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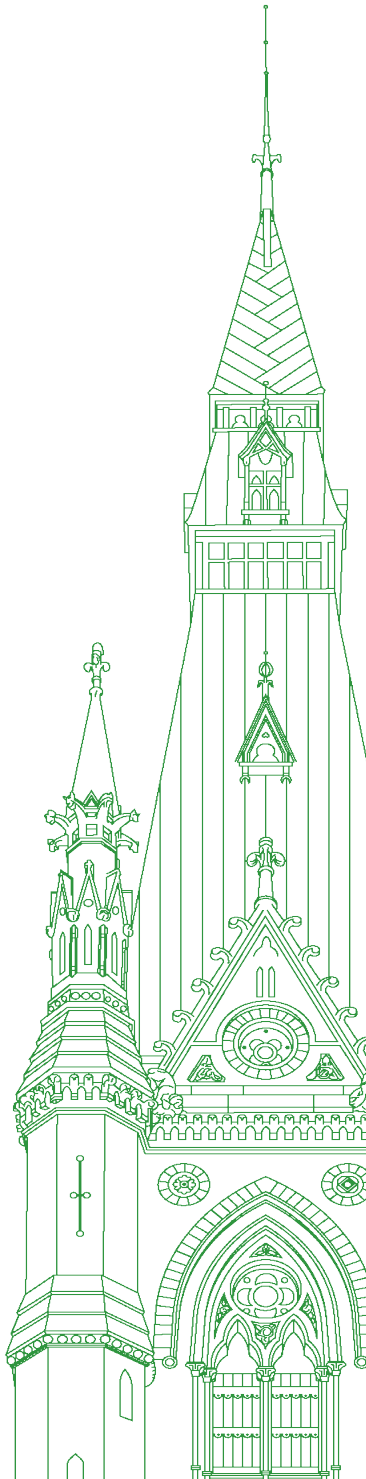

Chair: The Honourable Kirsty Duncan

Standing Committee on Science and Research

Thursday, June 9, 2022

● (1830)

[*English*]

The Chair (Hon. Kirsty Duncan (Etobicoke North, Lib.)): Good evening, everyone. I call this meeting to order.

[*Translation*]

Welcome to meeting number 15 of the Standing Committee on Science and Research.

[*English*]

The Board of Internal Economy requires that committees adhere to the following health protocols which are in effect until June 23, 2022.

All individuals wishing to enter the parliamentary precinct must be fully vaccinated against COVID-19. All those attending the meeting in person must wear a mask, except for members who are at their place during proceedings. Please contact our clerk of the committee for further information on preventive measures for health and safety.

As the chair, I will enforce these measures, and as always, colleagues, I thank you for your co-operation.

I'd like to welcome all our witnesses. We are grateful to have you, your time and your expertise.

[*Translation*]

Today's meeting is taking place in a hybrid format pursuant to the House order of November 25, 2021.

[*English*]

I'd like to outline a few rules to follow.

Interpretation services are available for this meeting. You may speak in the official language of your choice. At the bottom of your screen, for those who are online, you may choose to hear the floor audio, or English or French. The "raise hand" feature is on the main toolbar, should you wish to speak.

[*Translation*]

I remind you that all comments should be addressed through the chair.

[*English*]

When you are not speaking, your microphone should be muted.

The committee clerk and I will maintain a speaking list for all members.

To let our committee members know, Mr. Ken Hartwick of OPG has been invited back and will appear next meeting.

Tonight is our third meeting on small nuclear reactors.

We're pleased to welcome from Canadians for Nuclear Energy, Dr. Christopher Keefer, president. Welcome. From Canadian Nuclear Laboratories, we have Joseph McBrearty, president and chief executive officer; and Louis Riccoboni, vice-president, corporate affairs. Welcome to you both. From the Coalition for Responsible Energy Development in New Brunswick, we have Dr. Susan O'Donnell, adjunct research professor. Welcome.

Each group will have five minutes to speak. At the four and a half minute mark, I will hold up this yellow card to let you know there are 30 seconds left for your testimony.

With that, we will hand it over to Dr. Keefer.

The floor is yours.

Dr. Christopher Keefer (President, Canadians for Nuclear Energy): Thank you so much for having me. It's a pleasure to be here.

My name is Chris Keefer. I'm a Toronto-based emergency physician and the president of Canadians for Nuclear Energy. I'll be making three main points in my testimony today. First, nuclear energy is the keystone technology of our clean energy transition. Second, SMRs are worthy of exploration, but our CANDU reactor technology should remain central to our decarbonization efforts. Third, Canada possesses the vital preconditions to rapidly and successfully deploy nuclear energy thanks to our CANDU refurbishment program.

Why is nuclear power fundamental to the success of our energy transition? Our remaining hydroelectric and geothermal opportunities are limited, and the real-world evidence is in: Wind and solar are unable to deliver on deep decarbonization or energy security.

Germany offers us a cautionary tale. Because the sun often does not shine and the wind often does not blow, Germany, despite a 550-billion euro green energy transition, relied on coal as its number one source of electricity in 2021. In addition to coal, it remains critically dependent on Russian natural gas, which is bankrolling Putin's war of aggression in Ukraine.

Nuclear energy, in contrast, has a proven track record. Ontario, unlike Germany, was able to phase out coal entirely thanks to nuclear energy. This action still stands as North America's greatest greenhouse gas reduction, and has delivered most of our national progress on emissions since 2005.

The need to rapidly scale up our nuclear fleet should not be controversial. All four IPCC decarbonization pathways that limit global warming to 1.5 degrees required nuclear to increase by 100% to 500% by 2050. Is it possible for us to accomplish such a task? If so, what is our quickest route to meeting the goals that the IPCC has set out for us?

SMRs are a promising suite of technologies. There's certainly a need for smaller reactors like the BWRX-300 and others to fit the grids of our less populous provinces and to decarbonize remote northern communities' mining and industrial sites.

There's also significant interest in SMRs coming from our NATO partners in Europe. Canada, as a first mover in the west, has the opportunity to domesticate a large part of this future SMR supply chain and support our European allies in their transition away from Russian fossil fuels. However, SMRs should be thought of as a complement and not a replacement for CANDU in the pursuit of net zero and energy security.

Why does CANDU offer Canada such an important opportunity? In Canada we brought 23 large CANDU reactors online in just 22 years. Nationally, it is our second-largest and second-cheapest source of electricity after hydro. We know it can be done. Countries like South Korea and China continue to efficiently build new nuclear. However, recent construction experience in the west has not inspired confidence, with nuclear plants under construction in the U.S.A. and Europe blowing past their deadlines and budgets.

What went wrong? In short, it was a perfect storm. These countries, after decades of no new nuclear construction, pursued novel first-of-a-kind designs with atrophied nuclear supply chains and workforces. Furthermore, they often paid for it using expensive private capital because of a lack of commitment from their respective governments and utilities.

What makes Canada different? We have in the CANDU a standardized reactor design with a record of excellent operational performance, and we are running our CANDU fleet better than ever. In the words of former national resources minister Seamus O'Regan, CANDU is a “gold standard” reactor. Many believe that if it were on the drawing board today, CANDU would be considered an advanced nuclear design.

Our CANDU refurbishment program is proceeding on budget and on time, and is renewing most of our nuclear fleet for another 40 years of operation. We are building not only most of the reactor components, like steam generators and pressure tubes, but also the critical project management, manufacturing and installation experience we need to build the new fleet of CANDU reactors that will decarbonize Canada.

Finally, Canada can facilitate access to affordable capital by, for example, including nuclear in the green bond framework. Private capital is eager to invest in nuclear. Nuclear is the ultimate economic stimulus, with a $1.40 return to the Canadian economy for every dollar invested due to our 96% made-in-Canada supply chain.

I have some final recommendations. We must extend the refurbishment program to include all of Canada's CANDU fleet, including Pickering. We must build new CANDU as urgently as possible, starting with the remaining licensed sites at Darlington and new sites in our larger provinces. We should continue to support the construction of the west's first new SMRs at Darlington and Chalk River. Finally, nuclear must be included in federal financial mechanisms like the green bond framework.

● (1835)

Thank you very much.

The Chair: Thank you so much, Dr. Keefer. We appreciate your being here.

Now we will hear from Canadian Nuclear Laboratories for five minutes, and I think it will be the president, Mr. McBrearty.

Mr. Joseph McBrearty (President and Chief Executive Officer, Canadian Nuclear Laboratories): Good evening, Madam Chair and committee members.

Thank you for the opportunity to appear before the House of Commons Standing Committee on Science and Research to discuss small modular reactors.

My name is Joe McBrearty, and I am the president and CEO at Canadian Nuclear Laboratories. Joining me today is Mr. Lou Riccoboni, our vice-president of corporate affairs and business development.

I wish to begin by acknowledging that CNL's operations across Canada occur on the unceded and unsurrendered traditional territories of numerous first nations. At CNL, we recognize the unique history, spiritual beliefs, cultural practices and languages of indigenous peoples in Canada, and we appreciate the responsibility they have as stewards of the environment. I also want to reaffirm CNL's commitment to being an active participant in Canada's journey towards healing and our journey towards reconciliation.

My remarks today seek to inform the committee's study of small modular reactors, or SMRs, and, in particular, our role at CNL in supporting their deployment.

CNL is Canada's national nuclear laboratory. As part of our clean energy program, we are working to help advance these technologies in order to accelerate the deployment of SMRs here in Canada. We are technology agnostic. Our role is to leverage our scientific capabilities to prove or disprove theories and to inform the regulatory process. In short, we are an incubator for the development of innovative clean-energy solutions.

Our Chalk River campus is the birthplace of CANDU reactor technology, and we have a long history in reactor development and design, which we are now applying to next-generation reactors, which include SMRs, advanced reactors and even fusion energy.

Advancing these technologies begins in the laboratory—to bring these concepts to life, to analyze their viability and to ensure that the safety cases are thoroughly studied and thoroughly understood. These are the principles of our small modular reactor siting program, which was launched in 2018. We have Canadian experts in thermal hydraulics, fuel development, reactor physics, cybersecurity and waste management.

Four companies are now participating in our siting process, and just last year the Canadian Nuclear Safety Commission announced that the licence application for Global First Power to construct an SMR in Chalk River would move to a formal review.

In addition, we have launched what we call the “Canadian nuclear research initiative”, a cost-sharing program to leverage our extensive resources to make them more accessible to SMR vendors, including Terrestrial Energy, Kairos Power, Moltex and even General Fusion for fusion energy research.

SMRs have tremendous potential for Canada. They are smaller in size than traditional reactors, can be constructed efficiently in a modular way, produce less waste, and are expected to be much safer, more efficient and more cost-effective than current designs. They can be deployed both on grid and off grid in remote locations, but the benefits go beyond electricity. SMRs also produce heat that could be used to support agriculture—think greenhouses or ammonia production—heat buildings or produce hydrogen to power vehicles or to store excess energy. The system could even be used for desalinization, turning salt water on remote shores into fresh drinking water.

Canada is well positioned to serve as an international leader in this technology. We are a tier 1 nuclear nation, with a strong and independent regulator, a mature supply chain and an established workforce. More importantly, Canada needs it. Here in Canada, with large regions that are sparsely populated with limited infrastructure, these reactors really do make sense, and the time to act is now.

This is particularly true in the Arctic, where there is a growing concern about the need to exert Canada's sovereignty. Other nations are eyeing the Arctic for its vast natural resources and shorter trade routes. Ensuring that Canada maintains an effective presence to protect our beautiful country will be critical in the future. To support that presence, we must be able to supply reliable, independent, clean, autonomous and long-lasting energy, and SMRs are really the only technology that checks all those boxes.

CNL just completed a feasibility study that showed that an SMR could provide clean, economical and reliable energy to our next-door neighbour, Garrison Petawawa, helping to reduce that base's reliance on fossil fuels and to enable its own energy security.

● (1840)

It is my hope that your study will reach the same conclusions that other nations have come to, which is that next-generation nuclear energy has a lot to offer environmentally, economically and socially, and from a national security perspective.

Thank you, again, for the opportunity to appear before the committee.

The Chair: Thank you so very much, Mr. McBrearty.

Now we will go to Dr. O'Donnell for five minutes. The floor is yours.

Dr. Susan O'Donnell (Adjunct Research Professor, Coalition for Responsible Energy Development in New Brunswick): Thank you, Madam Chair.

I come to you from the territory of the Wolastoqiyik, the people of the beautiful and bountiful river.

Thank you for inviting me.

I represent the Coalition for Responsible Energy Development in New Brunswick. I sit on the coalition for the RAVEN project at the University of New Brunswick, where I am an adjunct professor and social science researcher with expertise in technology adoption. Because I'm speaking about science and research, I'll mention that I am a retired senior research officer from the National Research Council of Canada, where I was vice-chair of the NRC research ethics board.

