

Briefing paper:
The proposed nuclear reactors (SMRs) for New Brunswick

Submitted to Minister Mike Holland, Natural Resources and Energy Development
Government of New Brunswick

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Introduction

- The small modular nuclear reactors (SMRs) proposed for New Brunswick are two unproven designs at an early stage of development: “ARC-100” and “Moltex SSR.” Both designs are based on experimental nuclear reactors built more than 50 years ago and never successfully commercialized.
- To date, the Government of New Brunswick has committed \$30M for the two SMR designs.
- The NB Government and NB Power have [stated](#) that building these two proposed SMRs will help the province reduce the carbon footprint of the electricity sector, and create jobs and low-carbon export opportunities.
- NB Power is supporting the development of SMRs as a way to continue as a nuclear utility after the Point Lepreau Nuclear Generating Station reaches its end of life in 2040.
- While we appreciate the Government’s commitment to economic development, creating jobs, and moving toward a zero emitting electricity system, we believe the chosen pathway – backing private companies to develop SMRs – is deeply flawed and will fail to meet these expectations, at great cost to New Brunswickers.

Our briefing paper addresses four considerations, presented as follows:

- 1 Will the proposed SMRs generate jobs by growing export markets?
- 2 Will the proposed SMRs help NB Power deliver electricity reliably, affordably and sustainably, as required under the *Electricity Act*?
- 3 Will the proposed SMRs help New Brunswick meet its climate action goals?
- 4 What are some additional considerations with the SMR designs?
- 5 Conclusion
- 6 Recommendations
- 7 Supporting documents and further information

1 Will building SMRs generate jobs by growing export markets?

- SMRs are financially viable only if they are built in large numbers. There is no clear evidence that customers for SMRs exist outside Canada. Very few countries are planning to set up new nuclear plants, and most of these are focused on large nuclear reactors.
- The Canadian SMR market [referenced](#) in the government's 2020 speech from the throne is a hypothetical market that includes remote northern communities and off-grid mining sites currently using diesel for electricity generation. However, the cost of generating electricity from small modular nuclear reactors could be much higher -- [up to ten times more](#) – than that of diesel-based electricity. Even optimistic estimates of the total demand for electricity at all of these remote sites is [insufficient](#) to justify the cost of building a production operation to manufacture SMRs.
- NB Power commissioned a study of the economic impact of building two demonstration SMRs in New Brunswick. The [analysis](#) claims that the building projects will generate \$1 billion in gross domestic product (GDP), 730 jobs per year over 15 years (approximately 11,000 job-years), and \$120 million in government revenue, all on the assumption that the billions of dollars required to build the proposed reactors will be forthcoming from the private and public sectors. Based on evidence from the U.S., we believe this assumption is false: sufficient private-sector financing will not be available to build the prototypes in New Brunswick.

2 Will the proposed SMRs help NB Power deliver electricity reliably, affordably and sustainably?

2.1 What can we learn from NB Power's experience with nuclear energy at Point Lepreau?

- Under the *Electricity Act*, NB Power is required to deliver electricity reliably, affordably and sustainably. According to NB Power's testimony to the Energy and Utilities Board, Point Lepreau is the most expensive baseload must-run generation asset in the NB Power fleet.
- The cost to build Point Lepreau, which opened in 1984, was \$1.4 billion, more than three times the original estimate. At \$2.4 billion, the refurbishment of the reactor, necessary because of premature aging of the nuclear components, was \$1 billion over budget ([Auditor General](#)).
- In 2001, to keep it off of NB Power's rate base, the provincial government took \$450 million of Point Lepreau debt off of NB Power's books and added it to the provincial debt.
- Throughout its lifespan, and even after the early retrofit, which the Energy and Utilities Board recommended against, the reliability of Point Lepreau has been "[an ongoing frustration for NB Power.](#)"
- According to the provincial [auditor general](#), the money borrowed to build and refurbish Point Lepreau is responsible for \$3.6 billion of NB Power's \$4.9 billion debt.

2.2 Will the cost of building the two proposed SMRs be affordable?

- Globally, sodium cooled reactors like the proposed ARC-100 have been [more expensive](#) than heavy water reactors like Point Lepreau on a capacity basis.
- The ARC and Moltex proponents have not publicly released their proposed costs. The CEO of Moltex [stated](#) in 2016 in the UK that building his model would cost between \$1.8 billion and \$2.6 billion CDN (£1 billion to £1.5 billion GBP).
- In the US, where other SMR ventures are underway, the cost of the most advanced project had risen by 2020 to [\\$6.1 billion](#) U.S. from \$3 billion for 720 MW of generation capacity. The capital cost of \$6.1 billion translates to a cost per unit of generation capacity of roughly \$8500/kW, much more than its renewable competitors such as wind (\$1,050 to \$1,450 U.S. per kilowatt) [and](#) utility scale solar (\$825 to \$975 U.S. per kilowatt). Lazard 2020 puts new build nuclear at \$7,675 to \$12,500 U.S. per kilowatt.
- To date, the New Brunswick government has committed \$30M to these projects. Building these SMR designs will require hundreds of millions of dollars in additional government subsidies. As of March 2020, the United States Federal Government has invested [\\$314 million U.S.](#) into just one SMR design, and promised up to \$350 million U.S. more.

