Submission by:
Coalition for Responsible Energy Development in New Brunswick, May 2, 2022
https://crednb.ca/ **PO Box 4561, Rothesay, NB, E2E 5X3**

To: the Natural Resources Committee of Parliament, Spring 2022 hearings re:
"Creating a Fair and Equitable Canadian Energy Transformation"

The Coalition for Responsible Energy Development – New Brunswick is comprised of 10 citizen groups who form CRED-NB's core coalition, and is supported by an additional 10 groups and businesses, and more than 100 individuals from across New Brunswick who have signed a public statement in support of CRED-NB's core objectives.

Through our website we provide information about energy development in New Brunswick that is missing from the Government of New Brunswick and nuclear industry (NB Power) websites. We invite New Brunswick residents to inform themselves about the drawbacks of nuclear and fossil fuel energy and the advantages of the alternative: rigorous energy efficiency, renewable energy generation, and developing the smart grid and storage capacity using technologies that are less harmful to the earth and our health.

We support phase out of energy generation from fossil fuels and nuclear fission and, instead, support investment in a modern model of: renewable energy, energy storage, energy conservation and the implementation of smart grid technology . We are opposed to the development of new nuclear energy technology such as 'small modular reactors' which would add new forms of radioactive waste to the existing waste accumulation, for which there is no proven safe method of disposal. Burning fossil fuels to generate electricity must be phased out as rapidly as possible to eliminate the green house gases this produces which contribute to the climate crisis.

We believe that our proposed model brings particular benefits of a fair and equitable energy transition:

- New, community-level, high-value jobs will be created in the building and maintaining of renewable facilities , and implementing related storage and smart-grid facilities.

- Energy efficiency measures installed in homes and businesses will allow citizens at all income levels, to reduce their energy demand and hence their energy bills. This is also, another source of high-value community jobs such as installing heat pumps and it supports local businesses engaged in insulation and retro-fit renovations.

- Replacing nuclear energy with renewables will reduce the cost of energy to all citizens, given that the cost of renewable energy is already lower than nuclear energy and continues to fall while the cost of nuclear power continues to go up. SMRs are expected to add to the cost of nuclear, given the loss of economies of scale as documented by various experts.

- The "clean energy fair and equitable transition" will require both:
  *subsidy or low-cost loans for low income households to access energy efficiency, technology or home retrofits, and
  *training programs which both: create the learning opportunities in the new technologies via apprenticeships and college and university courses; and subsidize mid-career and younger people with earnings while they transition to these new high-value job opportunities.

CRED-NB is also working across Canada with groups that know that next generation nukes are "dirty, dangerous distractions" from the work we all need to be doing to address the climate crisis. More than 120 public interest, Indigenous and civil society groups across the country have endorsed a statement opposing federal funding for more nuclear reactors.

Our understanding that nuclear is not a solution to the climate crisis is informed by world experts whose analysis is included in the following summary of seven articles by experts in nuclear power and energy in general. They conclude that it is too risky, too expensive and, most of all too late!

Countering Nuclear Industry Narrative:
100% Renewable is Reliable Power for Addressing Climate without Nuclear(Summary of Authoritative Sources)

Part 1: Nuclear is not a climate solution:
Part 2: 100% Renewables can provide reliable energy without nuclear:
Part 3: SMRs are not a solution for nuclear industry or for the climate:

Part 1 -Nuclear is not a Climate Solution

Nuclear is just not part of any feasible strategy that could counter climate change https://www.nuclearconsult.com/blog/

Communiqué – Statement – January 6, 2022 published by Nuclear Consulting Group, by:

- *Dr. Gregory Jaczko, former Chairman of U.S. Regulatory Commission*
- *Prof. Wolfgang Renneberg, former Head of reactor Safety, Radiation Protection and Nuclear Waste, Federal Environment Minister Germany*
- *Dr. Bernard Laponche, former Director General, French Agency for Energy Management, former Advisor to French Minister of Environment, Energy and Nuclear Safety*
- *Dr. Paul Dorfman, former Secretary of the UK Government Committee Examining Radiation Risk from Internal Emitters (CERRIE)*

These four experts issued the recent communique, citing the urgency of the climate crisis and need to cut GHG emissions to address it and concern that nuclear power is being promoted as a response, whereas it cannot meet that challenge. They state that "The reality is nuclear is neither clean, safe or smart; but a very complex technology with the potential to cause significant harm."

