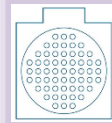


Canadian Nuclear Roadmap to 2050

Canada's Tier 1 Nuclear Industry



FLEET: 19 operating CANDU Reactors in Canada at the Bruce Power, Darlington, Pickering, New Brunswick stations

CANDU Technology: SNC-Lavalin has exclusive rights to CANDU technology IP
SUPPLY CHAIN: 200+ companies providing products and services



UTILITIES: 3 nuclear reactor utilities safely operating the Fleet – Ontario Power Generation, Bruce Power, New Brunswick Power

R&D: several internationally recognized facilities furthering nuclear innovation: Canadian Nuclear Labs (CNL) & universities



EDUCATION: institutions training high-skilled professionals for next generations: McMaster, UOIT, UWO, Durham College, etc.

MINING: 2nd largest exporter of Uranium led by Cameco; Saskatchewan has highest-grade Uranium in the world



WASTE MANAGEMENT: global leader in permanent spent fuel disposal led by NWMO: Deep Geological Repository solution

ASSOCIATIONS: representing the industry and educating the general public: OCNI, CNA, CNS, NAYGN, WiN-Canada, UNENE



\$6B/year Industry
 60,000 direct & indirect jobs
 40,000 spin-off jobs
 \$1.2B in exports

Policy Objectives

Recognize Nuclear as Clean Energy providing base load electricity

- Nuclear electricity produces carbon emissions comparable to renewables
- Widely recognized as a key technology to combat climate change
- Nuclear is a key part of a low carbon electricity portfolio (e.g., 60% of Ontario's electricity comes from nuclear)
- Provides reliable electricity: highest capacity factors

Foster Socio-Economic benefits of the Nuclear Industry

- Significant economic impact of major projects:
 - Life extension of Ontario fleet
 - New build in Canada and internationally
- Low cost electricity from nuclear fosters a competitive economy
- Creates long-term high-skilled jobs in science, technology and engineering
- Education programs maintain specialized skillset
- Non-power applications:
 - Medical imaging, diagnosis and cancer treatment
 - SMRs for desalination, mining, Oil & Gas
- Develop aboriginal communities through delivery of electricity to remote locations

Maintain Canada's Nuclear Tier 1 status through investment in R&D / Innovation

- Next Generation CANDU & advanced fuels
- Life Extension tooling and robotics
- Development of Small Modular Reactors (SMR) & Very Small Modular Reactors (VSMR)
- Development of Gen IV reactors
- Decommissioning and waste management (D&WM) technology
- Maintain leadership in nuclear medicine applications
- Health: imaging, diagnosis, cancer treatment

Strengthen Canada's International Nuclear Leadership and Engagement

- Export Canadian-developed CANDU technology to international markets such as China, Argentina, the UK and Romania
- Nuclear governance mentor: Internationally recognized nuclear regulator
- Diplomatic leader in:
 - Nuclear Trade
 - Nuclear disarmament
 - Nuclear as part of the climate change solution

Trends and Pressures

Government & Regulatory:

- Importance of government support in export markets
- Complexity of nuclear export control regime impacts already long sales cycle
- Lack of global consensus on nuclear being "clean"

Energy Market:

- Federal and provincial pressure on carbon reductions
- Competition with heavily subsidized electricity generation sources (wind/solar)
- Low natural gas prices

Social License:

- Increased importance of social license: public acceptance & increased use of social media
- Misunderstanding of nuclear: peaceful vs. weapons
- Concerns regarding management of spent fuel and radioactive waste
- Increased engagement of aboriginal communities

Industry Dynamics:

- Industry shift & consolidation: major players merging, restructuring & exiting
- Workforce Generation Gap: several high-skilled professionals retiring soon
- West to East economic shift: rising populations and emerging markets
- Emergence of China as key player in nuclear projects

Financial and Project Risk

- Lack of funding for new build projects: large up-front capital investment leads to public to private funding shift
- Lower risk appetite for large projects

