October 24, 2022

Standing Committee on Environment and Sustainable Development
Sixth Floor, 131 Queen Street
House of Commons
Ottawa ON K1A 0A6
Via email: ENVI@parl.gc.ca

Re: Moltex Energy Canada Inc. Brief on Clean Technologies in Canada

The Standing Committee on Environment and Sustainable Development has an essential role to play in shaping the direction and speed of Canada's transition to net zero carbon emissions, with implications for Canada's economy, grid stability, and energy security. Moltex Energy Canada Inc. (Moltex) welcomes this opportunity to provide industry perspective in support of that critical role and responsibility.

Moltex is a company developing two complementary technologies to both address nuclear waste and produce carbon-free energy. Combined, they can significantly reduce the volume of high-level radioactive waste in Canada, in the process producing 6 GW of carbon-free power for 60 years, with no new mining, complete fuel supply security, and at a lower cost than any other long-term solution currently envisioned for spent nuclear fuel.

- WAste To Stable Salt (WATSS) is an affordable, small-footprint facility for recycling spent fuel bundles from Canada's existing CANDU reactors, producing safer end products and fuel for a molten salt advanced small modular reactor (aSMR).

- The Stable Salt Reactor – Wasteburner (SSR-W) is an aSMR that uses the fuel produced by WATSS, capable of producing up to 500 MW of carbon-free electricity, in an inherently safe facility that occupies much less space than required by a conventional reactor.

An additional technology, called GridReserve, completes a full Moltex power plant. GridReserve is not a new innovation by Moltex; instead, it is a commercially proven system for thermal energy storage transferred from the concentrated solar power industry for use in conjunction with the SSR-W. The addition of GridReserve to a Moltex power plant enables the plant to provide "peaking" power that is responsive to the dynamics of the modern electrical grid, which includes both variable load and variable generation from renewable sources (wind and solar). Thanks to GridReserve, a Moltex power plant provides dispatchable *capacity* to the grid (megawatts of power on demand), which complements the intermittent *energy* (megawatt *hours*, which are produced when the sun shines or wind blows) from renewable energy sources.

Each of these Moltex technologies offers essential benefits necessary to meeting Canada's (and the world's) goals for decarbonization and environmental stewardship – as well as the social needs of energy security, employment, and economic growth. Some of these benefits are 1) common to all nuclear reactors (such as carbon-free energy), some are 2) common to all aSMRs (such as inherent safety and small footprint), and some are 3) unique to Moltex (such as reduction of nuclear waste). We will now look in closer detail at each of these sets of benefits.

1. The role of the nuclear sector

Grid operators, electrical engineers, and policy makers worldwide share a growing consensus that cost-effective decarbonization while maintaining a stable grid and energy security, is impossible without at least maintaining the existing nuclear fleet. For example, the US Department of Energy (DOE) has modelled every scenario considered technically viable to achieving carbon reduction targets and has determined that keeping all 94.7 GW of currently operating commercial reactors in the US online is an absolute requirement for grid stability, cost efficiency, and energy security. However, the same DOE models have also shown that for electrification of transportation and heating, which would require a doubling or tripling of grid capacity, the US would need to double its existing nuclear fleet for decarbonization to be technically and economically viable. Moreover, the required contribution for nuclear power is higher in northern climates, where heating requirements are greater and solar power is weaker, especially during the heating season.

Real-world examples from three jurisdictions illustrate the point.

- In Ontario in 2019, nuclear provided 59% of electrical power, hydro 24%, wind 8%, solar 1%, and gas peaking plants most of the remainder.[1] In this way, Ontario has achieved a world-leading low-carbon intensity of 25 grams of CO2 per kWh of electricity, at a cost to rate payers of C$0.12/kWh.

- California, on the other hand, gets far more intense sunlight than Ontario, and nuclear now provides only 7.4% of California's electricity, while renewables provide 40%. Yet California's carbon intensity is currently 242 grams of CO2 per kWh, and this comes at a cost to consumers of over C$0.30/kWh.[2]

- Meanwhile, at a northern latitude similar to Ontario's, Germany has in the past decade spent over U$150 billion to install renewable generation, and has achieved a 40% renewable contribution to its grid, while phasing out nuclear, which now provides 12% of the country's power. However, Germany estimates that going all the way to net-zero carbon emissions with renewable energy would cost an additional U$5 trillion,[3] and its current carbon intensity is 349 grams of CO2 per kWh[4], costing rate payers over C$0.40/kWh. As well, Germany unfortunately finds itself today in an unacceptable position, facing a cold winter without energy sovereignty. Experts estimate that if Germany had made the investment in nuclear that it has made in renewables, that nation's electricity generation could be at net zero emissions today, and would be far more energy secure.

