

## Executive Summary

Since 1952, Canada's investment in nuclear technology has produced commercial electricity spanning five power plants in three provinces, over 20 power reactors, and generates nearly 20% of Canada's electricity to date. Consequently, public and political concerns have increased pressure to reduce energy consumption and costs. This project report seeks to research, explore and understand the drivers behind and barriers to the ongoing innovations in the Canadian Nuclear Industry. The primary focus of this project will be based on the development and application of Small Nuclear Reactors (SMRs). This report will discuss in detail the feasible application of SMRs, political climate and regulatory framework for nuclear energy in Canada (specifically in Ontario) and cost feasibility of SMRs. Finally, recommendations are provided to overcome barriers to innovation in the nuclear industry.

As the origins of nuclear technology were based in war and weaponry, it is understandable that even clean and peaceful nuclear power generation becomes controversial. SMR technology can help quell some of the traditional fears around safety and security of nuclear power. Regulatory agencies have invested into reviewing newer reactor designs, including SMR, in the hope of advancing the nuclear power generation industry. The Canadian Nuclear Safety Commission (CNSC) has initiated this by conducting pre-licensing Vendor Design Reviews and released and welcomed feedback on their SMR: Regulatory Strategy, Approaches and Challenges document. This paper summarizes the political landscape and regulatory aspects related to SMR and proposes non-binding regulation agencies for newer automation technologies as well uniting the population over a common goal to be a leader in the SMR space.

Ontario has a rich operating history of commercial nuclear power plants, with a vast network of qualified suppliers and vendors, a workforce comprised of both seasoned professional and SMEs and young and fresh minds, and a top-tier academic as well as specialized research facilities. Significant challenges will be faced in knowledge retention, in an economy where staff turnover is very high for an industry that requires longer term retention. The energy outlook for the province predicts a steady, but flat, increase in power demand over the next 20 years, which does not necessitate new nuclear builds in the sense of traditional nuclear power plants, but the need for catering to remote on and off grid communities remain.

Some of the recommendations being put forth by our team that is expected to play a major role in driving the innovation and deployment of SMRs in Ontario are as follows:

- Modernize legacy systems and introduce AI/Analytics into new builds
- Cross-provincial collaboration and goal setting towards a lower emissions portfolio
- Invest in knowledge retention
- Cross-organizational collaboration
- Early community engagement and consultation
- Risk-sharing and cost efficiency
- Centralize database for lessons learned

Canada's ability to offer sustainable, innovative applications of nuclear technologies and energy systems will yield solutions permeate further economic growth, and environmental stewardship in the power sector.

The Appendices include case studies for notable successes and failures in the nuclear industries. The stated lessons learned bolster and provide additional context to the recommendations described in the sections above.