

# **Small Modular Reactor (SMR) Development and Deployment in Ontario**

**Presentation to the Council of State Governments Delegation**

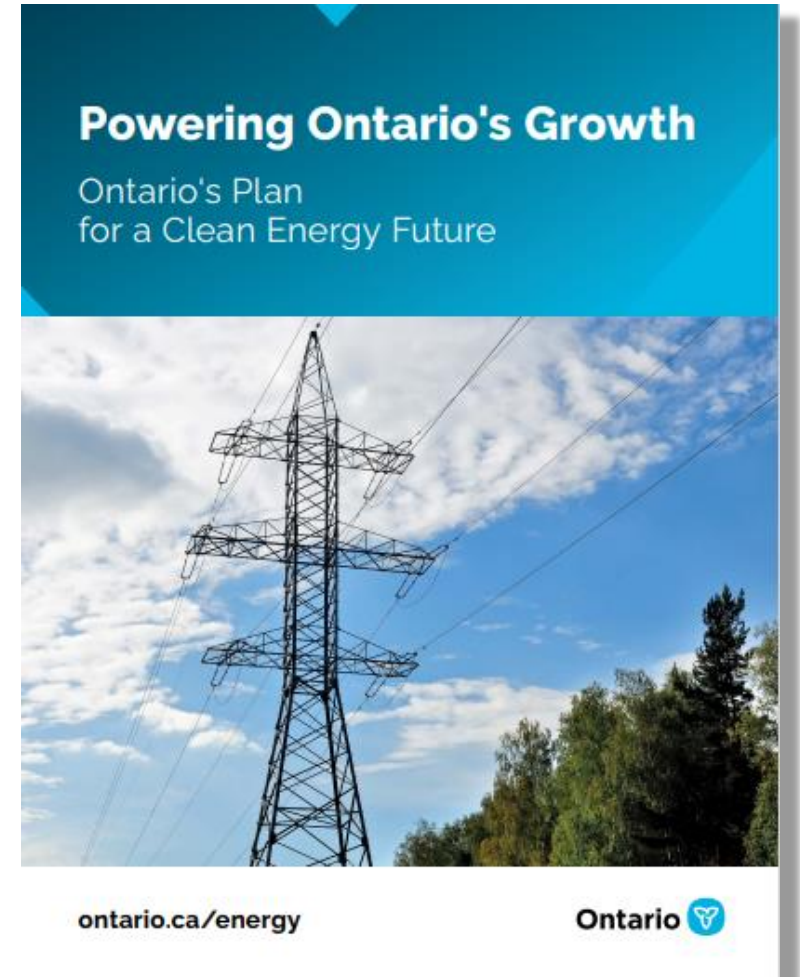
August 2024

## Ontario's Nuclear Advantage

- Ontario has one of the cleanest electricity systems in the world with about 90% of our electricity generation coming from non-emitting sources in 2022.
- Ontario is home to a mature nuclear industry, starting with the first CANDU power reactor going into service in 1962.
  - Ontario's nuclear industry is comprised of more than 200 companies and is a source of innovation and specialized employment supporting about 65,000 jobs, mostly in Ontario, and adds over \$17 billion per year to Canada's GDP.
  - The CANDU reactor has been exported to countries like Romania, Argentina and South Korea.
- Nuclear is part of Canada's national science and innovation sector, involving over 30 universities and several major research centres, many of them located in Ontario (e.g., McMaster University, Ontario Tech University).
- The nuclear industry in Ontario is leading the way on a new generation of innovative nuclear technology – small modular reactors (SMRs).
  - Grid-scale SMRs could help Ontario meet increasing electricity demand due to economic growth and electrification. Smaller-scale SMRs could be used at remote mines and industrial operations to provide heat and power.
  - Ontario's robust nuclear supply chain and experienced nuclear operators are uniquely positioned to support SMR development and deployment in Ontario, Canada and globally.

