Political Affairs

Prairie Power: A Case for Small Modular Reactors in Saskatchewan

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Introduction

Climate change has emerged as one of the most complex and high-priority issues of this time, with a focus on greenhouse gas (GHG) emissions reduction as one of the pivotal solutions to the multifaceted crisis. In Canada, this has taken different forms, including a carbon tax meant to reduce emissions, as well as a move to zero-emission electricity production. In Saskatchewan, the sitting government has announced their plan to move to nuclear power in the form of small modular reactors supplemented by intermittent renewables. Due to the federal government's mandate that coal power must be phased out by 2030, as well as price uncertainties regarding the future of natural gas, pursuing small modular reactors supported by intermittent renewables is the best way to meet the zero-emission standards imposed by the federal government while also meeting Saskatchewan's energy needs. This essay will first define the concepts of an energy baseload and intermittent renewables to provide necessary context. Secondly, it will look at Saskatchewan's current energy mix and how its energy needs are being met. Thirdly, it will prove the viability of small modular reactors as a way to fulfill these needs. Finally, it will lay out the path that Saskatchewan has chosen in order to achieve this goal.

Definitions

When discussing energy policy, the terms intermittent renewables and baseload are used to denote the type of energy that is created and what purpose it is serving. Renewable energy comes from sources such as wind or solar power and is often emissions-free. Due to the wind not always blowing and the sun not always shining, they are labelled as intermittent and are not considered efficient enough to power an entire grid. They are unable to account for the demands of an entire grid and are not sufficient when taking peak load times into consideration. As explained by Jay Squalli (2017), "the intermittency of renewable energy sources necessitates the use of a baseload power source such as coal, natural gas or nuclear power" (p. 479). By having a reliable source of power, it fills any gaps that would lead to an interruption in services.

Saskatchewan's Current Energy Mix

In Saskatchewan, power generation falls under the responsibility of SaskPower, a crown corporation owned and operated by the Government of Saskatchewan. According to SaskPower, most of Saskatchewan's power comes from non-renewable sources, with 44 percent coming from natural gas, 28 percent coming from coal-fired plants, and the remaining 28 percent coming primarily from hydroelectricity, with renewables such as wind, solar, and biomass plants adding to the total as well (2020). Much of the power generation stations are located in the southern half of the province, with the largest being the Boundary Dam coal plant outside of Estevan. Only 14 kilometers north of the US-Canada border, Boundary Dam produces 672 megawatts of power, over a fifth of Saskatchewan's total load amount. Regarding natural gas, the majority of the stations follow Highway 16, which passes north-west through Saskatoon and North Battleford into Lloydminster. The hydroelectric stations are spread throughout the northern half of the province due to the abundance of lakes and rivers. Finally, the wind power facilities follow the Trans-Canada Highway, passing through Regina, as well as Moose Jaw and Swift Current, all the way into southern Alberta (SaskPower Map, 2021).

As Canada moves towards its goal of lowering emissions nationwide, Saskatchewan has been slow to keep up with the rest of the country. Due to various factors including a very low population density, as well as an economy focused primarily on resource extraction, Saskatchewan has the highest per capita greenhouse gas emissions in Canada (Hurlbert et al., 2011). With the majority of power generation coming from fossil fuels, and especially coal, it is clear why this is the case. There are;however, concerns with the future of fossil fuel electricity generation. The federal government has mandated that coal-fired electricity must be phased out by 2030, leading to the question of how that gap will be filled.

For many, the prospect of replacing coal-fired electricity with natural gas-fired electricity is a simple transition. Natural gas is proven to be cleaner than coal, and the technology is accessible and proven to be safe. That being said, natural gas does not come without its own set of challenges and difficulties. One of those challenges is gas leakages. Natural gas is mostly comprised of CH4 or methane. When methane leaks into the atmosphere, it causes serious damage to the ozone layer. As Jeff Tollefson writes, "because methane is some 25 times more efficient than carbon dioxide at trapping heat in the atmosphere, releases [of 4%] could effectively offset the environmental edge that natural gas is said to enjoy over other fossil fuels" (2012). Additionally, the future of natural gas is expected to be affected by carbon pricing. Over time, the Government of Canada will continue to raise the tax on fossil fuels until they are no longer economically viable to use.