2.3 Are the proposed SMR prototypes based on previous reliable and cost-effective technology?

- Both the ARC and Moltex designs are unproven designs based on older, experimental, nuclear reactors that were never commercially successful. Therefore, the costs of developing the designs into successful commercial nuclear power plants are highly unpredictable. Historically prototype reactors in Canada have ended up as duds. Four small nuclear reactor prototypes were built and scrapped without ever becoming commercial: Gentilly-1, Maple 1, Maple 2, and Slowpoke 3.
- The Moltex design is a molten salt reactor. Only two molten salt reactors have operated, both more than 50 years ago. Neither generated electricity, and neither operated for long (less than one year, and less than four years, respectively).
- The ARC design is a sodium-cooled fast reactor. Sodium-cooled reactors have suffered severe accidents, including partial nuclear meltdowns at the EBR-1 and Fermi-1 reactors.
- Around the world, sodium-cooled reactors have had [numerous sodium leaks](#) causing fires and other technical problems, leading the U.S., the UK, and Germany to abandon the commercialization of sodium-cooled reactors.

2.4 Will the proposed SMRs keep electricity rates low?

- A [recent study](#) by the Energy Futures Group in the Atlantic region found that electricity generated by SMRs is likely to be more expensive relative to the rapidly falling cost of renewable energy (including the cost of providing firm capacity through storage).

- The higher cost of SMRs will result in higher electricity costs to New Brunswickers. Further, building SMRs will multiply the long-term cost liabilities of dismantling radioactive plant structures and managing radioactive wastes. Alternatively, renewable energy and efficiency investments promise to cap and eventually lower power rates.

3 Will the proposed SMRs help New Brunswick meet its climate action goals?

3.1 Will the proposed SMRs be ready in time to meet greenhouse gas reduction targets?

- According to the Intergovernmental Panel on Climate Change (2018), the world must reduce climate changing emissions by at least 50% by 2030 to limit global warming to 1.5 degrees C. Accordingly, Canada's current 2030 targets will most certainly be increased.
- Under federal law, the Belledune coal-fired power plant must be phased out by 2030. The ARC and Moltex designs are not yet licensed to operate in Canada and the Canadian Nuclear Safety Commission has not yet evaluated such designs in any detail. Even if funding is secured quickly, the nuclear industry has a poor track record for on-time and on-budget new builds.
- Even if they end up working, it is highly unlikely that these prototype reactors could replace carbon-emitting power plants by 2030.
- NB Power has anticipated this eventuality by not including these reactors in their 2020 Integrated Resource Plan. Instead, the public utility is lobbying Ottawa for exemptions from federal requirements, allowing them to continue to emit carbon pollution. This is not responsible, given the urgency of the climate crisis.
- With the cost of carbon pollution set to rise nationally, NB Power's plan to run its fossil fuel plants into the 2040s, while it waits for SMRs to replace them, will incur unnecessary carbon charges, paid for by ratepayers.

3.2 Is nuclear an effective climate change mitigation strategy?

- Low-carbon emitting technologies include solar, wind, hydro and nuclear. Cost will drive the demand for these technologies when used for a mitigation strategy. New (and existing) nuclear is not competitive with the low cost of wind, solar and hydro.
- Unlike nuclear, the renewable technologies are demonstrated, affordable, and can be deployed at scale quickly.
- New Brunswick's most reliable, available and affordable climate change mitigation path is a rapid expansion of renewable energy infrastructure, refurbishing the Mactaquac facility, investing aggressively in energy efficiency, and upgrading interconnections to access existing hydro from the Atlantic Loop and Quebec.

- Recent [analysis](#) found that power systems organized around expensive nuclear have difficulty integrating renewable energy technologies. To a great extent, they are mutually exclusive.

4 What are some additional considerations with the proposed SMRs?

4.1 Will the proposed SMRs produce clean energy?

- The industry claims that the proposed SMRs will reduce the nuclear waste from the Point Lepreau nuclear generating station. On the contrary, the ARC and Moltex designs would create new, dangerous radioactive waste streams that will be expensive to manage and will have to be kept out of the environment and away from people for thousands of years.
- The Moltex design proposes to remove high-level radioactive solid waste from used CANDU fuel bundles now stored in concrete silos on the Point Lepreau site and dissolve it in molten salt to make new fuel for its proposed reactor. This process is highly theoretical, [risky](#), unproven, and very expensive. It has never been done anywhere.
- The liquid sodium coolant from the proposed ARC design will become a new category of liquid radioactive waste, posing special problems that promise to be very expensive.
- Should the SMRs be built and actually operate, the additional costs for managing even greater volumes of nuclear waste and keeping it out of the environment will be borne by the province's ratepayers and/or taxpayers, not the private companies that will benefit in the short term.