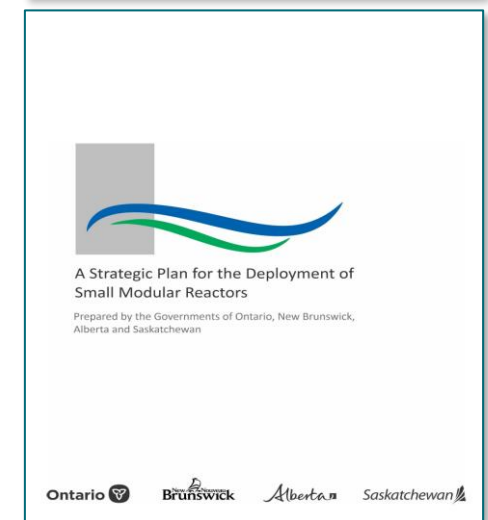
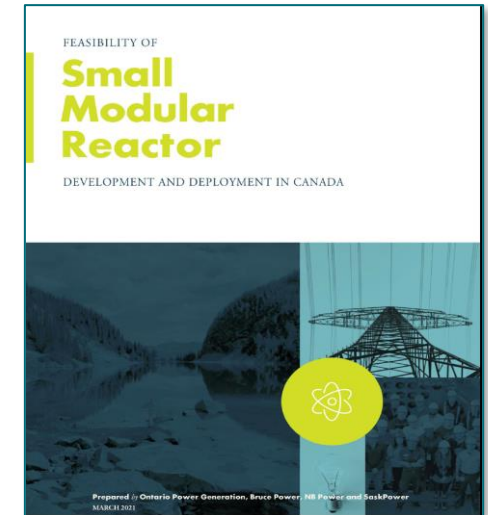
## Nuclear Energy in Ontario – Key Initiatives

- In July 2023, the Ontario government released the *Powering Ontario's Growth* plan, which outlines the actions the province is taking to meet the increasing demand for electricity driven by strong economic growth and electrification through the 2030s and 2040s.
  - Recent major industrial announcements, particularly around the electric vehicle supply chain and green steel, are expected to significantly increase industrial electricity demand.
  - Residential demand is growing as the population increases and as more households transition to electric vehicles and electric heat pumps for heating.
  - Energy projects, especially nuclear and transmission, require **significant lead time** for planning and approvals. There is a need to **take action now** and also to **plan for long term growth**.
- The *Powering Ontario's Growth* plan includes immediate actions towards enhancing the role of nuclear energy in Ontario's electricity system such as additional SMRs and refurbishments, and new large-scale nuclear.



## Ontario's Strategic Interest in SMRs

- The Ontario government recognized the potential of SMRs at an early stage and has been monitoring developments in the SMR market for several years and exploring the potential benefits for Ontario.
  - In 2016, Ontario released a feasibility study on the deployment of SMRs to replace diesel power at remote mines in the province.
  - In 2018, Ontario participated in the development of a *Canadian Roadmap for SMRs*, which outlined next steps for interested provincial / territorial governments, power utilities and industry.
  - In 2020, Ontario contributed to *Canada's SMR Action Plan*, which outlined the steps being taken in order to address the recommendations in the Canadian Roadmap for SMRs.
  
- Ontario is collaborating with partner provinces on SMR development across Canada:
  - In 2019, Ontario signed a Memorandum of Understanding (MOU) with Saskatchewan and New Brunswick, committing to collaborate on the development and deployment of SMRs. In 2021, Alberta joined the MOU.
  - In 2021, power companies from Ontario, Saskatchewan and New Brunswick released a feasibility study on SMRs for on-grid and off-grid use across Canada.
  - In 2022, the four provinces released *A Strategic Plan for the Deployment of SMRs*.



## Inter-provincial SMR Strategic Plan

- The Strategic Plan identified the following five priority areas for SMR development and deployment:
  1. **Technology Readiness:** Advance SMR projects along the three streams of SMR deployment identified by the utilities in order to ensure Canada becomes a global leader and a SMR technology hub;
  2. **Regulatory Readiness:** Streamline Canada’s nuclear regulatory and licensing processes to ensure timely and cost-effective approvals while ensuring safety;
  3. **Economics and Financing:** Federal-Provincial risk-sharing and federal financial support is key to advancing identified SMR projects and reaping the economic benefits;
  4. **Nuclear Waste Management:** Ensure that the federal nuclear waste management policy and framework appropriately incorporates radioactive waste from SMRs; and
  5. **Indigenous and Public Engagement:** Inform the public about the economic and environmental benefits of SMRs and create opportunities for Indigenous communities to participate in SMR projects.
- The Strategic Plan also identifies key considerations for provincial decision-making on proposed SMR projects by the utilities (e.g., electricity system and ratepayer impacts, emissions reduction impact, economic benefits, Indigenous partnerships).