They list ten insurmountable challenges: (summarized here in brief)
* too costly in absolute terms;
* more expensive than renewable energy;
* too Costly and risky for financial market investment – so dependent on very large public funding;
* unsustainable due to unresolved problem of radioactive waste;
* financially unsustainable as full risk is uninsurable;
* militarily hazardous – risking proliferation;
* inherently risky given cascading accidents from eight sources;
* subject to unresolved safety problems with newer unproven concepts; too unwieldy and complex for efficient industrial regimes to build or operate;
* unlikely to help mitigate climate by 2030's given lengthy development/construction times.

Every euro invested in nuclear power makes the climate crisis worse

https://www.dw.com/en/nuclear-climate-mycle-schneider-renewables-fukushima/a-56712368

Interview with Mycle Schneider, Lead Author 2021 World Nuclear Status Report (WNISR 2021 409 pages) by DW News August 29 2021 (Deutsche Welle – Germany's international broadcaster)

When questioned about the role of nuclear power in keeping the Global temperature increase down to 1.5 degrees Celcius, Schneider highlighted the urgency of reducing GHGs and the criterion of how much and how fast that can be done with every Euro spent.

New Nuclear takes too long and diverts funds from faster decarbonizing options

"And if we're talking about the construction of new power plants, then nuclear power is simply excluded. Not just because it is the most expensive form of electricity generation today, but above all, because it takes a long time to build reactors. In other words, every euro invested in new nuclear power plants makes the climate crisis worse because now this money cannot be used to invest in efficient climate protection options."

Existing Nuclear cannot compete on cost

Schneider explains that even for the power plants that exist, their use is limited because:

* "…many of the measures needed for energy efficiency are now cheaper than the basic operating costs of nuclear power plants", and

*"… renewables today have become so cheap that in many cases they are below the basic operating costs of nuclear power plants."

Why new-builds or continuing unprofitable operation?

Schneider highlights drivers behind apparent uneconomic nuclear power plans. Factors range from military strategic interests based on the links to civil power in France, to the building of the Hinkley Point plant in the UK co-financed by China as part of their infrastructure investments for geopolitical rather than financial goals. As well, accounting and financial implications play a role in delaying decommissioning investments, for example, in France where "only a third (of the required funds) have been put aside."

High Level Radioactive Waste Costs

Schneider notes that "No one knows how much this really costs, because there is no functioning permanent storage facility." He notes that the most advanced projects are in Finland and Sweden where the 1980's storage facility design has encountered corrosion problems with the copper containers and viability is still unclear. Also, discussion of waste reprocessing is "even further away".

Nuclear Energy Will Not Be the Solution to Climate Change

https://www.foreignaffairs.com/articles/2021-07-08/nuclear-energy-will-not-be-solution-climate-change

Article by Allison Macfarlane in Foreign Affairs magazine July 2021 Prior to appointment at UBC's School of Public Policy, Macfarlane was Professor of Science Policy and International Affairs, George Washington University. She has a PhD in geology from the MIT. From July 2012 until December 2014, she served as Chairperson of the U.S. Nuclear Regulatory Commission as the only person with a background in geology to serve on the Commission. From 2010 to 2012, Dr. Macfarlane served on the Blue-Ribbon Commission on America's Nuclear Future, created by the Obama Administration to develop a national strategy for the nation's high-level nuclear waste.

Acknowledging that "The world is almost out of time with respect to decarbonizing the energy sector.", Macfarlane notes the private and government interest in innovative nuclear electricity,
She concludes, however, that "Given the long lead times to develop engineered, full-scale prototypes of new advanced designs and the time to build a manufacturing base and a customer base to make nuclear more economically competitive, it is unlikely that nuclear power will begin to significantly reduce our carbon energy footprint even in 20 years…"

Current and past experience. Macfarlane notes the many nuclear closures in the U.S. while nuclear struggles to remain viable. She describes the capital cost and delivery time challenges of various start-up small modular reactors and then highlights their major challenge -i.e., their requirement for new fuels, " which must be licenced as well as produced, managed during use, and stored and disposed of when spent." Many require higher enrichment than is done in the U.S. and also have higher proliferation risk. She outlines the current signifcant cost overruns and delays of nuclear mega projects currently under construction in the US, France and Finland

Listing the numerous economic, technical and logistical hurdles faced by nuclear power, she concludes that we need strong government support of existing, readily-deployable, non-carbon- emitting technologies to focus on saving the planet from climate change, rather than relying on a nuclear 'silver-bullet'.