The climate crisis needs technologies to help us radically cut emissions by 2030. SMRs are in the design phase and can't do that.

Given that you are the science and research committee, I hope your report about how SMRs can contribute in the future will be based on science and peer-reviewed research and reports by experts, without a conflict of interest or profit motive.

You heard last week that nuclear proponents want to construct micro SMR units in modules in a factory, and roll them out to remote communities that are currently using diesel to generate electricity. However, peer-reviewed research shows that building a factory to manufacture micro SMRs cannot be justified. Why? Because the total energy needed to replace diesel in all the remote communities in Canada is so small that a factory would never pay for itself.

Peer-reviewed research shows that the types of nuclear reactors planned for New Brunswick have never been successfully commercialized. Why not? Because of technical problems unresolved after decades of trying. If SMRs are not commercialized, there will be no economic development. In the past two years, the government has given almost $100 million to three private nuclear companies for research to develop their SMR designs.

Experts not funded by the nuclear industry have identified many potential problems with SMRs. The Canadian Nuclear Safety Commission has a pre-licensing vendor design review for SMRs—a VDR—but it's optional, not required. The CNSC is clear that a VDR is not a technical review.

What is the government's scientific review process for SMR funding? Is the process fair, transparent and based on independent, scientific review?

In 2021, the government gave more than $50 million to the Moltex company for SMR research to develop the technology to extract plutonium from spent CANDU fuel stored on the Bay of Fundy. The National Research Council of Canada conducted the technical review for the Moltex project. Despite the NRC and the serious concerns raised about the Moltex research, the government approved the project.

It is necessary to ask whether the government acted in accordance with the recommendations of the NRC scientific review? Your committee needs to insist that the NRC report be made available to you for your deliberations. Read the NRC report and ask yourselves why the Moltex project was approved.

I worked at the National Research Council during the war on science, when the government ignored or contradicted expert opinions by government scientists for political reasons. I have to ask, is another war on science happening now? Why would the government not consider expert advice from its own scientists before approving an SMR research project worth more than $50 million?

Your committee can recommend that all funding for SMR research and development should require a transparent, independent scientific review. I urge you to make this recommendation. Perhaps the whole funding envelope for net-zero technology research could be moved to the Natural Sciences and Engineering Research Council of Canada. Why? Because then the public will be confident that SMR research and development will compete with other net-zero technologies in a fair competition to ensure that public funds are spent supporting scientific excellence.

If we're serious about climate action, we will need new technology supported by science.

Thank you.

● (1845)

The Chair: Thank you, Dr. O'Donnell.

Again, I'd like to thank all of our witnesses. We are grateful for your time and expertise.

We're now going to our members. We have a really good committee: Our members are interested in what you have to say.

We're going to start with our six-minute round, and tonight we begin with Mr. Williams. The floor is yours.

Mr. Ryan Williams (Bay of Quinte, CPC): Thank you very much, Madam Chair, and I will start with Dr. Keefer tonight.

Dr. Keefer, is there any realistic path to net-zero emissions without nuclear power?

Dr. Christopher Keefer: As I said in my opening remarks, Canada is blessed with hydroelectric resources. In four of our main provinces, we get more than 90% of our energy from hydro. Those provinces have clean grids, and that brings Canada's average emissions, when it comes to electricity, to a pretty competitive level—not to a deep decarbonization level but a pretty good level. We have outlying provinces that aren't as blessed with hydro resources. Those would be our prairie provinces like Alberta and Saskatchewan, and also Ontario. You wouldn't think so, because we have Niagara Falls, but we're a large economy and we have huge demand.

Ontario managed to achieve what is the gold standard of deep decarbonization, a grid of less than 50 grams of CO2 per kilowatt-hour. It did that with nuclear energy. Right now in this room, 61% of our power is coming from nuclear. We have other options, of course, as I mentioned in my opening remarks, wind, solar, and batteries. There are many modelling studies claiming that we'll be able to deliver a reliable decarbonized grid with these technologies.

I have to say that Germany, one of the richest and wealthiest countries, a real industrial hub, is nowhere close to leveraging these technologies after almost half a trillion euros spent, so Canada really needs to take a pause. We need to assess, in a technologically neutral manner, what is working and what has worked for Canada. We simply don't have enough rivers to dam. We need to double our electric grid, apparently, in order to achieve our net-zero goals. That's going to require the addition of something like 113 Site C dams or the equivalent of 96 large CANDU reactors.

We need to get building quickly. We need to do what works. We have a proven track record, and nuclear is that technology. There are other options, and other things that will complement that, but we're moving from a hydro phase toward a nuclear phase, if we are serious about achieving net zero.

● (1850)

Mr. Ryan Williams: With electrical generation under provincial jurisdiction, in meeting that demand, what role does the federal government need to play, in your opinion?

Dr. Christopher Keefer: The federal government has been involved in issues of energy generation. Famously, the TMX pipeline was bought by this federal government. There's the share in the Hibernia oil field, and our hydroelectric projects at Muskrat Falls and Site C have been bailed out by the federal government.

Certainly, there is a role for the federal government to get involved. I was very involved in advocacy to include nuclear within the green bond framework. I'm glad to see that the government included nuclear within the mandate of the Canada Infrastructure Bank.

When we're dealing with a situation that is urgent, that is emergent, as the climate situation is, the government needs to get creative. Certainly, there's a role, I think, to partner with the provinces to find vehicles, financial mechanisms, and to support the spread of nuclear energy in this country.

It was done at Point Lepreau, for instance. The federal government came up with some of the funding, and each province, actually at that time, was offered a percentage of the funding for the first CANDU reactor that was built. Those mechanisms have existed, and we can put them into play in the future.

Mr. Ryan Williams: You talked about nuclear being the second cheapest and the second largest. What makes nuclear cheaper than any other greener energies, besides hydro?

Dr. Christopher Keefer: Nuclear energy represents a large up-front cost in terms of the capital costs of getting a reactor built, but it delivers. Our CANDU reactors have been running for 40 years. They're at mid-life, the time when we refurbish them and give them another 40 years of operation.

That capital expense is averaged out over many, many years, and the evidence speaks for itself. Right here in Ontario, hydro is about 7¢ or 8¢ per kilowatt-hour. Nuclear is about 9¢, gas is about 14¢ or 15¢, and solar is 50¢s per kilowatt-hour. The facts speak for themselves. It is an up-front capital investment. It's like building a bridge; it's like building an airport. These things take some resources to get going, but nuclear pays itself back over many, many years.

Mr. Ryan Williams: I was reading your testimony before the natural resources committee in April. You spoke a great deal on how we handle nuclear waste in the long-term. This is an issue that has also been raised by this committee.

Could you elaborate for the committee what is different about Canada's nuclear waste compared with other nations, and the safety of long-term storage of our nuclear waste?

Dr. Christopher Keefer: I found this pop can in the ice bin out there, and I brought it to sit with me, because this is the amount of nuclear waste that you would produce if, during your entire life as a member of an OECD country, all of your energy was produced by nuclear energy. We produce very little waste, and all of the waste that Canada's produced in the last 60 years could be stored in one hockey rink piled 32 feet high, or the height of one telephone pole. It's incredibly energy-dense and therefore produces very little waste, and we have a good, permanent solution for that, which is the deep geologic repository. There's one being built in Finland right now, and that can store waste on geologic time frames.

The challenge that anti-nuclear people have when it comes to nuclear waste is demonstrating a mechanism for it to get out and harm people. The geology that we are looking at contains water; water can only move one metre per million years through that rock, and that's the mechanism by which any of this waste could ever get out. We have excellent geology here; we have a proven way to deal with nuclear waste on a long-term basis.

Those were some of my comments at the NRC committee last month.

Mr. Ryan Williams: Thank you.

I'll have you submit the answer to this last question in writing since I'm going to run out of time. Are there any credible concerns from the potential proliferation of uranium that will be used in Canadian SMRs and MMRs?

Thank you, Madam Chair.

● (1855)

The Chair: Thank you, Mr. Williams.

Thank you for answering that last question in writing. We will of course follow up with you.

We will go to Ms. Diab for six minutes. The floor is yours.

Ms. Lena Metlege Diab (Halifax West, Lib.): Thank you very much, Madam Chair.

Thank you to all of our witnesses for coming to our science and research committee.

I'm going to direct my first questions to Canadian Nuclear Laboratories. I was quite interested in your opening remarks, where you quite frankly said that research all begins in the laboratory. You have to study it, research it and, of course, this is part of what we are doing at our committee here. We want to hear from researchers, scientists and so on.

I have some questions for you. To what extent are Canadian universities or educational institutions involved in SMR development projects currently in Canada? What role do you see them playing in these projects?

Mr. Joseph McBrearty: I'm not sure I can authoritatively speak for all of the academic organizations involved, but many—I believe McMaster University, and probably McGill University—are involved in these studies. We, as a national nuclear laboratory, bridge the gap between the academic world and the industry, so we are able to take academic ideas and research and put them to the test in our laboratories to be able to prove that systems work, or do not work. I think the entire synergistic part of the academic world and universities with national laboratories, and the industry and the industry's own research all play a very valuable part in providing the necessary research and information to make decisions about this technology.

Ms. Lena Metlege Diab: Do you see a role for the federal government to play here to make it easier for you to bridge the gap between academia and industry, and are we doing that?

Mr. Joseph McBrearty: I certainly think there is a role for the federal government with increased funding, increased attention to where these gaps exist, from the research, from test bed research, to demonstration reactors, to getting out to actual industrial production. One thing this industry is very accustomed to—very similar to the airline industry—is doing prototypes or demonstrations. You want to be able to take the theory that you have and put it into practice and test it. You could say that you kick the tires of these things and see how they work. We've shown this in multiple reactor technologies throughout the world, and much of the reactor technology that's been talked about for SMRs has been demonstrated throughout the world, whether through pressurized water reactors, boiling water reactors or high-temperature gas reactors. This information exists, but you also want to be able to have a test bed so you can ensure that your technology works.

Thank you.

Ms. Lena Metlege Diab: Thanks for that.

I want to move to another topic, one that I'm very familiar with from my provincial roles.

We have a lot of labour challenges in the country on many fronts, but here we're talking about SMR developments in Canada. What are the labour challenges in regard to that?

Dr. Keefer, if that's something you can comment on, I would be interested in hearing about it. We had previous witnesses who have said that there are.... I think there was a witness who said that, no, we have enough. I want to get your opinion on that, because for this to move on, we certainly need to have enough researchers, scientists and people who are qualified and capable to carry on with this. What can you tell us on that front? What currently are the capabilities that we have within our labour force?

Dr. Christopher Keefer: I can speak more to the labour side. I would defer questions about scientists and academics to my colleagues at the CNL.

Canada is uniquely well positioned in the west. We have a vibrant supply chain, which is activated. We are building critical CANDU components as we speak right now and installing them and gaining the project manager experience, etc.

There are 76,000 men and women working in the sector right here in Canada, so we have a huge advantage when it comes to labour. Again, an investment in nuclear benefits our labour force hugely because these are well-paid union jobs. The nuclear sector has the highest union density of any sector across the country.

I'm going to defer the rest of your question over to my co-presenter here in regard to scientific and academic expertise.

● (1900)

Mr. Joseph McBrearty: Thanks, Dr. Keefer.

Ms. Lena Metlege Diab: Anyone can take that.

Mr. Joseph McBrearty: I'll start.

It is probably pretty obvious that with the amount of research that's going on and the amount of plants that we believe need to be designed and built, you need a lot of people. I don't think that's a surprise to anyone.

When we look at the amount of energy technology that has to be developed and executed over the next 10, 15 and 20 years, I think it's paramount that the government and industry invest in the education for the young people coming up. Many of the folks in the nuclear industry are starting to reach their retirement age, and having a youthful approach and new blood, so to speak, into the—

The Chair: Mr. McBrearty, I am sorry to do this. It's the worst part of this. Please forgive me.

Ms. Lena Metlege Diab: Thank you very much. We're always constrained with time. It's much appreciated.

The Chair: Thank you, Ms. Diab.

[*Translation*]

It is now Mr. Blanchette-Joncas' turn, who has six minutes.

Mr. Maxime Blanchette-Joncas (Rimouski-Neigette—Témiscouata—Les Basques, BQ): Thank you, Madam Chair. I'd like to welcome my colleagues and the witnesses with us this evening.

My questions are for you, Ms. O'Donnell. I'd like to hear more about the Moltex project, which you know well.

In March 2021, the federal government awarded $50 million to the project. It included a letter from the assistant deputy minister of Natural Resources Canada, Ms. Mollie Johnson. The letter states that the technology used by Moltex is a potential pathway to recycling spent CANDU fuel. It could provide Canadians with emission-free energy for years to come by reducing long-lived radioactive waste.

Can you tell us if there are any scientific studies to back up these claims? Did the federal government actually have scientific peer reviews done on pyrolysis technology before funding this $50 million project?