## Darlington SMR Project

- In 2021, OPG announced it will work together with GE Hitachi Nuclear Energy to deploy an SMR at the Darlington new nuclear site by the end of the decade.
  - OPG conducted an extensive review process, starting in 2018, to examine many different SMR technologies and short-listed three technologies for its selection process (i.e., BWRX-300, Xe-100, IMSR-400).
  - Each technology was assessed against safety, technological readiness, licensing risk, environmental impact, economic development potential, and cost.
  - The Ontario government did not have a role in the technology selection but did concur with OPG’s final selection and approve next steps for the SMR project.
- In July 2023, the Ontario government announced that OPG will commence planning and licensing for three additional SMRs at Darlington to meet increasing demand from electrification and strong economic growth.
  - Once deployed, the four SMR units would produce a total 1,200 MW of electricity, equivalent to powering 1.2 million homes.
  - Subject to Ontario Government and federal regulatory approvals on construction, the additional SMRs could come online between 2034 and 2036.



The Darlington New Nuclear Project site (i.e., adjacent to the existing Darlington Nuclear Generating Station) is planned to be the site of Canada’s first 300 MW on-grid SMR by the end of the decade.

The Darlington site has already completed an Environmental Assessment (EA) and obtained a “License to Prepare Site” for a new-build project from the CNSC, which provides Ontario with a ‘first-mover’ capability for on-grid SMRs.

The construction and operation of one 300 MW SMR over its life is expected to create around 2,460 jobs across the province and increase GDP by more than \$2.5 billion, while lowering CO2 emissions by 0.3 - 2 megatons (MT) per year.



## Darlington SMR – Project Oversight

- The Ontario government recognizes that nuclear projects can be complex and challenging with respect to oversight, cost controls, project implementation and community engagement.
- Ontario has a multi-stage approvals process in place for the Darlington SMR project and is closely monitoring OPG's planning and preparation activities to ensure that project implementation minimizes costs and risks for Ontario and its ratepayers and maximizes economic and environmental benefits for the province.
- Ministry of Energy and Electrification has retained an Independent Oversight Advisor to monitor the Darlington SMR Project on behalf of the government and report to the ministry on a regular basis.
  - The Advisor provides an independent expert perspective which supports the ministry in carrying out due diligence, oversight and decision-making with respect to the planning and implementation of the Darlington SMR project, ensuring value for electricity ratepayers and maximizing benefits for Ontario's energy sector.
- The Darlington SMR project is a rate-regulated asset. OPG can recover capital and operating costs for the project through regulated prices charged to electricity consumers under the oversight of Ontario's independent energy regulator, the Ontario Energy Board (OEB).
  - OEB's public and transparent rate-setting process, which involves significant public and stakeholder input, will ensure that OPG can only recover prudently incurred costs for the project from Ontario ratepayers.

## Darlington SMR – Community and Indigenous Engagement

- Public opinion is generally favorable to nuclear energy and SMRs:
  - In 2021, Abacus Data on behalf of the Canadian Nuclear Association found that **69% of respondents** in Ontario agreed that investing in nuclear technologies can help Canada replace carbon-based fuels with electricity (only 11% disagree); and
  - In 2023, Angus Reid found that **70% of respondents** in Ontario support expanding the role of nuclear energy.
- OPG is actively engaging with local communities around the Darlington new nuclear site to share information about the SMR project through community events and open houses.
  - OPG is also actively engaging and consulting with potentially affected Indigenous communities for which the SMR project resides on their traditional territory. OPG is exploring economic opportunities for these communities such as commercial participation and employment in the SMR project.
- The Canadian Nuclear Safety Commission (CNSC) is currently reviewing OPG's application for a Licence to Construct its first SMR unit at Darlington, which provides additional engagement opportunities:
  - The Licence to Construct process includes opportunities for Indigenous communities and the public to review information about the project, discuss the application, raise areas of interest and participate in a public hearing (scheduled in October 2024 and January 2025).
  - Note: The Government of Canada through CNSC also has a legal duty to consult, and where appropriate to accommodate, any potentially affected Indigenous communities.



