nuclear Energy Advisory Council consisting of senior executives and Ministers to review progress annually and discuss ongoing strategic priorities for the future.

This Roadmap is not the end of the road, it is the beginning. It is a call to action for Canada.

And the future looks bright.

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1. Why an SMR Roadmap — The opportunity and key considerations

To understand why we undertook this SMR Roadmap, we need to understand the context for nuclear energy in Canada.

Nuclear energy in Canada is a strategic asset. Canada is a Tier 1 nuclear nation[1], with a full-spectrum industry that we leverage for significant economic, geopolitical, and social and environmental benefits.

The nuclear sector contributes $6 billion to the economy annually[2], providing 30,000 direct jobs[3]. Our longstanding leadership in nuclear science and technology is a beachhead for strategic international engagement with key partners and it maintains Canada's influence at strategic, multilateral tables on issues affecting Canada's foreign policy and national security.

Nuclear energy is also an important part of Canada's non-emitting energy mix and will play an important role in achieving Canada's low-carbon future. All told, nuclear energy provides 15% of Canada's electricity supply (approximately 60% in Ontario and 33% in New Brunswick) and avoids over 50 million tonnes of carbon dioxide every year in Canada—that's equal to nearly a quarter of Canada's greenhouse gas reduction target under the Paris Agreement[4]. Canada is the second largest producer of uranium in the world, and our exports avoid over 500 million tonnes of carbon dioxide emissions the world over.

And the future for nuclear in Canada looks bright, with the Province of Ontario investing $26 billion to refurbish the province's nuclear reactors—investments that will sustain and grow the sector into the next decade. At Chalk River Laboratories, the federal government is investing $1.2 billion to revitalize the birthplace of Canada's nuclear sector and the centre of Canadian leadership in nuclear science and technology for the past 60 years. In Atlantic Canada, New Brunswick has invested $10 million—with an additional $10 million matched from industry—to establish an SMR nuclear research cluster in the province.

Canada has:

- Longstanding leadership in nuclear science and technology.
- A full-spectrum industry with a supply chain primed for growth.
- Revitalized labs with new capabilities for research and innovation.

All this begs the question:
What's next?

[1] Tier 1 nuclear countries are often defined as those with full-spectrum nuclear capabilities (research reactors, power reactors, fuel manufacturing capabilities, R&D, etc.). Other Tier 1 countries include US, France, UK, Russia, and China.
[2] GDP contribution based on data from Statistics Canada's Environmental and Clean Technology Products Economic Account (2017) with uranium sector data from Natural Resources Canada (2018).
[3] Employment estimates from Canadian Manufacturers and Exporters (2012).
[4] See https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Small Modular Reactors, or SMRs, could be the answer.

In Canada and around the world, markets are signalling a need for smaller, simpler, and cheaper nuclear energy. At the same time, demand for nuclear energy is poised to grow with global action on climate change: the International Energy Agency projects that nuclear energy will need to double globally within 20 years to meet a 2-degree Celsius climate target.[5]

> *The International Energy Agency projects that **nuclear energy will need to double** within 20 years to meet a 2-degree Celsius climate target.*

SMRs are not the same nuclear reactors we have seen in the last half-century. They are innovative technologies that promise to help enable the clean energy transition, with designs that are:

- **Smaller**, with a lower up-front capital investment than traditional nuclear power plants;
- **Simpler**, involving modular designs and a fleet-based approach to control costs and shorten project schedules;
- **Cheaper** to compete with alternatives, enabling new applications such as hybrid nuclear-renewable energy systems, with SMRs serving as a dynamic, load-following source of energy, paired with variable renewables on a decentralized grid.

Many SMR designs also offer enhancements to further improve safety, performance, and prevention of accidents.

With SMRs, we could witness the emergence of a new industrial subsector, and first-movers in this market will lock in significant economic, geopolitical, and social and environmental benefits in this area of high-tech innovation with substantial export potential.

For Canada, this could mean:

- Anchoring domestic and global research and development at Canadian Nuclear Laboratories through SMR demonstration projects, accruing benefits from Intellectual Property and positioning Canada as a world-class hub for innovation on SMRs;
- Securing the position of Canada's supply chain in global markets to fortify manufacturing, expert nuclear services, and jobs in Canada;
- Maintaining Canada's influence at strategic, multilateral tables on issues affecting Canada's foreign policy and national security;
- Demonstrating regulatory excellence internationally and influencing the development and enhancement of international regulatory guidance on SMRs; and
- Attracting inclusive, diverse, global talent and next-generation leadership to Canadian universities and organizations—building the future pipeline of innovators and professionals needed to ensure a strong and safe nuclear sector in Canada.

[5] International Energy Agency (2017) *World Energy Outlook*, Paris, France.

The federal government used its convening power to bring together provinces, territories, and utilities because Canada has a narrow window to lead in the emerging domestic and global market for SMRs.

Competitors are moving quickly with significant investments, and the lead time for development of SMR technologies and the timing of key decisions mean that the time to act is now. Decisions made by industry and governments in the next year will determine whether Canada will lead or cede the emerging global SMR market.

Through innovative, collaborative national, sub-national, and industry leadership, this SMR Roadmap addresses all the relevant considerations for enabling the development and commercialization of SMRs in Canada: regulation, liability, waste management, economics, Indigenous and public engagement, and technology assessment.

In essence, this Roadmap lays the groundwork for the co-creation of an SMR action plan for Canada: a plan involving all the essential enabling partners of this technology.

*Decisions **in the next year** will determine whether Canada will **lead or cede** the emerging global SMR market.*

What's next?

The Roadmap is our answer.

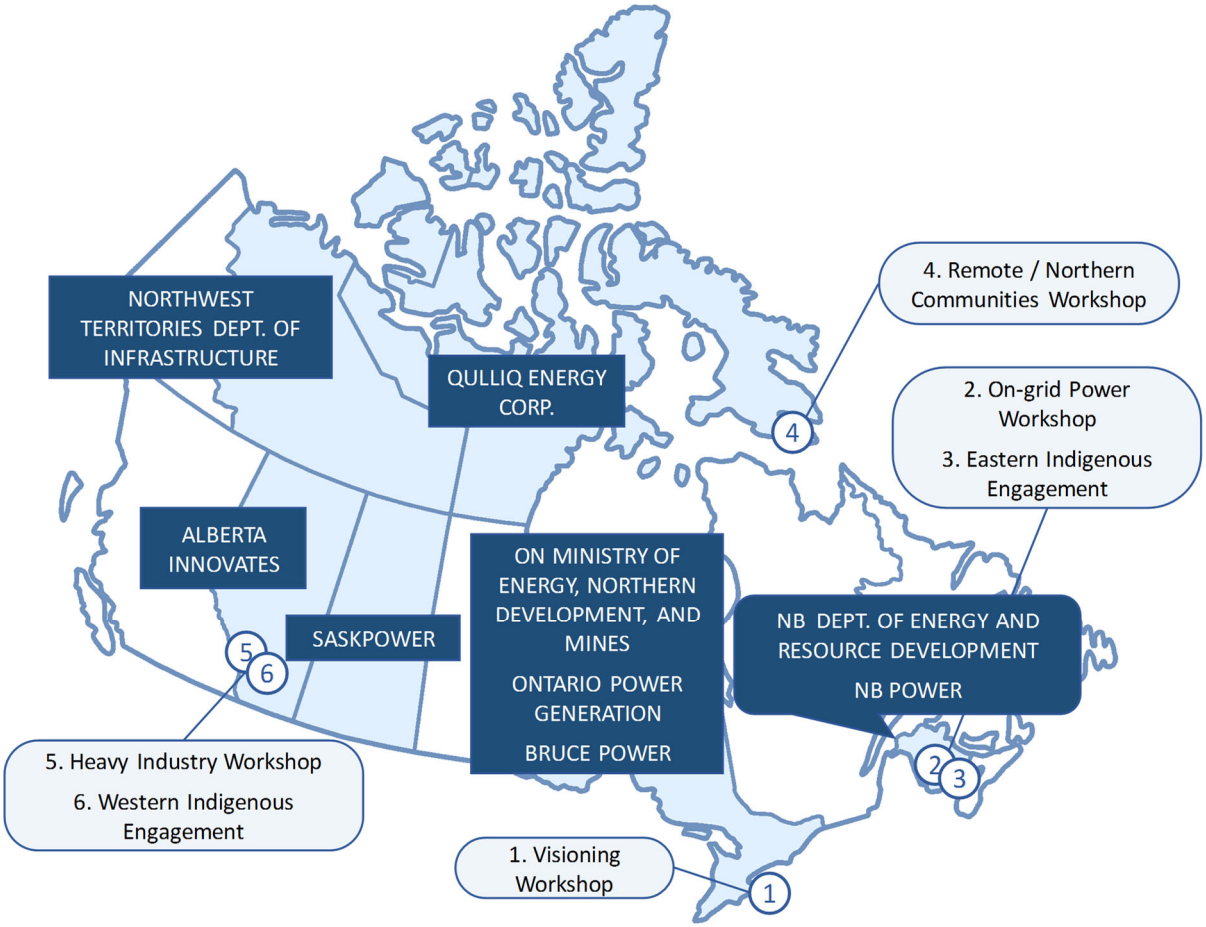
2. What We Did — A collaborative national approach

With an eye to the opportunity set out earlier, key enablers from across Canada's nuclear sector came together to undertake a pan-Canadian SMR Roadmap: an example of innovative, collaborative leadership to co-create a common vision for SMRs and lay the foundation for Canada's success in this field.

The Roadmap was built with a collaborative, national approach, both with respect to its leadership and engagement. All interested provinces, territories, and power utilities from across Canada were invited to join the Steering Committee, ensuring that a range of interests and potential applications were considered.

SMR ROADMAP STEERING COMMITTEE

- Natural Resources Canada *(Chair, non-voting)*
- Alberta Innovates
- Bruce Power
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Northwest Territories Department of Infrastructure
- Ontario Ministry of Energy, Northern Development and Mines
- Ontario Power Generation
- Qulliq Energy Corporation
- SaskPower
- Atomic Energy of Canada Limited *(non-voting)*



Leveraging the convening power of the federal government, Natural Resources Canada served as the Chair of the Steering Committee and participated as a non-voting member. Atomic Energy of Canada Limited (AECL) also participated on the Steering Committee as a non-voting member. The CNA served as the Secretariat for the Roadmap.

Work under the Roadmap took a number of tracks, involving **extensive engagement** with industry and other stakeholders through technical workshops; **initial dialogues** with Indigenous communities and organizations; and **expert analysis** by five working groups to address the key questions around SMR deployment.

Extensive engagement with industry and end users

The Roadmap held technical sessions in different regions across Canada to gain perspective on the unique realities and needs of industries and end users, dealing with potential on-grid, off-grid, and heavy industry applications for SMRs.

In sum, over 130 individuals representing 40 organizations across 10 sectors and subsectors participated. These included: federal departments and agencies; provincial and territorial governments; laboratories and academia; labour unions; supply chain and industry; and a range of potential end users, including utilities, and extractive and heavy industries.

Initial dialogue with Indigenous communities and organizations

At the outset of the SMR Roadmap process, the Steering Committee identified engagement with Indigenous groups in Canada as an essential component of the process and committed to beginning a constructive and respectful conversation with Indigenous peoples about their interests, priorities and concerns related to SMR development. The objective was to begin a dialogue on SMRs, with the understanding that more engagement will be necessary before any SMR proposals could be considered.

Over 50 individuals from 14 Indigenous organizations and communities participated in Indigenous engagement sessions, which took place in New Brunswick, Alberta and Nunavut, and focused on national, regional and sub-regional organizations.

Expert analysis

Five expert working groups reporting to the Steering Committee were created to address key areas of analysis for SMR deployment. These comprised 18 organizations, each with unique expertise to bring to bear.

WORKING GROUP	MANDATE AND KEY ACTIVITIES	MEMBERS
Technology	Mandate: Identify SMR technology categories that could meet stakeholder requirements with regard to: size, energy output, technology readiness, deployment timelines, geographical considerations, and supply chain, among others. Key Activities: ■ Analysis of technology categories against Canadian SMR end-user requirements ■ Identification of gaps in research and development for preferred technology categories	■ Alberta Energy ■ Atomic Energy of Canada Limited ■ Bruce Power ■ Canadian Nuclear Laboratories ■ JMH Technology Consulting ■ Natural Resources Canada ■ New Brunswick Power ■ Ontario Ministry of Energy, Northern Development and Mines ■ Ontario Power Generation ■ SaskPower ■ Canadian Nuclear Safety Commission
Economics and Finance	Mandate: Produce cost estimates for SMR technologies for profitability and break-even analysis. Key Activities: ■ Literature review and/or meta analysis of available literature, data, and methodological approaches for conducting cost estimates ■ Develop consensus on methodological approach to be used ■ Sensitivity analysis with alternative financing and policy scenarios	■ Alberta Innovates ■ Canadian Nuclear Association ■ Canadian Nuclear Laboratories ■ MZConsulting ■ Natural Resources Canada ■ Ontario Ministry of Energy, Northern Development and Mines ■ Ontario Power Generation ■ SaskPower
Indigenous and Public Engagement	Mandate: Identify current trends in public opinion on nuclear energy and SMRs, and outline best practices for Indigenous and public engagement in SMRs. Support and provide advice on the Roadmap's direct Indigenous engagement undertaken through sessions across Canada. Key Activities: ■ Literature review on public opinion and on public engagement in nuclear projects, in particular SMRs ■ New analysis of public opinion research raw data, where possible, and proposals for new outreach and engagement ■ Identification of Indigenous and public engagement best practices for Canadian SMR applications	Indigenous engagement advisors from: ■ Alberta Energy ■ Atomic Energy of Canada Limited ■ Bruce Power ■ Canadian Nuclear Association ■ Canadian Nuclear Laboratories ■ Natural Resources Canada ■ New Brunswick Power ■ Nuclear Waste Management Organization ■ Ontario Ministry of Energy, Northern Development and Mines ■ Ontario Power Generation ■ Qulliq Energy Corporation ■ SaskPower ■ Canadian Nuclear Safety Commission

WORKING GROUP	MANDATE AND KEY ACTIVITIES	MEMBERS
Waste Management	Mandate: Identify waste disposal and storage considerations for Canadian SMR applications Key Activities: ■ Review Canada's waste management framework (policies, legislation, and regulations) for SMR readiness and identify any gaps ■ Analysis of waste streams, short- and long-term waste transportation, disposal and storage requirements, and decommissioning considerations ■ Identification of gaps in research and development for SMR waste	■ Atomic Energy of Canada Limited ■ Canadian Nuclear Laboratories ■ Natural Resources Canada ■ New Brunswick Power ■ Nuclear Waste Management Organization ■ Ontario Ministry of Energy, Northern Development and Mines ■ Ontario Power Generation ■ Canadian Nuclear Safety Commission
Regulatory Readiness	Mandate: Identify barriers and challenges to the deployment of SMRs under current regulatory regime Key Activities: ■ Comprehensive review of federal, provincial, and territorial legislation and regulations for SMR readiness ■ Analysis of the current Canadian regulatory regime for SMR deployment ■ Identification of gaps in regulatory regime, and proposed way forward	■ Atomic Energy of Canada Limited ■ Bruce Power ■ Canadian Nuclear Laboratories ■ CANDU Owners Group ■ Environment and Climate Change Canada ■ Natural Resources Canada ■ New Brunswick Power ■ Ontario Power Generation ■ Canadian Nuclear Safety Commission

The Roadmap also took advantage of analyses from a variety of sources. It unfolded in close coordination with various parallel initiatives on SMRs, and benefited from their work:

- CNSC's workshop on graded approach and consultations on SMR licensing issues, such as its discussion paper on SMR regulatory strategy, approaches, and challenges, and subsequent public report and presentations.
- Canadian Nuclear Laboratories' Request for Expressions of Interest (RFEOI) and Invitation for Applications to assess and pursue viable options for SMR demonstration projects in Canada.
- CANDU Owners Group (COG) SMR Technology Forum, engagement with nuclear operators and vendors to review SMR licensing pathways in Canada.
- The Roadmap also built on the work of Canadian industry stakeholders, such as the Canadian Nuclear Association's 2017 "*Vision 2050: Canada's Nuclear Advantage*."

Other key initiatives that unfolded in parallel included CNSC's efforts to ensure regulatory readiness for SMRs in Canada, CNSC's pre-licensing engagement with SMR vendors, and Vendor Design Reviews.

Key Questions and Areas of Analysis Addressed by the Roadmap

All told, through extensive engagement with industry and other stakeholders, initial dialogue with Indigenous communities and organizations, and expert analysis, the Roadmap addressed key areas of analysis surrounding SMR deployment, such as:

- **Stakeholder and Indigenous engagement**, with a focus on demand-side, community and end-user requirements
- **Economic analysis,** including market valuation, costing, and financial models
- **International strategies** to understand Canada's niche and the role of global partnerships
- **Regulatory readiness**, enabling frameworks, and transportation policy
- **Waste management** and long-term storage liabilities
- **Social and environmental factors**, including gender-based analysis, strategic environmental assessments, carbon pricing and climate change
- **Technology assessments**, advantages, disadvantages, and risks

3. What We Heard — Engagement across Canada

3.1 Visioning

The Roadmap kicked off with a visioning exercise held in March 2018, in Mississauga, Ontario, with 30 participants from 16 organizations.