Dr. Susan O'Donnell: Thank you for your question. I listened to it in French, but I'll answer it in English.

[*English*]

No, to my knowledge, there were none of these studies that were done. In fact, the Moltex project is quite interesting, because they're offering a new kind of reprocessing technology. Last week, I heard some of your witnesses say that this reprocessing has been done in other countries for years.

The reason this is innovative is that it's a new type of technology called "pyroprocessing". It's only been done in one place in the world—in the Idaho national labs in the U.S.—and it has been a technological and financial fiasco. They've been trying for more than 10 years to reduce the amount of waste and it hasn't worked out at all. What they have done is make a big mess and a lot of additional waste products that they now have to deal with. It's very complex.

The problem is that less than 1% of the fissile material that's left in the CANDU fuel bundles once they're outside of the reactor can actually be called so-called recycled, but there's no evidence to show that you can cleanly remove the plutonium from the fuel, so what you're left with is a lot materials that will still need to be dealt with for millions of years.

Plus, you'll have a lot of new liquid waste, and that's what we're mostly concerned about in New Brunswick, namely, that as taxpayers we're going to have to pick up the cost of the new liquid waste, of storing the waste. They don't even know what kinds of materials can contain these wastes. There have been no studies done on this project. We don't want to be left to clean up the big mess. That's the big problem.

I could talk about the non-proliferation aspects later, if you like.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Ms. O'Donnell.

I will now turn to the subject of non-proliferation.

As you know, Canada signed non-proliferation contracts on everything related to the nuclear sector. A prestigious panel of American nuclear non-proliferation experts, including former senior White House advisors, wrote to Mr. Marc Garneau, who was the minister of Foreign Affairs at the time, as well as to the Prime Minister and the Deputy Prime Minister, stating that the processing of spent fuel and recycling of plutonium was contrary to the Nuclear Non-Proliferation Treaty.

Could you elaborate on this warning to Canada from the United States?

● (1905)

[*English*]

Dr. Susan O'Donnell: Sure. What the government keeps saying about that is that we're not risking nuclear arms in Canada or non-proliferation in Canada. That's not the issue. It's the signal, and it makes it very clear in the letter from the U.S. non-proliferation experts, that it's the signal that it's giving to other countries.

In particular, South Korea has been trying to do the same type of technology, pyroprocessing, for more than 10 years and the United States has not given it permission because of the very volatile nuclear situation on the Korean peninsula.

Just last week, I was looking at a video from the head of the International Atomic Energy Agency. They are very concerned about a new nuclear test by North Korea.

The Korean peninsula is extremely volatile. What they're concerned about in the U.S. is if Canada starts doing this technology called pyroprocessing, it basically gives the green light to South Korea to do the same thing, and it risks destabilizing a very fragile situation right now with nuclear weapons around the world. You know that this is in the news every day. It's a very fragile situation right now around the world. They're concerned about why Canada is giving the signal that this type of technology is okay, given that there was an informal ban on it for many years in Canada.

[*Translation*]

Mr. Maxime Blanchette-Joncas: I'd like to know what you think of the statement by Moltex's CEO, Rory O'Sullivan. He has made it clear that his intention is to sell his reactors to the world.

Doesn't this raise the possibility that Canada's publicly funded plutonium technologies will increase the risk of nuclear proliferation abroad?

[*English*]

Dr. Susan O'Donnell: Exactly. Some experts have said that if we start exporting that, we're basically exporting bomb-making capabilities. Of course, there are international safeguards, and there's policy and are all kinds of guidelines for it but, again, I would ask you to really consider if Canada wants to be exporting this kind of technology.

We already know what happened in the seventies in India when Canada gave a peaceful reactor to India. They actually used reprocessing technology and they exploded the their first bomb. That's when the U.S. actually banned reprocessing and they did the same in Canada.

The Chair: Dr. O'Donnell, I'm so sorry to interrupt you. I'm sure if members want to follow up, they will.

[*Translation*]

Thank you, Mr. Blanchette-Joncas.

[*English*]

We welcome Ms. Zarrillo to our committee tonight.

You have six minutes, please.

Ms. Bonita Zarrillo (Port Moody—Coquitlam, NDP): Thank you very much.

I'll start my questioning with Madam O'Donnell and then I have a question for Mr. Keefer.

Madam O'Donnell, you mentioned the funding of science right now. I wonder if you could elaborate a bit on if there is fair and open processes right now in Canada for energy innovators and for scientists to get research and prototype funding.

Dr. Susan O'Donnell: That actually was the focus of my presentation. Thank you for the question, through the chair.

We have tri-councils in Canada that fund research and the one that would fund the appropriate research we're talking about tonight is NSERC. When it goes through NSERC, it's funded by independent scientific review. The public has a lot of confidence in that.

Unfortunately, the way the projects have been funded so far do not go through the same level of scientific review, so we've no guarantee that the projects have been vetted scientifically. But there is a process, and that's why I would strongly recommend to your committee that we consider moving the funding for all net-zero technologies to NSERC.

Ms. Bonita Zarrillo: Thank you very much.

Mr. Keefer, you mentioned a possibility for refurbishment. One of my colleagues at the table also mentioned the labour shortages, so the two are together.

I had a visit recently from the boilermakers and they're very concerned about the lack of high-pressure welders and access to high-pressure welders.

I'm wondering if you have any comments on the expertise of high-pressure welders that we don't have enough of in Canada right now for the current nuclear reactors. I used to live in Pickering, so that was interesting to me.

Do you have any thoughts about those high-pressure welders and the lack of that skill set in Canada right now for refurbishment?

● (1910)

Dr. Christopher Keefer: I'm afraid I have to confess that the question is a little too specific for my area of expertise. I'm well acquainted with the boilermakers, and they are very involved in our CANDU refurbishments.

However, just briefly on the topic of refurbishment, we are again getting another 40 years of the lowest-carbon source of power that we have on our electricity grid. It's very interesting. We are refurbishing Darlington and Bruce, but not Pickering.

One of my recommendations is that we continue our refurbishment to include Pickering. The loss of that plant, which is the same age as the Bruce A one that is being refurbished, is going to eliminate all of Canada's national emissions reductions progress to date. We're going to be adding the equivalent of eight million transatlantic flights every year, because we're replacing that clean nuclear energy with natural gas. It's my group's strong recommendation that we reconsider that.

Absolutely I think that the boilermakers deserve to be listened to, and we need to be supporting apprenticeships in these essential skilled trades. The refurbishments are moving along on budget and on time, and I think that they can continue to do so. Once we finish at Darlington, we can shift those workers over to Pickering and seal in Canada's nuclear advantage.

Ms. Bonita Zarrillo: Mr. Keefer, how many members does Canadians for Nuclear Energy have? How many members are in your group?

Dr. Christopher Keefer: The last count was 44.

Ms. Bonita Zarrillo: There are 44 members, and you haven't heard before about the lack of high-pressure welders to be able to do refurbishments?

Dr. Christopher Keefer: No, I haven't.

Ms. Bonita Zarrillo: Okay, great.

Do I have a little time?

The Chair: You have about two minutes and 20 seconds.

Ms. Bonita Zarrillo: Mr. McBrearty, I have a quick question.

You mentioned “expected to be much safer”. Could you elaborate a little on why there was the disclaimer “expected”?

Mr. Joseph McBrearty: Thanks very much for that question.

Most of the new technology involves much more passive safety features. Today's reactors require some sort of active safety measures in their design. The newer reactors are really designed to be able to walk away from it and not have to worry about decay heat and fuel damage, so they're really much safer. They're designed to be more straightforward to operate. That's the crux of the safety. The fuel is designed to be much more accident resistant. The passive designs are designed to provide cooling through any type of accident.

When you look at it from a safety perspective, that's the basis of “safer”.

Ms. Bonita Zarrillo: I'm going to ask you one more question, around indigenous communities. When you started speaking today, you acknowledged indigenous communities. We know, especially in the north, that indigenous communities would like to have energy autonomy, and they'd like to manage it themselves.

Do you believe that these SMRs can be managed in communities where there are smaller populations?

Mr. Joseph McBrearty: That's a very good question.

The first thing you have to understand is that the industry needs to listen to the folks who are in those communities. As we go out to try to spread the message of why nuclear is valuable, the first step with the process is really getting folk's opinions and listening to their concerns.

The Chair: Thank you, Ms. Zarrillo.

Again, we're glad you were able to join us tonight.

We're now going to the five-minute round, and this time we begin with Mr. Tochor.

Mr. Corey Tochor (Saskatoon—University, CPC): Thank you, Madam Chair.

I'll start with the Canadian Nuclear Laboratories.

Do you know what private sector company has the most indigenous employees in Canada?

Mr. Joseph McBrearty: I believe it's Cameco in Saskatchewan, which is a uranium mining and processing organization.

Mr. Corey Tochor: Absolutely. I'm very proud of them. They're located in northern Saskatchewan, with a stellar environmental record and record on economic reconciliation that cannot be matched. I'm very proud of that company's involvement.

When we talk about the jobs that come from nuclear, I was lucky enough to meet with some of the union representatives from the nuclear industry in Ontario. Their message—and I'd like your comment on it—is that we would ramp up, and it's a good thing to have shortages, as in there will be more staffing, more employment and more families to get paycheques from nuclear energy.

Would that be a fair assessment?

● (1915)

Mr. Joseph McBrearty: I think that's a very fair assessment. As we touched on a little bit earlier in the conversation, this is going to be a growing industry. You are going to need not only the scientists and the engineers, but also skilled trades to execute these construction projects, and you're going to need skilled operators to operate these plants.

Mr. Corey Tochor: We're really hopeful, with the EV technology that is coming onboard, that we'll lower our emissions, but what's the point of an electric vehicle if it's going to be powered by natural gas or other energy sources? Nuclear energy seems like a no-brainer.

We've heard before that we'll never meet our doubling of the electricity needs on EV with existing technology. Is there anything that would be anywhere close to nuclear?

Mr. Joseph McBrearty: I think this is probably an opportunity to see and to discuss how nuclear ties into hydrogen fuels going into the future.

Regarding the ability of today, basically hydrogen is produced mainly through electrolysis or catalysis. It requires a fairly significant amount of energy—basically fossil fuel energy—to be able to make that happen.

The beauty of a small modular reactor or even a larger reactor is that you can use that process heat. Remember that a reactor produces heat to produce steam to turn the turbine to make electricity. With that process heat, you have the ability to produce hydrogen, not only to produce electricity but also to produce hydrogen so that you can fuel the vehicles.

Mr. Corey Tochor: Thank you.

I'll switch gears to Dr. Keefer.

In the last 10 years, have any lives been lost to the storage of nuclear waste in Canada?

Dr. Christopher Keefer: This has been researched, not just in Canada but around the world, and we've not been able to ascertain a single death from stored civilian nuclear waste.

Mr. Corey Tochor: So it's a misconception; it's not reality that I've been told.

In your example of the waste the would fit in a pop can, how much energy would still be stored in there that we hope, be it by the Moltex design that might solve some of that, or future technology that could recycle that waste? The ultimate, great thing about nuclear is that you might get more energy out of that pop can.

What per cent of energy is removed from that pop can through the first pass through it?

Dr. Christopher Keefer: It's about five per cent, so there's a significant amount more energy in what we call “spent” nuclear fuel, and there are promising technologies that will enable us to access that other 95%.

That was a big part of our plans early on in the evolution of nuclear energy. Obviously we've discovered that there's a lot more uranium in the world, and it's more economical to use that at this time, but certainly these are promising technologies that we should look into it as a tier 1 nuclear nation.

Mr. Corey Tochor: Absolutely.

Chair, how much time do I have left?

The Chair: You have one minute and five seconds.

Mr. Corey Tochor: I'm going to go back to the Canadian Nuclear Laboratories.

We talk about nuclear and the benefits of such. In Ontario—yes or no—would you agree that it's a good thing that we got rid of the coal-fired generation?

Mr. Joseph McBrearty: Absolutely.

Mr. Corey Tochor: Now I'll switch gears to Dr. O'Donnell.

Is it a good thing that we got rid of coal use in Ontario?

Dr. Susan O'Donnell: Certainly, and we're hoping to do the same in New Brunswick. We have a coal-fired plant here.

Mr. Corey Tochor: That was done through nuclear, and there is no other energy source—and maybe you can correct me if I'm wrong, Dr. O'Donnell—in Ontario that could backfill that coal. Is that correct?

Dr. Susan O'Donnell: Well, I can say that I've just recently read a study showing that in 10 years we could, with better transmission lines from Quebec and with the price of storage dropping, and wind and solar—

The Chair: I hate to do this, Dr. O'Donnell.

Mr. Tochor, would you like a written response?

Dr. Susan O'Donnell: I'll send it in writing.

Thank you.