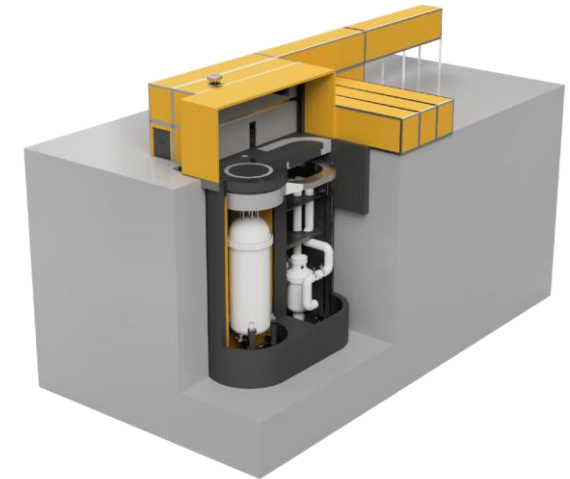
## Off-grid and Industrial SMRs in Ontario

### Global First Power

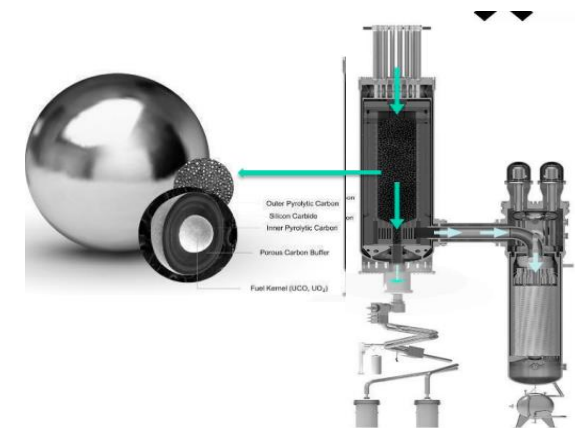
- In 2020, Global First Power Ltd. (GFP) announced it will build, own and operate a Micro Modular Reactor (MMR) project at Chalk River Laboratories in Ontario.
  - This first-of-a-kind project is designed to demonstrate the commercial viability of SMRs in off-grid applications as an economic alternative to diesel generation and in heavy industry.
- The MMR is a high-temperature gas-cooled reactor by Ultra Safe Nuclear Corporation (USNC) capable of operating at various power levels of up to 45 MW of process heat or 15 MW of electrical power.
- The GFP project is undergoing a federal Environmental Assessment and CNSC review of the “Licence to Prepare Site” application, the first of three licences that will be required before the SMR begins producing power.

### X-Energy

- OPG and X-Energy have signed a framework agreement to pursue opportunities to deploy Xe-100 SMRs for electricity and high-temperature steam for industrial applications in Ontario and Canada (e.g., oil sands, petrochemical).
  - The Xe-100 is a high-temperature gas-cooled reactor with an electricity capacity of 80 MW.



Global First Power - MMR



X-Energy – Xe-100

## Other Nuclear Initiatives

### Pickering Refurbishment

- In September 2022, the Ontario government asked OPG to update its 2009 feasibility assessment for refurbishing the Pickering Nuclear Generating Station’s “B” station (i.e., Units 5-8) as a due diligence measure to support future electricity planning decisions. In August 2023, OPG delivered its updated feasibility assessment to the Ministry of Energy and Electrification.
- In January 2024, the Ontario Government announced support for OPG’s plan to proceed with the next steps toward refurbishing Pickering “B” units, as part of a multi-stage approvals process. If refurbished, Pickering refurbishment could secure more than 2,000 MW of clean reliable power for at least another 30 years.



Pickering Nuclear Generating Station

### Bruce New Build

- In 2023, Ontario announced pre-development work with Bruce Power to site the first large-scale nuclear build in over 30 years to potentially provide up to 4,800 MW of reliable, emissions-free power to help meet rising electricity demand.
- Bruce Power has started consultations with local and Indigenous communities and undertaking a federal Impact Assessment for the project.