While affordability, decarbonization, grid stability, and energy security are all essential, we cannot overlook jobs. The nuclear industry employs more than 40,000 Canadians today.[5] According to statements made publicly at the 2022 G4SR-4 conference in Toronto, Ontario Power Generation (OPG) estimates that full decarbonization, which requires electrification of transportation and heating, would require at least 13 GW of new generation capacity in Ontario. Because the 18 operating CANDU reactors in Ontario have a total capacity of just over 13 GW –

[1] https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html
[2] http://www.caiso.com/todaysoutlook/pages/emissions.html
[3] https://world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx
[4] https://www.statista.com/statistics/1290224/carbon-intensity-power-sector-germany/
[5] http://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/protecting-workers.cfm

and because Ontario's 200+ hydro dams have already tapped almost all of the province's hydro potential – it is reasonable to envision a fully decarbonized energy sector for Ontario involving a doubling of nuclear capacity, with the potential to create approximately 40,000 new, permanent, well-paying jobs, in addition to tens of thousands of jobs in construction.

Meanwhile, New Brunswick sees the potential for its own nuclear industry growth and development. In addition to corporate and plant jobs, there is the promise of a stimulating local supply chain as about half of the SSR-W's components could be manufactured in the province. A supply chain conference in June 2022 attracted vendors from more than 150 organizations across the province, highlighting the strong, local interest in this opportunity.

For all of these reasons, the nuclear sector in Canada deserves consideration similar to that shown by the recent Inflation Reduction Act in the US, which included economic stimulus of U$700 million for new nuclear fuel production capacity, and billions more for supporting operations of existing nuclear plants and incentivizing the construction of new ones – particularly, providing additional incentives when new nuclear plants replace coal-fired generation, and when the construction prioritizes the domestic supply chain.

2. A revolution in nuclear energy: aSMRs

Advanced small modular reactors are not an incremental improvement on the existing CANDU technology. They represent a step-change, and offer a revolutionary set of advantages. The existing nuclear fleet is known as "generation two," or "Gen-2" technologies. There are significant improvements on these designs in Gen-3 reactors, such as the GE-Hitachi BWRX-300 SMR, or the Rolls-Royce SMR, which are smaller than Gen-2 reactors and have enhanced safety features. However, the most compelling and transformative improvements are found in the Gen-4 reactors (or aSMRs). Briefly, most Gen-4 reactors:

- offer inherent safety, by using innovative fuel concepts, which nearly eliminate the potential for a core meltdown, and by *not* using water as a coolant, enabling operation at low pressure;

- operate at hundreds of degrees Celsius higher than conventional reactors, so they can produce electrical power much more efficiently, and produce heat suitable for industrial processes, including hydrogen production; and

- cost less than other reactors to build and operate.

While aSMRs have been demonstrated to work safely as designed for decades, they have not yet been commercialized at scale. As with any new technology, especially in the energy sector, the first-of-a-kind commercial aSMRs will cost more to develop than subsequent ones. To overcome the cost barrier to adopting these important technologies, public support is needed in two areas:

- First, funding support from the public sector will help reduce the private cost of developing the technologies, unlocking private investment that will flow into the sector as the public sector commitment is demonstrated. Federal and provincial funds have already been provided to aSMR companies in Canada and this is highly commendable. Still, a doubling or tripling of financial support to the sector is essential to enabling Canada to meet its decarbonization commitments, while ensuring affordability and energy security.

- Second, outreach and engagement will be vital to proactively addressing concerns the public will reasonably raise about potential risks and benefits of these technologies, in comparison with alternatives. Complementing this, Canada must have a robust regulatory process that neither skips over any prudent oversight nor places an excessive burden, in terms of time and cost, on the industry. Specifically, those in the sector, including the Canadian utilities, believe that the Environmental Impact Assessment process, which takes over five years to complete, can and should be optimized to take no more than three years, without compromising the comprehensive due diligence required for public assurance.

3. Advantages unique to Moltex technologies

Moltex holds global patents that make the Moltex molten salt aSMR safe and cost competitive. However, the company's most important unique benefit relates to WATSS, the world's only cost-effective approach to spent nuclear fuel recycling. Conventional fuel reprocessing has three disadvantages: it is more expensive than mining fresh uranium, it occupies over 100 acres per facility, and such a facility can be used to produce weapons-grade plutonium. In contrast, the WATSS process is an order of magnitude cheaper, can fit inside a school gymnasium, and cannot by any means be used to achieve a level of plutonium purity that could be used in nuclear weapons. WATSS grants social licence to operate to the entire nuclear sector, by dramatically reducing the volume, radioactivity, and disposal cost of nuclear waste.

Moltex also helps answer the question of future nuclear waste, clearing the path to further deployment of conventional reactors and SMRs that use uranium nuclear fuel. As well as having a key role to play in Canada's energy ecosystem, Moltex represents global leadership for Canada in clean nuclear energy. By providing a better answer to the issue of nuclear waste, Moltex supports both domestic development and export of all Canadian nuclear fuel, technologies, and services.

Summary

Consensus on the need for new nuclear power generation to meet domestic and global climate goals is emerging, just as the advantages of the Gen-4 reactors become clear. As the increasing demand for clean, low-carbon electricity grows, we believe that the revolution in nuclear energy will become irresistible. The only question is whether Canada will take a leadership role in it. The federal government can bring this about, by considering all the benefits of aSMRs, while providing R&D funding and supporting collaboration in developing appropriate regulation pertaining to the fuel cycle. Moltex would be proud to take part in this essential change.

Respectfully submitted,

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