The Chair: Thank you, both, and I'm sorry to interrupt.

With that, we're going for five minutes to Mr. McKinnon, please.

Mr. Ron McKinnon (Coquitlam—Port Coquitlam, Lib.): Thank you, Chair.

I'd like to thank all the witnesses for joining us today. There are so many questions and so little time. I'm going to have to focus on CNL.

I'm dying to ask about things like microreactors, which are very small and so on, and the importance of reactors in the north. What I'd like to focus on first is waste.

Over your tenure at Chalk River—50 or 60 years—you've accumulated a small amount of waste that you have in in-ground storage.

What is state-of-the-art in repurposing that waste? What sorts of new nuclear processes do we need to develop for new reactors to make better use of it? What can we do to harvest that energy?

● (1920)

Mr. Joseph McBrearty: From a standpoint of being able to harvest the capability and energy inside spent fuel, it's reprocessing. Reprocessing is an option. Other countries use it. We have the capabilities at CNL to provide the technological R and D to companies like Moltex to be able to figure out how to do that and how to make sure that the systems you're putting in place are safe.

From the standpoint of making sure you're getting energy out of the waste, as Dr. Keefer said, there's an awful lot of fuel that remains. If policies lined up and technologies were approved, that fuel could be used for future energy production.

Mr. Ron McKinnon: What kind of research focus do we need to be able to advance that challenge?

Mr. Joseph McBrearty: From the spent fuel research into usable fuel, you have to understand the processes and what the risks are with that fuel from a proliferation standpoint, but you also need to be able to understand what the fuel and material components are and how they are going to interact. You want to make sure that you understand the safety cases that those fuels provide to you.

At the end of the day, you also have to understand what waste management processes and procedures you have to put in place to provide a final repository for the spent fuel.

Mr. Ron McKinnon: What does reprocessing this fuel look like? Is it a matter of extracting U-238 out of the mix, or is it about extracting other fissile products from the results of different processes? Are there nuclear reactors that can be designed to use those other by-products of fission?

Mr. Joseph McBrearty: The processes are chemical and physical processes that you can use to extract the material. As we know, those processes are used overseas, in other countries.

I would be remiss to go too much more into detail on how that process works. I am not an expert in the fuel reprocessing area.

Mr. Ron McKinnon: I have a minute left, so let's talk about fusion. It's pretty exciting. I know it's not commercially viable anywhere in the world.

Can you give us some guidance on where that's going and when we'll get there?

Mr. Joseph McBrearty: There are many projects under way throughout the world. General Fusion, for instance, out of British Columbia, is working on a project. The ITER project in the south of France is a large, international project that is supposed to get the first plasma within the next few years. The ITER project is still a demonstration project.

I would hesitate to say an exact date when you will see energy come out of fusion, and more energy come out than you put in. It's probably 20 or 30 years. That would be tight for me.

Mr. Ron McKinnon: Thank you.

The Chair: Thank you very much, Mr. McKinnon. I appreciate that.

With that, we will go to Mr. Blanchette-Joncas for two and a half minutes.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you very much, Madam Chair.

My question is for Ms. O'Donnell.

Ms. O'Donnell, are there any other critical aspects we should know about regarding the technology Moltex is currently developing?

● (1925)

[*English*]

Dr. Susan O'Donnell: Yes, I think it's important to go back to the letter from U.S. experts. What they have asked for, and I think what we really need, is an international committee to actually examine the non-proliferation aspects of the Moltex technology they intend to export.

We do know that it has raised a lot of concerns internationally, so that's where the focus should be. Canada should not be in place where we're actually blindly subsidizing and being seen to subsidize technology that could destabilize the non-proliferation situation right now.

The other thing I will have to say that the experts asked for and that we're really concerned about is that if Moltex doesn't get the billions of dollars that it will take to complete its project, we could be left with a huge environmental mess on the shores of the Bay of Fundy. It's of huge concern, with all the new wastes that are being developed, that if the project is started and not completed, we will have this mess on our hands.

Thank you.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Ms. O'Donnell.

In a letter to the Prime Minister, American experts pointed out that Japan is the only non-nuclear-armed state that reprocesses spent nuclear fuel, causing both domestic and international controversy.

Can you tell us about the situation with Japan?

[*English*]

Dr. Susan O'Donnell: I would prefer to answer that question in writing, and I will give you a complete answer that way. Thank you.

[*Translation*]

Mr. Maxime Blanchette-Joncas: How much time do I have left, Madam Chair?

[*English*]

The Chair: You have one minute and 50 seconds.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you.

Ms. O'Donnell, you were an officer of the NRC, the National Research Council. What do you think the government should do instead of investing in small modular reactors?

Are there other solutions, specifically in the renewable energy sector?

[*English*]

Dr. Susan O'Donnell: I think that's why Canada has this huge net-zero technology fund and why we want innovation. My point is that we have to be measuring SMRs against the other technologies that are out there. We can't just be giving $50 million to one technology without a proper scientific review. They have to be competing with each other and have to be judged accordingly to find out what is the best technology moving forward. It might be nuclear; it might be something else. There are lots of ideas out there. Why are we focusing all of the money on SMRs without doing a proper scientific review?

The Chair: Dr. O'Donnell, thank you.

[*Translation*]

Thank you, Mr. Blanchette-Joncas.

[*English*]

The last two and a half minutes will go to Ms. Zarrillo.

Go ahead, please.

Ms. Bonita Zarrillo: Thank you, Madam Chair. I'm going to ask questions of Mr. McBrearty again.

I want to hear you talk a little bit about Chalk River. If I understand correctly, your organization runs Chalk River. Could you give some insights around the labour issues? I'm interested in the high-pressure welders, but I'm also interested in ongoing consultation that your organization might have with community partners like first nations, NGOs in the community, regional districts or municipalities. I'd like to hear a little bit about how your business runs and what's working and how you stay connected to the community.

Mr. Joseph McBrearty: Thanks very much.

To address the first part of the question, we have a very active recruiting program to make sure we can get a broad spectrum of engineers, trades and skilled scientists throughout, and we link ourselves with universities so we can draw from those organizations to supply our research needs. Our research needs are not only in the nuclear world but also in cybersecurity and biology as well.

With respect to community outreach and relations with communities, we have a very extensive outreach program of not only public outreach but also indigenous outreach.

In Pembroke last week, we actually just went through part two of our hearing for a near-surface disposal facility. Together with the CNSC, we provided evidence of hundreds of interactions and connections, not only with the public but most importantly, I would say, with indigenous communities. It is incredibly important to continue to grow relations with the indigenous communities. This is a growing thing that I think everyone's starting to learn how to do. It's important for us to be able to understand the needs of the communities and to be able to answer their needs.

Thank you.

● (1930)

Ms. Bonita Zarrillo: Thank you.

Dr. Keefer, you mentioned that there were 44 members in your organization. I'm wondering if first nation communities or NGOs or any municipalities are members of your organization. Could you could give us an idea of what your membership looks like?

Dr. Christopher Keefer: Sure. Membership is individual citizens. We have members from coast to coast to coast, from Victoria, B.C., to Nunavut and right out to the rock in Newfoundland. It is all private individuals. This is not a coalition organization.

The Chair: Thank you, Dr. Keefer, and thank you, Ms. Zarrillo.

Dr. Keefer, Mr. McBrearty, Mr. Riccoboni and Dr. O'Donnell, it is my job to thank you. We appreciate your time, your expertise and your being so gracious to join us all tonight. We thank you.

Colleagues, we will suspend briefly before our next panel.

● (1930)

_____(Pause)_____

● (1930)

The Chair: Colleagues, we're back.

We are on the third night of our study regarding small nuclear reactors.

In our second panel, we have Evelyn Gigantes appearing as an individual; from the Canadian Coalition for Nuclear Responsibility, Dr. Gordon Edwards, president; and from Westinghouse Electric Canada, Mr. Saab, president.

Each organization will have five minutes. At the four-and-a-half-minute mark, I will hold up a yellow card to let you know that you have 30 seconds left.

You have a committee that is interested in what you have to say. We'd like to welcome you. We're grateful that you're here. We look forward to hearing from you.

With that, we will begin with Ms. Gigantes, please.

● (1935)

Ms. Evelyn Gigantes (As an Individual): Thank you, Madam Chair.

I am not a supporter of the development of SMRs, either in Canada or anywhere else. The reason is that our weather over the last few years is giving us clear evidence that climate change is rapidly becoming a challenge to all life on this wonderful planet.

SMRs are being touted by the nuclear industry as a necessary part of slowing and containing climate change. I believe the complete opposite: I think the nuclear industry is trying to save itself from a downward spiral and is waging a desperate campaign to convince the public and elected representatives to invest massive public funds in an ill-placed effort to battle climate change through SMR development.

The fact is that here and abroad the best-informed scientists and economists are stating the obvious: The surest, least costly and quickest way to reduce the carbon emissions that threaten life on our earth is to limit our energy use through conservation measures, to use electricity as our major source of energy and to generate that electricity with renewable resources. In Canada, that means a combination of wind, solar, geothermal and hydro.

I have provided your committee with an article co-written by two experts, a Canadian and an American. It describes the way we can electrify our major energy usage while deftly shifting energy supply sources and meeting backup demand. I've also provided an article about the recent study by the David Suzuki Foundation that comes to the same conclusion. That's the positive part of what I'd like your committee to be ready to report.

There is also a negative part, which I hope you will consider and determine to report. Nuclear power is not an answer to any problem. Nuclear power has generated waste that threatens life and health wherever it is in use or has been in use. Its history both here and abroad is linked to preparation for war, and that history repeats itself to this day as we watch, pained and frightened by the terrible threat to nuclear reactor sites in Ukraine.

Here in Canada, we have scandalous nuclear waste piled up in places like Chalk River and Elliot Lake. We are engaged in the pretense that there will soon be a new nuclear waste management policy, which will deal with these kinds of awful, life-threatening messes. Meanwhile, the former chair of the Canadian Nuclear Safety Commission ensured that most SMRs would not even require an environmental impact assessment under the Impact Assessment Act of 2019 because he managed to arrange matters to ensure that most SMRs are not included on the project list associated with the act. It's an astonishing fact that most current Canadian SMR proposals will not be subject to any environmental review.

I've also provided a third article on the subject of the extraordinary levels of nuclear waste that would be generated by developing SMRs. It outlines the fact that per unit of energy produced, SMRs would produce much larger amounts of high-level nuclear waste than the much larger CANDU reactors.

To sum up, I believe that SMRs are unnecessary given that there are alternative methods of electrifying our energy sources, which will be much cheaper, faster, more flexible and environmentally acceptable, and the last thing this world needs is SMRs sold to countries where their existence would add to the dangers posed by terrorism and war.

Thank you.

● (1940)

The Chair: Thank you, Ms. Gigantes. We appreciate your being here.

We're now going to go to the Canadian Coalition for Nuclear Responsibility and Dr. Edwards for five minutes.

Before you start, Dr. Edwards, could I ask anyone who's got a blurred background to take it off? It's affecting the quality of the transmission.

Dr. Edwards, the floor is yours for five minutes, please.

Dr. Gordon Edwards (President, Canadian Coalition for Nuclear Responsibility): Thank you, Madam Chairman.

My name is Gordon Edwards. I'm very grateful for this opportunity to make a brief presentation on SMRs. I'm a retired professor of science and mathematics. I'm also a co-founder and president of the Canadian Coalition for Nuclear Responsibility and have served as a consultant on nuclear issues for many years.

The nuclear industry has been declining for the last quarter century. In 1997 nuclear power contributed 17% of global electricity supply. Today, that share has dropped to 10% and is still going down. In North America no new large reactors were ordered after 1978 for the rest of the century. The CANDU industry is moribund.

Exorbitant costs and lengthy construction delays, as well as questions about radioactive waste, reactor accidents and the proliferation of nuclear weapons have plagued the industry. The current push for a nuclear renaissance based on a fleet of hitherto untested small modular reactors, or SMRs, is not the first time the industry has promoted a new golden age of nuclear power. The first big push came after the 1973 oil embargo when AECL predicted that hundreds of CANDU reactors would be built from coast to coast in Canada. That turned out to be a false alarm.

Hydro-Québec itself envisioned at that time up to 50 new large power reactors along the St. Lawrence River, but none of them were ever built. The only Quebec reactor that was under construction at the time is now shut down permanently.

The second big push came when the 21st century began. There was much fanfare about a global nuclear renaissance whereby thousands of large reactors would be built around the world, but that nuclear revival also turned out to be a bust. Only a handful of new reactors were ever ordered, including one in Finland; one in Flamanville, France; and four in the southern states of Georgia and South Carolina. Those projects all experienced years of delay and massive cost overruns. Two nuclear corporate giants were bankrupted.