The main objectives of the Visioning Session were to:

- Ensure the proper focus, structure, content, and participation for the Roadmap;
- Begin to map out the stakeholder universe;
- Inform the activities of the five Roadmap working groups;
- Set the foundation for the subsequent Roadmap workshops; and
- Begin to identify the key elements and key considerations for an SMR vision for Canada.

The Visioning Session included a series of presentations and roundtable discussions, which led to a fulsome discussion of what a shared vision for Canadian leadership on SMRs could look like.

There was consensus on a number of preliminary points, which formed the basis for discussion:

- There are at least **three potential applications** for SMRs in Canada: on-grid, heavy industry, and remote communities. Each of these has different energy demands and it is not likely that a single design could meet all of these needs.

VISIONING SESSION PARTICIPANTS

- Alberta Innovates
- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- Inuit Tapiriit Kanatami *(observer)*
- JMH Technology Consulting
- MIRARCO Mining Innovation
- Mitacs
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Nuclear Waste Management Organization
- Ontario Ministry of Energy, Northern Development and Mines
- Ontario Power Generation
- Qulliq Energy Corporation
- SaskPower
- Suncor Energy

- **A fleet approach is desirable**, involving a relatively small number of designs. By taking advantage of project experience and common supply chains, it would help keep costs down and shorten construction schedules for future projects. Coordination of procurement approaches across jurisdictions could help enable a fleet approach.
- Governments are both **stakeholders and potential customers**: they will play an important role in bringing SMRs to fruition, but could also purchase SMRs, for example, to power government sites in remote locations.
- There are a **range of pathways and options for demonstration**, including a variety of different models of public and private cooperation.

As the discussion continued, key elements of a shared vision began to emerge:

- Participants saw a future involving **Canadian leadership in the demonstration and deployment of SMRs** domestically and as a key player on the export market, capturing economic, geopolitical, social and environmental benefits for Canada. It was agreed that Canada has a significant opportunity in SMRs and that quick action will be necessary to seize it.
- SMR demonstration and deployment could **help create jobs and bolster energy security** while building a robust domestic supply chain and seizing export opportunities, supporting economic development in Ontario and Atlantic Canada and potentially extending to other regions over time.
- SMRs could serve as a beachhead for **strategic engagement with other countries**, while reinforcing Canada's traditional leadership role in multilateral nuclear engagement (e.g. International Atomic Energy Agency, Nuclear Energy Agency) and allowing us to continue to influence norms and frameworks. Canada's world-leading nuclear regulator, the CNSC, was also seen as a potential standard-setter.
- SMRs are the next step in building **on Canada's leadership in nuclear energy innovation** which has historically given Canada **strong and effective influence in international bodies dealing with nuclear and national security issues** such as respect to non-proliferation and safety.
- As a source of inexpensive, clean energy, SMRs could also **aid in meeting Canada's climate change objectives** by reducing reliance on fossil fuels for baseload electricity generation.

Participants agreed to move forward and continue to examine this opportunity, with an eye toward a number of the key considerations that had been identified. Each of these fell under broad themes that would continue to re-emerge throughout the Roadmap process.

<u>Demonstration and deployment</u>

- **First of a kind (FOAK) and so-called "N-th" of a kind (NOAK) issues:** What are the unique hurdles faced by a first project (i.e. FOAK), in terms of technology, financing, construction, and other issues? How can these be mitigated as we move forward with future projects that can incorporate learning and efficiencies to reduce project schedules and costs (i.e. NOAK)?
- **Economics and finance questions:** How competitive could SMRs be in comparison to other clean energy sources? What are the pathways to financing these projects? How can competitive procurements across jurisdictions and markets be coordinated to help realize the cost benefits of fleets?
- **Waste management considerations:** Given the range of potential applications and sitings, what work needs to be done to ensure resulting waste is appropriately managed?

Policy, legislation and regulations

- **Importance of regulatory certainty from all regulators that have a role in SMRs:** Is the existing regulatory framework robust enough for deployment of SMRs? Are there any unintentional barriers from the past focus on large reactor projects?

Capacity, engagement and public confidence

- **Engagement, capacity building, and public confidence:** Does Canada have the expertise to support a world-leading SMR industry? What steps are needed to sustain and grow Canada's capacity in nuclear innovation? Are Canadians open to discussing SMRs?

International partnerships and markets

- **Importance of strategic partnerships within Canada and internationally:** Who are the essential enablers, in Canada and abroad? What does partnership between them need to look like to realize these opportunities?
- **Size of domestic and international markets:** How big is the opportunity? Should Canada's focus be on domestic applications or are there more benefits on the global export market?

3.2 Indigenous Engagement

Indigenous engagement workshops took place in New Brunswick, Alberta, and Nunavut.

Indigenous peoples have their own backgrounds, views, interests and drivers. A range of views were expressed during these engagement sessions. That said, some common themes have started to emerge through the discussions:

- The importance of historical legacy and the need for respect and building trust.
- Priorities should be placed on building constructive relationships with Indigenous peoples, including in the form of business partnerships that allow for revenue sharing and economic development.
- Environmental stewardship and long-term effects are priorities: some characterized this as a “seven generations lens.” While this relates in part to global climate change, an equally important focus was on local effects such as on land, water, air and biodiversity.
- There were questions and concerns about nuclear safety, waste management, and transportation of materials, which were similar to those often expressed by the general public.
- Nuclear energy can be a challenging subject. While some participants were open to the option of SMRs, others were not. Many participants were skeptical of nuclear energy, and some participants who were open to the option acknowledged the challenge of discussing SMRs in their home communities.
- Indigenous youth have a role to play in Canada’s transition toward low-carbon energy, and priority should be placed on developing and supporting opportunities for Indigenous youth in the nuclear industry.

The SMR Roadmap Steering Committee understands that Indigenous participants provided initial, and not final, feedback on their views related to SMRs. As engagement continues, Indigenous peoples will have the opportunity to provide additional feedback.

New Brunswick First Nations

At the workshop held in Saint John, New Brunswick on April 18, 2018, there were 16 participants from seven communities and organizations.

EASTERN INDIGENOUS ENGAGEMENT

- Kopit Lodge – Elsipogtog First Nation
- Mi'gmawe'l Tplu'taqnn Inc.
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Ontario Power Generation
- Qulliq Energy Corporation

It was found that there is a high level of knowledge and experience with regard to nuclear energy in the region. Priorities were placed on reciprocity, revenue sharing, climate change mitigation, and keeping a small land footprint.

Some concerns were raised relating to the long-term management and transportation of waste. It was emphasized that SMRs must be safe, with a minimal impact on the environment, and confer appropriate benefits to Indigenous communities.

There was some interest in potential business opportunities, and some participants expressed interest in perhaps siting an SMR in a community and selling power back to the grid, but recognized that there would be challenges in ensuring community support for such a project.

Inuit Communities in Nunavut

The Northern and Remote Communities Workshop, held on May 10 and 11 in Iqaluit, Nunavut, had a focus on Inuit engagement. Nunavut has a unique context with its own challenges: it is entirely off-grid, reliant on diesel generation, and the majority of the population has Inuktitut as their mother tongue. Inuktitut is not widely spoken elsewhere and technical terms for some nuclear technology do not exist in that language.

NORTHERN AND REMOTE COMMUNITIES WORKSHOP PARTICIPANTS

- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- City of Iqaluit
- Canadian Nuclear Safety Commission
- Hamlet of Arctic Bay
- Hamlet of Clyde River
- Hamlet of Hall Beach
- Hamlet of Pangnirtung
- Member of Legislative Assembly for Iqaluit
- Natural Resources Canada
- Northwest Territories Department of Infrastructure
- Nunavut Department of Community and Government Services
- Nunavut Department of Environment – Climate Change Secretariat
- Nunavut Research Institute / Nunavut Arctic College
- Ontario Power Generation
- Qulliq Energy Corporation
- Yukon Research Centre / Yukon College
- Inuit Tapiriit Kanatami *(observer)*

As Nunavut is not a nuclear power jurisdiction, it was found that there was little familiarity with nuclear energy as a means to generate electricity. However, there is some prior Inuit experience with uranium exploration and development. Though not all participants were interested in the option

of SMRs, others were open. Top of mind, participants noted the historical legacy of government and industry projects leaving behind harmful contaminants, and emphasized that this legacy is still impacting communities today. In this context, participants noted their concerns about the potential impact of nuclear power on land and wildlife, including traditional food sources.

Generally, there was an emphasis on the need for integrated, holistic energy planning on a community basis, considering all options in concert: renewables, SMRs, locally sourced natural gas, energy efficiency, storage, etc.

Particular emphasis was placed on the desire to enable engagement by Inuit on equal terms, rather than relying on information provided by outside organizations. Inuit participants expressed a desire to hire their own advisors who could provide them with impartial information and advice, and for capacity building to develop the skills and knowledge among Inuit to engage with outside organizations on issues related to SMRs. Some participants expressed interest in visiting Indigenous communities in Ontario, New Brunswick and Saskatchewan to learn from their experiences with nuclear and uranium mining, and with SMRs if and when they are deployed in the south of Canada.

Alberta and Saskatchewan First Nations

At the workshop held on June 18, 2018 in Calgary, Alberta, there were eight participants from seven communities and organizations.

WESTERN INDIGENOUS ENGAGEMENT

- Cote First Nation
- Federation of Sovereign Indigenous Nations
- First Nations Power Authority
- Prince Albert Grand Council
- Samson Cree Consultation Unit
- Saskatchewan First Nation Natural Resource Centre of Excellence
- Tsuut'ina Nation (elder)
- Alberta Energy
- Atomic Energy Canada Limited
- Natural Resources Canada
- Ontario Power Generation
- SaskPower

The high cost of power on reserve lands is a burden, and retaining capacity on reserve lands is a priority. Although Alberta and Saskatchewan are not presently nuclear power generating jurisdictions, groups were found to have a relatively high level of familiarity with nuclear energy because of their experience with the uranium mining sector in Saskatchewan. SMRs were seen as a potential clean energy option, but it was emphasized that there is a need to know the implications of potential worst case scenarios.

As with elsewhere, there was an emphasis on the need for business partnerships with First Nations, for which they have a strong capacity. A variety of potential models were discussed, including regional ownership models.

ONGOING ENGAGEMENT

Indigenous engagement that began under the SMR Roadmap was the beginning of a dialogue with Indigenous peoples on this subject. Members of the SMR Roadmap Steering Committee will build on this initial engagement to meet with interested groups and communities, including First Nations and Métis groups in Ontario, to encourage a meaningful, two-way dialogue on the potential for SMRs in Canada's clean energy mix.

3.3 On-Grid Applications

This was the first of three workshops focused on distinct markets and applications in Canada, which brought together relevant potential end users, demand-side stakeholders, and other key enablers.

ON-GRID APPLICATIONS WORKSHOP PARTICIPANTS

- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- Canadian Nuclear Safety Commission
- Canadian Nuclear Society
- Canadian Standards Association Group
- CANDU Owners Group
- IBEW-37 (labour union)
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Nuclear Insurance Association of Canada
- Nuclear Waste Management Organization
- Ontario Ministry of Energy, Northern Development and Mines
- Ontario Power Generation
- Opportunities New Brunswick
- Organization of Canadian Nuclear Industries
- Power Workers Union
- Qulliq Energy Corporation
- SaskPower
- Suncor Energy
- University of New Brunswick

This workshop focused on on-grid applications for SMRs and brought together 42 participants from 22 organizations in Saint John, New Brunswick on April 19 and 20, 2018.

The workshop's objective was to have a collaborative discussion on technical requirements for on-grid SMRs, covering the following questions:

- What are the regional and national opportunities for on-grid power generation by SMRs?
- What characteristics are required for on-grid SMRs?
- What are the opportunities and risks for the Canadian supply chain?
- What policy levers and industry contributions would be necessary to support SMRs in this market?

There were a number of key takeaways from the workshop:

- **Different provinces are interested for different reasons**: New Brunswick and Saskatchewan have expressed interest in SMRs to help reduce emissions from electricity generation and reliance on fossil fuels, while Ontario may be interested in meeting demand in the longer-term, should the need arise.
  - The Province of New Brunswick has invested $10 million to support research and development of two advanced SMR technologies which, if successful, could lead to one or more commercial demonstration units at the Point Lepreau site in the 2030 timeframe.

- SMRs have a number of attributes of interest to potential users that set them apart from other options:
  - They are a reliable, **clean**, non-emitting source of energy, with costs that are predictable and competitive with other alternatives;
  - SMRs are scalable, fitting a number of different demand profiles, and are able to respond to growth in demand;
  - They are high-tech, create good, stable jobs (especially in Science, Technology, Engineering, and Math, or "STEM" fields), and have significant potential to contribute to Canada's economy;
  - SMRs have the potential to replace economic activities lost when phasing out conventional coal-fired electricity generation;
  - They have **potential to complement variable renewables**, such as wind and solar, and to integrate with smart grids and energy parks. Rather than just competing with variable renewables, SMRs could **enable them**. They can support **grid modernization** (e.g. smart grid, load growth) and help replace existing aging infrastructure.
- There is a **need for appropriate risk-sharing between private and public partners** to support a demonstration project, which carries unique risks.
- It is **important to consider SMRs in a global context** where Canada is just one of many players: there is a global market, with global value chains and significant opportunities on the export market.
- Key enablers, especially industry, end users and investors, **consider regulatory clarity and certainty to be a key issue**. Given the timelines for SMR projects and large associated investments, they must have confidence in the process, including with respect to transparency, costs and timelines.
- Projects will require Indigenous and public **confidence and support**.
- **It is necessary to define a waste management strategy** that reduces/recycles waste, and that factors in all relevant costs (e.g. decommissioning, transportation, etc.).
- **Canada's nuclear supply chain must be ready to pivot** to support a growing SMR industry, supporting a number of different designs. This includes considerations like supporting different fuel types and reactor systems, as well as managing different kinds of waste.
- **Life cycle research and development support** (i.e. through Canadian Nuclear Laboratories' work with the Canadian nuclear research ecosystems) will be a tremendous asset to Canada.

3.4 Northern and Remote Communities

On May 10 and 11, 2018, the Roadmap came to Iqaluit, Nunavut to engage with Northern and Indigenous groups on the potential for SMRs in off-grid communities, particularly as it relates to reducing reliance on aging diesel generators. Thirty people from 19 organizations participated.

The purpose of the workshop was to initiate preliminary discussions with participants from Nunavut and Northern communities about their future energy needs and explore whether nuclear energy from SMRs could be an option in addressing those needs. Some communities have explored the use of renewables to supplement their energy supply, but these are generally in the early stages. There is still ample time to consider other options as technology options mature. This was an opportunity to listen directly to Northern and Indigenous communities to hear their views and priorities and to share their perspectives.

With respect to current and future power generation, participants raised a number of points, including issues that SMRs could potentially alleviate:

- **Reliability:** Outages in the North are considered a liability and can be challenging to fix, particularly during winter storms. Further, there is also a limited window every summer to bring in the diesel needed for the year into Nunavut. Not receiving this diesel prior to winter would have a significant impact on reliability.
- **Demand Growth:** Population is increasing rapidly and the mining industry has increased operations in Nunavut in recent years. This has resulted in increased energy demands and stress on the current system.

NORTHERN AND REMOTE COMMUNITIES WORKSHOP PARTICIPANTS

- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- City of Iqaluit
- Canadian Nuclear Safety Commission
- Hamlet of Arctic Bay
- Hamlet of Clyde River
- Hamlet of Hall Beach
- Hamlet of Pangnirtung
- Member of Legislative Assembly for Iqaluit
- Natural Resources Canada
- Northwest Territories Department of Infrastructure
- Nunavut Department of Community and Government Services
- Nunavut Department of Environment – Climate Change Secretariat
- Nunavut Research Institute / Nunavut Arctic College
- Ontario Power Generation
- Qulliq Energy Corporation
- Yukon Research Centre / Yukon College
- Inuit Tapiriit Kanatami *(observer)*

- **Energy Conservation:** Currently, energy costs are highly subsidized for many in Nunavut. This has led to minimal economic incentives for Northerners to conserve energy.
- **Climate Change:** Northern communities see the impacts of climate change more directly than the rest of Canada, though any action taken by them would have little impact on climate change overall.
- **Potential Environmental Impacts:** The potential environmental impacts of any proposed energy project will need to be considered and scrutinized. Impacts of a potential accident, on the land, water, and wildlife is a major concern to Northerners. Fisheries make up one of the largest industries in the North, and wildlife such as seal, whale and caribou have always been, and are still, critical food sources to Inuit.

- **Ownership/Partnership:** In the past, investments made in the North, and resulting benefits, have left the area. Any new project or initiative should look for ways to ensure that Inuit have an ownership or partnership stake so that benefits remain in the region.

