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Canada's SMR Action Plan

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Outline

Context - Canada's Strengthened Climate Plan

Nuclear in Canada

Small Modular Reactors (SMR)



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Canada's Strengthened Climate Plan

2015: Under the Paris Agreement, the Government of Canada committed to reduce GHGs by 30% below 2005 levels by 2030

2016: Canada produced its first ever national climate plan, the Pan-Canadian Framework on Clean Growth and Climate Change

2020: The Government of Canada released its Strengthened Climate Plan: A Healthy Environment and a Healthy Economy

Exceeding 2030 targets and reaching net zero by 2050

- **\$15 billion** in clean energy investments
- Putting a price on carbon pollution
 - Rising to **\$170 per tonne of CO2** in 2030
- Supported by a strong policy framework, including:
 - Clean Fuel Standard
 - Hydrogen Strategy for Canada
 - Canada's Small Modular Reactor Action Plan

Five Pillars of Canada's Strengthened Climate Plan

- 
MAKING THE PLACES CANADIANS LIVE AND GATHER MORE AFFORDABLE BY CUTTING ENERGY WASTE
- 
MAKING CLEAN, AFFORDABLE TRANSPORTATION AND POWER AVAILABLE IN EVERY COMMUNITY
- 
CONTINUING TO ENSURE POLLUTION ISN'T FREE AND HOUSEHOLDS GET MORE MONEY BACK
- 
BUILDING CANADA'S CLEAN INDUSTRIAL ADVANTAGE
- 
EMBRACING THE POWER OF NATURE TO SUPPORT HEALTHIER FAMILIES AND MORE RESILIENT COMMUNITIES

IEA Report: Nuclear is needed for climate change goals

- Special report on the need for nuclear in global climate policies
 - Launched at the Clean Energy Ministerial in May 2019 by IEA Executive Director Fatih Birol
 - First IEA report on nuclear in 20 years
- Key findings:
 - **Nuclear plant retirements will significantly constrain global efforts to meet Paris targets**
 - Investments in nuclear energy life extensions and new builds make it **cheaper and easier to meet Paris targets**
 - **Not investing in nuclear energy increases risk of failure to meet targets**
 - It will cost an estimated **US\$1.6 trillion less to meet targets with nuclear** than without

Bottom Line: IEA recommends including nuclear energy in climate policies and programs, and recommends strong support for nuclear energy, including SMRs

Nuclear Power in a
Clean Energy System



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For over 70 years, Canada has been a world leader in nuclear energy

2nd

country ever to achieve criticality (i.e. produce nuclear power)

1 of 8

countries in the world that has developed and sold its own reactor technology

2nd

largest uranium producer in the world (\$600M+ in exports)

40%

of world production of Cobalt-60, used to sterilize medical equipment (e.g., gloves, syringes) and treat cancer

1st

country with nuclear capabilities to declare nuclear would only be pursued for peaceful purposes (in 1965)

0

major radiological accidents that have caused environmental/health impacts in nearly 50 years of commercial operation in Canada

1/4

of Canada's Nobel prizes awarded related to nuclear science

\$22B

put aside by nuclear operators for decommissioning and long-term waste management to ensure no burden is left to future generations as of 2020



Canada's Nuclear Sector is a Strategic Asset

ECONOMIC Benefits

\$17B to the economy and **76,000 total jobs**.

200+ small and medium-sized enterprises

\$1.4B uranium exports annually

\$26B investments to refurbish Ontario's fleet

15% of Canada's electricity from 19 home-grown CANDU reactors

GEOPOLITICAL Benefits

Beachhead for strategic international engagement

Nuclear science leadership positions Canada at nuclear security tables

SOCIAL AND ENVIRONMENT Benefits

Canada supplies 40% of world's supply of Cobalt-60 for sterilization of single-use medical equipment

2nd largest source of non-emitting electricity in Canada, offsetting 50M+ tonnes of CO₂, and supporting transition off coal

Waste management framework is **seen as the gold standard** internationally



What is a Small Modular Reactor?