Today we're told of a new renaissance of nuclear power involving a multiplicity of reactor designs called small modular reactors. Pardon my skepticism. Is this another flash in the pan? Will this renaissance go anywhere, like the previous ones?

There are warning signs. First of all, there are no customers. It's a technology in search of a market. Second, there is insufficient funding. What little there is is public funding which, if withdrawn, would kill the SMR surge almost instantly. Third, the alternatives to SMRs are proving to be faster, cheaper and much more attractive, much more in demand than nuclear.

This committee can provide an important service to Canadians by recommending that science and research be brought to bear to examine the various contentious claims being made by SMR proponents in order to attract public support and public funding.

First, on radioactive waste, a recent report published by the U.S. National Academy of Sciences, co-authored by Allison Macfarlane, the former chair of the U.S. NRC, has found that the radioactive legacy from SMRs will be significantly larger and more problematic per unit of energy produced than is the case with large power reactors. SMR advocates have disputed these claims, but I urge this committee to recommend an objective investigation of this dispute by independent scientists to help decision-makers and the public know the truth.

Second, weapons proliferation has already been brought up. Nine non-proliferation experts from the U.S.A. who have served under six different U.S. presidents have urged Canada to undertake an independent review of the proliferation vulnerability associated with the proposed Moltex plant in New Brunswick, a small modular reactor that requires plutonium extracted from Canada's existing nuclear fuel—something we absolutely do not need. There is no rationale for such a step.

Nevertheless, plutonium extraction is a key step in proliferating nuclear weapons capabilities. I urge this committee to recommend an independent scientific and security review of the proliferation risks of plutonium extraction, which I underscore again is entirely unnecessary.

Third, on public accountability, I request this committee to ascertain and publish any detailed science-based rationale, if any exists, behind the decision to forego environmental assessments of almost all SMRs, thereby hampering public accountability.

The fourth is negawatts rather than megawatts. Energy efficiency is cheaper, faster and more certain than any energy supply option. To be specific, I urge the committee to recommend a scientifically based study of the comparative costs and effectiveness of deploying heat pumps in various buildings throughout Canada rather than building SMRs.

● (1945)

SMRs are a poor response to the climate emergency. They are too slow, too costly, and too dubious. In fact, it's kicking the can down the road, and hoping for the best. Some call it “hopium”. SMRs will make no contribution to fighting climate change in the next five years. It will make marginal contributions at best in the next decade. I am not alone in believing that the claims made by SMR proponents cannot be substantiated. However, I'm willing to see those claims put to the test, and this committee can help do just that

The Chair: Thank you, Dr. Edwards. Thank you for your testimony. We appreciate it.

We're now going to go to Westinghouse Electric Canada, and President Saab, for five minutes, please.

Mr. Edouard Saab (President, Westinghouse Electric Canada): Thank you, Madam Chair, and to the Standing Committee on Science and Research for the opportunity to share my testimony of how small nuclear reactors can benefit our environment, the economy, and our fellow Canadians.

As president of Westinghouse Electric Canada, I have the privilege of witnessing the positive impacts that our nuclear employees, services, and technology make every single day.

For transparency, I've spent my entire 20 year career with the Canadian nuclear industry, largely focused on supporting Canada's top performing CANDU nuclear power plants, which tonight are powering six of every 10 light bulbs in the House of Commons with carbon-free energy from Bruce Power and Ontario Power Generation.

With respect to the environment, research conducted by EnviroEconomics and Navius, on behalf of the Canadian Nuclear Association, concluded that, between 2030 and 2050, SMRs could reduce greenhouse gas emissions by 216 megatonnes in the industrial heavy sector alone. This means that SMRs can contribute to Canada's net-zero 2050 objective by reducing emissions an average of 14 megatonnes per year. That's equivalent to taking over three million cars off the road each and every year.

At Westinghouse, it is our engineering-based position that the carbon-free benefits of SMRs, including from our eVinci microreactor, will extend beyond power generation to bring social, economic, and emission reduction benefits to Canadians across our provinces and territories. In reality, the positive impacts of commercial nuclear power continue to be realized today for which Westinghouse has proudly been innovating with for the past 134 years.

This past March, Westinghouse Canada was honoured to receive a $27 million contribution agreement from the strategic innovation fund's net-zero accelerator program. For our part, we will invest an additional $40 million into our Canadian eVinci R and D program. We will create an additional 60 highly-skilled full-time jobs, and sponsor over 250 co-op students. The contributions of just our eVinci microreactor program will stimulate significant spend in Canada's domestic supply chain, and contribute to the advancement of more than 300 highly-skilled individuals. This is in addition to the 250 talented employees already working for Westinghouse Canada today. For context, Westinghouse had a single employee in Canada four years ago. I am witness that nuclear is truly a GDP catalyst.

Federal support will continue to be critical if we are to put Canada at the forefront of this emerging technology. SMRs will provide clean electricity and heat to where it's needed the most, while enabling economic development and job creation.

We as a country, you as elected officials, us as members of industry, must work together to remove unnecessary hurdles that can risk holding up our potential solutions for Canadians, such as in remote communities starved for reliable energy, looking to end their dependence on transported diesel and using eVinci to power year-round greenhouses or desalinate drinking water; in mining sites, wanting to reduce their carbon emissions with a reliable 24-7 power source that can partner with renewables, such as wind and solar; for industrial users with high temperature applications who consume large amounts of fossil fuel today and are seeking carbon-free, high-quality heat for bitumen extraction or even hydrogen production; for indigenous communities, looking to use more energy as fundamental to their economic and social betterment, but wanting, rightly, to have a role in project ownership and management; and at universities, where the versatility of eVinci, as a research reactor, can inspire a new generation of students in pursuing further benefits from this clean energy source, including medical isotope production.

SMRs are truly positioned to help Canada export this technology globally to new and existing marketplaces, building upon Canada's safe track record of exported nuclear technology to six other countries championed by AECL.

Westinghouse selected Canada to accelerate our eVinci commercialization program, because Canada has all the necessary elements to help us succeed. We have true market needs, a world-class nuclear regulator in the Canadian Nuclear Safety Commission, capable nuclear laboratories under the stewardship of Canadian Nuclear Laboratories, a mature supply chain and domestic uranium mining industry led by Cameco and Denison Mines, extensive nuclear operating experience from Bruce Power, OPG and NB Power, and a strong talent pool of existing and future employees. Finally, last but not least, Canada has a strong international brand, as well.

Madam Chair, thank you for allowing me to share my perspective on the potential, and the realized benefits of small nuclear reactors today. I would be pleased to take questions from the standing committee.

● (1950)

The Chair: Thank you, Mr. Saab.

I'd like to thank all of our witnesses. We appreciate your time, your expertise and your perspectives tonight.

We're now going to our committee members. We really have a very dedicated committee that is very interested. They're eager to ask you questions.

We're going to begin with a six-minute round.

Tonight we begin with Ms. Gladu, for six minutes.

The floor is yours.

Ms. Marilyn Gladu (Sarnia—Lambton, CPC): Thank you, Chair, and to all of the witnesses.

I want to start off by talking with Mr. Saab.

I want to start off by correcting some of the misinformation and disinformation that's out there regarding the environmental reviews of SMR projects. We had testimony from multiple witnesses who indicated that yes, they are under environmental review, and that, in fact, those reviews were extending the timeline of the approval of their projects. I want to put that on the record.

First of all, there have been some allegations that somehow nuclear power is very dangerous.

Mr. Saab, how many deaths in Canada from nuclear power or nuclear waste have we seen in the last 50 years?

Mr. Edouard Saab: I don't have the specific fact, Ms. Gladu, but my understanding is that the number has been incredibly low. Any death related to nuclear has come from construction, not from the operations of nuclear. In fact, nuclear has probably one of the best records for energy generation compared to any of the comparables.

To your point about the environmental assessment and impact assessment, I think it's Bill C-69 you're referring to. The requirement is for an impact assessment for anything over 300 megawatts, but the truth is there is also the allowance for the environment minister to call upon an impact assessment for any project. It's not like anything is hiding under the bill. The bill does allow for the right projects to have the right reviews when necessary.

Ms. Marilyn Gladu: Absolutely.

We have heard that SMRs are being subject to environmental review, as they should, so I just want to get that on the record.

How many medical impacts do we see in Canada from nuclear power or nuclear waste? My impression is that really we have not had any incidents related to that. As you said, it's all about construction incidents and the like.

Mr. Edouard Saab: Correct.

Maybe I could just add to the medical side. The other part that might not be promoted as much is the benefits to the medical industry, for example, the sterilization of medical equipment, the cancer treatments that medical isotopes such as cobalt-60 and lutetium provide. There are additional benefits to nuclear beyond power production, which many are not really aware of.

Ms. Marilyn Gladu: Would you agree, Mr. Saab, that really Canada cannot support its energy needs—as they're increasing over time as our economy grows and more businesses are put in place—without nuclear power?

Mr. Edouard Saab: That's absolutely correct. I believe science has told us, and also it's been repeated by the former minister of Natural Resources Canada, that there is no credible path to reaching net zero by 2050 without nuclear. The energy—

Sorry, go ahead.

● (1955)

Ms. Marilyn Gladu: Go ahead and finish.

Mr. Edouard Saab: The density of energy available through uranium is incredibly high and we need to continue on the generation of nuclear for us to get to a path that Ontario, as discussed, has successfully done in the past several years.

Ms. Marilyn Gladu: We've heard some testimony that says there are barriers facing people who are trying to get SMR technology commercialized and sold in the world. What do you think those barriers are?

Mr. Edouard Saab: I'll speak for myself.

Really, there haven't been significant barriers. At this point, as the other panel was mentioning, it's an opportunity for us to listen, to learn, to understand what the requirements will be and what the expectations will be of end users. That's really the exercise we're going through.

From a technology perspective, we have an incredibly high confidence. Westinghouse has been a pioneer of commercial nuclear for.... I think Shippingport was the first commercial power plant in 1957, so we have an excellent track record. We don't have to be concerned about this technically.

What we need to do is to educate. We need to listen and we need to understand. Then we need to work with our peers. We need to work with industry and also the regulator to ensure that we follow a very credible and very mature path to ensure that we are doing things right the very first time.

Ms. Marilyn Gladu: We have heard some concerns that Canada is facing a shortage of trained workers for this industry and that we need to take action to address that. Would you agree?

Mr. Edouard Saab: I think trained employees are required in pretty much every industry. I think that as technology improves, we're going to see a demand requirement.

I've had the luxury over the last four years in leading Westinghouse Electric Canada. I was that single employee four years ago and we have been able to scale to 250 employees, and as I said before, we want to scale beyond that.

Part of that is engaging with communities, with universities, understanding that we need to promote, to educate, and also to sponsor to ensure that we have the workforce not only for today, but also for tomorrow. It's something we're proud to be doing, because it stimulates the economy. It also generates additional workers for more than just nuclear, really, for Canada to increase the GDP requirements across the country.

Ms. Marilyn Gladu: We appreciate your work.

What else can the federal government do to make sure that we grow and make our nuclear industry successful?

Mr. Edouard Saab: To be quite honest, I'd love to continue to just review facts.

We've been put through very stringent due diligence for what was part of the net-zero accelerator program, and that is incredibly positive. We need to have those challenges put in front of us, so we can work together to inform, educate, and also, where there are challenges we can't overcome, to work with the government to understand funding, sponsorship, and what needs to happen for Westinghouse and for the industry to be successful in Canada.

Ms. Marilyn Gladu: Excellent. Thank you so much.

I think that's about the end of my time. I saw the card go up.

Thanks, Chair.

The Chair: Thank you so much, Ms. Gladu. I appreciate your comments, as always.

As I said, we have a very interested committee.

We will go to Ms. Bradford, for six minutes, please.

Ms. Valerie Bradford (Kitchener South—Hespeler, Lib.): Thank you very much.

Thank you to our witnesses for being here this evening.

I'm going to direct my questions largely to Mr. Saab.

In a previous life, I interviewed the president of Westinghouse Canada, when the company was located in Hamilton. There was a big power generation plant there.

I'm very interested. Can you tell me where your 250 employees are located now?

Mr. Edouard Saab: Yes, absolutely. We're spread across southwestern Ontario. We have a manufacturing plant in Peterborough and an engineering office in Burlington. We have two smaller engineering offices, in Stratford, Ontario, and London, Ontario. We also have a satellite office in Port Elgin.

Beyond that, we're also trying to grow in the rest of Canada. We have an employee in Vancouver, B.C., several employees in Ottawa, and we have one individual in New Brunswick.

Ms. Valerie Bradford: Okay. That's great.

On scaling up the ability to produce or the government's use of SMRs, while important, it doesn't really fall within the scope of this committee.

What I'm going to be focusing on is the research that your company is doing, either independently or with post-secondary institutions. You have already alluded to some of that. What are the areas of research that are most necessary for the progression of SMR technology?