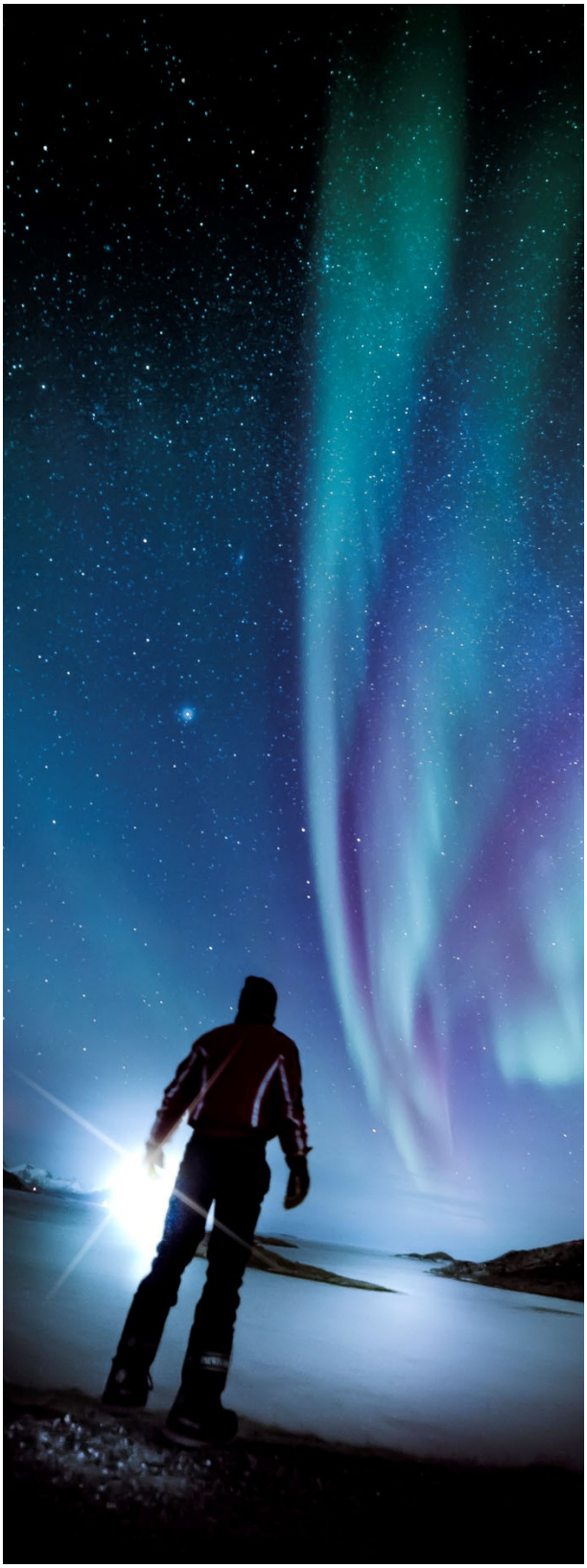
With respect to future engagement, the following guidance was provided by participants:

- **Preparation:** Participants need to prepare themselves prior to the engagement. In particular, Southerners should read the "*Truth and Reconciliation Commission of Canada: Calls to Action,"* before the meeting. Further, prepare clear, relevant and respectful materials and information, and translate those materials into Inuktitut. Also, be aware and respectful of historical context and legacy concerns.
- **Engage within the Communities:** Reach out to the Hamlets' councils and plan a visit directly with the communities. Be prepared to have a broader discussion about community priorities and energy needs, and present SMRs as a potential option. There may be apprehension about nuclear energy in some communities.
- **Holistic Community-based Energy Planning:** Support community-based energy planning discussions that put forward all options so communities can make informed decisions about their future energy mix.
- **Build Trust:** Building trust with Northerners would be the most critical factor in successful engagement. Look for ways to connect and partner with the communities, and have the right person who is fluent in Inuktitut speaking in the communities. Also, ensure the terminology and language being used is clear and honest.

There were a number of key takeaways from the session:

- Priorities in the North include: environmental issues (both local and climate change), preserving culture and social development, ensuring energy security, and reducing the cost of energy.
- The North has **unique challenges** not faced by other potential markets for SMRs:
  - Given its remoteness, logistics are a challenge. There is also a short shipping season;
  - Communities are small and distant from one another, and many are only connected by air;
  - The most common language is neither English nor French but Inuktitut, creating language barriers for outside organizations;
  - There is lower direct experience and familiarity with nuclear energy in the North than in existing nuclear jurisdictions. People living in Nunavut must be provided with adequate information and opportunities to ask questions before projects can be considered;
  - Historical context is key: it is important to build trusting, collaborative relationships with Northerners, especially in the spirit of reconciliation.

- While some communities are not interested in the prospect, **others may be interested** in continuing the discussion. Some have requested further engagement, capacity building and feasibility studies.
- Utilities and government departments and agencies (notably the Qulliq Energy Corporation and the Northwest Territories Department of Infrastructure) are looking at **all** options and are interested in continuing to engage.
- It is important to **keep all options on the table** for reducing reliance on diesel (SMRs, wind, solar, small hydro, etc.).
- While there is potential for deployment in the North, the most probable successful pathway would see demonstration and deployment in Southern Canada first.
  - However, **it is crucial not to postpone engagement with Northerners**. Any delay in engagement would risk decisions being made exclusively in the South without consideration of Northern priorities and needs.
  - There is a need to engage Northerners in decisions being made in the South, so that future options are relevant and applicable to Northern needs.



3.5 Heavy Industry Applications

The Roadmap then turned to discussion of potential heavy industry applications for SMRs, particularly in areas that presently rely heavily on heat and power from fossil fuel generation, such as mining, and oil and gas extraction. A Workshop was held in Calgary, Alberta on June 19 and 20, 2018, which included 60 participants from 40 diverse organizations.

Discussion at the workshop involved a wide range of topic areas including: current nuclear operations in Canada; potential SMR applications (i.e. mining, oil sands, on-grid); current SMR research and development activities; challenges to SMR deployment (i.e. economics, regulatory, waste); and how Canada's supply chain can support SMR design and deployment. The following are some of the common themes that surfaced from these discussions regarding the potential deployment of SMRs.

HEAVY INDUSTRY APPLICATIONS WORKSHOP PARTICIPANTS

ACADEMIA
- CESAR
- Saskatchewan Research Council
- University of Regina

FINANCE
- GH Enterprise Technology
- Gowling WLG
- MZConsulting

LABOUR
- Power Workers Union

MINING
- McEwen Mining
- MIRARCO

OIL & GAS
- Canadian Association of Petroleum Producers
- Canadian Oil Sands Innovation Alliance
- Conoco Phillips
- Imperial Oil
- PTAC
- Suncor Energy

NUCLEAR INDUSTRY
- Aecon
- Cameco Corporation
- Canadian Nuclear Association
- Canadian Nuclear Laboratories
- Hatch
- Organization of Canadian Nuclear Industries
- PCL
- SNC-Lavalin

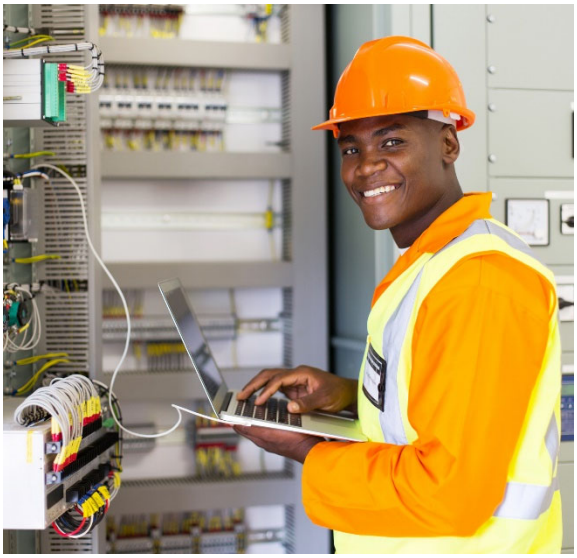
UTILITIES
- Alberta Electric System Operator
- ATCO Electric
- Bruce Power
- New Brunswick Power
- Ontario Power Generation
- SaskPower

GOVERNMENT
- Alberta Energy
- Alberta Environment and Parks
- Alberta Innovates
- Atomic Energy of Canada Limited
- Canadian Northern Economic Development Agency
- Canadian Nuclear Safety Commission
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development

OTHER
- Former CEO, AECL

Key takeaways were:

- **Heavy industry applications have common energy needs** regardless of the industry they serve: high quality steam and energy security including combined heat and power.
- Economically, there are two distinct sub-markets, each with unique demands:
  1. Off-grid/off-diesel, e.g. mining;
  2. On-grid/competing with gas, e.g. oil sands;
- **A successful demonstration project will be critical** as a proof of concept before industry can seriously consider the option.
- Most heavy industry stakeholders are not interested in developing nuclear expertise or operating SMRs themselves. Instead, they would prefer to partner with experienced nuclear operators or have an experienced operator license, build, operate, own, and sell combined heat and power **as a service**.
- There is **strong potential in the mining sector**, which has significant energy needs that are currently being met by diesel. There is a need for specific engagement in SMRs in this sector building on the Roadmap. The potential for SMR deployment in other industrial applications such as in the oil sands, will depend on carbon pricing initiatives, as these are currently serviced by natural gas.
- SMRs would be a long-term commitment and industry is sensitive to risk. **Regulatory clarity and manageable regulatory timelines** are key to promoting serious consideration of SMRs. It is also crucial to ensure that SMR planning and licensing timelines align with heavy industry planning timelines.



4. What We Learned — Key findings from expert working groups

4.1 Technology

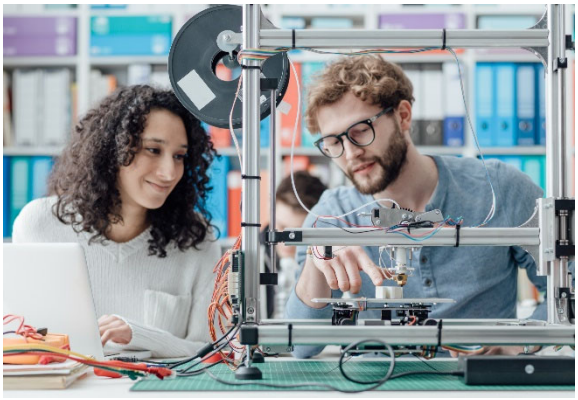
The Technology Working Group examined the following lines of inquiry:

- What SMR technologies are being developed?
- Of these, which would bring most benefit to end-user needs in Canada, and which would enable Canada to capture the greatest value from emerging SMR supply chains?

First, the Working Group developed a set of requirements for three different potential end-user applications for SMRs in Canada: on-grid power generation; heat and power for heavy industry; and energy for remote and Northern communities. Second, Working Group members surveyed over 100 SMR designs to define six SMR technology categories. Finally, they evaluated what would be needed to deploy the six SMR technologies in each of the three end uses.

*The Technology Working Group surveyed **over 100 SMR designs**.*

The Working Group considered both the status and development of SMR technologies, and the development and deployment of actual SMR projects. Working Group members consulted literature, material from SMR developers, and their own expert knowledge. They also drew extensively from what we heard at engagement workshops, as well as interviews with domestic and international industry experts.

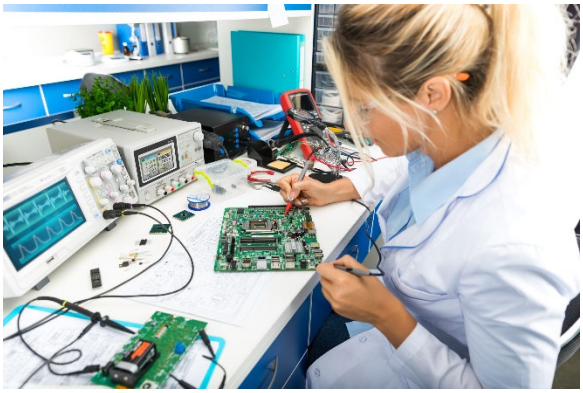


Key findings:

1. **SMRs are real and happening now: there are several project options for Canada to consider today.** SMR development has progressed to the point where several technologies are near demonstration readiness and some near deployment readiness. Projects that could meet end-user needs are ready to move forward in Canada. Other countries are moving quickly to deploy SMRs, with significant investments. In Canada, Canadian Nuclear Laboratories is taking steps to successfully demonstrate at least one SMR technology by 2026, while some other options could be ready for commercial deployment on a similar timeline.
2. **Demonstration of SMRs in Canada is critical for anchoring research, experience, knowledge, and therefore SMR supply chains, in Canada.** Demonstrating SMRs in Canada is a critical step for locking in significant research and intellectual property benefits at national labs, universities, and research organizations. Demonstration projects will yield the experience and knowledge required to

leverage our Tier 1 nuclear sector and to anchor SMR supply chains in Canada, capturing benefits from emerging SMR value chains for industrial development and global export opportunities.

3 **Canada has what it will take to succeed in the emerging SMR space.** Canada has differentiating capabilities at its national nuclear laboratories, universities, and research centres. We have the expertise and facilities to lead in developing SMR technologies. New areas of activity will need to be pursued, but these are within reach. All pathways to demonstration in Canada will leverage capabilities at Canadian Nuclear Laboratories—whether a demonstration project is sited there or not—as the labs have key personnel and facilities that do not exist elsewhere in Canada.



4 **There are many technologies with different risks and rewards for Canada.** The Technology Working Group surveyed over 100 SMR designs and found varying benefits and opportunities for Canada. Certain early-stage technologies may offer the greatest potential for Canada to capture value because the supporting supply chains are not yet established, and demonstrating these technologies would anchor research and development, and supply chain benefits in Canada. At the same time, these technologies have higher risks associated with their development. This range of opportunities may lend itself to a portfolio approach that advances both nearer-term, lower-risk designs, as well as more innovative, advanced designs. These would provide greater benefit to the domestic supply chain, but also carry a higher level of risk of missing the opportunity of becoming an early-mover on the global market.

5 **SMRs will most likely be deployed in a fleet approach.** Project proponents looking to deploy in Canada recognize the advantage of a fleet approach and are taking steps to enable this strategy whereby a large number of identical units would be deployed in multiple jurisdictions. An implication of this is that the design will need to be finalized and remain unchanged from unit to unit across the entire production run. Labs and supply chain partners will need to be ready to accommodate this new business model, which is a radically different approach in contrast to the traditional model of full scale nuclear power plants, where designs were often updated and changed between new build projects. The design, licensing, construction, and operational experience gained from first-of-a-kind demonstration projects and early deployment in Canada will be essential in enabling a standardized, fleet-based approach for SMR deployment.

6 **SMRs may require access to new types of fuel.** Although nearly all SMR designs will still run on uranium, they will use a grade of low-enriched uranium fuel, and fuel types that are different from the natural uranium fuel bundles currently used in Canadian nuclear reactors. While fuel for demonstration projects may be able to be sourced from the United States, both China and

Russia are positioning to lead in the commercial SMR fuel supply market. Canada may consider building domestic capabilities and developing strategic partnerships in this area. There could be a significant value added opportunity for Canada, with some of the activities anchored in Saskatchewan alongside the uranium mining sector. To realize this opportunity would require some targeted capacity building including, for example, in the area of advanced manufacturing. There may also be opportunities to reprocess used fuel from existing nuclear power plants in Canada, as some SMR designs plan to position themselves to run on reprocessed fuel.

7 **Canada's supply chain is well-positioned to capture value.** Canada has a robust supply chain that is primed for growth, leveraging the $26 billion refurbishment projects underway in Ontario. This is in contrast to some other countries, where supply chains have atrophied. At the same time, the ramped-up Canadian supply chain will need to retool to successfully transition to the new manufacturing and service needs of SMRs. Here, partnerships among federal, provincial, industry and academic actors will play a key role, and can benefit from existing programs.

4.2 Indigenous and Public Engagement

The Indigenous and Public Engagement Working Group addressed the following lines of inquiry, as a first step toward understanding Indigenous and public views on SMRs and nuclear energy more broadly:

- **Indigenous and public views**: reviewing and synthesizing existing literature and public opinion research, performing gap analyses, and developing recommendations.
- **Indigenous engagement best practices and lessons learned**: reviewing policies and practices across some relevant organizations (NWMO, CNSC, OPG [Hydro], Cameco, etc.), and identifying best practices and lessons learned, taking into account the "*Truth and Reconciliation Commission of Canada: Calls to Action"* and engagement guidelines published by Indigenous peoples.

At this time, existing public opinion surveys on public perceptions of SMRs are limited. The Working Group reviewed existing research relating to Indigenous and public perceptions of nuclear energy more broadly.

Public Confidence

Within the Canadian context, it is important to note regional differences in public opinion toward nuclear energy. There is a large cluster of support for nuclear power in Ontario and New Brunswick, perhaps because these provinces have a long history with it and have invested in nuclear research, education and innovation. It was also found that areas in close proximity to nuclear facilities have the highest support of all, potentially due to the economic benefits from nuclear energy in those areas and the knowledge and understanding of nuclear power that comes from living close to a nuclear facility. There is also higher-than-

average support for nuclear energy in the province of Saskatchewan, potentially due to its status as the second largest exporter of uranium in the world. In other provinces where civil society, policy makers and regulators have less experience with nuclear power, public opinion is significantly less supportive.