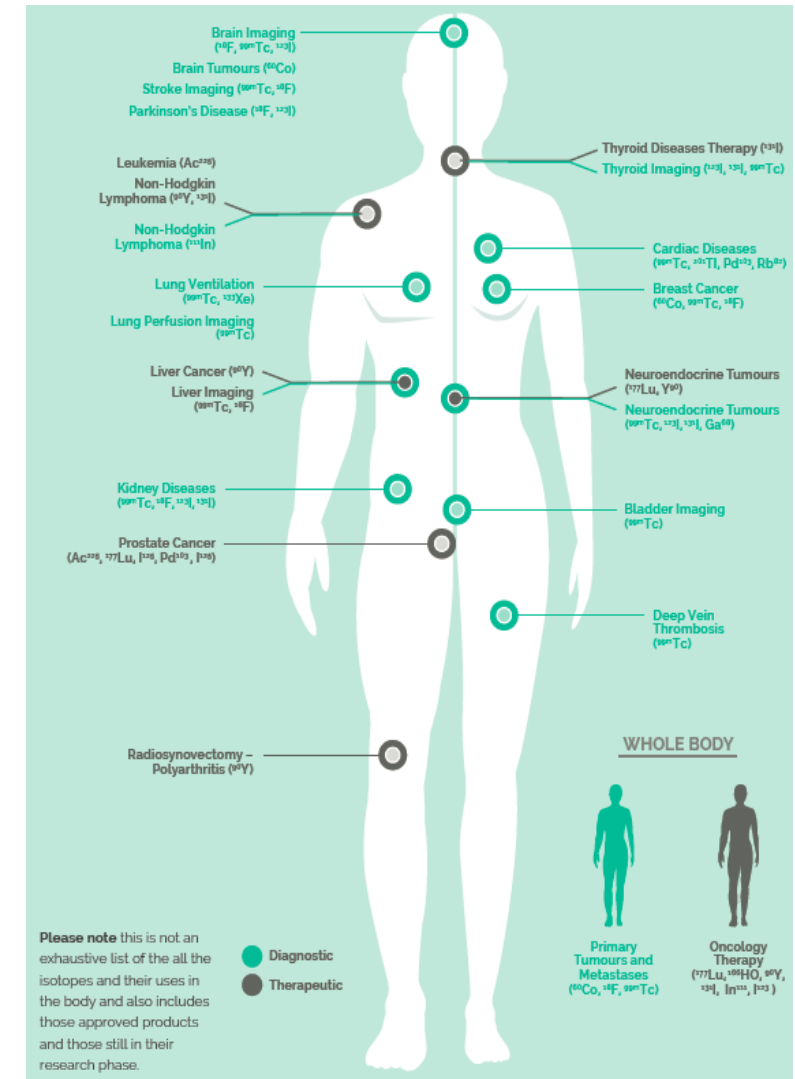
Bruce Power site – home to the existing Bruce Nuclear Generating Station

### Nuclear Feasibility Study: OPG, Bruce Power, Independent Electricity System Operator (IESO)

- Following the release of *Powering Ontario’s Growth*, the Ministry of Energy and Electrification asked OPG, Bruce Power and IESO to collaborate on a study for a common approach to developing future nuclear generation facilities at multiple sites in Ontario and report back by December 2024. The study will inform future government decisions on major nuclear projects (both SMRs and large reactors).

# Nuclear Innovation – Medical Isotopes

- Medical isotopes are currently produced in several Ontario’s nuclear facilities.
  - **Cobalt 60:** Bruce Power and OPG currently work with Ottawa-based Nordion to supply about half of the world’s Cobalt-60, a medical isotope used in various medical applications including medical device sterilization and cancer treatment:
- OPG and Bruce Power are undertaking a number of new initiatives to expand medical isotope production from their reactors. For example:
  - **Helium 3:** In 2021, OPG began producing Helium-3, a rare isotope used in quantum computing, neutron research, border security and medical imaging. Helium-3 is obtained from tritium that is removed from heavy water and stored at Darlington. OPG is the first civilian, non-military source of Helium-3.
  - **Lutetium-177:** In 2022, Bruce Power became the first commercial power reactor in the world to produce Lutetium-177.
  - **Molybdenum-99:** In 2025, OPG expects to commence commercial production of Molybdenum-99 at Darlington, a key diagnostic medical isotope, pending regulatory approvals.
  - **Yttrium-90:** In 2025, OPG expects to begin production of Yttrium-90 at Darlington, pending regulatory approvals. Once irradiated, Yttrium-90 will be sent to BWXT Medical Ltd.’s facility in Kanata, Ontario, to be packaged and then distributed to more than 30 countries globally for use in targeted radiation therapy to kill cancer cells and shrink tumours.
- Research reactors in Ontario also produce life-saving medical isotopes, such as McMaster Nuclear Reactor at McMaster University, (e.g., Lutetium-177, Rhenium-186 and Iodine-125 and Holmium-166 for cancer treatment) and Canadian Nuclear Laboratories (Actinium-225 for cancer treatment).
  - In March 2023 the Ontario government announced an investment of \$6.8 million in the McMaster Nuclear Reactor to expand its operations to 24 hours a day, five days a week to increase the amount of isotopes it produces.



Source: Canadian Nuclear Isotope Council

**Questions?**