

Canadian Nuclear Association: Queen's Park Day

November 29, 2022





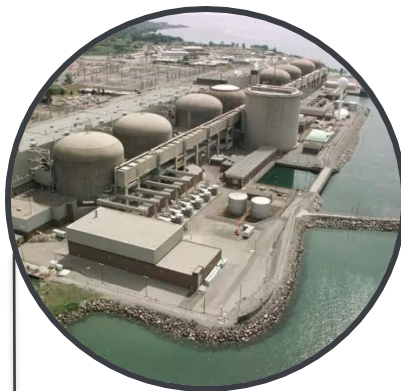
Canada's nuclear industry provides affordable and reliable clean electricity; good quality, high paying jobs; and medical innovations that diagnose diseases, treat illnesses and sterilize medical equipment.

Ontario's Nuclear Fleet



Bruce Power

1977/1984
6400 MW
~50 TWh per year
IESO Contract



OPG Pickering

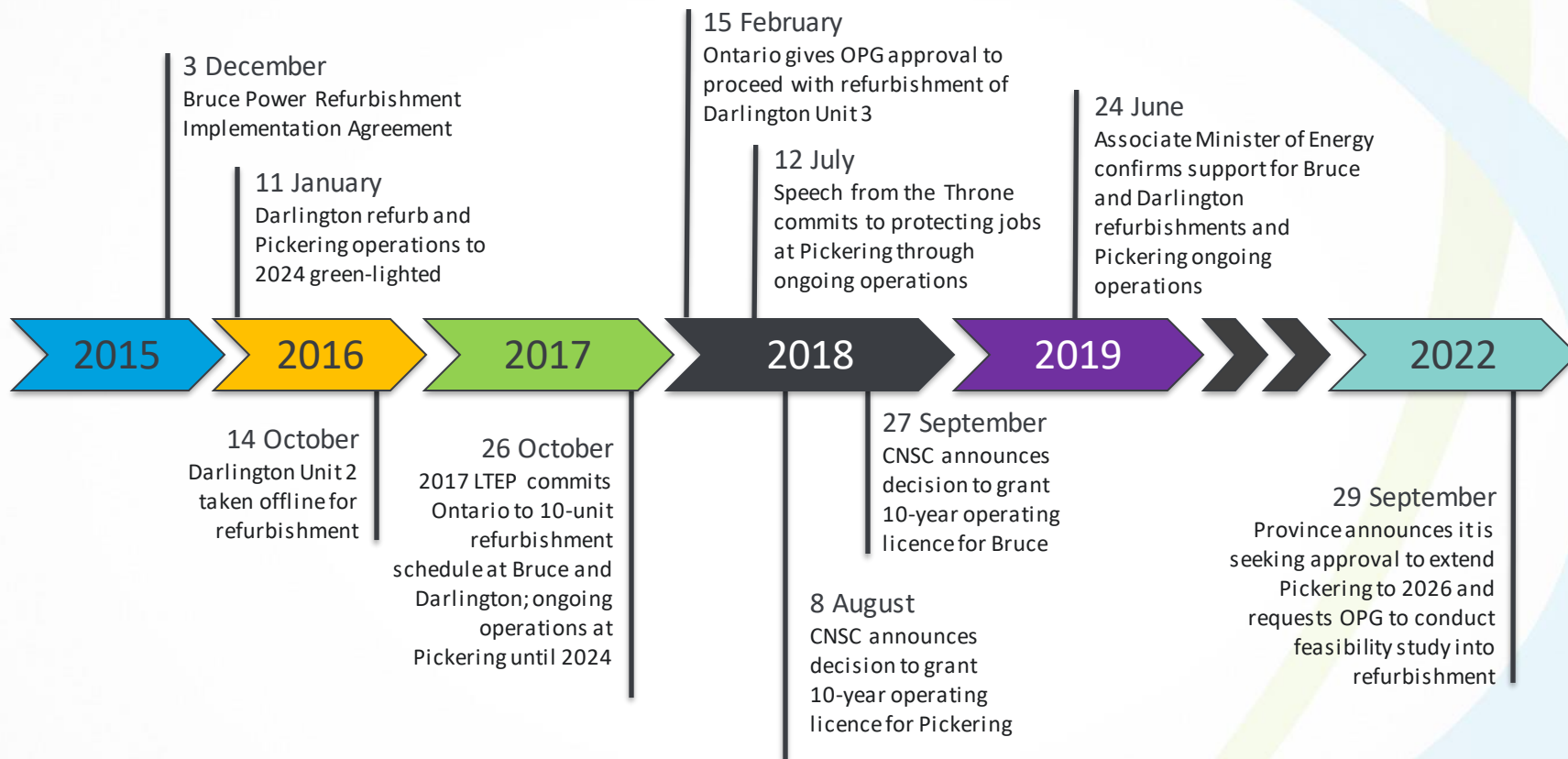
1971/1983
3100 MW
~20 TWh per year
OEB Regulated