Small

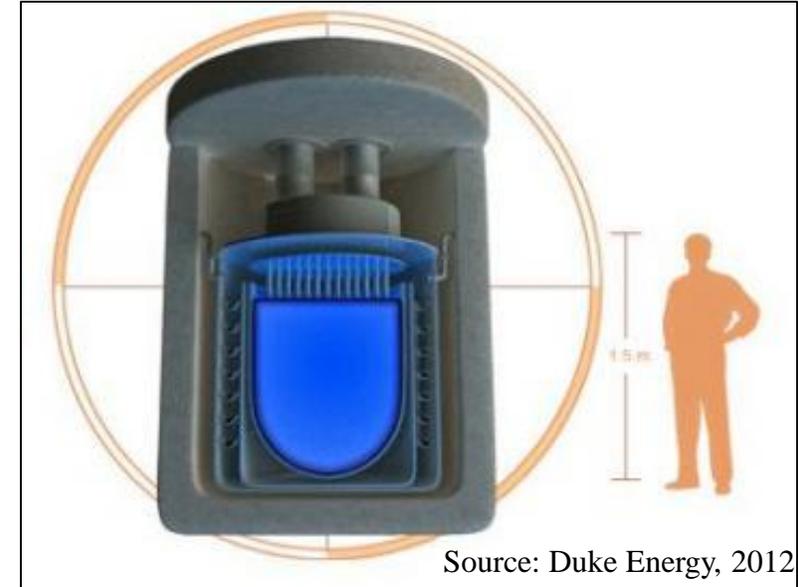
- Small in size and power output relative to conventional nuclear power reactors
- Some SMR designs are small enough to fit in a gymnasium, others are larger but still smaller than today's reactors

Modular

- Manufactured in factories and transported to site for lower capital costs as well as ease of installation, operation, and removal

Reactor

- SMRs use nuclear power, a non-emitting and efficient way to generate electricity
- Some SMR designs also provide district heating, heat for year-round greenhouses, desalination, and water purification
- Next generation SMRs are designed for simplified (“passive”) safety and proliferation resistance



Small modular reactors are nuclear *re-imagined*...



Data Centre



Remote Community



Industry



Catalyst for Clean Growth

There are three distinct markets for SMRs in Canada and the global export market



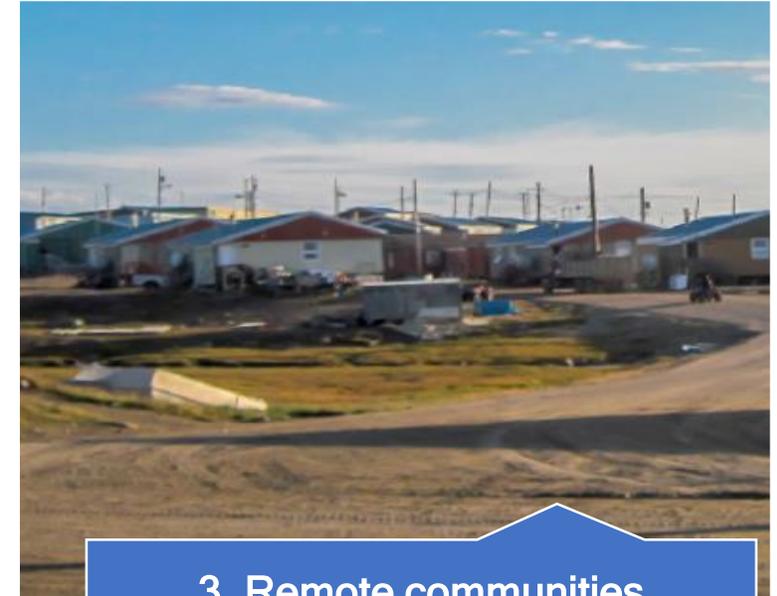
1. On-grid power (150 to 300 MWe)

Competitive option for replacement of coal-fired generation



2. Heavy industry (10 to 80 MWe)

SMRs could reduce mine energy costs by 20-60%



3. Remote communities (1 to 10 MWe)

Longer-term market; over 70K communities internationally

An SMR sub-sector is emerging in Canada, with an eye to a pan-Canadian domestic market...

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**

SMRs could yield up to **\$19B in total annual economic impact** between 2030-2040, creating over **6,000 new jobs annually** across the country.

...and an immense global SMR opportunity driven by climate change mitigation and energy security imperatives.

Replace coal-fired power generation

- SMRs can further transition the power sector away from coal
- Even in a 2-degree scenario IEA projects 1100 GWe
- 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**