4.2 Will the proposed SMRs introduce new security and legal issues?

- The nuclear fuel recycling proposed by the Moltex design requires the extraction of plutonium from the high-level radioactive waste at Point Lepreau. Since plutonium is usable in nuclear explosives, this will require heightened security and increased inspection levels by international regulators at Point Lepreau.
- The extraction of plutonium has long been associated with nuclear weapons proliferation, and Canada should not be promoting this technology.
- Importing used nuclear fuel or weapons-grade fissile material from dismantled nuclear warheads from the U.S., as [suggested](#) by the ARC proponent, will be contested both politically and legally.

4.3 What are the global trends for nuclear energy?

- Nuclear power has been declining as a percentage of the world electricity generation and is now barely 10 percent, down from a maximum of 17 per cent. But for government subsidies which are keeping private nuclear companies afloat in the U.S., and high power rates to customers, this fraction would be even lower.

- Because it is such a risky investment, private sector investment in SMRs is highly unlikely without government guarantees.

5 Conclusion

- There is no evidence of any real markets for SMRs, export or domestic, at anywhere near the scale that would make these developments profitable. Consequently, it is highly unlikely that SMRs will generate any substantial economic spin-offs for New Brunswick, other than what public money might generate in the short term.
- Proposed SMRs would not help NB Power deliver electricity reliably, affordably and sustainably. On the contrary, local, national and international evidence suggests that building SMRs is financially risky and will drive up the cost of electricity to New Brunswick ratepayers.
- The proposed SMRs would not help New Brunswick meet its 2030 climate action goals, and international research strongly suggests that nuclear is not an effective climate change mitigation strategy over the next few decades.
- The proposed SMRs introduce significant additional risks to New Brunswick: new forms of dangerous, long-lived radioactive wastes that will be expensive to manage and for which there is no permanent solution, and increased nuclear weapons proliferation and security risks.
- The New Brunswick government and NB Power have a regrettable record of speculating on new economic growth drivers: consider Bricklin, Orimulsion, and JOI Scientific's saltwater hydrogen. Spending scarce tax dollars on unproven nuclear concepts is not responsible financial or environmental stewardship.
- Spending public money on unproven nuclear reactor concepts is the path to escalating power rates, long-term billion-dollar liabilities, and a growing radioactive waste legacy that will burden future generations far beyond any useful lifespan of these plants.

6 Recommendations

6.1 Make reliable information about SMRs available to the public

- The information available on the government and NB Power websites about the SMR projects and investments is presented as nuclear industry promotion. In our briefing paper, we provide independent information from credible sources.
- We urge the government to share this information on its appropriate websites. Without balanced credible information, the industry (NB Power) can sow confusion in the minds of New Brunswickers, for example by promoting "recycling" as a solution to Point Lepreau's used nuclear fuel problem.

6.2 Implement protections from financial risks. We need:

- An Auditor General report on the full costs of liability for nuclear wastes, existing and proposed, including importing toxic wastes from other countries.
- An independent feasibility study of the proposed SMRs based on credible market data. Given the 2021 Auditor General report showing the contribution of nuclear investments to NB Power's debt crisis, the province should conduct a financial risk assessment of SMR investments to NB Power's debt reduction obligations.

6.3 End subsidies for SMR development

- The New Brunswick government should halt all public funding of these projects. If the business case is sound, private sector investors will not require coaxing.

6.4 Pivot to an economic strategy based on renewable energy and efficiency

- Accept that energy efficiency and renewable energy is the path to low-cost energy security, low carbon footprints, regional economic development, and a clean, healthy environment.
- Invest in energy efficiency, renewable energy and energy storage technologies, instead of risky nuclear technologies. This is the best way to meet New Brunswick's legal requirements for greenhouse gas emission reductions by 2030 (NB Climate Change Act; federal coal phase out).
- Develop a provincial decarbonisation plan focused on: Green Economic Development: electrification of the economy and phasing out fossil fuels; phasing in energy efficiency, renewable energy and storage; and creating the Atlantic Loop.
- Update the province's climate action plan to reflect the need to exceed 2030 greenhouse gas reduction targets on the way to zero well before 2050.
- Use carbon pricing revenue to generate incremental investments to implement our decarbonisation economic strategy.

7 Supporting documents and further information

This document, supporting documentation, and further information will be available through the RAVEN research project at the University of New Brunswick at this link:

<https://raven-research.org/smrs-nb-briefing>

Respectfully submitted,

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