Key findings from the review of existing public opinion research were:

1. Ontario, New Brunswick and Saskatchewan have the highest approval levels for nuclear energy, potentially due to their experience with nuclear power reactors and/or uranium mining.
2. People are most likely to be concerned about nuclear safety, waste and used fuel management, as well as perceived environmental risks. Nuclear energy is also perceived as an expensive form of power generation.
3. Individuals with higher levels of formal education are more likely than others to support nuclear power.
4. Men, particularly those with higher levels of income and formal education, are more likely than women to view nuclear power favourably.

Most people accept the positive aspects of nuclear power generation (e.g. non-emitting electricity generation) and nuclear medicine. However, unprompted, few will note these and many feel these benefits are outweighed by the unknowns around radiation exposure, long-term nuclear waste and used fuel management, or they conflate nuclear power with nuclear weapons.

These concerns often lead to assumptions about the risk of nuclear power. The nuclear industry must be prepared to clearly address any misunderstandings about nuclear power and previous incidents if they are to engage in constructive conversations about nuclear energy and SMRs. Speaking to Canada's safety and operational record in nuclear operations, as well as the innovative "passive safety" features of proposed SMR technologies, could help to address concerns. Passive safety features are those that allow the unit to naturally shut down during an emergency; also referred to as "inherent" safety.

Engaging Indigenous Peoples

There have been few reports on Indigenous attitudes toward nuclear power. The Working Group considered two recent studies.

- ***The Nuclear Energy Sector: Overview of Saskatchewan Attitudes*** by the Nuclear Policy Research Initiative (NPRI) and the Social Science Research Laboratories (SSRL) at the University of Saskatchewan (2014).

NPRI conducted a survey of Saskatchewan residents, including Indigenous persons, to gain a better understanding of their attitudes related to the nuclear sector. The survey was administered as a 15-minute telephone survey with a fixed set of questions. The study found that Indigenous participants were more likely than other respondents to report a negative response when asked about their opinion regarding future nuclear developments, and to report a mainly or entirely negative overall impression of nuclear power. Indigenous respondents were also more likely to see greater levels of risk from nuclear power than other residents, and were more likely than others to report opposition to nuclear power generation in Saskatchewan.

- ***Northern Indigenous Peoples & the Prospects for Nuclear Energy*** by Dr. Ken Coates and the International Centre for Northern Governance and Development.
  More recently, in 2016, the University of Saskatchewan and the Fedoruk Centre for Nuclear Innovation conducted a study on the attitudes of Northern Indigenous peoples toward nuclear power. In contrast to the telephone survey methodology used by NPRI, the study focused on in-person interviews with community leaders in Northern Saskatchewan, Yukon and the Northwest Territories. Though participants expressed many real and substantial concerns, the study found considerable openness toward nuclear power and an interest in receiving more information on how it could be deployed in the North.

Key findings with respect to future Indigenous engagement were:

1. There is a need for more engagement to understand Indigenous views on nuclear power, covering more regions. Indigenous peoples are diverse, and communities may have different backgrounds, views, interests and drivers.
2. There is an important historical context, beyond nuclear power, which has included *many* mistakes and failures that have led to an erosion of trust. Much work is needed to rebuild trust.
3. Indigenous engagement is not a one-time checklist exercise. Authentic engagement can provide opportunities to strengthen mutually beneficial and respectful relationships with Indigenous peoples by ensuring Indigenous communities have agency to make decisions about their energy futures. Indigenous engagement activities must begin well in advance of project proposals and continue through the full life cycle of the project.
4. There are some good examples to follow, with which organizations should familiarize themselves before undertaking engagement:
   - The "*Truth and Reconciliation Commission of Canada: Calls to Action,"* the "*United Nations Declaration on the Rights of Indigenous Peoples,"* and engagement guidelines published by Indigenous peoples themselves.
   - Nuclear sector organizations with experience in this area, notably: the NWMO, CNSC, and utilities such as Qulliq Energy Corporation, NB Power, Ontario Power Generation, Bruce Power and SaskPower.

4.3 Waste Management

The Waste Management Working Group addressed the line of inquiry:

- Is Canada's current waste management framework sufficient for SMRs and, if not, what would need to be changed?

The Working Group convened technical experts, including waste owners, Canada's Nuclear Waste Management Organization, and the regulator to conduct a comprehensive review of the legislative framework, and waste management policy and practice in Canada. This included a series of table-top exercises to understand how Canada's framework would apply to the types of waste that would be produced by SMRs.

The Working Group differentiated its findings according to two classes of waste produced by SMRs: used fuel, and low- and intermediate-level waste. "Used fuel" is the used nuclear fuel that is removed from nuclear reactors after it has been used to produce energy. "Low- and intermediate-level waste" refers to all forms of radioactive waste, except used nuclear fuel; limited waste from the production of medical isotopes; and the waste from uranium mining and milling.

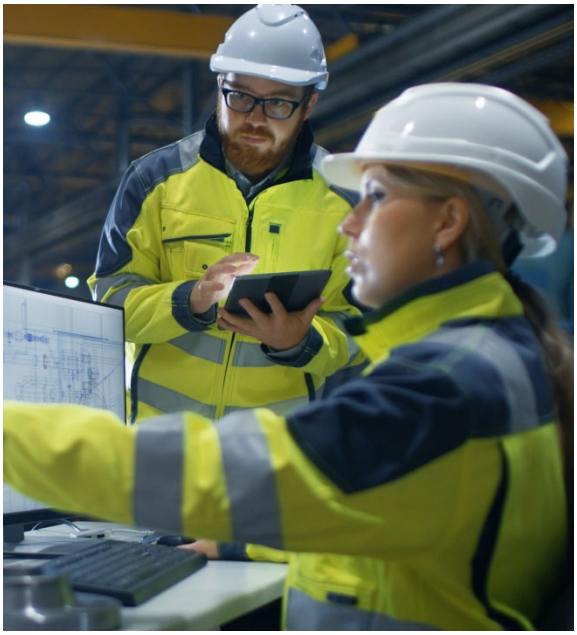
Key findings with respect to used fuel:

1 **Canada's existing legislative, policy, and technical framework is sound,** including the principles of the funding formula that the NWMO would use to charge waste owners for disposal of used fuel from SMRs. That said, there is uncertainty around the cost to new waste owners, especially where the waste type is significantly different than CANDU fuel. Costs will depend on: any modifications needed to the NWMO facility design, new packaging requirements, the normal transportation and disposal costs, as well as a proportional share of costs already incurred by the NWMO. The cost uncertainty presents a risk to the business case and economic viability of SMRs, and in the near term, affects the ability of SMR proponents to attract private-sector financing since full, life cycle costs are uncertain. As market forecasts and technology selection and design work become more certain, so too will projected waste management costs for used fuel.

2 **Canada's technical solution for long-term disposal of used fuel waste is sufficiently flexible to accommodate new fuel types from SMRs.** Early engagement by proponents with the NWMO will be important to facilitate work that may be needed on the side of the proponent to demonstrate how new types of used fuel from SMRs can be accommodated in the proposed facility and/or to consider possible changes to the technical specifications of Canada's long-term disposal facility. As the design of the NWMO facilities matures, the ability to incorporate future changes to accommodate new SMR requirements will become reduced.

Key findings with respect to low- and intermediate-level waste:

1. **There is no legislative or regulatory gap for low- and intermediate-level waste.** In practice, these wastes are safely stored at existing facilities as there is currently no approved final disposal facility for these wastes in Canada. This situation may present challenges for the entry of new SMR operators as the need to establish waste storage facilities would add cost and long-term liability risk that may not be commercially viable. It may also present challenges for public acceptance of SMRs if there is no path for disposal of low- and intermediate-level wastes. To allow a competitive market for SMR operators, access to disposal facilities (and until available, storage facilities) is required.
2. **Currently, the most practical management practice for low- and intermediate-level waste from SMRs is safe storage at regulated sites.** Over time, however, storage costs will increase and eventually become a competitive disadvantage for SMRs in Canada, compared to other jurisdictions that have implemented mechanisms for safe disposal of these wastes. The lack of both storage and disposal options for small scale producers, including SMRs, presents an economic uncertainty that could present a barrier to some new market entrants.
3. **The ultimate solution is long-term disposal in a safe repository.** Industry does not yet have low- and intermediate-level waste disposal facilities available. The two major projects in the regulatory decision process do not presently contemplate receiving wastes from small volume producers (including SMRs). While technical requirements are well-elaborated, uncertainty in what it takes to get a repository approved in Canada with respect to the impact assessment and associated processes, will be reduced once one or both of these projects have been approved. Low- and intermediate-level wastes from SMRs are not characteristically different from those generated by existing nuclear power plants in Canada. Therefore, the need to finalize a plan for safe disposal already exists today. There are a number of different options that may be considered, and solutions for existing low- and intermediate-level waste could apply equally to incremental waste streams generated by SMRs.



4.4 Regulatory Readiness

The Regulatory Readiness Working Group considered the full range of existing regulatory and legislative processes, carrying out line-by-line analyses and tabletop exercises to evaluate how they might apply to SMR deployment. This review considered over 150 pieces of federal, provincial and territorial legislation and regulations, applicable codes and standards, as well as additional documents and comments from industry.

The Working Group focused their detailed review on federal legislation in order to provide the perspective of a pan-Canadian approach rather than a particular region of the country. The Working Group also leveraged the existing body of knowledge prepared by other Canadian organizations such as COG and the Canadian Standards Association (CSA) who have their own internal review processes concerning SMRs.

The Working Group had the following key findings:

1. **Canada's enabling framework is sound.** Existing regulatory and legislative processes are ready for SMR deployment in Canada, although some refinements would improve efficiencies.
2. On Canada's nuclear liability framework, the existing legislation is sound and current regulations assign liability limits to existing Canadian nuclear facilities based on the concepts of a graded approach, commensurate with risk. It is anticipated that some revisions to the regulations under the *Nuclear Liability and Compensation Act* will be required in order to apply these same concepts to small power reactors, thereby acknowledging the small size and low inherent risk of many SMR designs.
3. On nuclear security, the current regulations would require SMRs to incorporate security infrastructure comparable to today's operating full scale nuclear power plants. Industry stakeholders and the CNSC are already engaged in discussions about potential changes to these regulations to take a graded approach, commensurate with size and risk, while continuing to ensure appropriate security coverage is maintained.
4. Some additional refinements have been identified which would improve efficiencies in some existing regulatory control areas such as staff training and emergency response. Due to the consultation already undertaken to date by CNSC on the regulatory framework for SMRs, both industry and the CNSC are aware of and understand these refinement opportunities and are confident they can be resolved. This confidence is based on past experience whereby similar technical regulatory issues have been satisfactorily resolved in the past.

*Existing regulatory and legislative processes are **ready for SMR deployment** in Canada.*

SPECIAL ISSUE FOCUS: FEDERAL IMPACT ASSESSMENT

The *Impact Assessment Act*, currently before Parliament, is designed to modernize federal impact assessment processes for major projects, potentially including SMRs.

Canada is at a moment of opportunity. Small Modular Reactors could have substantial environmental and economic benefits, as outlined in this report. Governments and industry alike recognize that enhancements in legislation around protection of the environment are key to a successful long-term sustainable development strategy for Canada. The *Impact Assessment Act* addresses important improvements to how major projects are assessed and approved in Canada, and is recognized as a key federal initiative. Initiatives to enable SMRs and the *Impact Assessment Act* need to work together to provide these benefits.

Stakeholders made specific recommendations to the federal government through the consultation process for the *Impact Assessment Act* with the goal of ensuring the *Impact Assessment Act* and the Roadmap work together.

4.5 Economics and Finance

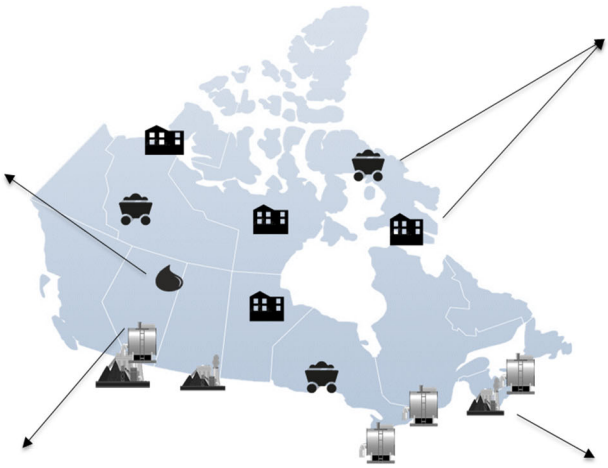
The Economics and Finance Working Group studied the market potential for SMRs, their competitiveness with other energy sources, as well as ways to overcome economic barriers to mass deployment. They reviewed existing literature, and undertook new analysis estimating cost competitiveness for on- and off-grid SMRs, with different sizes of SMRs, carbon pricing levels, technology readiness and discount rates.

They addressed the following questions:

1. What is the domestic market potential for SMRs, and what are the potential economic benefits?
2. Could SMRs be competitive with large nuclear power plants and other electricity generation options?
3. Which policy measures would be most effective in fostering a vibrant SMR industry? How can the costs of first-of-a-kind units be kept down, unlocking private investment?

The Working Group's key findings were:

1 **The domestic market potential is significant.** SMRs could be a key player in meeting Canada's commitment to phase out the use of conventional coal-fired power plants by 2030, and as Canada strives to secure 90% non-emitting electricity supply by 2030. They have other applications, such as providing non-emitting heat and power to oil sands facilities, remote communities, heavy industry plants and off-grid mines.



Oil sands

- Steam for SAGD and electricity for upgrading at **96 facilities**
- 210 MWe average size for both heat and power demands
- 5% replacement by SMRs between 2030 and 2040 could **provide $350-450M in value annually**

High-temperature steam for heavy industry

- 85 heavy industry locations (e.g. chemicals, petroleum Refining)
- 25-50 MWe average size
- 5% replacement by SMRS between 2030 and 2040 could **provide $46M in value annually**

Remote communities and mines

- 79 remote communities in Canada with energy needs > 1 MWe
- SMRs replacing costly diesel and heating oil could **reduce energy costs to the territorial government**
- **The high cost of energy from diesel is a barrier. SMRs could facilitate and enable new mining developments**
- 24 current and potential off-grid mines

Replacing conventional coal-fired power:

- 29 units in Canada at 17 facilities
- 343 MWe average size
- 10% replacement by SMRs between 2030 and 2040 could **provide $469M in value annually**

2 **SMRs meeting a fraction of this potential can provide significant economic benefits for Canada**, including up to 6,000 direct and indirect jobs per year between 2030 and 2040, and up to $10 billion in direct impacts and $9 billion in annual indirect impacts over the same timeframe. These are conservative estimates that do not take into account potential future uses of SMRs, such as powering greenhouses, desalination, and hydrogen production, all of which could increase their overall economic potential.

Additional information about these estimates is available in the full report of the Economics and Finance Working Group.

3 **SMRs can be a competitive option in terms of capital costs and electricity prices.**

The Working Group considered a range of on- and off-grid applications, with different sizes of SMRs, carbon pricing levels, technology readiness and discount rates. They found that SMRs can be competitive with alternatives including large nuclear power plants, diesel, natural gas, hydro, wind and solar.

SMRs have numerous advantages compared to large nuclear power plants, such as lower capital costs, modularity, economies of multiples, simpler designs, and potentially shorter construction schedules.

While many analysts expect natural gas prices to stay low over the next decade, an unexpected increase in prices would further strengthen the economic case for SMRs.

Figures 1 and 2 compare levelized cost of electricity from on-grid SMRs with:

a. *Natural gas*, which is expected to be a key source of low cost electricity for the next decade;

b. *Large hydro*, Canada's single largest source of electricity; and,

c. *Wind*, presently the fastest growing source of electricity in Canada.

Figures 1 and 2 compare levelized cost of electricity only, and do not reflect other systems and reliability costs, such as backup generation and storage costs. Solar, not included in Figures 1 and 2, would be more expensive than wind generation.

With the most favourable assumptions for on-grid SMRs, which include a 6% discount rate, NOAK costs, and more innovative technology, they are one of the least expensive options, potentially cheaper than large hydro plants and natural gas, even without a carbon price in place.

Even with the least favourable assumptions for on-grid SMRs, which include a higher discount rate, NOAK costs, and less innovative technology, they are competitive with large hydro plants, wind generation, and natural gas, assuming a carbon price is in place.

Moreover, while natural gas prices are expected to remain relatively low over the next decade, an unexpected increase in gas prices would further strengthen the economic case for SMRs.

The ranges of levelized costs of electricity for wind in Figures 1 and 2 reflect projects from various regions across North America. There are other salient reference points, however, including a specific recent experience in Alberta that saw an average price of $37 per MWh for wind projects selected in an auction for 600 MWe.