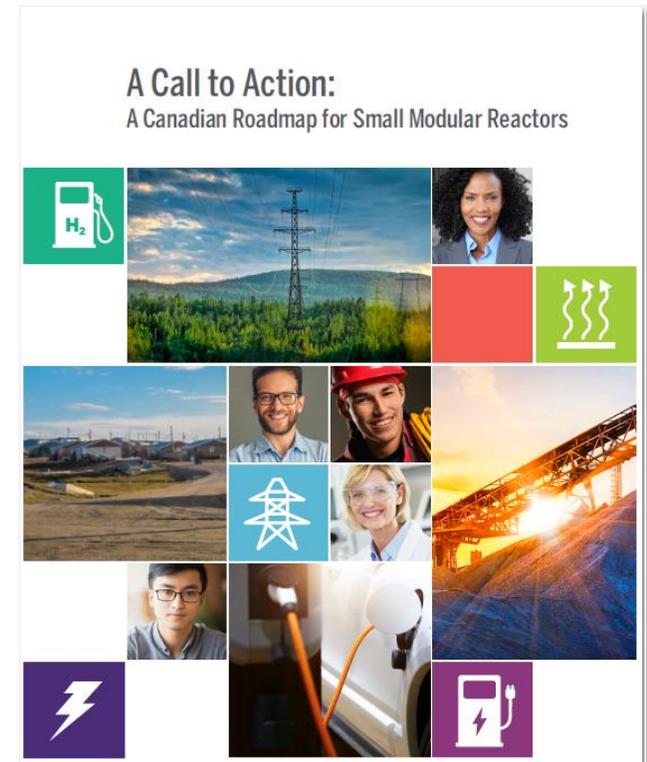
Steam for heavy industry

- 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.

Bottom Line: Estimated global value of \$150B per year by 2040.

Canada's SMR Roadmap – The focal point for developing Canada's SMR Policy Framework

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



www.smrroadmap.ca



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From Roadmap to Action Plan

The Action Plan builds on the momentum of Canada's SMR Roadmap, which convened Team Canada to chart a vision for this emerging area of nuclear innovation. The Roadmap marked the beginning of Canada's plan to lead the world in this game changing technology.

SMR Roadmap

Vision

53 Recommendations

55 Contributing Organizations

Initiated Indigenous Engagement

smrroadmap.ca

SMR Action Plan

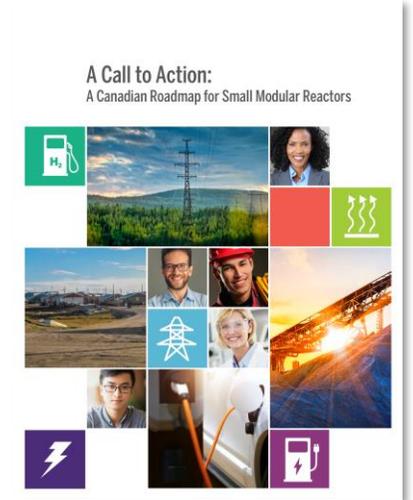
Principles

497 Actions

111 Participating Organizations

Ongoing Indigenous Engagement

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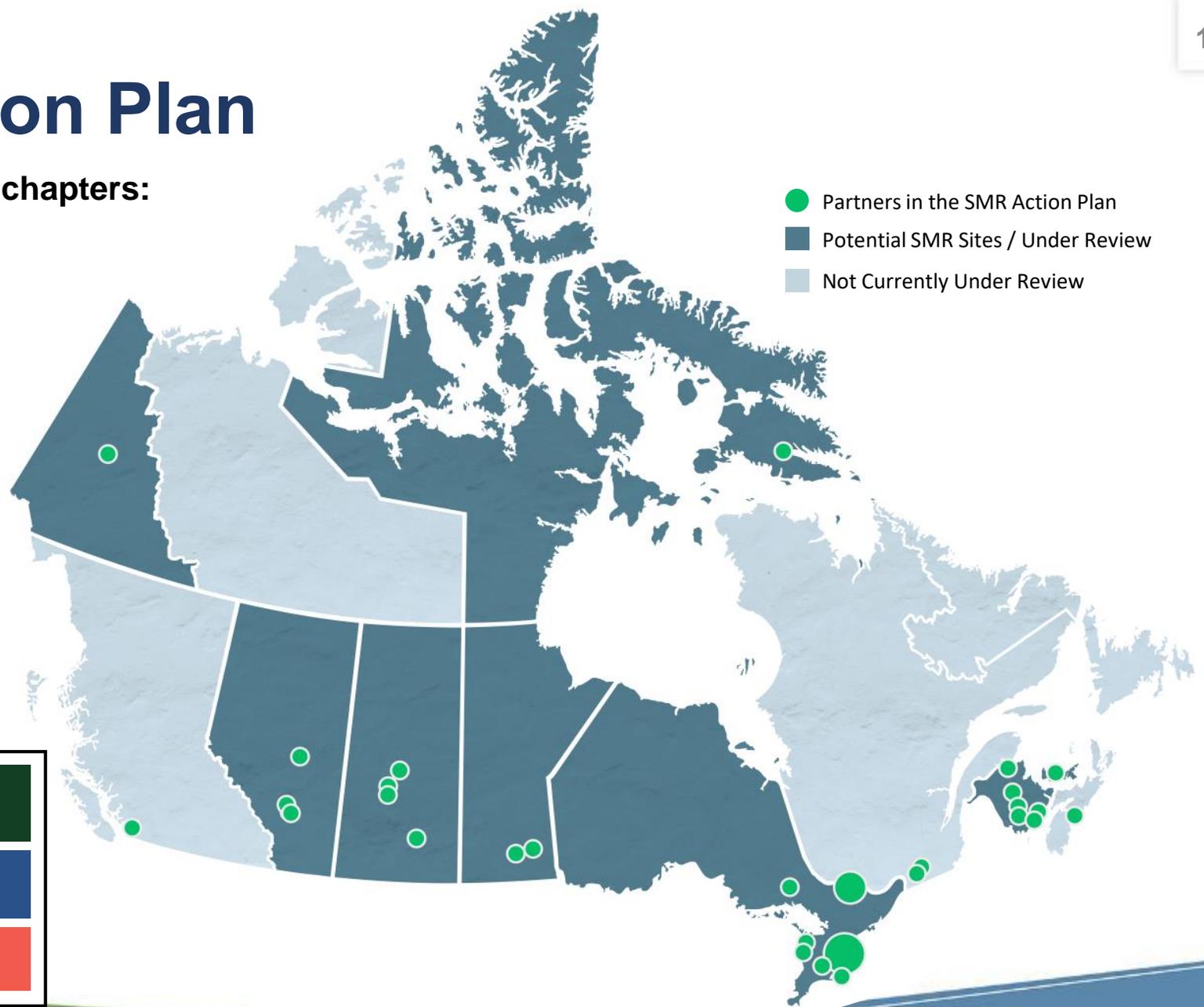
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Canada's SMR Action Plan