Technology

- SMR popularity in Canada for remote locations and various applications
- Electrification of transportation and heating and cooling systems

Other

- Emerging wave of facilities that are reaching end of life: Pickering, G2
- Shut down of NRU will challenge industry's ability to supply isotopes and conduct nuclear R&D

Policy Balances

Maintaining low electricity prices and supporting electrification while achieving carbon reduction commitments

How to address diff electricity needs of urban, remote and northern communities: SMR vs. Large CANDU Reactor

Encouraging Innovation and New Technologies that satisfy market demand

Addressing nuclear concerns (e.g., safety & cost) while maintaining public acceptance

Growing a new and sustainable workforce with fluctuating project commitments

Leverage international financing (e.g. Chinese) vs. maximizing Canadian jobs through Export Credit

Streamlining regulatory requirements while ensuring safety and security

Balancing a centralized nuclear strategic policy that meets market requirements

Balancing federal (e.g., regulation and R&D) and provincial (supply mix) jurisdiction for nuclear policy issues

Natural Resources Canada Levers

Legislation and Regulation

- NRCan has authority over Nuclear Research & Development, Uranium resource development and nuclear regulation through the Nuclear Safety and Control Act
- The Canadian Nuclear Safety Commission (CNSC) is the Nuclear regulatory agency and operates independently from the Minister's authority
- Ability to provide input required for science-based policy making (e.g., Mission Innovation)

Funding

- NRCan has a number of funding programs available for industry to support technology development and international engagement

Convening Power

- National leadership for provinces and territories on nuclear and energy policy given the separation of jurisdictions
- Ability to bring industry players together to address industry wide-issues and public concerns

Information Broker

- Host industry-wide forum for information sharing
- Seeks industry input on government-to-government related issues.

International Engagement

- Ability to lead international engagements in collaboration with Global Affairs. E.g., nuclear trade missions & bilateral discussions
- Ability to support industry-led initiatives
- Primary interface with international nuclear agencies (e.g., IAEA)

Governance

- CNSC and Atomic Energy of Canada Limited (AECL) are engaged with NRCan via the Minister of Natural Resources.
- Nuclear export control regime governed by Global Affairs Canada & CNSC.

Actions Requiring Ministerial Attention

Nuclear as part of the Climate Change Solution:

- Continue to support Nuclear Initiatives under Mission Innovation and Clean Energy Ministerial Programs
- Play a leadership role among like-minded countries to support the use of nuclear in a low carbon economy

Level Playing Field for Nuclear:

- Establish appropriate market measures to incentivize development of low-carbon electricity sources including nuclear. E.g, carbon tax.

Acknowledgement of Nuclear's Contribution

- Publicly acknowledge the merits and contribution that Nuclear energy makes
- Address key areas of public concern with science and evidence-based information

Funding & Financing

- Identification and allocation of accessible funding for new nuclear technology development
- Allocation of funds for financing nuclear projects (e.g., EDC) and to access export markets

Policy & Planning

- Develop centralized strategic policy that supports market needs and industry priorities for R&D
- Federal government, provincial government & industry dialogue for long-term expansion of nuclear fleet and leadership in key areas

Vision to 2050: Maintaining Tier 1 Status

- Strategic alignment with other Nuclear nations to address trade, environment & disarmament issues
- Embed Nuclear as part of a low carbon future from an international, federal and provincial government policy position
- Enhance public support and social license for Nuclear to underpin consistent policy
- Successfully life extend and operate 10 CANDU Reactors in Ontario
- Build new CANDU reactors in Canada for domestic electricity consumption and export
- Develop and export new CANDU Reactors abroad
- Develop new nuclear technologies
- Deploy and localize SMR technology for remote & non-nuclear applications in Canada
- Sustain and renew R&D facilities in Canada
- Successfully implement long-term facilities for low, intermediate and high-level waste storage
- Successfully decommission nuclear facilities in Canada and abroad
- Renew the nuclear workforce in Canada
- Be a leader in the nuclear medicine field