If coal is being phased out, and natural gas will be phased out over time as well, then in theory it should be easy to replace them with renewable energy. For many, the turn to

renewables is the solution that addresses the faults of fossil fuels. In some capacity, a greater use of wind, solar, and hydroelectricity is the best path forward. Nevertheless, there are also many challenges involved. According to a 2018 article on the expansion of solar power in Saskatchewan; the southern half of the province, particularly the area around Estevan where Boundary Dam is still operating, has the highest photovoltaic potential in Canada, rivaling the solar energy potential of places such as Los Angeles and New Mexico (Dolter and Boucher). Furthermore, hydroelectricity is not only renewable, but runs at all times as opposed to intermittently. Investing in renewables is the best way forward, but it is not enough to support all of Saskatchewan's energy needs. In Northern Saskatchewan, where communities and key industry hubs are secluded, the disadvantages of renewables are felt even more deeply. The quality of wind and solar power is much lower than that of the southern half, especially in the winter when it is needed most. Further, hydroelectricity is not scalable and cannot be moved to suit one's needs (Policy North, 2019). Investment in renewable energy is crucial, but it cannot be treated as a one-size-fits-all solution. Without a strong baseload supporting the renewable sources, any and all of their disadvantages will be amplified.

The Nuclear Option

In order to meet the energy needs of a province like Saskatchewan, there are certain conditions that must be met. As was laid out earlier, the power source must be able to: provide a baseload to supplement with renewables, work no matter where it is located in the province, be able to reach remote communities, and above all else it must be zero-emissions. Of all the energy sources listed, there is one option in particular that meets all of the criteria: nuclear power. Being a nearly zero-emission baseload power source, nuclear power has been presented as the most viable alternative to fossil fuels. Nuclear energy has been used in Canada for almost 60 years, primarily in Ontario. Currently, there are 5 plants being run out of 3 provinces: Ontario, New Brunswick, and Quebec. While there has never been a nuclear power plant operated in Saskatchewan, the construction of one would serve as the best alternative to the fossil fuels that are currently being used.

When speaking of nuclear power, there are certain concerns that will always arise. The first of those concerns is the cost. The construction of any large-scale power plant will come with high upfront costs, especially in the case of nuclear plants. The next concern is about the safety of nuclear power plants. Decades of highly televised disasters such as the reactor meltdowns at Three Mile Island or in Fukushima have led to an overly sensationalized view of dangers surrounding nuclear energy. In addition to fears of a meltdown, there are also many concerns around the long-term storage of nuclear waste. All of these concerns are valid. Nuclear power's reputation of being volatile and dangerous is not entirely unfounded. When fissile material such as uranium breaks down inside a reactor core, it releases heat which is then used to turn water into steam, powering turbines and

generating electricity that way. If not properly managed, the heat from the core can lead to the steam building up and causing an explosion. This can also arise in the case of an outside shock such as the tsunami that hit Fukushima which led to the generators failing. While the concerns about reactors being destroyed are fair, it must be said that modern reactors account for these flaws and have led to one of the most promising innovations in today's energy policy: the small modular reactor.

Small Modular Reactors

Taking from the definition listed on Canada's SMR (small modular reactor) action plan website, "Small Modular Reactors (SMRs) are a new class of nuclear reactors that are considerably smaller in size and power output than conventional nuclear power reactors, with enhanced safety features" (SMR Action Plan, 2021). These are reactors that are smaller in scale compared to the CANDU reactors that are currently operational, producing only 300 megawatts of power compared to the 600+ generated normally. In addition to them being smaller, they are also modular, meaning that each part would be factory produced and assembled on-site. Due to this, they would be able to be transported and built anywhere with road access. Their small size would mean that they do not need to be custom-built to accommodate for the site where they are being constructed. Finally, the smaller output of the reactor means that it can be operated more safely with less risk to both the operators and the surrounding environment (El-Emam and Subki, 2021).