OPG Darlington

1990
3500 MW
~25 TWh per year
OEB Regulated



Ontario's Commitments to Nuclear



Ontario Nuclear by the Numbers

65,000

Ontarians employed
across the
province's nuclear
industry

\$17 billion

Added to national GDP
by Ontario's nuclear
sector

~60%

Share of Ontario
power supply

10 million

Equivalent number of
homes powered by
nuclear in Ontario

Lower Emissions, Cleaner Air



PROTECTING OUR HEALTH

- Output from Ontario's nuclear fleet and greenhouse gas emissions from the electricity sector are inversely correlated.
- Nuclear powered the phaseout of coal generation and reduced Ontario's annual GHG emissions by the equivalent of 5% of Canada's total carbon emissions
- This was the largest single GHG reduction ever in North America
- Thanks to nuclear power generation, Ontario smog days fell from 30 in 2012 to fewer than 2 per year after the last coal plant was retired.

Local Jobs, Local Benefits



BUILDING OUR ECONOMY

- Collectively, Ontario's nuclear industry is the single largest employer in the province's energy sector and among the largest industrial employers in the province.
- The nuclear sector generates more than \$2 billion in labour income and \$2.5 billion in direct and secondary economic activity annually.
- Many of the companies in Ontario's nuclear industry are among the largest employers in their host municipalities.
- \$1.5 billion in annual federal and provincial tax revenue is generated by the nuclear sector.

Nuclear Medicine



SAVING LIVES EVERY DAY

- Nuclear medicine saves lives by diagnosing diseases, treating patients and sterilizing medical equipment.
- Canada has consistently led the world in producing radioisotopes for medical use, many of which are produced in CANDU reactors
- Bruce Power and OPG have long-term agreements with Ottawa-based Nordion to supply Cobalt-60, a radioactive isotope used to sterilize 40% of the world's single-use medical devices and equipment.
- Nordion and Bruce Power have also executed a MOU for the supply of High Specific Activity (HSA) Cobalt-60.
- Only produced in a small number of nuclear reactors globally, life-saving HSA Cobalt-60 is used in the radiation-based treatment of cancer and other diseases.

Reliable Power, Where it's Needed



KEEPING OUR LIGHTS ON

- Nuclear's 24/7 energy and reliable, all-season capacity profile cannot be replaced by a single source of alternative clean power (i.e., imports, renewables, or conservation).
- There is no credible, affordable path to net-zero emissions without nuclear in the mix.
- Diversity of supply – meaning a broad mix of power generation and storage technologies – will be key to ensuring security of supply and mitigation against weather, market, and system shocks.