Mr. Edouard Saab: What we're looking at right now in Canada is application development. What we are developing is a nuclear battery essentially. We've been able to license the technology from Los Alamos laboratories, and our action has been to scale that technology to allow it to be of commercial use.

What we would like to do with the technology is to provide clean, safe nuclear energy—about five megawatts, which would last about eight years at 100%—and also provide high-temperature heat where required. What we're looking at is not entirely on the device itself, because we have the engineers, the technical capability and the licences to understand that technology.

Where we want to work with universities and communities is on how we can use this technology to really empower and enable.... I used some examples before, in terms of remote communities we've talked to that are looking for clean drinking water, or being able to have reliable heat or to turn electricity on. What we are trying to do with the universities is to really look at those applications.

To be more specific, what Westinghouse has been doing is sponsoring OTU, for example, with scholarships for women in STEM. We've been working with McMaster to understand what we can be doing together to look at technologies. We're also working with the Saskatchewan Research Council to see what applications Westinghouse can do in western Canada. We're not just focused in Ontario.

● (2000)

Ms. Valerie Bradford: Okay. You are working with McMaster University and out in Saskatchewan. Are those the two primary post-secondary institutions that you're working with currently?

Mr. Edouard Saab: We have the sponsorship with Ontario Tech University for the women in STEM program.

Ms. Valerie Bradford: Okay, great.

Mr. Edouard Saab: We mentor and we also sponsor students in the program.

Ms. Valerie Bradford: Is that located in Durham?

Mr. Edouard Saab: Yes, that's right. It's in Whitby.

Ms. Valerie Bradford: Whitby, right. That's great.

I know there is a great shortage of medical isotopes. It was critical a year or so ago, I think because Chalk River was down for a bit.

What is your role in that, and can you elaborate a bit on where you are and how you can contribute?

Mr. Edouard Saab: Sure.

My role is secondary for now, in supporting Bruce Power and OPG. Bruce Power and OPG provide cobalt-60 to Nordion, which is the global leader in cobalt-60. In fact, I think Nordion supports 80% of the global needs for cobalt-60, and about two-thirds of that comes from CANDU plants.

Pretty much every medical device that's been sterilized is thanks to cobalt-60 and what Bruce Power and OPG are doing for the program there.

Ms. Valerie Bradford: What kind of research is your company engaging in, besides R and D, that focuses on improving SMR marketability? There have been some witnesses who have indicated that there's a market for these. So can you tell us what your focus is in that area?

Mr. Edouard Saab: We are looking at what the market needs are. What we're hearing and what we're seeing—we're also using third parties, so it's not just our telling ourselves that there's a market there—is that there is a need for industry to find ways to reduce their dependence on fossil fuel.

As we know, if we're going to meet the Canadian 2050 net-zero requirements, they're going to have to scale off fossil fuels. We're seeing heavy industry look for replacements for backup diesel generators, for example. We're also seeing that communities, customers and industry on edge-of-grid applications where they aren't heavily serviced by T and D, or transmission and distribution, lines. They also require some high source of reliable power.

We're also looking at how the eVinci microreactor can be used for research. Coming back to your isotope question, there might be an opportunity for us to develop our microreactor to also look at being able to do other isotopes beyond just cobalt-60.

Ms. Valerie Bradford: That's interesting. Thank you.

Dr. Edwards, many people do feel that there is a role for nuclear power in helping to address our carbon emissions target. I know that you have an awful lot of concerns, as many people do, about the issue of nuclear waste. I don't have much time left, but are you aware of any promising research that addresses the issue of nuclear waste? I know that it's been a concern and a focus of yours.

Dr. Edwards...?

Dr. Gordon Edwards: Really, the technology for dealing with nuclear waste has not even been implemented for high-level waste. Also, as of now, Canada does not even have a policy for dealing with post-fission intermediate-level waste. We're really still at the dawn of the age of nuclear waste, and we don't know—

The Chair: Dr. Edwards, I'm sorry to interrupt you. Perhaps one of our colleagues will follow up.

Thank you very much, Ms. Bradford, for your questions.

With that, we go to Mr. Blanchette-Joncas.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Madam Chair.

I'd like to welcome the witnesses joining us this evening.

My questions are for Mr. Edwards.

Mr. Edwards, I'll ask you to continue along those lines and tell us about radioactive waste management, particularly its associated costs.

My other question is also on waste management. After a ten-year environmental assessment process, the Seaborn Commission unanimously recommended creating a nuclear waste management and decommissioning agency, independent from industry and organizations that promote it, such as Natural Resources Canada.

Could you tell us about that?

● (2005)

[*English*]

Dr. Gordon Edwards: Yes. This is a real problem. The unanimous recommendation of the Seaborn panel, way back in 1998, was that there should be a fully independent nuclear waste agency with a board of directors that represents various stakeholders. Instead what we have is a radioactive waste management organization that represents the waste producers. There is kind of a conflict of interest there that could become very serious when things start going wrong.

In Germany, for example, they had an underground waste repository. For 10 years the people in charge did not reveal that it was leaking into the groundwater and into the surface waters. Now they're spending over $5 billion in Canadian equivalent to take that waste out of that underground repository. It will take 30 years and it will cost a lot of money, and it's quite dangerous.

We need to have people who are independent of the industry and who do not see the necessity to cover up problems because it's bad PR for the industry.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Edwards.

Can you tell us more about the cost of managing radioactive waste? We're talking about a cost of over $100 billion Canadian. I have other examples, including negligence affecting the Chalk River and Port Hope projects.

What's your opinion on it?

[*English*]

Dr. Gordon Edwards: Well, I think $100 billion is more than I have heard. I've heard that it's about a $16-billion federal legacy of radioactive waste disposal.

The difficulty is that we don't know how to eliminate or neutralize these wastes, so all we can do is stabilize them. The Port Hope waste, for example, consists of about two million cubic metres of radioactive waste materials. After eight years of trying to find a home for these wastes all over Ontario, they came up empty-handed. This was called the "siting task force" of the federal government.

Now, as a kind of booby prize, they have two large mounds right near Port Hope that will hold about one million cubic metres each. They're now using that temporary facility at Port Hope, which was never the goal in the first place. They're now using that model at Chalk River to have a giant mound of post-fission radioactive waste right beside the Ottawa River, about a kilometre away, with half-lives in it. Half of the radioactive materials in that mound have half-lives of over 100,000 years.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Edwards.

You are right, I was mistaken. The $16 billion was for the Chalk River plant. Rather, I was referring to the $100 billion for cleaning up radioactive waste at the Hanford nuclear site, in Washington state, and Sellafield, in England.

I'd like to hear from you on the proposal that the Nuclear Waste Management Organization should not report to the minister of natural resources, but rather to Environment and Climate Change Canada.

What can you tell us about that?

[*English*]

Dr. Gordon Edwards: When we come to the Nuclear Waste Management Organization, this organization will be spending an anticipated $26 billion to dispose of Canada's high-level radioactive waste from the commercial nuclear power plants. However, if they, for example, were to choose a site and emplace the waste, as they did in Germany, and then discovered that the site was unsuitable, they would be faced with a tremendous dilemma, because if they have to take the waste out again and start all over again, obviously the costs mount greatly. That's what happened in other countries, as you said.

In Hanford, Washington, for example, and at Sellafield in northern England, the costs of cleanup have amounted to the equivalent of $100 billion. That's just to deal with the cleanup of that waste. Remember that cleanup doesn't mean that we're eliminating it, simply that we're storing it in a better condition.

This is a problem that is going to plague our grandchildren's grandchildren, whether we like it or not. It's not something that we can rid of by snapping our fingers.

When you reprocess the waste to recover plutonium, many studies have shown that, in fact, you generate even more complicated waste. You do not reduce the volume of the repository, nor do you reduce the overall volume of the actual waste, because you add to the volume of waste with contaminated equipment, etc. Reprocessing is not a solution to the waste problem, although the industry portrays it as such.

One of the things I'm concerned about is that the industry is looking for government funding in order to help their industry survive and to help Canadians. However, I think this committee should recommend research that is specifically aimed at protecting the health and safety of Canadians from the by-products of this industry.

● (2010)

[*Translation*]

Mr. Maxime Blanchette-Joncas: I'm done, Madam Chair.

The Chair: Thank you, Mr. Blanchette-Joncas.

[*English*]

We will now go to Mr. Cannings for six minutes.

Mr. Richard Cannings (South Okanagan—West Kootenay, NDP): I'm sorry. I missed the presentations, so I'm hoping that Ms. Zarrillo is still there and can take the questions.

The Chair: Thank you, Mr. Cannings.

Ms. Zarrillo is indeed here. Thank you, Ms. Zarrillo.

Ms. Bonita Zarrillo: Thank you very much.

I will carry on with a question to Mr. Edwards and then I will have a question for Mr. Saab.

Mr. Edwards, I wanted to ask again about the proliferation concern. We heard some testimony today about what's being marketed as a nuclear battery. I wanted to get your thoughts on whether a layperson could realistically handle nuclear batteries, if we call them that.

Dr. Gordon Edwards: Generally speaking, these kinds of devices can be handled by a layperson over the short term. It's really a question of what happens afterwards. Cobalt-60 was mentioned earlier. We in Canada—OPG and Bruce Power—send cobalt-60 sources all over the world. Eighty per cent of the market is from Canada.

What they don't mention, however, is that all of that cobalt-60 comes back to us as radioactive waste. In fact, the largest component that's going into the radioactive waste mound at Chalk River—99% of it—is cobalt-60. That's the problem with these radioactive materials. Radioactivity cannot be shut off. That's why nuclear reactors melt down, even after they're shut off, because the radioactivity generates so much heat that it will melt the core of the reactor.

It's this long-term legacy waste that is left behind that constitutes an enormous burden on future generations.

Ms. Bonita Zarrillo: Thank you, Mr. Edwards.

Mr. Saab, I want to carry on in that vein. We talk about abandoned oil wells right now in the Prairies. There's this idea that private corporations took all of the profits and left the taxpayer and the environment with the cleanup, I would say. Even in municipalities, we know that they are left with empty pipelines as new pipelines get built.

I wanted to hear your thoughts about what kinds of upfront protections there are for cleanup on the back end. I guess that relates to the idea of these nuclear batteries, so my second question is about the lifespan of those nuclear batteries and what the disposal plan might be.

Mr. Edouard Saab: It's a great question.

Maybe I can answer it in a couple of different ways.

First, when we look at the eVinci microreactor technology, for context—I did provide some information and I'll follow up with the committee to ensure that they have their questions answered about the technology itself—it is a five-megawatt nuclear reactor about the size of one sea container for the reactor itself, and then there are one sea container for the I and C equipment and one sea container for the power conversion unit.

The flexibility and luxury we have with the sea container is that it is mobile, so we can take it to sites, leave it at sites and power sites for eight years with 100% non-emitting energy, whether it's electricity or for heat. At the end of the eight years, should they not require another one, the whole unit as is can be taken back, leaving no legacy waste or legacy damage. The eVinci microreactor does not use external water, and the only output there would be would be heat.

To answer your question on the proliferation, I think there was a question there, too, about the fuel itself. The luxury that we have with the eVinci microreactor is that it uses TRISO fuel: tiny pellets encapsulated by a protection barrier. First, that makes it nearly impossible to do anything damaging with it, but the luxury of a microreactor is that the amount of fuel and uranium required is incredibly small, so in terms of any bad actors trying to do something with microreactors or our nuclear battery, they would require thousands of these microreactor sea containers to be able to put it together, and it would be physically and technically impossible to do so.

● (2015)

Ms. Bonita Zarrillo: Thank you, Mr. Saab.

In thinking about the future of it, we know that a lot of e-waste goes overseas or gets shipped away from Canada and then ends up as pollution. I want to understand if there is any protection, and if those conversations are already happening on a global scale around what SMR waste might look like for the globe going forward.

Mr. Edouard Saab: Yes, not at a global scale.... I'm sure it's happening at the IAEA, the International Atomic Energy Agency, but every country is looking at that mandate to ensure that they do handle the fuel correctly. Nuclear Waste Management Organization Canada, along with the CNSC, our regulator, would have plans in place to ensure the stringent requirements of the CANDU plants in Canada are followed by any of the SMR providers having to deploy their units in Canada itself, and it's the same with the NRC in the U.S. The national regulatory council would do the same thing for U.S. colleagues as well.

Ms. Bonita Zarrillo: Okay. Thank you.

The Chair: Thank you, Ms. Zarrillo.

Colleagues, we are now going to go to our five-minute rounds.

This time, we'll begin with Mr. Soroka.

Mr. Gerald Soroka (Yellowhead, CPC): Thank you, Madam Chair.

Thank you to all the witnesses for being here this evening.

I'll start with Mr. Saab.

Did I hear you correctly when earlier you said that there are really no challenges, policies or issues with building nuclear—such as SMRs—in Canada? Would this also include Bill C-69?