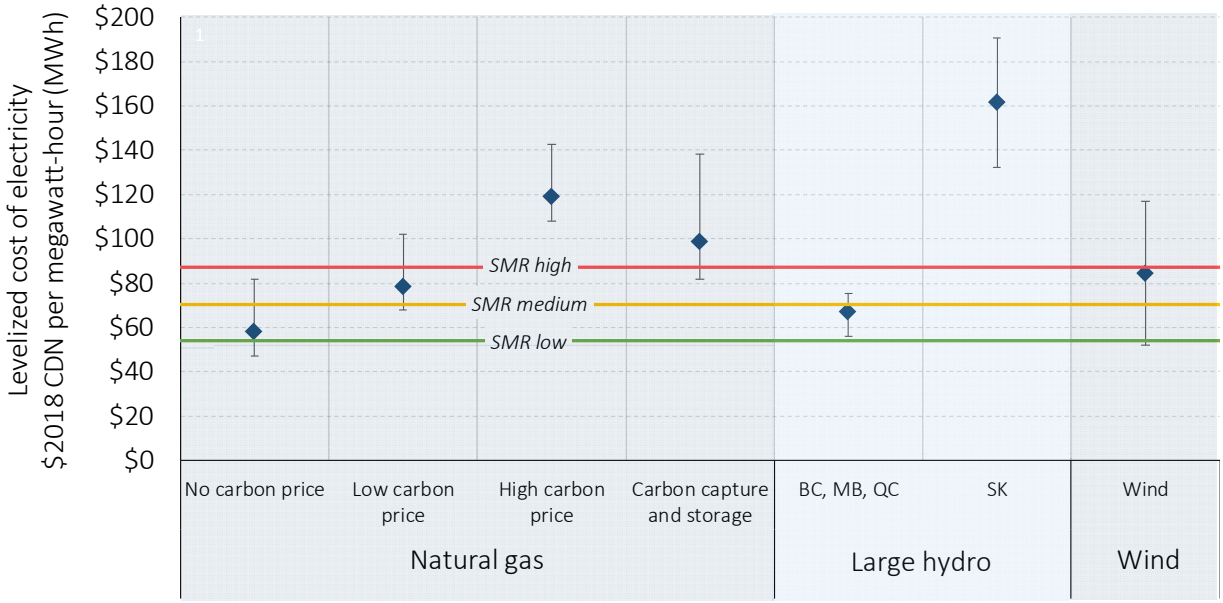


Figure 1. Comparison of levelized cost of electricity from on-grid SMRs with other options: Best case (6% discount rate, more innovative technology)

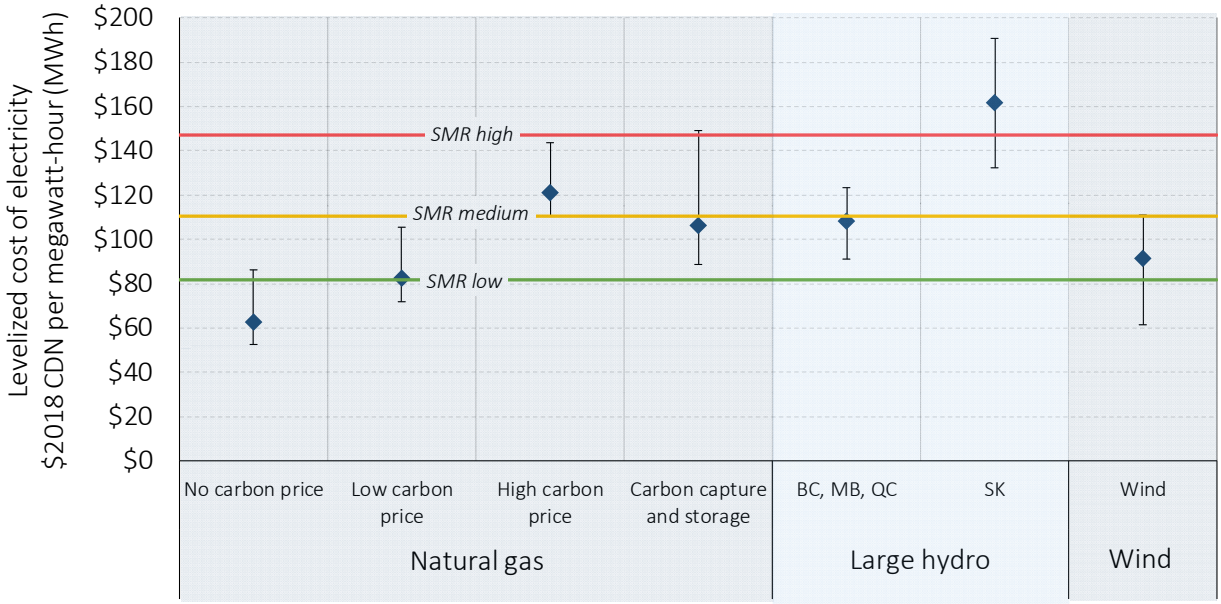


Figure 2. Comparison of levelized cost of electricity from on-grid SMRs with other options: Worst case (9% discount rate, less innovative technology)

Off-grid, where SMRs would compete against existing diesel generators, cost savings are highly sensitive to discount rate but would be substantial at sizes appropriate for mining sites (20 MWe) or small communities (10 MWe) (Figure 3).

In very small communities such as remote communities in Nunavut, a lower discount rate leads to a slight decrease in costs, while a discount rate of 9% would lead to slightly higher costs than diesel generators. Other benefits such as greater reliability and reduced emissions could offset this higher cost.

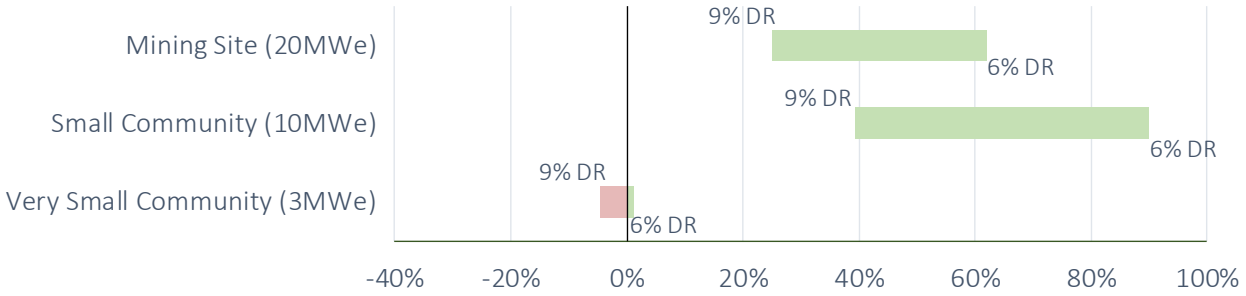


Figure 3. Cost advantage of SMRs over diesel: The difference between the levelized cost of electricity of diesel and SMR options, expressed as a percentage of the levelized cost of electricity of diesel in three remote/off-grid applications (shown for 6 and 9 percent discount rates).

4 While other drivers have significant impacts, **the cost of capital is the single most important driver in determining the competitiveness of SMRs.** As demonstrated in Figure 4, which shows the impact of different key economic drivers on SMRs' levelized cost of electricity, cost of capital is the most significant. A 3% reduction in the cost of capital on a 300 MWe first-of-a-kind SMR can reduce the levelized cost of electricity from $163/MWh to $124/MWh – an over 30% reduction.

Like any new, innovative technology, first-of-a-kind projects carry more risk and face higher costs. First-mover firms would absorb initial engineering costs, costs for R&D to build the licensing case, and costs for demonstration units to build the business case, from which other projects then benefit. Private actors would have little incentive to act first.

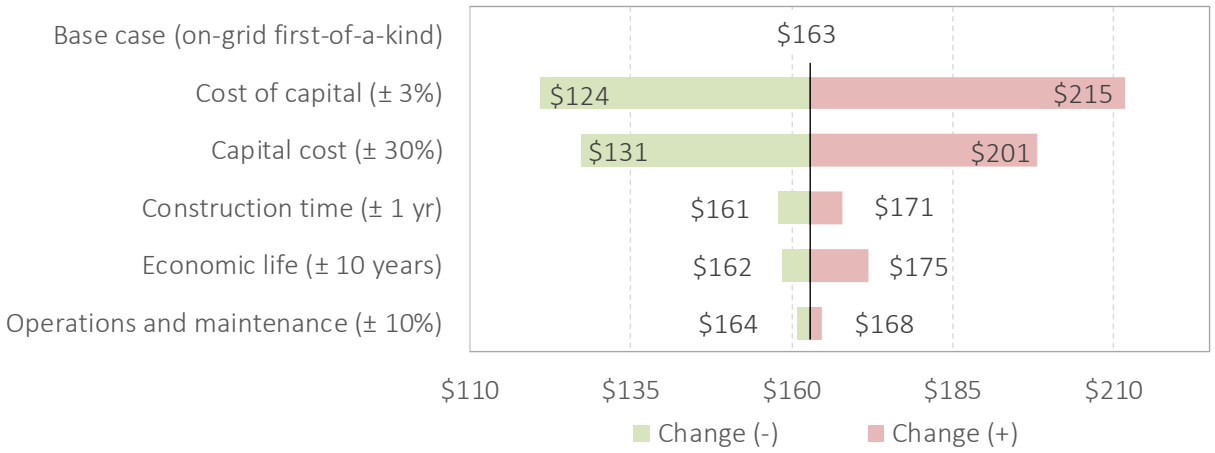


Figure 4. Sensitivity analysis: How levelized cost of electricity ($/MWh) for a first-of-a-kind SMR is affected by variations in cost of capital, capital costs, construction time, economic life, and costs of operations and maintenance.

5 **Federal and provincial governments have a role to play in sharing the risk and reducing the cost of capital.** Without government support, the private sector may not make the necessary investments to set the stage for an SMR industry in Canada. This risks forgoing benefits associated with being a first-mover market, such as supporting innovation, building expertise and reinforcing our robust supply chain.

Given the importance of the cost of capital in determining the competitiveness of SMRs, policy measures aimed at reducing the cost of capital were found to be most effective. In addition to policy levers aimed at reducing the cost of capital, other options—such as carbon emission credits, accelerated capital cost allowances, and grid reliability credits—were modelled, but found to be less effective than measures directed at reducing the cost of capital. Federal and provincial governments can reduce the cost of capital through a suite of policy levers that act across the life cycle of an investment:

a. Cost-sharing in the **development** phase. Government cost-sharing would reduce risks associated with development of earlier-stage, advanced SMR technologies, which are a critical barrier to bringing these technologies to market.

b. Loan guarantees in the **construction** phase. Due to the uncertainties surrounding first-of-a-kind SMR technology and project execution and operation, early projects would benefit from loan guarantees, resulting in lower financing costs.

c. Contracts for difference, power purchase agreements, or tax incentives to the generator in the **operating** phase of early projects. Long-term agreements with a credit-worthy counterparty at a competitive rate can lower the levelized cost of electricity of an SMR by decreasing its cost of capital, and provide revenue certainty for its production (e.g. a power purchase agreement at the market rate or contracts for difference).

As the technology matures, costs of individual units will decrease. Following the first one to two commercial units, SMR costs are expected to decline sufficiently that government risk-sharing would no longer be needed. Several factors will determine how quickly these costs decline: how many SMRs are built, construction experience, and the degree of standardization within SMR fleets.

One of the advantages of building a large nuclear power plant is that the operational, security, regulatory, and insurance costs can be spread over a larger revenue base. Accordingly, there may be a further role for government to create enabling frameworks for smaller SMRs in off-grid markets, taking a graded approach using risk-informed criteria so that the viability of SMRs—which are smaller and simpler, with enhanced safety—is not overwhelmed by disproportionate legislative or regulatory requirements.

5. International Context

Replace coal-fired power generation

- SMRs can further transition the power sector away from coal
- Even in a 2-degree scenario IEA projects 1100GWe
- Potential market over $100B/year

Remote island nations and off-grid communities

- Large potential in over 70k communities
- $30B/year market

Heat and power for mines

- SMRs powering of new mines between now and 2040 could yield total global value of $3.5B/year market

Steam for heavy industry

- Potentially $12B per year global market. Joint project from Idaho NL and NREL identified 850 facilities where SMRs could provide steam for US heavy industry.

Diesel generator photo © Ken Lane (2015). Photo has been modified. For source and licence: https://www.flickr.com/photos/kenlane/23354939966.

5.1 Global Market Potential for SMRs

Alongside the domestic engagement and analysis undertaken by the Roadmap, there is a broader international context for SMR development and commercialization.

For the ***international*** market, the estimated total global export potential of SMRs is approximately **CDN$150 billion** per year for 2030 to 2040. This includes applications for electricity generation, remote mine sites, island nations, and off-grid communities. This estimate is based on conservative assumptions.

The global market for SMRs could be much larger if SMRs achieve widespread commercial success as the world moves forward to reduce and ultimately eliminate fossil fuel use for electricity generation.

While there remains work to be done to validate these initial estimates, capturing even a small share of these end use markets could amount to billions per year to Canada's economy.

5.2 What Are Other Countries Doing?

Other countries are also moving quickly to advance SMR technologies with programs and investments to support SMRs and advanced nuclear energy development at national labs, private sector companies, and state-owned enterprises:

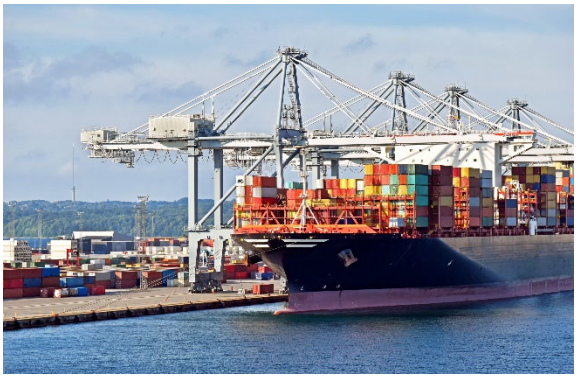
- The **United States** has established a program to support SMR development, providing $755 million since 2012, including $336 million to a single developer. This funding has been granted incrementally, with more to come. The current Administration's support for nuclear energy shows, with a 20% increase in the US Department of Energy's (DoE) nuclear budget.
- The **United Kingdom** has previously announced an envelope of $423 million over five years for development of SMR technologies. In the past year, the UK has announced approximately $150 million for research and development for advanced SMR technologies, feasibility

projects, advanced manufacturing and construction, and a supply chain improvement program.

The UK has also announced a "Sector Deal," whereby the government committed to: fund SMRs and nuclear innovation, consider new building financing options, and launch capacity building programs and supply chain support. In exchange, the UK's nuclear industry has committed to: nuclear project cost reductions, domestic and international sales targets, and a gender diversity commitment to double the representation of women in the sector by 2030.

- **China** has nearly completed its first SMR, a high-temperature gas reactor, and is designing other advanced SMRs, such as a molten salt reactor and a floating SMR.
- **Russia** has just completed a floating barge SMR to access remote locations, and Russia's state-owned nuclear company, Rosatom, claims to have an international order backlog exceeding $170 billion.
- **Korea** has designed an SMR for the export market, with Saudi Arabia already signing a purchase agreement with Korean firm KAERI.
- **Argentina** is nearing completion of a 25 MWe prototype.

Through the SMR Roadmap, we also heard that the likely path to commercialization will involve strategic partnerships and global value chains. This recognizes a growing trend toward a greater emphasis on private sector innovation, and the development of global supply chains for nuclear energy technologies.



Effective collaboration will require strong government-to-government relationships to enable nuclear energy trade and innovation, enabled by Nuclear Cooperation Agreements (NCAs), and multilateral engagement—not just in nuclear-only for a, such as the Nuclear Energy Agency and the International Atomic Energy Agency, but also at broader clean energy tables, such as the Clean Energy Ministerial and Mission Innovation.

6. Potential Benefits for Canada

Through the extensive engagement with industry and other stakeholders, initial dialogue with Indigenous communities and organizations, and expert analysis undertaken by the Roadmap, it became clear that SMRs are more than just a technology story.

The successful demonstration and commercialization of SMRs will require a broad support infrastructure of technical expertise, research facilities, manufacturing and service capabilities, operating experience, and highly qualified professionals. It will require enabling legislative, regulatory, and policy frameworks that can accommodate innovative technologies and new business models. And it will require a market "pull" from prospective end users to enable a range of different applications for SMRs—some of which are radically different than the current market for traditional nuclear power plants.

In other words, we heard that SMRs are a full-fledged innovation story, and a potential game-changer for the nuclear industry and Canada's natural resource sectors more broadly.

Canada could have a leading role in this international contest. A role that would unlock a range of benefits: economic, geopolitical, and social and environmental.

The complex and specialized nature of the elements required to bring SMRs to market means that first-movers will have significant competitive advantage: leverage to lock in or capture these benefits, with new entrants facing barriers to compete with first-to-market technologies.

