BRIEFING NOTE

To

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The Honorable Minister of Energy

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From

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ISSUE

The role of Small Modular Reactors(SMR) in Ontario's energy mix

BACKGROUND

Ontario has set ambitious electrification goals that would require the doubling of its nuclear energy capacity over the next 26 years to reduce its dependence on polluting energy resources like fossil fuels, according to the Ontario public grid operator Independent Electricity System Operator's(IESO's) 2050 decarbonization scenario. This would mean adding 17.8 GW of nuclear power in less than 3 decades[1].

SMRs are nuclear fission reactors that are compact in size and modular in design, allowing them to be portable and scaleable. SMR's are also versatile in nature and can be used for several targeted applications, including electricity generation, desalination, district heat production, and steam generation for mining and manufacturing industries[2].

CURRENT SITUATION

Nuclear power has a foundational role in Ontario's electricity system, accounting for over 30 percent of the province's total generation capacity but almost 60 percent of total output. It is a primary supplier of long-term, emissions-free baseload electricity generation. In the Reliability Outlook published by the IESO, 53.2% of electricity output in 2023 came from nuclear power. Ontario's first SMR nuclear reactor is scheduled to be opened in 2027, with three additional plants scheduled to be opened by 2035. All four SMRs will be located at the Darlington nuclear facility, adding a combined 1200 MW of new system capacity[4].

However, the benefits and scale of these projects do not match the expected demand over the coming three decades and do not fully consider the wider benefits that SMRs can provide to remote and isolated locations like mines and indigenous communities[3].

The electrification of the transportation sector will aid Ontario in reducing air pollution, and the Canadian government plans on achieving 100% non-polluting vehicle sales by 2035. This will, however, result in a rapid increase in electricity demand and increase the load on existing power generation and transmission infrastructure. SMRs can play a crucial role in aiding the IESO in meeting these future demands due to their lower upfront cost, reliability, and modular nature without having to revert to electricity generated from fossil fuels.

GOAL

The goal is to investigate the role of SMR in Ontario's energy mix and identify the key areas that will benefit from further research and investigation.

TECHNOLOGY OPTIONS

Canada has the full spectrum of the necessary pre-requisites to build and establish SMR facilities, as it has provincial and federal government support, a well-established nuclear industry, an extensive nuclear supply chain, extensive nuclear R&D infrastructure, an active nuclear workforce, available and supportive sites for prototype development, and many potential on- and off-grid applications for small reactors[5].

SMRs can be particularly beneficial for the following applications in Ontario's energy mix:

1. Balancing load variability for wind and solar energy, which are intermittent in nature. As the penetration of wind turbines and solar panels increases, SMRs can resolve the issue of intermittent energy generation by providing the baseload energy and enhancing the reliability of wind and solar power generation.

2. Compatibility with microgrids and smart grids. With an increased interest in distributed technologies where power is generated at or near its point of use, SMR's fit naturally into the equation due to their compact and modular attributes.

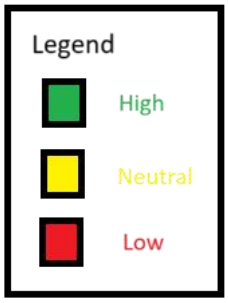
3. Energy for remote and isolated communities in Ontario. SMR's can play a significant role in providing reliable heat and electricity in remote locations throughout Ontario that otherwise rely on polluting diesel engines, with diesel being delivered by air in some locations, further increasing the cost of energy for the members of these communities.

4. Clean electricity and hydrogen for vehicles and industries. With the increased commitment to non-polluting vehicles, it is essential that the electricity or hydrogen powering these vehicles have to be produced without causing pollution. SMRs can play a role in producing clean electricity and clean hydrogen. Canada is developing a process to produce hydrogen using the copper-chlorine thermochemical cycle using steam at 500 °C which are compatible with the operating temperature of non-water cooled advanced SMRs[5].

OPTIONS ASSESSMENT

These options are assessed in the below heat map against the economic, environmental, social, technologocal benifts and the political will to make it possible:

	Economic benefit	Environmental benefit	Social benefit	Technological benifit	Political will
Load variability for renewable energy	Moderate	High	Moderate	Moderate	low
Micro-grids and smart grids	Low	Moderate	Moderate	Low	low
Energy for remote and isolated communities	Moderate	High	High	Moderate	High
Clean Hydrogen for vehicles and industry	High	High	Moderate	High	High



RECOMMENDATION

It is recommended to proceed with an in-depth study of investing in option 3, (Energy for isolated communities) and option 4 (clean hydrogen for industry), as these have the highest economic, environmental, social, technological and political benefits for the public at large.

REFERENCES

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