Nuclear Power cost comparison

International reporting by Lazard for 2020, on levelized costs of power from various sources. In US dollars per Megawatt, costs range as follows:

Electricity Source	Range of levelized costs per MWh	
Wind	$26	$54
Utility Scale Solar	$29	$42
Geothermal	$59	$101
Large Scale Nuclear	$129	$198

Part 2 - 100% Renewables can provide reliable energy without nuclear

Busting 3 renewable energy and grid myths https://e360.yale.edu/features/three-myths-about-renewable-energy-and-the-grid-debunked

Article in Yale Environment 360, co-authored by:
Amory Lovins, American writer, physicist and chairman/chief scientist of the Rocky Mountain Institute. A long time advocate of soft energy path – increase in energy efficiency and renewable energy sources and related social benefits. M. V. Ramana, Professor and Simons Chair in Disarmament, Global and Human Security at the School of Public Policy and Global Affairs (SPPGA), UBC. He received his Ph.D. in Physics from Boston University and has held academic positions at the UofT, MIT, Yale and Princeton Universities, working on the future of nuclear energy in the context of climate change and nuclear disarmament.

They address three myths that have mitigated against broad acceptance of renewable power in response to climate change.

Myth 1 The first myth that they rebut is the idea that "A grid that increasingly relies on renewable energy in an unreliable grid". Using 2020 SAIDI data representing average power outage duration' experienced by customers, they have shown much lower outage rates for grids with increased renewable share of electricity, both in European and U.S. locations.

Myth 2 The second myth – the idea that "Countries like Germany must continue to rely on fossil fuels to stabilize the grid and back up variable wind and solar power". They show how between 2010 and 2020, Germany's renewables and energy savings more than offset significant declines in fossil and nuclear power, allowing renewable energy at zero or modest cost, while reducing greenhouse gas emissions.

Myth 3. The oft-repeated cliché is that solar and wind energy cannot be created "when the wind doesn't blow or the sun doesn't shine", they cannot be the basis of a grid that has to provide power 24/7, 365 days per year. This too is shown to be a false argument for traditional power sources such as nuclear. While fossil fuel and hydro also have some vulnerabilities to fuel supply disruptions or low water levels, nuclear plants have the highest planned and unplanned shut downs especially in France.

Nuclear plants in Japan and the USA have experienced increasingly frequent interruptions by climate/weather conditions in the past decade. The best approaches, which can draw on cost effective renewables include: the use of the (smart) grids to back up non-functional plants, accurate weather forecasting to allow some renewables to back up others, resilience of local renewables, use of battery storage as it becomes cheaper, demand flexibility and diversity of sources – both geographically and technologically.

Note: Nuclear unplanned shutdowns are also part of Canadian experience. Point Lepreau station, NB has had reliability issues since its $2.4-billion, four-and-a-half year refurbishment in 2012, requiring an additional $500 million in capital improvements since. The latest shutdown was 40 days in peak demand season starting in January 2021, due to mechanical problems.

U.S. can get to 100% clean energy with wind, water, solar and zero nuclear, Stanford Professor Says

https://www.cnbc.com/2021/12/21/us-can-get-to-100percent-clean-energy-without-nuclear-power-stanford-professor-says.html

Article by Catherine Clifford, Climate and Environment reporter CNBC interview with Mark Jacobson, a professor of civil and environmental engineering at Stanford University and director of its Atmosphere/Energy Program.[1] Jacobson, who has developed technical and economic plans to convert the energy infrastructure for 50 states, 143 countries (including Canada) and dozens of cities to be powered with 100% wind, water, and sunlight and without nuclear!

Jacobson sees a way for the U.S to meet its energy demands by 2050 with 100% wind, water and solar and has 'roadmapped' transition to a clean energy grid by 2035, with 80% by 2030.

Planning for grid stability is key given variability of both solar and wind.
Jacobson notes "But as it turns out, first of all, when you interconnect wind and solar over large areas, which is currently done, you smooth out the supply quite a bit."
"Similarly, wind and solar are complementary and hydro is the perfect back up, because you can turn it on and off instantaneously."
He also notes that electricity pricing can help shift demand to off-peak times.
Lastly, Jacobson's current roadmap now includes innovative use of four-hour batteries for grid stability whereas ultra-long duration batteries have yet to become commercialized.

Responding to Nuclear Industry Competing Narrative

In the last section of the article, Jacobson describes the challenge of having to promote urgent implementation of existing renewable power technology in competition with well-funded promotion of nuclear innovation currently in long term development and not be available for urgent transition.

Countering the nuclear narrative which relies on the fear of blackouts requires showing how grid stability is accomplished. The energy mix for each state is designed using three types of models: -converting current demand to 2050 projected levels, a weather model that predicts wind and solar fields every 30 seconds, and thirdly model matching of the 2050 demand to the energy supply from wind, water and solar every thirty seconds.