Through the Roadmap, we identified the following potential benefits to Canada:

*SMRs are an innovation story and a **potential game-changer** for our nuclear industry and Canada's natural resource sectors more broadly.*

1. Economic benefits:
   - **The creation of a new industrial subsector**: An estimated 6,000 new jobs supporting a high-skill labour force, and adding up to an estimated $10 billion to Canada's GDP between 2030 and 2040[6]. Capturing value from an emerging segment will sustain and grow Canada's nuclear workforce and supply chain, leveraging the Province of Ontario's $26 billion investment in nuclear reactor refurbishments. Essentially, this is to develop a new industrial subsector in Canada to respond to a clear market signal for smaller, simpler, and cheaper nuclear energy for multiple applications.

[6] These estimates are based on analysis by the Economics and Finance Working Group. Additional information about these estimates is available in the Working Group's full report.

- **Anchoring cutting edge research in Canada**: SMR demonstration projects to lock in research and intellectual property at Canadian Nuclear Laboratories, Canadian universities, and research organizations in critical areas of innovation such as materials science, fuel testing and qualification, advanced manufacturing, control systems, cybersecurity, and remote operation. Leveraging federal investments at Chalk River to attract private investment and the best and the brightest from around the world to a revitalized science campus, and a hub for SMR innovation.
- **Canada at the centre of a global export market**: Leading in deployment and operation of SMRs internationally, with Canadian power utilities as global SMR operators. Capitalizing on domestic supply chains, expertise, and operating experience to capture value in an emerging global market estimated at $150 billion per year by 2040.
- **Leadership in the mining sector**: Enhancing competitiveness in the mining sector with SMRs as a lower-cost source of low-carbon heat and power in remote frontier areas. Opening new opportunities for development in Canada, and leveraging the international footprint of Canada's mining sector to access global export markets for Canadian-supported SMR technologies.

2 Geopolitical benefits:

- **Global leadership in SMR policy expertise**: Nuclear energy has been a beachhead for strategic international engagement; Canadian leadership on SMRs would sustain this benefit into the future. Canada as a Tier 1 SMR nation, with a full-spectrum SMR industry and a successful enabling policy framework. Enhancing Canada's strong brand with a pathway to SMR commercialization, serving as a model to strengthen Canada's position in international relations with key partners and in strategic multilateral nuclear energy fora.
- **Canada as a key international leader on regulatory excellence**: Canada can influence SMR regulatory practices internationally to assist in building a strong enabling framework for SMR deployment globally.

3 Social and environmental benefits:

- **Meeting Canada's climate change commitments**: Deployment of SMRs in several markets to enable key milestones in Canada's pathway to a low-carbon future: The complete phase-out of conventional coal-fired electricity. Deep decarbonization of heavy and extractive industries while

maintaining competitive advantage. And new opportunities for the radical transformation of the underpinning of our industrial base from one driven by fossil fuels to an economy powered by clean energy.

- **Unlocking regional growth opportunities**: Growing a pan-Canadian nuclear industry: In Atlantic Canada, with leadership on revolutionary molten salt SMR technology. In Saskatchewan, with new opportunities for uranium and fuel exports. And in Ontario, to provide advanced manufacturing and nuclear supply chain services to the world.
- **Constructive relationships and a positive energy dialogue**: Building on the opportunity for SMRs as an option in remote and Indigenous communities, there could be opportunities to develop best practices and engage in positive dialogue on broader remote energy issues, and development opportunities in communities interested in more information on the full range of options available.

Through the Roadmap, we heard that Canada is well-positioned to lead if we choose to seize the opportunity to capitalize on benefits for Canada. With a **supply chain and national laboratories primed for growth**, we can leverage the investments underway in Ontario and at Canadian Nuclear Laboratories. We have a strong international brand, an **independent regulator dedicated to safety and open to innovation**, and **viable sites for demonstration** of multiple SMR technologies.

We also heard that **Canada's time to lead is now**, given the lead times necessary for SMR technology development, the timing of key decisions regarding energy investments in different provinces, and the fact that the race is on. Other competitors are moving quickly to demonstrate and commercialize SMR technologies.

SMRs are an innovation story that will require strategic partnerships—in Canada and internationally. Achieving these potential benefits for Canada will require contributions from a host of essential enabling partners—everyone pulling together to put the different pieces in place.

This Roadmap starts with a Team Canada approach, involving actions from the essential enablers needed to realize the promise of SMRs in Canada.

7. Team Canada — Shared roles and responsibilities

Throughout the Roadmap, it has become clear that success will rely on strategic partnerships—across the sector and internationally. No single organization can do this alone.

As a result, there is a clear need for coordination and collaboration among all essential enabling partners in Canada. A truly national plan for action is needed to realize the historic opportunities associated with SMRs, bringing together key enablers, each with different resources, roles and responsibilities, from different jurisdictions. The Roadmap was built with this in mind: building the engagement, analysis, and recommendations needed to lay the groundwork for a *bottom-up* action plan with a common vision co-created and endorsed by all key enablers, rather than a top-down approach.

Canada is good at this. It is one of the few countries with capabilities that cover the full nuclear life cycle, from mining to plant construction to operation to waste management, and it is one of an even more select few that have been able to build the cross-sectoral consensus on a path forward that the Roadmap exemplifies. Our nuclear industry is a united front: a “Team Canada” approach where each partner builds on the strengths of the others, which has enabled tremendous success in international meetings and trade missions in recent years.

In nuclear energy and electricity generation, the federal government, provinces, territories and Indigenous peoples all have their own roles, responsibilities and jurisdictions. The federal government has jurisdiction over the regulation of all nuclear-related activities, including uranium mining and mills, nuclear power and nuclear waste management, as well as policies in the national interest, such as research and development. It also has a constitutional duty to consult Indigenous peoples when their rights may be affected by a federal decision.

Provinces and most territories have ownership over the natural resources and electrical grids within their boundaries, except on Indigenous lands and some federal lands. Provinces and territories set the pace and extent of resource development within their jurisdiction, including electricity resources and related infrastructure, transmission and distribution.

> *A truly **national plan for action** is needed to realize the historic opportunities associated with SMRs **—bringing together key enablers**, each with different resources, roles and responsibilities, from different jurisdictions.*

Indigenous peoples and communities have Aboriginal and Treaty rights and a unique relationship with the land that must be respected. Recognizing the diversity of their backgrounds, views, interests and drivers, Indigenous peoples and communities should be engaged constructively from the outset of proposals that might affect them. Some Indigenous communities are also owners of clean energy projects on their lands and contribute generating capacity to local and regional electricity grids.

Federal, provincial and territorial governments will be key players in bringing SMRs to fruition, in consultation with Indigenous peoples and communities. This work must be done in concert with a range of other stakeholders who each bring key strengths to bear.

These players and their roles and responsibilities with respect to SMRs are diverse:

- **Federal Government:** The federal government, given its jurisdiction over nuclear energy and issues deemed to be in the national interest, can play a leadership role in enabling SMRs in Canada. It can help de-risk demonstration and first-commercial projects by providing clear signals of support, or through policy levers and programs. It can ensure that the federal legislative, regulatory, and policy framework is sound and ready for SMR deployment, while working with bilateral and multilateral partners to align international engagement and cooperation with Canadian priorities on SMRs. The federal government can also support and enable SMR research and development work to help advance designs through demonstration to commercial deployment stages.
- **Interested Provincial and Territorial Governments:** Given that provinces and territories generally have jurisdiction over electricity resources and related infrastructure, they will need to play a leadership role on any proposal to build SMRs and develop the infrastructure to support them. Like the federal government, they have significant policy levers at their disposal to help support SMR demonstration projects and ensure Canada's nuclear supply chain is prepared. Several of the options identified above also apply to provincial and territorial governments, which can partner with each other and with the federal government to advance SMRs.
- **Canadian Nuclear Safety Commission (CNSC):** The Canadian Nuclear Safety Commission regulates the use of nuclear energy and materials to protect health, safety, security and the environment; to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public. Any proposed project to build and operate an SMR would require licensing from the CNSC.
- **Atomic Energy of Canada Limited (AECL):** As a federal Crown corporation, AECL's mandate is to enable nuclear science and technology and fulfill the federal government's radioactive waste and decommissioning responsibilities. Its sites, managed and operated by Canadian Nuclear Laboratories under contract with AECL, are hubs of nuclear science and technology in Canada.

- **Canadian Nuclear Laboratories (CNL):** As Canada's premier nuclear science and technology organization, Canadian Nuclear Laboratories serves Canada as an enabler of business innovation and technology transfer, and fosters the development of highly qualified personnel for the knowledge economy to come. Canadian Nuclear Laboratories is playing a leadership role through its Invitation for Demonstration process, where it is inviting SMR vendors and technology developers to apply to site a demonstration project.
- **Nuclear Waste Management Organization (NWMO):** Responsible for designing and implementing Canada's plan for the safe, long-term management of used nuclear fuel. The founding members are Ontario Power Generation, New Brunswick Power Corporation, and Hydro-Québec. These organizations, along with Atomic Energy of Canada Limited, are mandated to fund its operations.
- **Canadian Nuclear Association (CNA):** A non-profit organization established in 1960 that serves as the voice of the Canadian nuclear industry and promotes the development and growth of nuclear technologies for peaceful purposes. CNA provides industry leadership and coordination of advocacy and policy development with federal and provincial governments on issues of interest to Canada's nuclear industry. CNA also plays a leading role raising public awareness of the many benefits of nuclear energy and technology.
- **CANDU Owners Group (COG):** COG is a private, non-profit organization primarily funded through voluntary contributions by utilities that operate CANDU nuclear power plants worldwide and Canadian Nuclear Laboratories with strong supplier participation. COG is a trusted nuclear industry leader comprised of highly skilled employees with extensive experience in many facets of CANDU nuclear technology and regulatory affairs. As an organization that manages collaborative projects and research and development for the nuclear industry, COG is uniquely positioned to support jointly funded work to enable SMR deployment in Canada. In the emerging space for SMRs, COG convenes the SMR Technology Forum, bringing together SMR technology vendors and SMR utilities to help chart a path forward on operational excellence.
- **Organization of Canadian Nuclear Industries (OCNI) and the Canadian Nuclear Supply Chain:** OCNI is an association of more than 200 leading Canadian suppliers to the nuclear industry in Canada and abroad. As its member companies collectively employ more than 12,000 highly skilled and specialized people who manufacture major equipment and components and provide engineering services and support to Canada's nuclear sector, OCNI will play a key role in ensuring that supply chain companies are ready to meet the needs from emerging SMR value chains—in Canada and internationally—and to anchor supply chain benefits from an SMR industrial subsector in Canada.
- **Canadian Nuclear Industry:** Advances nuclear energy in Canada, with an annual economic impact of $6 billion and supporting 30,000 direct jobs across Canada.
- **Utilities and Owner/Operators:** Responsible for defining the overall project and plant requirements to meet end-user needs, and for establishing plant economic viability. The utility owner-operator will act as an informed customer, considering SMRs as a potential option, engaging with prospective vendors at an early stage, and building internal expertise to provide design, licensing and project oversight as the ultimate project licensee. They would also arrange to manage the resulting waste.

- **SMR Vendors and Technology Developers:** Potential SMR vendors are responsible for advancing SMR designs. They have a role in developing complete and technically sound designs, pursuing viable business models to bring these technologies to market, and engaging with the regulator to ensure their designs address Canadian regulatory requirements. Vendors must ensure that implications from novel features and fuel cycles—including waste management—are understood and contemplated by relevant stakeholders in Canada. Vendors also have a role in understanding how research, development, and supply chain capabilities in Canada can be leveraged to support technology development.
- **Universities and Colleges, Research Institutions, and Laboratories:** Provide an essential education and training role, ensuring that the industry's human capital and knowledge base are primed for leadership on SMRs and advanced reactor technologies. They could conduct early-stage research and advance international collaboration on topics relevant to development of advanced SMRs, addressing knowledge gaps and anticipating future industry needs.
- **End-User Industries:** As the demand side, potential users such as heavy industry define the need. For example, they identify the range of energy applications, such as power and industrial or district heating. This means that end users also need to be educated consumers, and able to evaluate and oversee projects.
- **Civil Society:** Civil society can play a role in enhancing transparency and accountability by contributing to increased public debate and awareness. Organizations such as labour unions, youth networks, women in STEM groups, technical societies, and other non-governmental organizations (NGOs), among others, bring important perspectives to bear in public discourse.

8. Priority Recommendations — The road forward

As we charted the path forward through the Roadmap, four thematic areas began to emerge as pillars for framing our recommendations:

PILLAR 1	PILLAR 2	PILLAR 3	PILLAR 4
Demonstration and deployment	Policy, legislation, and regulation	Capacity, engagement, and public confidence	International partnerships and markets

The Priority Recommendations in this section are the heart of the Roadmap.

Pillar 1. Demonstration and Deployment

- **Funding for SMR demonstration projects.** Federal and provincial governments interested in SMRs should provide funding to cost-share with industry in one or more SMR demonstration projects for advanced reactor designs. Demonstration projects are a critical step to advance these novel SMR technologies and business models that offer significant benefits to Canada and the Canadian nuclear supply chain.
- **Risk-sharing measures for first-commercial SMRs.** Federal and provincial governments should implement measures to share risk with private investors to incentivize first-commercial deployment of SMRs in Canada, with the potential of exporting SMR technologies and related innovations developed in Canada to international markets. Providing a clear path to deployment in Canada will build private sector confidence and help unlock near-term investments to support research and development of SMR technologies.

Pillar 2. Policy, Legislation, and Regulation

- **Federal impact assessment.** The federal government should work to align the modernization of Canada's federal impact assessment process with other initiatives to develop and deploy SMRs. This recognizes that SMRs could have substantial environmental and economic benefits that are fully aligned with the goals of improving how major projects are assessed and approved in Canada. Annex A includes specific recommendations on key aspects of the *Impact Assessment Act* and associated regulations that would ensure that efforts to deploy SMRs are not inadvertently inhibited, while also protecting the safety of Canadians and the environment.
- **Nuclear liability.** The federal government should review liability regulations under the *Nuclear Liability and Compensation Act* to ensure that nuclear liability limits for SMRs are aligned with the risks they pose, using a graded scale based on risk-informed criteria.
- **Regulatory efficiency and nuclear security.** The Canadian Nuclear Safety Commission should engage with industry, public, and Indigenous representatives on amendments to the

Nuclear Security Regulations to ensure a graded approach based on risk-informed criteria. This recognizes that, while the policy, legislative, and regulatory framework in Canada is sound and ready for the safe deployment of SMRs, there are efficiencies that could be pursued to provide further flexibility and clarity in SMR licensing and regulation.

- **Waste management.** Canada's existing legislative, policy, and technical framework for radioactive waste management is sound. On used fuel, SMR technology vendors should engage with Canada's Nuclear Waste Management Organization (NWMO) to ensure that planning for NWMO's deep geological repository is well-informed by the technical specifications of these novel technologies. On low- and intermediate-level waste, Canada's Radioactive Waste Leadership Forum should take steps to ensure consideration of SMR waste streams in its integrated radioactive waste management plan. On demonstration projects, the federal government should consider risk-sharing in some of the costs of management and disposal of low- and intermediate-level wastes.

Pillar 3. Capacity, Engagement, and Public Confidence

- **Indigenous engagement.** Federal, provincial, and territorial governments, and utilities interested in SMRs, should continue and build on the initial dialogues with Indigenous groups that were started under the Roadmap. This should involve meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific proposals.

Pillar 4. International Partnerships and Markets

- **International enabling frameworks.** The federal government, with support from industry, labs, and academia, should continue strong and effective international engagement in SMRs. In particular, position Canada as a leader, contributing policy and regulatory expertise to influence the development of international enabling frameworks for these technologies.

Alongside these priority recommendations, additional detailed recommendations are set out in Annex A.

The following next steps are critical to turning the Roadmap into action, capitalizing on its momentum, and realizing the promise of SMRs in Canada:

Step 1: **Take early action on priority recommendations.** Essential enablers that are identified in the priority recommendations above should take action now on these key activities.

Step 2: **Finalize an SMR action plan that responds to the recommendations in the Roadmap.** All essential enablers are called upon to review the recommendations of this report and make commitments for action that respond to the recommendations. Enablers should seize this opportunity to finalize a Canadian SMR Action Plan.

Step 3: **Implement the plan, report on progress, and pursue strategic priorities for future action.** Industry and governments to form a Nuclear Energy Advisory Council, composed of senior executives and ministers, which will meet annually to report on progress made on the SMR action plan and discuss strategic priorities for future action.

9. Conclusion — Strategic vision and next steps

There is a new reality for nuclear energy in Canada: this Roadmap is living proof.

Proof that the nuclear sector in Canada, once vertically integrated, is now one of collaborative leadership, with a range of essential enabling partners holding individual pieces to a larger puzzle.

But it's also proof that all the pieces do fit together.

This was a landmark, 10-month effort that was unlike any other initiative the sector has ever undertaken. Through the SMR Roadmap, the federal government, provinces, territories, utilities, Canada's nuclear sector, and enabling partners came together to chart a vision for this emerging area of nuclear innovation.

And we learned some very important things through the process.

First, **the opportunity is real**. SMRs are happening in order to respond to market forces for smaller, simpler, cheaper nuclear energy. And if successful, there will be a large global market for this technology, driven not just by climate change and clean energy policies but also by the imperatives of energy security and access.