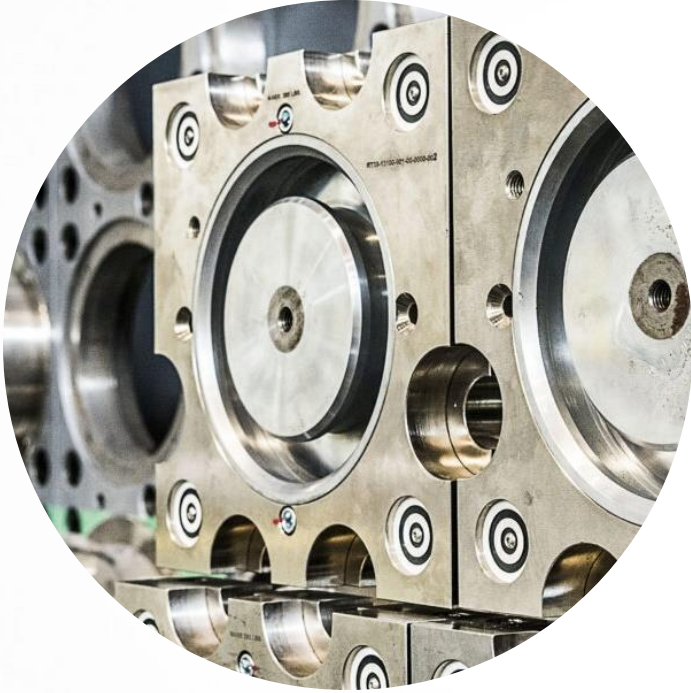
Ontario's Growing Demand



PREPARING FOR THE FUTURE

- Ontario's electricity needs are growing due to electrification of transportation, industrial and residential fuel switching.
- Supply needs are set to grow to almost 3,900 MW in 2030 according to IESO.
- All resources will play a key role in ensuring lights remain on in Ontario.

Bruce and Darlington Refurbishments



ON TIME & ON BUDGET

- The two largest infrastructure projects in Canada.
- OPG's Refurbishment of Darlington will contribute \$15 billion to Ontario's GDP over the course of the project, with employment increasing by an average of 8,800 jobs and peaking with 11,800 jobs between 2014 and 2023.
- Full operations at Bruce Power helps support 22,000 direct and indirect jobs, as well as \$4 billion in annual economic investment across the province.

Darlington SMR Project



INNOVATING FOR THE FUTURE

- OPG is working with GE-Hitachi to deploy a 300 MWe water-cooled, natural circulation Small Modular Reactor (SMR) with passive safety systems.
- Set to begin operation as early as 2028.
- If operated for 60 years, will have \$2.5 billion impact on GDP.
- 700 jobs during project development, more than 1,600 jobs during manufacturing and construction, and over 200 jobs during operation.

The Future of SMRs



RANGE OF APPLICATIONS

- Very Small Modular Reactors (vSMRs) or Micro Modular Reactors (MMRs) generate around 10 MWe, while larger SMRs generate around 300 MWe - much smaller than Canada's flagship CANDU reactors, which average around 700 MWe.
- SMRs are ideal for many of Canada's remote and smaller communities not easily connected to power grids.
- The country's resource industries, such as mining and oil extraction, need the heat and electricity that SMRs will be able to provide without having to build the reactors onsite.
- Some SMR designs are being advanced in Canada, which has the materials and the skills to become a world leader; being at the forefront of the SMR revolution could bring great economic benefits to Canada.

CANDU: Canada's energy workhorse



RELIABLE, CLEAN POWER

- CANDU reactors provide extremely cost-competitive power and are over 96% manufactured in Canada – mostly in Ontario
- Uses products and services from over 190 Canadian suppliers
- Fueled with natural, unenriched Uranium
- There are 27 CANDU reactors currently operating on 4 continents
- With Latest CANDU design, Canada is 1 of only 5 western countries to have a regulator-approved Large Reactor design.

The Nuclear Fuel Cycle



UNMATCHED ENERGY DENSITY

- Nuclear fuel is very energy dense, so a nuclear reactor needs very little fuel.
- Uranium pellets weigh about 20 grams each (a little less than the weight of a AA battery) and fewer than 10 pellets are needed to power the average Canadian household for a year.
- Canada is the world's second-largest producer of uranium, accounting for 13% of total global output.
- Uranium's transformation from ore into nuclear fuel and the handling of waste products is called the nuclear fuel cycle.

Canada's National Nuclear Laboratory



70 YEARS OF INNOVATION

- Canadian Nuclear Laboratories (CNL) headquartered at Chalk River, Ontario, has 50 unique laboratories with a diverse team of over 500 PhDs and researchers
- CNL works on the full range of nuclear technology and innovation, including:
 - SMR and Advanced Reactor development and siting
 - Breakthrough technologies in nuclear medicine
 - Support for the current reactor fleet globally
 - Ground-breaking research into low dose radiation
 - Advances in all aspects of hydrogen economy
 - Leading work in low-carbon energy systems
 - Deep expertise in waste management and environmental science