As demonstrated above, small modular reactors are a zero-emission baseload power source, and one that will not only be able to reach remote communities but will also function at the same level of efficiency regardless of where in the province the reactor was located. The benefits that Saskatchewan would be able to take from replacing the fossil fuel-fired electricity with nuclear are immense. As a 2020 report by Zhang et al. finds, this is especially notable seeing as "Saskatchewan has the highest GHG emission growth rate in Canada, which is four times the national average" (p. 3). In addition to being an energy source that covers all of Saskatchewan's needs, they also claim that nuclear power is uniquely beneficial to the province as northern Saskatchewan has some of the largest high-grade uranium deposits in the world. Not only that, but it is also the largest uranium-producing area anywhere in the world (2020). Saskatchewan is in a special position in which it is poised to receive the greatest benefits from switching to nuclear power.

The Path Forward

The question of nuclear power as an option for Saskatchewan has been on the institutional agenda for a long time. Over a decade ago, Brad Wall's newly elected Saskatchewan Party sought to find more uses for the uranium reserves up north as opposed to just exporting it. While a large nuclear reactor may not be a feasible project, a smaller reactor (not unlike the SLOWPOKE-2 research reactor that was operating at the University of Saskatchewan at the time) was still available as an option. As time passed, the targets for emission

reduction became stricter and policy was guided towards more concrete solutions (Hurlbert and Eisler, 2020). Eventually, Brad Wall stepped down as Premier and Scott Moe took over as the leader of the Saskatchewan Party in 2017. Moe had previously acted in the role of the Minister of Environment before winning the party's leadership race. While he has been a vocal critic of the federal government and their plans to implement a federal carbon tax, he has gone further than any previous Premier in terms of real nuclear policy.

In 2019, Moe co-signed a memorandum of understanding (MOU) on behalf of the Province of Saskatchewan alongside the Provinces of New Brunswick and Ontario in order to collaborate on the strategic implementation of small modular reactors. Alberta was added to the document in April of 2021. The stated goal of the document reads that "[t]his MOU is intended to constitute an expression and mutual understanding of the Parties' willingness to work collaboratively in support of the development and deployment of SMR's" (2019, p. 2). The document describes the various commitments that will be undertaken by the four Parties, as well as describing how the Ministers responsible for energy will meet and direct their respective ministries to collaborate on a feasibility report. The commitments include the addressment of key issues such as: nuclear waste management, public and Indigenous engagement, influencing the federal government to give both public and financial support to the pursuit of nuclear energy, and capitalizing on the environmental, economic and innovatory benefits of nuclear energy (2019).

The document also states that the Parties "were instrumental in the development of 'A Call to Action: A Canadian Roadmap for Small Modular Reactors', referred to as the 'Canadian SMR Roadmap'" (p. 1). The action plan describes itself as "Canada's plan for the development, demonstration and deployment of SMRs for multiple applications at home and abroad" (SMR Action Plan, 2021). The plan was developed and contributed to by a wide variety of actors, each with their own contributions and stakes tied to nuclear power. In the public sector, there are contributions from not only the provincial organizations responsible for power generation, but also Indigenous groups such as the First Nations Power Authority and academic institutions like the Sylvia Fedoruk Canadian Centre for Nuclear Innovation. In terms of private actors, corporations all the way throughout the supply chain, as well as industries that would benefit from the power generated, have partnered to help produce the action plan. Additionally, small modular reactor vendors like NuScale, Moltex, and Hitachi are also listed as having participated in the development. By following the Action Plan and collaborating with both industry, as well as other jurisdictions, Saskatchewan will be able to accomplish its goals of having a zero-emission baseload power supply with intermittent renewables being used to supplement and support it.

Conclusion

In order for Saskatchewan to move away from fossil fuel-fired electricity and reduce its greenhouse gas emissions from electricity generation; intermittent renewables are not enough by themselves as they would not cover all of the province's needs and leave many remote communities vulnerable to energy shortages and interruptions. Intermittent renewables must be supported by a strong baseload and nuclear energy being produced by small modular reactors is the best option that Saskatchewan has. As coal plants are shut down, eventually followed by natural gas, a combination of both renewables and nuclear power must be deployed to fill the gaps left by fossil fuels. If Saskatchewan wants to keep up with the rest of the country by having a low GHG emissions per capita, while also maintaining its resource extraction-based economy, this is the best path to take.

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