Second, **Canada has what it needs to seize the opportunity** but the time for action is now. With refurbishments underway in Ontario and a revitalized nuclear science campus at Chalk River, we have a chance to leverage our longstanding leadership in nuclear energy to make this happen. And others are looking to Canada to lead, with a strong, independent regulator dedicated to safety and open to innovation, a solid brand and full-spectrum nuclear industry, and viable sites for demonstration. Demonstrating SMRs in Canada could lock in significant research and intellectual

property benefits at national labs, universities, and research organizations, and position Canada to leverage our Tier 1 nuclear sector for industrial development and global export opportunities. But competitors are also moving quickly in this space, and decisions over the next six to 12 months will be critical to capitalize on this opportunity.

Third, no single player can do it alone. **Strategic partnerships will be key to success**, across the sector in Canada and internationally. This is why we undertook the SMR Roadmap: to serve as the focal point for bringing together all essential enabling partners to chart the recommended path forward for how Canada can step up to lead on SMRs and their emerging global value chains.

But if it ends here, all we did was write a report.

The Roadmap is not an end, it is a beginning. And it starts with a Canadian vision for bringing this emerging, innovative technology to fruition:

SMRs as a source of safe, clean, affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians.

WHY ACT NOW?

Early-mover advantage will be critical to capturing global market share. Demonstration projects in Canada will be important to anchor benefits—science and technology, intellectual property, supply chain, jobs—in Canada. All other major nuclear nations are making strategic investments in order to position their domestic industries to capitalize on the opportunity. Early action on demonstration and deployment in Canada will be important to keep innovation opportunities and investment from moving abroad.

What is at stake for Canada? A range of potential economic, geopolitical, and social and environmental benefits:

- New jobs, economic growth and innovation, with potential to capture significant value from domestic and international markets, anchored by an existing $6 billion industry that is a strategic asset for Canada.
- Policy leadership on SMRs, and Canada as an international standard-setter, strengthening our influence with key partners and at strategic, multilateral tables.
- Delivering on climate action, while opening opportunities for regional growth and opportunities across Canada, and enabling a positive dialogue with northern and Indigenous communities on remote energy issues.

The Roadmap is a call to action for Team Canada. Enablers must now leverage its momentum, respond to its recommendations, and take action. Essential enablers must act now on the priority recommendations. Enablers are also called upon to make commitments to finalize a comprehensive Canadian action plan on SMRs.

We've come a long way to start this journey. When the Roadmap began we didn't know where we would end up. But through collective leadership and collaboration, we now have a path forward.

And the future looks bright.

ANNEX A Detailed Recommendations — From Roadmap to Action

The Roadmap is a call to action. It is proposed that Team Canada respond to the recommendations in the Roadmap with concrete commitments for action.

This annex provides the full set of detailed recommendations for Canada's SMR Action Plan. They include the priority recommendations from Section 8 of the Roadmap, as well as additional insights and considerations.

Recommended Vision for Canada's SMR Action Plan:

SMRs as a source of safe, clean, affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians.

Detailed Recommendations:

A-1 For the Federal Government

A-1-1 Demonstration and deployment

DEMONSTRATION AND DEPLOYMENT: **SMR demonstration projects**	**01**
RECOMMENDATION The federal government should provide funding to cost-share one or more SMR demonstration in Canada, leveraging investment from interested provinces, utilities, and the private sector.	EXPECTED RESULTS • One or more SMR demonstration constructed and in operation in Canada by 2026. • The technology-readiness of one or more SMR technologies is advanced to the pre-commercial stage. • Canada is positioned to capture research benefits and value for the domestic supply chain from the demonstration of these earlier-stage SMR technologies.

DEMONSTRATION AND DEPLOYMENT: **Risk-sharing measures for first-commercial SMRs**	**02**
RECOMMENDATION The federal government should implement measures to share risk with private investors, incentivizing first-commercial deployment of SMRs in Canada, aimed at: • Reducing the cost of capital, for example with loan guarantees • Providing long-term price stability, for example through a Production Tax Credit • Reducing capital cost tax burden, for example through an Investment Tax Credit or extending Accelerated Cost of Capital Allowance provisions for renewable energy to nuclear energy projects	EXPECTED RESULTS • SMR developers see a clear path to deployment in Canada, building private sector confidence and unlocking near-term investment in SMR technologies. • First-commercial SMR deployment by 2030.

DEMONSTRATION AND DEPLOYMENT: **Waste management risk-sharing**	**03**
RECOMMENDATION The federal government should consider risk-sharing some of the life cycle costs of management and disposal of radioactive waste from demonstration projects.	EXPECTED RESULTS • Increased certainty regarding costs associated with long-term waste liabilities for demonstration projects.

A-1-2 Policy, legislation, & regulation

POLICY, LEGISLATION, & REGULATION: **Canada's SMR Action Plan**	**04**
RECOMMENDATION The federal government, with support from Team Canada enabling partners, should finalize Canada's Action Plan for SMR development, demonstration, and deployment in Canada and globally with subnational partners.	EXPECTED RESULTS • Public and private decisions are informed by a strategic, action-oriented plan. • The plan respects and builds on the respective roles and responsibilities of essential enabling partners and sets out timelines for action to maximize benefits to Canada.

POLICY, LEGISLATION, & REGULATION: **Nuclear Energy Advisory Council**	**05**

RECOMMENDATION

The federal government should work with partners to co-create a Nuclear Energy Advisory Council (NEAC).

- Through the Council, senior executives and ministers would meet annually to review progress on Canada's SMR Action Plan and discuss strategic priorities going forward.
- Meetings could be held on the margins of the CNA's annual conference or the annual Energy and Mines Ministers' Conference (EMMC).
- Two co-chairs: one rotating among industry representatives, the other rotating among the federal, provincial, and territorial governments interested in SMRs

EXPECTED RESULTS

- Progress on development and commercialization of SMRs in Canada is advanced in a manner that respects shared roles, responsibilities, and jurisdictions—and leverages benefits to Canada and supports strategic partnerships.
- Key decision makers have a venue for discussing progress and priorities for future action on nuclear innovation and nuclear energy matters broadly.

POLICY, LEGISLATION, & REGULATION: **Nuclear liability**	**06**

RECOMMENDATION

The federal government should review nuclear installation classification in the regulations under the *Nuclear Liability and Compensation Act* to ensure that liability amounts for different SMR categories are aligned with the risks that they pose.

EXPECTED RESULTS

- Regulations are clarified to support SMR applications, particularly for the smallest reactors in off-grid markets.
- Based on their risk assessment, appropriate classes and liability amounts for different SMR categories will be made in the regulations under the *Nuclear Liability and Compensation Act*.

POLICY, LEGISLATION, & REGULATION:
Canada's proposed rules for impact assessment of major projects

07

RECOMMENDATION

Governments and industry alike recognize that enhancements in legislation around protection of the environment are key to a successful long-term sustainable development strategy for Canada. Initiatives to enable SMRs and the new *Impact Assessment Act* should be mutually reinforcing.

The Canadian Environmental Assessment Agency sought public comments from February 8 to June 1, 2018 to help inform the approach to developing two regulations to support the federal government's proposed new *Impact Assessment Act*. Stakeholders have made specific recommendations to the federal government through this consultation process for the new proposed impact assessment legislation (i.e., Bill C-69) and regulations (e.g. the "Project List"). Many of the stakeholder organizations which participated in the preparation of the SMR Roadmap also took the opportunity to provide written comments and recommendations during this consultative period. A complete list of all submissions can be found on the Canadian Environmental Assessment Agency's website. Two examples of recommendations provided by SMR Roadmap participants are:

- *Bill C-69 should be implemented in a way that ensures the Act addresses the specific impact of a project rather than be used as a venue to debate a specific policy.*
- *Project applications to construct, operate, and decommission SMRs equal to or below an electric capacity of 300 MWe should be excluded from the Project List, on the basis of having a low risk for potential adverse environmental effects in areas of federal jurisdiction.*

EXPECTED RESULTS

- The new proposed *Impact Assessment Act* provides improved regulatory clarity and manageable regulatory timelines for project proponents and reduced project risk while maintaining strong environmental, health, social, and economic standards and protecting the well-being of Canadians.

POLICY, LEGISLATION, & REGULATION: **Fuel supply security**	**08**
RECOMMENDATION The federal government should convene stakeholders—including provinces, territories, Canadian fuel suppliers, and others as appropriate—to develop options and recommendations for addressing SMR fuel supply security.	EXPECTED RESULTS • Relevant decision makers and stakeholders develop a clear set of options, analysis, and a recommended approach for ensuring security of SMR fuel supply in Canada.

POLICY, LEGISLATION, & REGULATION: **Ensure clean energy programming is open to nuclear energy**	**09**
RECOMMENDATION The federal government should include nuclear energy in programs and policies that target the development of clean, non-emitting sources of energy. • For example, by applying a technology-neutral approach to clean energy funding programs; expanding renewable energy tax credits or production incentives to include nuclear energy.	EXPECTED RESULTS • Nuclear energy development is placed on equal footing, and included in federal government programming and policies in support of clean and non-emitting energy sources.

A-1-3 Capacity, engagement, & public confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Indigenous engagement**	**10**
RECOMMENDATION Federal, provincial and territorial governments and utilities that are interested in SMRs, should conduct meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific SMR project proposals.	EXPECTED RESULTS • Positive relationships are built with Indigenous groups. • Governments and industry have a greater understanding of Indigenous views, concerns, and priorities related to SMRs. • Indigenous groups have capacity to engage with governments and industry on SMRs.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Engagement and capacity building in remote communities**	**11**
RECOMMENDATION The federal government should support engagement and early feasibility studies in remote communities and jurisdictions who have indicated interest in SMRs through the Roadmap. • Studies could address questions about technical and economic feasibility of SMRs, local ownership models, options for the management of radioactive waste, and emergency management planning and response.	EXPECTED RESULTS • Trust and a positive dialogue on Northern and remote energy issues is built in communities interested in more information on SMRs. • Northern and remote communities are better informed and have information on the full range of energy options available. • Northern and remote communities have increased capacity to engage with SMR project developers to explore opportunities for local ownership models and partnerships.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Public and Indigenous views**	**12**
RECOMMENDATION Federal, provincial and territorial governments and utilities, interested in SMRs should undertake regional qualitative and quantitative research to assess the views, attitudes and understandings of Canadians, including Indigenous peoples in Canada, on all potential energy options, including nuclear energy and SMRs.	EXPECTED RESULTS • Clear and reliable information on public and Indigenous views with respect to nuclear energy.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **National SMR development research program**	**13**
RECOMMENDATION The federal government should establish an SMR development program that brings together AECL, Canadian Nuclear Laboratories, industry, universities, CANMET labs, and other research organizations to carry out focused research, linked to SMR demonstration projects.	EXPECTED RESULTS • Capacity is built among the next generation leaders and workforce—including youth, women, and Indigenous people. • Canada is able to capture additional research and development benefits by leveraging expertise in areas such as materials science, shared broadly among enabling research and development partners.

A-1-4 International partnerships & markets

INTERNATIONAL PARTNERSHIPS & MARKETS: **Global SMR market validation**	**14**
RECOMMENDATION The federal government should conduct a study to validate initial estimates of the global SMR market. • The study should repeat the rigour of the domestic SMR market analysis conducted under the Roadmap to explore specific end-use markets for SMRs in detail (e.g. extractive industries, small island states, etc.) and provide estimates on the potential value that Canada could capture from global supply chains.	EXPECTED RESULTS • Canadian stakeholders have information on the size and potential applications for SMRs globally, and the value that Canada could capture in global supply chains.

INTERNATIONAL PARTNERSHIPS & MARKETS: **International enabling frameworks for SMRs**	**15**
RECOMMENDATION The federal government should engage with key partners and strategic multilateral initiatives to develop international enabling frameworks for SMRs: regulation, transportation, liability, and waste management.	EXPECTED RESULTS • Viable pathways are developed to enable international deployment of SMRs—in both newcomer and existing nuclear countries. • Canada is strategically positioned to enable access to export markets for technologies with supply chains anchored domestically.

A-2 For Interested Provincial and Territorial Governments

A-2-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **SMR demonstration projects**	**16**
RECOMMENDATION Provincial governments should collaborate with the federal government on SMR demonstration projects, which may include providing funding to cost-share one or more SMR demonstrations in Canada, leveraging investment from the federal government and the private sector.	EXPECTED RESULTS • One or more demonstration SMRs constructed and operating in Canada by 2026. • The technology-readiness of one or more SMR technologies is advanced to the pre-commercial stage. • Canada is positioned to capture research benefits and value for the domestic supply chain from the demonstration of these earlier-stage SMR technologies.

DEMONSTRATION & DEPLOYMENT: **Risk-sharing measures for first-commercial SMRs**	**17**
RECOMMENDATION Provinces to implement measures should share risk with private investors, incentivizing first-commercial deployment of SMRs in Canada, in coordination with federal risk-sharing provisions. • Provincial risk-sharing measures could include Power Purchase Agreements, feed-in tariffs, Clean Energy Credits, or tax measures.	EXPECTED RESULTS • SMR developers see a clear path to deployment in Canada, building private sector confidence and unlocking near-term investment in SMR technologies. • First-commercial SMR deployment projects are proposed for application to, or negotiation on, measures to share risk with governments by mid-2020s.

A-2-2 Policy, Legislation & Regulation

POLICY, LEGISLATION & REGULATION: **Nuclear energy in climate change and clean energy planning**	**18**
RECOMMENDATION Provinces and territories that are interested in SMRs should develop public policy statements to explicitly include nuclear energy in climate change and clean energy planning and policies.	EXPECTED RESULTS • Climate change and clean energy policies are aligned with, and support, the development of innovative, low-carbon nuclear energy technologies across all interested provinces and territories in Canada.

A-2-3 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Indigenous engagement**	**19**
RECOMMENDATION Provincial and territorial governments that are interested in SMRs should conduct meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific SMR project proposals.	EXPECTED RESULTS • Positive relationships are built with Indigenous groups. • Governments and industry have a greater understanding of Indigenous views, concerns, and priorities related to SMRs. • Indigenous groups have capacity to engage with governments and industry on SMRs.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Retooling supply chains for global SMR value chains**	**20**
RECOMMENDATION Provinces should support Canadian industry to acquire, maintain, and augment the skills and capabilities needed to successfully transition and capture benefits from emerging global SMR value chains.	EXPECTED RESULTS • Canada's supply chain is well-positioned to lead in the development of global value chains for SMRs.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Grade school and high school programming**	**21**
RECOMMENDATION With jurisdiction over education and curriculum development, provinces and territories are encouraged to include energy options such as nuclear energy, in grade and high school curriculum development to promote an informed understanding of all energy options in Canada.	EXPECTED RESULTS • Increased access to evidence-based information about all of Canada's non-emitting energy options.

A-3 For the Canadian Nuclear Safety Commission (CNSC)

A-3-1 Policy, Legislation & Regulation

POLICY, LEGISLATION & REGULATION: **Nuclear security**	**22**
RECOMMENDATION The CNSC should revise the *Nuclear Security Regulations* to cover high-level principles similar to other regulations and remove prescriptive requirements. A CNSC regulatory document (REGDOC) should then be produced providing necessary details and including the concept of a graded approach.	EXPECTED RESULTS • Revised Nuclear Security Regulations only cover high-level principles similar to other regulations and prescriptive requirements are removed. • New CNSC REGDOC produced providing necessary details and including the concept of a graded approach.

POLICY, LEGISLATION & REGULATION: **Regulatory efficiency**	**23**
RECOMMENDATION The legislative, regulatory, and standards framework in Canada is sound and ready for SMRs. To increase efficiencies in SMR regulation, the CNSC should consider regulatory refinements in existing regulatory documents (REGDOCS) based on a graded approach using risk-informed criteria. A typical example of such a refinement would be: • *Revise REGDOC 2.10.1 to eliminate the 10 MW thermal lower limit for application of the full suite of requirements in REGDOC 2.10.1. The need to apply the full suite of requirements should be based on risk-informed criteria, not an arbitrary low limit on reactor thermal power.*	EXPECTED RESULTS • Additional efficiencies are unlocked to provide further flexibility and clarity in SMR licensing and regulation.

A-3-2 Capacity, Engagement, & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Public, community, and Indigenous engagement in SMRs**	**24**
RECOMMENDATION The CNSC should continue public, community, and Indigenous engagement in meaningful dialogues on a range of issues, such as the licensing process and waste. CNSC to continue to deliver on its mandate of disseminating objective scientific, technical, and regulatory information to the public.	EXPECTED RESULTS • The public and Indigenous communities continue to have full information on and active engagement in Canada's regulatory framework in relation to SMRs on a range of issues—including licensing and waste.

A-3-3 International Partnerships & Markets

INTERNATIONAL PARTNERSHIPS & MARKETS: **International collaboration**	**25**
RECOMMENDATION The CNSC should continue international collaboration, providing Canadian leadership in key multilateral fora and with national regulators to provide leadership in the development of international enabling frameworks for the global deployment of SMRs.	EXPECTED RESULTS • Canada is well-positioned to influence and lead in the development of international enabling frameworks for global deployment of SMRs.