111 Participating Organizations submitted chapters:

- Government of Canada
- Provinces and Territories
- Indigenous
- Municipalities
- Power Utilities
- Civil Society and Education
- Academia and Research
- Industry Associations
- Heavy Industry
- EPC Firms and Value Chain
- SMR Vendors



Endorsed **THE VISION**

Committed to **KEY PRINCIPLES**

Taking **ACTIONS**



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Canada's SMR Action Plan

THE VISION

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.

KEY PRINCIPLES

To seize this Canadian opportunity, we intend to:

1. Support the development and deployment of SMR technologies in Canada.
2. Engage international partners.
3. Integrate SMRs with other clean energy sources.
4. Pursue waste minimization.
5. Strengthen diversity in the nuclear industry.
6. Leverage Canada's extensive capabilities.
7. Support actions outlined in partner chapters.

ACTIONS

Responds to all 53 recommendations in the Roadmap and also includes voluntary actions guided by four thematic pillars:

- Pillar 1:** Demonstration and Deployment
- Pillar 2:** Policy, Legislation, and Regulation
- Pillar 3:** Capacity, Engagement, and Public Confidence
- Pillar 4:** International Partnerships and Markets

Projects emerging along three parallel “streams”



Stream 1: *Near Term On-Grid SMRs in Ontario and Saskatchewan*

- Ontario and Saskatchewan pursuing higher-readiness SMRs for faster deployment
- Potential deployment in Ontario by late 2020s, and Saskatchewan by the early 2030s



Stream 2: *Next Generation On-Grid SMRs in New Brunswick*

- New Brunswick pursuing innovative next generation SMRs for its Point Lepreau site and the export market, that would include first-of-a-kind waste recycling technologies
- Potential deployment in the early 2030s



Stream 3: *Off-Grid SMRs for Mining*

- Mining companies signalling interest and carrying out feasibility studies for SMRs to replace diesel
- Licensing application and environmental assessment for demonstration by 2026



Questions?

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ANNEX



Radioactive Waste Management

- All waste is currently safely managed at facilities that are licensed and monitored by CNSC
- Canada's approach is guided by the "polluter pays" principle
 - Nuclear operators are responsible for full life-cycle management of waste they produce
 - Financial guarantees are set aside by nuclear operators for decommissioning and long-term waste management
- The Nuclear Waste Management Organization (NWMO) is mandated under legislation to design and implement Canada's plan for the safe, long-term management of all used nuclear fuel, including used nuclear fuel from future SMRs
 - In 2010, NWMO launched a process to identify a willing host community for Canada's Deep Geological Repository
 - 22 communities voluntarily came forward, NWMO announced the top 2 in 2020 with plans to select a final site by 2023