Mr. Edouard Saab: Yes, I was referring to the technology itself. Thank you for the question.

In terms of legislative requirements, yes, I wouldn't say that there are challenges, but there are processes that we need to follow. As a nuclear reactor provider, we would work with utilities, end-users and customers to follow the Canadian Nuclear Safety Commission environmental assessment requirements.

Should we be looking at a microreactor under 200 megawatts, although Bill C-69 may not be mandated for us, there might be a possibility that impact assessment would be required. Now, the impact assessment does add a burden. It does add costs. It also would slow down for anything less than I think 300 megawatts the allowances that are required. There is a potential for us to take a technical process and make it a little longer and more expensive, and ultimately, the sad part of it is to delay some of the solution that could be provided to these remote communities and these industrial users of technology.

Mr. Gerald Soroka: Would you find that the policies in place are making it any safer? Or is this just to give the public the feeling that it's safer?

Mr. Edouard Saab: That's a good question.

I guess the truthful answer is that with more rigour would probably come more questions and then more time to ensure diligence is made. Ultimately, if it's going to answer questions that had not been answered by an environmental assessment or any of the internal work done by a reactor developer such as Westinghouse, or an end-user, or even under the requirements of the licensing process under the CNSC.... I would not anticipate any questions or challenges to be posed that were not identified through those current steps, so no, I don't think the benefit, at least for Bill C-69, would be truly there for the public.

Mr. Gerald Soroka: I have another question.

The committee has talked about remote communities not having an SMR and just continuing on with the current diesel or whatever other system they have to generate electricity, but in these remote communities, would having an SMR not give them more opportunities to either create a new business or to increase the area and number of people coming in so it would sort of give them a growth factor? Would this be an opportunity?

● (2020)

Mr. Edouard Saab: You are absolutely correct.

It's not just about the power and electricity provided. It really is about the economic development that clean, safe, reliable electricity and heat can provide for these areas. We are having those conversations, and that is what's being told to us. They do require the electricity because it is a GDP provider and because it will allow them to do more than what they currently can do.

To answer your question, it's an absolute yes. An SMR, our eVinci microreactor, would be a true enabler for remote communities needing clean drinking water and clean electricity, and it would really improve their quality of life and allow them to do more.

Mr. Gerald Soroka: Thank you for that.

Dr. Edwards, we've heard from witnesses who have stated that there is a critical issue with public confidence in small nuclear energy.

Do you find this to be critical in the implementation of SMRs in our community, and how vital is public engagement and communication when you are attempting to establish an SMR?

Dr. Gordon Edwards: Thank you.

You've certainly touched on something very important. What we've heard from the industry is that they have visions of how these SMRs could be used if somebody wanted them. The difficulty is that they don't have customers clamouring at the door and actually signing on the dotted line and saying, “As soon as these are ready, we'll buy them.” They're not like electric cars, which are selling like hotcakes. Nuclear reactors are not selling like hotcakes.

In the past they've even tried to give these things away. Here in Quebec, they tried to give away a small reactor to the University of Sherbrooke, and they couldn't succeed even there.

It's moot whether people are going to want these things and also whether the problems associated with them are as simple as presented.

With regard to environmental assessments, the only reason one small modular reactor is undergoing environmental assessment today is that it's under the old law. No new SMRs would be subject to an environmental assessment under the existing statute if they were under 200 megawatts.

Thank you.

The Chair: Thank you, Mr. Soroka.

Again, I just want to acknowledge all you witnesses and how much we appreciate your being here.

We will now go to Mr. Collins for five minutes.

Mr. Chad Collins (Hamilton East—Stoney Creek, Lib.): Thanks, Madam Chair.

Thank you to the witnesses for their attendance this evening.

I'll start with Mr. Saab.

Mr. Saab, some critics have argued that the technology won't be ready until at least 2030, if at all, and they have characterized SMRs as an expensive science experiment. They've suggested at the same time that we should obviously be looking at wind, solar and other options. We've heard that tonight from some of the other witnesses while you've been present.

What's your response to that?

Mr. Edouard Saab: Thank you for the question.

I can answer it in two parts.

First, with respect to the technology-readiness level, as I mentioned before, the luxury we have had is that we are taking an existing technology and scaling it up. We have a very high comfort that the technology will be ready well before 2030. The truth is that we already have the electrical demonstration unit up and running whereby we take electricity to you to create electricity, and that is really proving the heat pipe design and the scalability of what we've licensed from the Los Alamos lab. That has been completed successfully.

The next step would be a nuclear demonstration unit, which we plan to have completed by 2026. That is well within the four years.

In terms of when it's commercially ready for the market—to the questions posed before—it really depends on the licensing process. The other question I believe Dr. Edwards mentioned was about the customer requirements as well. We do have customers who do want the unit now and we're hoping that the licensing process will be much shorter and they will have access to the unit itself today.

In terms of the partnership with renewables, I'm a huge supporter of renewables, both wind and solar, but we've heard countless times before—right now it's not sunny in Toronto—that there are times when the sun's not shining and the wind's not blowing.

We can envision technology like the eVinci microreactor being coupled with wind and solar to allow safe backup whenever we don't have that power coming from the renewable itself. It might actually exploit and support renewables to grow even further than what they have today—because they don't have the safe backup required—and they sometimes require, I think, diesel backups to provide power when the wind's not blowing.

Mr. Chad Collins: Thanks for those answers.

I was intrigued by Dr. Edwards' comments relating to the marketability of SMRs. We've had a number of witnesses in front of us who have talked about the investments made by the private sector in getting us to a point in time where the technology is proven and is ready to be sold to customers.

Can you respond to how much money the private sector has invested in the technology? Maybe just deal with that from a domestic perspective here in Canada. What does the customer base look like? Who will be purchasing these SMRs, and what kind of dollars and investments are at play as it relates to marketability?

We've heard about the economic uplift once they're in communities and jobs have been created, but I'm interested in the sales themselves. I find it hard to believe that the private sector would invest so much in the technology only to find out that there's no ROI at the end of the day.

Can you comment on that?

● (2025)

Mr. Edouard Saab: We believe there is an ROI; otherwise, we wouldn't be investing our own funds into the technology. Maybe I can speak to what's been public information, and I can be a little more specific about Westinghouse because I don't want to talk for the industry when I don't have the details.

Through the strategic innovation fund, through Innovation, Science, and Economic Development Canada, they have funded three different reactor technologies: Terrestrial, Moltex, and Westinghouse Electric Canada for our eVinci reactor.

For our eVinci reactor, for example, Mr. Collins, we've been given $27 million—not given; it's a contribution agreement, and we pay it back, for the record. We have a contribution agreement for $27 million to accelerate the spend within Canada. Ninety-five percent of that spend will be in Canada by Canadians to accelerate that technology. On top of that, we are going to put another $40 million just for the program tied to what we're doing under the strategic innovation fund. That does not include all of the work that Westinghouse does to ensure the technology with our people in Canada and around the world.

That investment I talked about, the $27 million plus the $40 million, is a small fraction of what's required to move it forward.

Having said that, we are a private entity, and we do have an ROI expectation. In consultation with customers, there is a requirement. As opposed to my and our saying that there are no customers required, let the customers talk to us and let them say. We are hearing from those who want to talk to us and who are proactively coming to Westinghouse looking for this technology now that they know about it. They are looking for these mobile, transportable, efficient five-megawatt batteries to complement or replace diesel backup generators.

Remote communities have stood up to say what—

The Chair: Thank you, Mr. Saab. I'm sorry. Interrupting is the worst part of this.

Mr. Edouard Saab: That's no problem. Thank you.

The Chair: Forgive me.

Mr. Edouard Saab: I can provide more information, Mr. Collins. Thank you.

The Chair: Now we have three minutes left, so to be fair and keep us on time for the next panel, we have Mr. Blanchette-Joncas for a minute and a half and Ms. Zarrillo for a minute and a half.

Thank you.

[*Translation*]

Mr. Maxime Blanchette-Joncas: I just want to make sure that I understood correctly, Madam Chair. Do I have two and half minutes?

[*English*]

The Chair: To keep us on time, you have a minute and a half so we can start the next panel, because we have a hard stop.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Very well, but that’s not in line with the rules we set at the start, Madam Chair.

[*English*]

The Chair: Mr. Blanchette-Joncas, you have a minute and a half, please.

Mr. Ron McKinnon: Madam Chair, I would support extending the time if we could, stealing time from the next panel perhaps, just to maintain peace in the house.

The Chair: Is that what you would like?

Mr. Ron McKinnon: Yes, please.

The Chair: Okay, that means you may lose it from the next panel. The reason we lost time here is that people were talking.

[*Translation*]

Mr. Maxime Blanchette-Joncas: I can't hear anything, Madam Chair. There's no interpretation right now.

[*English*]

The Chair: I'm sorry, Mr. Blanchette-Joncas.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Could you repeat that, please? There was no interpretation.

[*English*]

The Chair: Okay. If we take it from this panel, we're going to lose it from the next panel. Does everybody agree to that?

Some hon. members: Agreed.

The Chair: Mr. Blanchette-Joncas, you have two and a half minutes.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Madam Chair.

I'd like to address Mr. Edwards again.

Mr. Edwards, could you come back to the issue of waste management? Are there any other critical aspects we should know on the subject?

[*English*]

Dr. Gordon Edwards: One of the greatest difficulties is how to prevent chemical reactions from occurring along the intermediate-level waste. In Carlsbad, New Mexico, there was a drum that exploded and turned into a flame-thrower. Radioactive dust went 750 metres up the shaft and contaminated 22 workers. This is because of chemical reactions. Chemical reactions can occur that then spread radioactive waste. This is a big problem over the long term.

● (2030)

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you very much.

In your last answer, you mentioned the issue of environmental studies. Currently, small modular reactors—that's every single project—are not subject to any environmental studies.

Can you tell us more about the lack of measures for studying small modular reactors?

[*English*]

Dr. Gordon Edwards: I think what we're seeing here is that the industry is coming to the government asking for accommodation to speed up the process so that they can get on with their private money-making job and also do, as they say, something about climate change. The problem is that they can't do anything about climate change for the next decade, so they want the money now, and they want to speed it up. One of the ways of doing that is to cut out environmental assessment—because democracy is too expensive; it slows you down too much, so let's not be democratic, and let's just move ahead and put the technology in place.

This has never been the case in Canada before. Nuclear projects always were subject to federal environmental assessment.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Edwards.

I'll give Ms. Gigantes a chance to comment.

You were rather frank. At the outset, you mentioned that nuclear energy is not the answer to the energy transition and carbon neutrality.

Can you enlighten us further with your point of view?

[*English*]

The Chair: Ms. Gigantes, give a short answer, please.

Ms. Evelyn Gigantes: I will make it short.

Currently, we know how to use renewables in ways across this country, with backup from hydro power, on a Canada-wide basis. We can do that when the sun doesn't shine and the wind doesn't blow. The schemes that have been developed both here and abroad to allow us to do that.... Canada is actually perfectly situated and granted the resources to do it with hydro as a backup.

The Chair: Thank you, Ms. Gigantes, and thank you Monsieur Blanchette-Joncas.

We will now go to Ms. Zarrillo for two and a half minutes.

Ms. Bonita Zarrillo: Thank you so much.

I have a question for Ms. Gigantes and then I am going to move to Mr. Edwards to talk about the question I asked Mr. Saab earlier about planning for waste.

Ms. Gigantes, you mentioned energy efficiency efforts and actually changing human behaviour. This is something that my colleague, Mr. Cannings, talks about. Can you expand a little on how we are going to change human behaviour if we just pivot to a new energy source?

Ms. Evelyn Gigantes: I'm suggesting that what we do to replace the kinds of carbon-producing energy we have is to use renewables, but the cheapest source of new energy is when we cut back our use. For example, in the house I'm living in, we installed a geothermal unit in 2009, and it paid for itself within 10 years. Now the cost of electricity in this house—it's run on an electric current, that geothermal unit—is amazing. It's quite amazing. I thoroughly recommend it to everyone. It's a good investment.

Ms. Bonita Zarrillo: Thank you very much. I think we heard some pushes for heat pumps too in this testimony.

Ms. Evelyn Gigantes: Yes.

Ms. Bonita Zarrillo: Mr. Edwards, I mentioned abandoned oil wells and abandoned natural gas pipelines. Are you aware of any conversations that are happening in governments and industry around having to make accommodation now for what will be waste later?

Dr. Gordon Edwards: That's certainly important, because right now in Port Hope, Ontario, we have the largest municipal environmental cleanup in Canadian history—over $1 billion, or $1.2 billion—simply to retrieve a huge amount of radioactive waste that was dumped in the harbour. Hundreds of homes and roadways were built using this material. It was dumped in ravines and so on. Simply retrieving that waste and demolishing the buildings that were contaminated is a very expensive project. These monies should be put aside very early.