A-4 For Atomic Energy of Canada Limited (AECL) and Canadian Nuclear Laboratories (CNL)

A-4-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Site preparation for SMR demonstrations**	**26**
RECOMMENDATION AECL and CNL should prepare sites at federally owned laboratories for SMR demonstration projects.	EXPECTED RESULTS • The timeline for demonstration of SMR technology in Canada is accelerated based on enabling work in the areas of research and development and environmental assessment.

DEMONSTRATION & DEPLOYMENT: **Federal Nuclear Science and Technology Work Plan**	**27**
RECOMMENDATION AECL should continue to consider federal priorities around SMRs when assessing projects under the Federal Nuclear Science and Technology Work Plan for the federal role on SMR development and future deployment, informed by the outcomes of the SMR Roadmap.	EXPECTED RESULTS • Some early-stage SMR research is maintained in order to begin to build knowledge and expertise that will be needed should Canada choose to seriously pursue the SMR opportunity.

A-4-2 International Partnerships & Markets

DEMONSTRATION & DEPLOYMENT: **Invitation for SMR demonstrations**	**28**
RECOMMENDATION CNL should continue its Invitation for Demonstration related to SMR demonstration projects.	EXPECTED RESULTS • Canada benefits from first-mover advantage by constructing an SMR demonstration plant at one of its federally owned sites.

INTERNATIONAL PARTNERSHIPS & MARKETS: **International lab-to-lab collaboration**	**29**
RECOMMENDATION AECL and CNL should advance international collaboration on SMR research and development, with appropriate international partners, guided by but not limited to the strategic framework and findings of the SMR Roadmap. • Collaboration should prioritize opportunities to anchor Intellectual Property in Canada and undertake enabling work broadly.	EXPECTED RESULTS • Canada leverages international partnerships and science and technology collaboration in support of SMR development activities that benefit Canada.

A-5 For the Nuclear Waste Management Organization (NWMO)

A-5-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Early engagement with SMR vendors on technical specifications and costs**	**30**
RECOMMENDATION NWMO to continue should offer early engagement with SMR proponents to ensure appropriate technical specifications for a safe disposal facility and compatible waste forms for SMRs that could be deployed in Canada.	EXPECTED RESULTS • The technical specifications for a safe disposal facility for used fuel fully accommodate used fuel types from SMRs that could be deployed in Canada. • SMR vendors are clear on the requirements for any conditioning of waste for acceptance at the used fuel waste facility. • Costs and funding requirements associated with fuel waste management are minimized through early engagement.

A-5-2 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Public and community engagement in used fuel from SMRs**	**31**
RECOMMENDATION NWMO should continue public, community, and Indigenous engagement in Canada's approach to the safe and long-term disposal of used fuel—including used fuel from SMRs.	EXPECTED RESULTS • Stakeholders continue to have full information and active engagement in Canada's approach to used fuel disposal.

A-6 For the Canadian Nuclear Association (CNA)

A-6-1 Policy, Legislation & Regulation

POLICY, LEGISLATION, & REGULATION: **Nuclear Energy Advisory Council**	**32**
RECOMMENDATION CNA should help co-create and support Canada's Nuclear Energy Advisory Council (NEAC) with the federal government and Team Canada partners. • Through the Council, senior executives and ministers would meet annually to review progress on Canada's SMR Action Plan and discuss strategic priorities going forward. • Meetings could be held on the margins of the CNA's annual conference or the annual Energy and Mines Ministers' Conference (EMMC).	EXPECTED RESULTS • Progress on development and commercialization of SMRs in Canada is advanced in a manner that respects shared roles, responsibilities, and jurisdictions—and leverages benefits to Canada and supports strategic partnerships. • Key decision makers have a venue for discussing progress and priorities for future action on nuclear innovation and nuclear energy matters broadly.

A-6-2 Capacity, Engagement & Public Confidence

POLICY, LEGISLATION, & REGULATION: **Public awareness and confidence**	**33**
RECOMMENDATION CNA should increase its outreach to other clean energy industry associations, ensuring appropriate representation of nuclear energy in broader clean energy dialogues.	EXPECTED RESULTS • Increased awareness of the role of nuclear energy in Canada's clean energy mix.

A-6-3 International Partnerships & Markets

INTERNATIONAL PARTNERSHIPS & MARKETS: **Promoting industry leadership on the global stage**	**34**
RECOMMENDATION CNA should continue to support industry participation in a Team Canada approach to international conferences and multilateral initiatives, with an emphasis on nuclear innovation and SMRs: • Invite Canadian SMR companies to participate in industry delegations to the IAEA General Conference and other international events. • Contribute, and encourage SMR companies to make contributions, to the Nuclear Innovation: Clean Energy Future (NICE Future) initiative under the Clean Energy Ministerial.	EXPECTED RESULTS • Canada presents a unified and coordinated approach internationally, showcasing the full breadth of the sector and leadership in nuclear innovation.

A-7 For the CANDU Owners Group (COG)

A-7-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT **SMR Technology Forum**	**35**
RECOMMENDATION COG should continue convening the SMR Technology Forum, bringing together SMR technology vendors and SMR utilities for practical collaboration.	EXPECTED RESULTS • SMR vendors and SMR utilities have a forum to enable a broad range of collaborative activities, as needs arise.

A-7-2 Policy, Legislation & Regulation

POLICY, LEGISLATION, & REGULATION: **Radioactive Waste Leadership Forum**	**36**
RECOMMENDATION As the Secretariat of Canada's Radioactive Waste Leadership Forum, COG should take steps to include the federal government in the discussions toward an integrated radioactive waste management plan that will also consider SMR waste.	EXPECTED RESULTS • Consideration of the needs of smaller waste producers is encouraged, including from SMR proponents who may not yet be represented. • Ensure that plans continue to develop in a timely fashion and progress continues to be made toward identifying pathways for disposal of all radioactive wastes, including from SMRs.

A-8 For the Organization of Canadian Nuclear Industries (OCNI) and Canadian Nuclear Supply Chain

A-8-1 Demonstration & Deployment

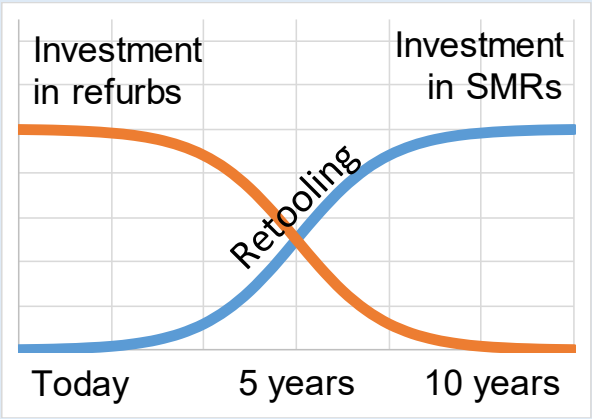
DEMONSTRATION & DEPLOYMENT:
Supply chain transition strategy

37

RECOMMENDATION

OCNI should lead on the development of a transition strategy for retooling the already ramped-up Canadian nuclear supply chain to meet demand growth for SMRs.

- Looking ahead to the successful conclusion of current refurbishment initiatives, this strategy would leverage Canada's supply chain—primed for growth from the refurbishments —and support it in pivoting to meet the needs of the growing market for SMRs.



EXPECTED RESULTS

- The Canadian nuclear supply chain, already ramped-up from the refurbishments in Ontario, is primed to pivot to a new emerging SMR subsector, leading in the development of global value chains and capturing benefits for Canada.

A-9 For the Canadian Nuclear Industry

A-9-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Initiatives to reduce SMR capital costs**	**38**
RECOMMENDATION Industry should develop and advance initiatives with a view to reducing SMR capital costs—for example, related to fleet economics (economies of multiples), advanced manufacturing, and 3-D printing. • Relevant actors include supply chain companies, Original Equipment Manufacturers (OEMs), Engineering Procurement and Construction companies (EPCs), utilities, owner-operators, national and commercial laboratories, and service providers.	EXPECTED RESULTS • Industry drives innovation and develops solutions to unlock efficiencies and savings that reduce the capital costs of SMR technologies, further enhancing their competitiveness and deployment potential.

A-9-2 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT, AND PUBLIC CONFIDENCE: **Promoting diversity in the future SMR workforce**	**39**
RECOMMENDATION In transitioning and retooling toward the emergence of a new subsector on SMRs, industry should develop plans to ensure the SMR workforce of the future is diverse and representative—including women, youth, minorities, and Indigenous persons. • Participate in “Equal by 30” under the Clean Energy Ministerial, and other initiatives to promote a diverse and inclusive workforce.	EXPECTED RESULTS • The future SMR workforce is diverse and equitably recognizes contributions from women, youth, minorities, and Indigenous people.

A-10 For Utilities and Owner-Operators

A-10-1 Demonstration & Deployment

DEMONSTRATION AND DEPLOYMENT: **SMR demonstration projects**	**40**
RECOMMENDATION Interested utilities should engage in the demonstration of one or more SMRs in Canada to share risks; bring expertise, judgement, and credibility to project proposals and business plans; and potentially cost-share funding.	EXPECTED RESULTS • One or more demonstration SMR constructed and in operation in Canada by 2026. • The technology-readiness of one or more SMR technologies is advanced to the pre-commercial stage. • Canada is positioned to capture research benefits and value for the domestic supply chain from the demonstration of these earlier-stage SMR technologies. • Utility risk-sharing enhances commercial-readiness of the demonstration by bringing utility perspective as an eventual operator of SMR technologies.

DEMONSTRATION AND DEPLOYMENT: **Strategic partnerships and business models**	**41**
RECOMMENDATION Interested utilities should advance strategic partnerships, joint ventures, and consortia, as appropriate, to develop demonstration project proposals for different applications in Canada and on the export market. • These arrangements could bring other enablers (e.g. EPCs and the Canadian supply chain) and end users (e.g. mining customers) into the proposals, as appropriate—in addition to SMR technology vendors and developers.	EXPECTED RESULTS • Demonstration proposals have a clearer and more compelling path to commercialization, as project proposals represent the full breadth of essential enabling partners needed to bring SMRs to market. • Demonstration proposals represent more value by enabling greater sharing of operational experience and lessons learned among partners, with projects benefiting from the perspectives of multiple enabling partners.

DEMONSTRATION AND DEPLOYMENT: **Fleet deployment pathways**	**42**
RECOMMENDATION With an eye to longer-term deployment plans, interested utilities should lead on the development of a white paper setting out potential fleet deployment pathways. • This white paper would respond to what we heard through the Roadmap on the importance of a fleet-based approach for long-term deployment across domestic jurisdictions and markets to leverage benefits, such as economies of multiples and other synergies (e.g. common fuel types, training). • Paper to be presented to federal, provincial, and territorial ministers at EMMC 2019.	EXPECTED RESULTS • Key considerations for the transition to a fleet are identified. • Key enablers understand the pathways that could be undertaken to enable a fleet-based approach for SMR deployment in Canada.

A-10-2 Capacity, engagement, and public confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Indigenous engagement**	**43**
RECOMMENDATION Utilities interested in SMRs should conduct meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific SMR project proposals.	EXPECTED RESULTS • Positive relationships are built with Indigenous groups. • Governments and industry have a greater understanding of Indigenous views, concerns, and priorities related to SMRs. • Indigenous groups have capacity to engage with governments and industry on SMRs.

A-11 For Vendors and Technology Developers

A-11-1 Demonstration & Deployment

DEMONSTRATION AND DEPLOYMENT: **Engagement with the regulator**	**44**
RECOMMENDATION Engage with the CNSC at an early stage through pre-licensing process available: • Vendor Design Reviews (vendors) • Pre-licensing (four-step process – licensing applicants)	EXPECTED RESULTS • Early engagement facilitates efficient licensing procedures.

DEMONSTRATION & DEPLOYMENT: **Engagement with NWMO on fuel waste management specifications and costs**	**45**
RECOMMENDATION Engage with NWMO on appropriate technical specifications for a safe disposal facility and compatible waste forms for SMRs that could be deployed in Canada.	EXPECTED RESULTS • The technical specifications for a safe disposal facility for used fuel fully accommodate used fuel types from SMRs that could be deployed in Canada. • SMR vendors are clear on the requirements for any conditioning of waste for acceptance at the used fuel waste facility. • Costs and funding requirements associated with fuel waste management are minimized through early engagement.

DEMONSTRATION AND DEPLOYMENT: **Strategic partnerships and business models**	**46**
RECOMMENDATION Consider where you are planning to seek to site your project and what that means about the strategic partnerships you need to be developing. For example: • If you intend to seek to site your project on AECL-owned lands, engage with Canadian Nuclear Laboratories' Invitation for Applications process. • If you intend to seek to site your project at an already licensed site, start engaging directly with utilities.	EXPECTED RESULTS • Project proposals and business plans are strengthened by strategic partnerships with Canadian enablers.

DEMONSTRATION AND DEPLOYMENT: **Fleet deployment pathways**	**47**
RECOMMENDATION To maximize your chances of success in Canada, develop your business case with a view to benefits for Canada. Consider partnering with Canadian operators, Engineering, Procurement and Construction (EPC) firms, Original Equipment Manufacturers (OEMs), and the broader Canadian supply chain.	EXPECTED RESULTS • SMR projects leverage the vast array of Canadian expertise and competencies in the nuclear sector.

A-12 For Universities and Colleges, Research Institutions, and Laboratories

A-12-1 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Training programs and education curriculum**	**48**

RECOMMENDATION

UNENE, universities, and colleges should lead in the following activities to ensure training and education programs are directed toward building the future SMR workforce:

- Develop a pan-Canadian plan to re-orient technical training programs and educational curriculum with a view to SMRs.
- Provide students with hands-on, practical experience through early-stage research and development programs.
- Engage with universities and research organization around the globe to further international cooperation on nuclear science and technology, and attract international talent to Canada.
- Bring nuclear examples to non-nuclear training programs and curriculum in areas, such as economics, accounting, marketing, policy and public administration, communications, etc.

EXPECTED RESULTS

- The future nuclear workforce has the skills, abilities, and resources needed for industry to meet the demands of a new emerging SMR subsector in Canada.
- The nuclear sector is strengthened by multidisciplinary perspectives and experience to develop new, innovative business models and solutions across technical, economic, and social issues.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Diversity of next-generation nuclear talent**	**49**

RECOMMENDATION

Universities, colleges, research institutions, and laboratories should promote and increase representation of women, youth, minorities, and Indigenous persons in the talent pipeline for the SMR workforce of the future.

EXPECTED RESULTS

- Enrollment by women, minorities, and Indigenous persons in university and college programs in nuclear energy is increased.
- The nuclear sector in Canada is able to draw from a diverse pool of highly skilled professionals that is fully representative of women, youth, minorities, and Indigenous persons.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Dissemination of nuclear energy information to non-nuclear audiences**	**50**
RECOMMENDATION Universities, research institutions, laboratories, and colleges should increase dissemination of nuclear energy information to non-nuclear audiences (e.g. by engaging communications students) and showcase the diversity of people and types of work in the nuclear sector.	EXPECTED RESULTS • The public has a better understanding of the diversity and breadth of the nuclear sector, the people who work in it, and their passion, using nuclear science and technology, to improve the health, safety, and well-being of Canadians and their environment.

A-13 For End-User Industries

A-13-1 Demonstration & Deployment

DEMONSTRATION AND DEPLOYMENT: **Exploring SMRs in the Canadian Minerals and Metals Plan**	**51**
RECOMMENDATION The mining sector, in collaboration with NRCan, provinces and territories, utilities, and nuclear sector stakeholders, should explore the role for SMRs as a source of low-carbon heat and power for remote mining operations through the Canadian Minerals and Metals Plan.	EXPECTED RESULTS • The mining sector has a full understanding of the potential benefits of SMRs for the sector, potential challenges, and efforts underway to develop and demonstrate SMRs in Canada. • Efforts to develop SMR technologies are informed by the needs and end-use requirements of mining companies in design and development work. • Mining sector stakeholders and SMR proponents continue to engage in and explore potential business models and partnerships.

DEMONSTRATION AND DEPLOYMENT: **Engagement with heavy industry**	**52**
RECOMMENDATION Heavy industry companies and organizations in oil and gas, oil sands, chemicals, and other heavy industry sectors should continue to engage in SMR development and deployment activities in Canada.	EXPECTED RESULTS • Canada's heavy industry sectors understand the potential applications and benefits for SMRs, potential challenges, and efforts underway in Canada. • The needs and end-user requirements of heavy industry are considered in the design and development of SMR technologies.

A-14 For Civil Society

A-14-1 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Engagement on SMRs**	**53**
RECOMMENDATION Civil society is invited to consider the Roadmap's key findings and recommendations. As industry and governments consider their options for responding to the Roadmap's recommendations, civil society and public perspectives will be sought.	EXPECTED RESULTS • Transparency, accountability, and evidence-based decision-making improves outcomes for Canadians and Canada.