Innovation and Science



MORE THAN JUST POWER

- Nuclear innovation and science is essential to the health, safety, and prosperity of every Canadian.
- Research initiatives at national laboratories, universities, and research reactors across Ontario support affordable electricity, product improvements, medical services, training, and other activities.
- Nuclear technology plays an important role in almost every technical field across Canada, including:
 - Advanced electronics
 - Advanced material development
 - Aerospace and automotive technology
 - Earth science & archaeology
 - Environmental technology food processing
 - Mining and natural resources
 - Nuclear medicine
 - Pharmaceutical and medical devices

Ontario Exporting to the World



DRIVING THE TRANSITION

- Ontario's nuclear industry has already exported CANDU technology and expertise to China, South Korea, Romania, India and Argentina.
- Over 180 private sector suppliers, 95% of which are Ontario-based, benefit from international nuclear projects using our intellectual property, manufactured goods, and unique services
- As one of only 5 western countries with modern reactor technology, Canada has the opportunity to help decarbonize countries all over the world while bringing science, technology, and manufacturing jobs to Ontario

Financing Nuclear in Canada



PRIVATE & PUBLIC FINANCING

- Canada, US, and Europe are pursuing new and innovative options for financing nuclear.
- The November 2022 Ontario Fall Economic Statement committed to a Clean Energy Credit Registry and a revisit of the Green Bond qualification.
- The federal government's new Clean Energy Investment Tax Credit includes SMRs and potentially large-scale nuclear and access to tax credit equivalents for crown corporations.
- Canada Infrastructure Bank provided a \$970 million loan for the Darlington SMR project and Canada's Strategic Innovation Fund (SIF) has provided funding for multiple SMR projects.

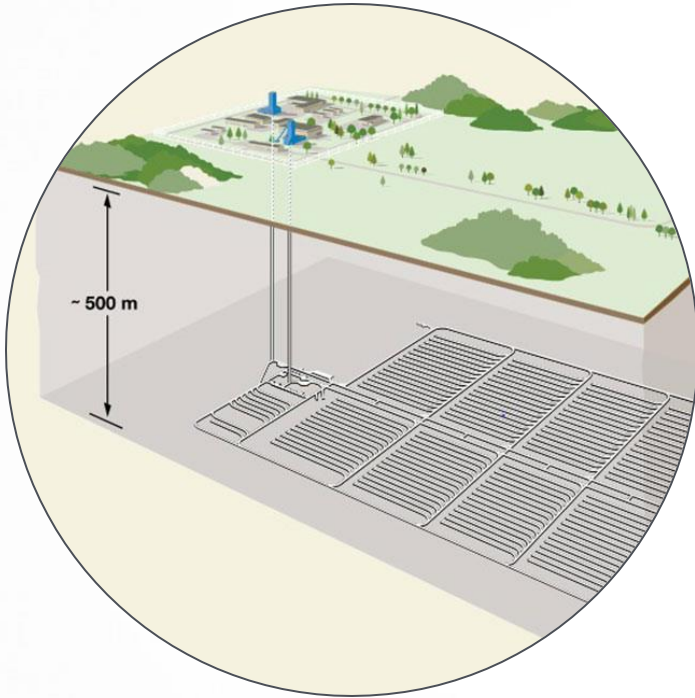
Nuclear Waste Storage



SAFE, SECURE, STORED

- When used nuclear fuel bundles are removed from a reactor, they are placed in a water-filled pool where their heat and radioactivity decrease.
- After seven to ten years, the bundles are placed in dry storage containers.
- OPG operates three facilities for the interim management of nuclear waste at the Pickering, Darlington and Bruce sites.
- In the long-term the industry is focused on achieving nuclear waste solutions which will last for thousands of years, such as a Deep Geologic Repository (DGR), an internationally accepted best practice for the permanent storage of nuclear waste.

Nuclear Waste Management Organization



INTERNATIONAL BEST PRACTICE

- The Nuclear Waste Management Organization (NWMO) was created to develop and implement Canada's plan, through engagement with Canadians, for safe long-term management of used nuclear fuel.
- Since 2010, the NWMO has been engaged in a multi-year, community-driven process to identify a site where Canada's used nuclear fuel can be safely contained and isolated in a deep geological repository (DGR).
- The DGR is a multi-barrier, high-technology system to ensure the protection of health, safety and environment.
- Site selection is expected in 2024, construction in 2033, and operation beginning in the 2040s.



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