Renewables vs. Nuclear: 256-0

https://www.pv-magazine.com/2021/09/28/renewables-vs-nuclear-256-0/

Article in PV magazine September 28, 2021 by Emiliano Bellini, interviewing Mycle Schneider, French Nuclear Consultant, baseload expert and lead author of 2021 World Nuclear Industry Status Report (WNISR).

Schneider explains that "Nuclear power is irrelevant in today's electricity capacity market," and outlines the 4% decline in nuclear power generated while non-hydro renewable power grew by 14%. This is explained by several factors:

Renewable Costs falling

"Globally the cost of renewables is now significantly below that of either nuclear power or gas." As an example of the cost shift, in the U.S. LCOE of Solar PV dropped from $64/MWh in 2015 to $37/MWh in 2020, while LCOE of nuclear increased from $117/MWh to $163/MWh.

The WNISR projects that "By 2050, solar PV costs are projected to be one fifth those from nuclear power, across the EU, China, India, and US." Similarly, the IAEA projects "major ongoing cost declines for offshore wind and solar.

Lengthy Time to build New Nuclear versus climate urgency

The report describes the length of time to build existing reactors, i.e., average time from start of construction to grid connection of 10 years.

Schneider particularly critiques proposals to design and build new '*fourth generation*' reactors: "We simply don't have the time to waste attention, intelligence, manpower and funding for fantasy technologies that might or might not work, more likely some time in the 2030s or 2040s, while affordable concepts from efficiency to renewables are readily available." He cites the example of Bill Gates investment in small modular reactors starting in 2006 : "Fifteen years later, he has nothing to show – no licensed design anywhere, no site, no prototypes." He also cites failure of designs in Russia and China.

Note: in a webinar held by UBC's School of Public Policy in October 2021, Mycle Schneider reflected on the conceptual change taking place: "Solar and wind alone cover a lot of what was called 'baseload' in the past." He clarified that "The baseload concept has flown out the window. Nuclear does not have that space, but is in direct competition." He suggested that the best system is one with multiple sources and a shift in system design to make the best use of them all.

Part 3: SMR's are not a solution for the nuclear industry or the climate

Can small modular reactors help mitigate climate change? (Appendix 3 Pages X to X)

https://doi.org/10.1080/00963402.2021.194160

Article published on line July 21 2021 and by Bulletin of Atomic Scientists 2021 Vol.77, co-

authored by: *Arjun Makhijani is president of the Institute for Energy and Environmental Research (IEER) and the author of Prosperous, Renewable Maryland: Roadmap for a Healthy, Economical and Equitable Energy Future. M. V. Ramana is the Simons Chair in Disarmament, Global and Human Security at the School of Public Policy and Global Affairs, UBC). Former member of the Bulletin's Science and Security Board and a member of the International Panel on Fissile Materials, the Canadian Pugwash Group, the International Nuclear Risk Assessment Group, and the team that produces the annual World Nuclear Industry Status Report.*

The authors apply nine different perspectives in examining the recent claims for proposed Small Modular Reactors (up to 300-345 MW electricity) in addressing climate change, as follows.

Typology – A number of start ups are proposing various new model which fall into two types: - Light water reactors which might be licensed with less complexity given similarity to to existing technology, versus new designs using a range of new fuels, moderators and coolants.

Economics and Scale – The authors conclude that lacking economies of scale compared to large reactors, SMR competitiveness with other sources of power will be a challenge. Historical experience casts doubt on claims for efficiency gained through producing multiples of a model. Mass production would require a highly unlikely volume of demand.

Mass manufacturing - This would require resolution of problems experienced in the past, including light water models requiring replacement of large expensive steam generators.

The 'track record' for development of SMRS in the last decade has failed to meet projections, with the most advanced light water design – Nuscale- in spite of heavy public funding and originally projected for certification review by 2015 is now projected for deployment not until 2029-2030 and cost estimates, with no construction yet begun, have gone from $4.8 Billion in 2018 to $6.1 Billion in 2020. At this point some original utility customers are dropping out.

The 'track record' of proposed non-light water SMR technologies is reviewed from the history of their research and development and past failures noted. These include 'sodium cooled', high temperature gas-cooled and molten-salt reactors.

Other challenges are examined : regulation; proliferation risks; addition to the decades ongoing costs of spent fuel wastes- including new problems unique to the specific newer technologies wastes; and the business risks of large scale factory set up facing uncertain demand.

Conclusion: The authors conclude, in light of their technical and economic analysis, that: "There is no realistic prospect that small modular reactors can make a significant dent in the need to transition rapidly to a carbon-free electricity system. To invest in them is to throw good money after bad."