With the SMRs, it's a real problem as to who is really going to be responsible. Almost all of the promotional literature says nothing about who is responsible for the waste.

● (2035)

The Chair: Thank you, Dr. Edwards.

To all our witnesses this evening, we really thank you for being part of this study. We thank you for your time, your commitment and your expertise.

With that, our committee will suspend briefly before we go on to a third panel.

Thank you again.

The committee is suspended.

● (2035)

_____(Pause)_____

● (2035)

The Chair: Dear colleagues, I'm going to pull you back.

You work so hard. Two hours is tough. We're going into a third hour.

We'd like to welcome our witnesses. We thank you for joining us tonight.

As an individual, and in person, we have Dr. Jeremy Rayner, professor. From the Canadian Nuclear Workers Council, we have Robert Walker, national director. And from the Sylvia Fedoruk Canadian Centre for Nuclear Innovation, we have Dr. John Root, executive director. We welcome all of you.

Each organization will have five minutes. At the four-and-a-half-minute mark, I will hold up a yellow card. It will allow you 30 seconds to finish up.

With that, we're going to start.

We will go to Professor Rayner. The floor is yours.

Dr. Jeremy Rayner (Professor, As an Individual): Thank you very much, it's a great pleasure to be here this evening.

My name is Jeremy Rayner, I'm a political scientist by training and a professor at the Johnson Shoyama Graduate School of Public Policy at the University of Saskatchewan. My research on the public policy implications of SMRs has been supported over the years by the Social Sciences and Humanities Research Council of Canada and by the Sylvia Fedoruk Canadian Centre for Nuclear Innovation.

As an aside, I would say that I was distressed to hear the suggestion earlier this evening that all funding for research on SMRs be routed through NSERC. There are very many important questions, perhaps the most important questions, about SMRs that actually fall within the purview of the social sciences and the humanities in terms of their success or failure.

I've been fortunate to be on sabbatical leave this year, and I spent some of that time at the Dalton Nuclear Institute at University of Manchester in the United Kingdom researching SMR developments in the U.K. and Europe. I have submitted some written evidence in the form of a peer-reviewed publication for the committee.

I'd like to start by saying that in the U.K. and Europe, anecdotally Canada is regarded as a world leader in SMR policy and governance. We are admired for the extent of collaboration between the provinces and the federal government; for bipartisan support for SMRs that provides confidence for investors; the relatively transparent processes for choosing SMR designs; and the clear responsibilities and timelines set out in the SMR road map, the action plan and this year's strategic plan. The challenge is to maintain our position as leaders and translate that leadership into the development of a technology that actually contributes to meeting our clean energy goals. My question has always been what should be the approach of policy and governance that would build on this successful start?

There are currently two issues that SMR advocates are trying to put on the federal policy agenda, and you've heard both of them this evening and at prior meetings of your committee: subsidies and regulation. You're unsurprised, I'm sure, to learn that advocates think SMRs should attract more of the former and less of the latter. On subsidies, there's a general principle of policy design that it's better to provide support for solutions to a problem rather than to specific technologies or industries. To some extent, of course, Canada has followed that path through the various clean energy funding initiatives. I draw your attention to the European Union's recent decision to include nuclear energy under some circumstances as a sustainable investment for funding purposes. I'd urge that this approach be continued.

Regulation raises the critical issue of public confidence in small nuclear reactors. If SMRs are really to be a transformational technology, rather than just a useful addition to our power generation options—and that's a good enough target to start with—then they must be built closer to where people live and work than traditional large reactors have been. This will only happen if we can raise public confidence in nuclear safety to new levels. The reputation of the CNSC for evidence-based regulation needs to be protected and efforts to rush the licensing of new designs, I think, be regarded with extreme caution.

There's also an issue that advocates are studiously avoiding or, at best, responding to with platitudes, and that is public engagement. Engagement is going to test federal-provincial collaboration and require some innovative thinking in science communication and knowledge translation. There is a strong temptation to place the responsibility for engagement on proponents—usually in this case a utility—and that's how the engagement requirements of project-based environmental assessment works. As in other cases involving infrastructure and natural resources, placing the responsibility for engagement on the proponent may seem logical, but it raises a well-known problem that will likely be experienced very strongly in the case of SMRs, which you've seen already this evening. The problem is that members of the public will want to raise broad questions of public policy and regulation around nuclear issues that are beyond the scope of a project-based assessment and outside the competence of a proponent to address. Examples are general questions about uranium mining or the disposal of nuclear fuel. Simply telling them that they can't raise such questions at an assessment is not going to help the deployment of SMRs, and I think we need to find some way of including those broader questions in public engagement processes in Canada.

● (2040)

In addition, it can be confidently asserted that there is no future for SMRs in Canada beyond a handful of first-of-a-kind demonstration projects taking place on sites already licensed for nuclear facilities without prior, informed and meaningful consent of indigenous peoples. Quite apart from new sites that need to be proposed on treaty land, or land over which unextinguished rights are asserted, SMRs may involve the transportation of modules, some of which may be already fuelled, and the disposal of waste that will not be concentrated—

● (2045)

The Chair: Professor Rayner, I am so sorry. You have a committed committee, and I'm sure they will want to follow up with questions. Please excuse my having to interrupt.

We're now going to Mr. Walker from the Canadian Nuclear Workers' Council, please.

Mr. Robert Walker (National Director, Canadian Nuclear Workers' Council): Thank you, Madam Chair.

Good evening. I'm Bob Walker, national director of the Canadian Nuclear Workers' Council. It's encouraging to see the science and research committee's interest in small modular reactors and the benefits nuclear offers for both the environment and our economy.

I'll briefly talk about our council, our perspective on Canada's nuclear industry, and SMRs.

Our council was formed in 1993 as an association of unions representing workers across Canada's nuclear industry. This ranges right from uranium mining in Saskatchewan through electricity generation to nuclear waste management. The council serves as our collective voice. We hold an annual conference in various nuclear host communities and regularly engage with labour, industry and the regulator. More information can be found on our website.

We have a very mature, made-in-Canada nuclear industry that was built on the pioneering work started by AECL more than seven decades ago.

The CANDU reactor has been deployed in Ontario, New Brunswick and Quebec, as well as exported to a number of other countries. CANDU reactors are a proven and reliable technology that currently supply about 60% of Ontario's and 30% of New Brunswick's electricity. That electricity is generated without carbon emissions or air pollution. The refurbishment programs for Canada's reactors will keep them generating that clean electricity for decades to come.

This has been said before, but it's important enough to be repeated: Nuclear energy enabled Ontario's transition off coal by providing both clean energy and quality employment.

The industry includes a number of great corporations that support employment for thousands of Canadians across many communities. These are skilled jobs with good pay and great working conditions. I believe I can speak with some authority when I say that our nuclear facilities are amongst the safest workplaces anywhere. We need more quality jobs like these.

Canada's nuclear industry is a mature industry that continues to evolve and demonstrate innovation in many areas, such as radioactive waste management; advances in nuclear medicine, including the production of medical isotopes; and exploring new opportunities to support a clean energy future, including SMRs.

We believe that the importance of our current CANDU reactors cannot be understated and that we need to plan for the construction of new conventional scale reactors, but some markets and some applications cannot support the large reactors, and SMRs offer a great opportunity.

SMRs have shone a light on nuclear energy's ability to combat climate change, and Canada has demonstrated great leadership in advancing that through the SMR road map, SMR action plan, and the great co-operation we've seen between provinces and utilities to explore opportunities for SMR deployment and development.

Many jurisdictions around the world are now watching the progress in Canada with great interest. Today we are seeing real action and real opportunity with the OPG's plans to build an SMR at their Darlington site, and possibly follow up with three more. Saskatchewan Power is expected to build their own SMR after OPG's is proven successful. BWXT in Cambridge is hoping to manufacture components for that BWRX-300 for both domestic use and for export, including Poland. NB Power is working with Moltex and ARC to develop advanced SMR technologies. Global First Power is progressing their proposed micro modular reactor at CBL's Chalk River site, and Westinghouse, as you heard, is working with the Saskatchewan Research Council and Bruce Power to progress their eVinci microreactor.

SMRs can help the world meet their clean energy needs, and Canada has a great opportunity as an early leader.

In closing, the nuclear industry is very important for Canada. It has been generating reliable, affordable, emission-free electricity for decades. It produces isotopes used for our quality health care and the supports for its many high-quality local jobs. These are great jobs.

SMRs have received a lot of attention, and there are global discussions about climate change as a source of emission-free energy. Canada has an opportunity to continue this leadership. Canada's nuclear industry was created with support from the Government of Canada, but that support has not been as consistent and encouraging as we believe is warranted.

We would like to see the government act as a champion for our nuclear industry as an important part of the solution to fight climate change, provide quality employment and support energy security.

Thank you very much for investigating this topic, and thank you for allowing me the time to talk.

● (2050)

The Chair: Thank you for joining us, Mr. Walker.

We're really grateful to all of you that you take your time.

We will now go to Dr. Root.

The floor is yours for five minutes, please.

Dr. John Root (Executive Director, Sylvia Fedoruk Canadian Centre for Nuclear Innovation Inc.): Thank you, Madam Chair.

I feel honoured by the invitation to participate with a panel of witnesses for this important study of small modular reactors.

I serve as the executive director of the Sylvia Fedoruk Canadian Centre for Nuclear Innovation. We are a not-for-profit corporation with a single institutional member, which is the University of Saskatchewan, but we have a fully independent board of directors.

The Fedoruk centre is funded through an agreement with Innovation Saskatchewan, an agency of the province, plus revenue from third parties for goods and services that we provide.

The purpose of the Fedoruk centre is to help place Saskatchewan among global leaders of nuclear research, development and training through four key activities. First, we fund research projects led by Saskatchewan scientists in some kind of nuclear topic of their choice. Second, we partner with Saskatchewan institutions to help them establish new faculty leaders of nuclear subjects in line with their strategic plans. Third, we operate a nuclear facility, the Saskatchewan Centre for Cyclotron Sciences. This is a resource for innovation in nuclear imaging for health and food security. Fourth, we establish consultative resources for the public and policy-makers. We facilitate partnerships and develop business related to nuclear innovation. Pretty well everything you do that has something with nuclear, it's our job to try to help Saskatchewan engage with these things.

At this time, the Province of Saskatchewan is moving forward with Alberta, Ontario and New Brunswick towards deploying small modular reactors to help achieve Canada's objective of a cleaner energy future and stimulate a wide range of economic activities and social benefits arising from this innovative technology. It seems very likely that Saskatchewan will place our first nuclear power plant onto the electricity grid in the mid-2030s. Then we will proceed in steps to replace the burning of fossil fuels with a new foundation of baseload electricity to which other clean energy technologies can add.

It is also reasonable to consider very small nuclear reactors to power resource extraction industries that are located far from the grid and would otherwise need to be burning fossil fuels to have the energy to operate.

Deploying a nuclear power technology in Saskatchewan would not only help to move Canada towards reducing the burden of greenhouse gases on our planet, but could also create opportunities for research and innovation in the surrounding fields, the topics connected to the power generation. Examples would be adding value to the uranium that is mined in Saskatchewan. Perhaps we could be enriching the uranium and fabricating enriched fuels. Both of these economic activities are only performed outside Canada at this time, so there's an opportunity to create new value if we put our minds to it.

Another possibility is to manufacture nuclear quality components in Saskatchewan. This would enable Saskatchewan companies to contribute to the Canadian supply chain for building SMRs. Perhaps we could be a part of responsible management of used fuel as a part of protecting the environment.

Saskatchewan will need people to serve as operators, technicians, designers, builders, regulators, safety engineers, control system architects and security experts. That means we will be needing to create many new jobs in Saskatchewan and fill them with people at all levels of educational development. That means we need to get started right away to establish a new capacity for leadership in research and education in nuclear topics at Saskatchewan post-secondary institutions. There are only three main ones here: the University of Saskatchewan, the University of Regina and Saskatchewan Polytechnic.

● (2055)

Now is the time to attract new leaders who can create educational programs and establish themselves as trusted knowledge keepers to whom the public can turn for unbiased advice on nuclear topics. Turning to them, we can learn how nuclear energy works, how nuclear safety is maintained, how we can minimize impacts on the land, how we can engage in respectful public conversations, and—

The Chair: Dr. Root, I'm sorry to interrupt. You're very gracious, all of you.

I thank all our witnesses. We're really glad you're here.

We're now going to hear from members of our committee, who are a dedicated group of people.

We're going to start with Mr. Tochor, for six minutes.

Mr. Corey Tochor: Thank you to our witnesses.

To Mr. Walker, earlier we heard about the need to train more pressure welders. I'm assuming some of your members are pressure welders.

Mr. Robert Walker: Yes. I was listening earlier, and I did hear that question.

Our membership includes unions representing people from mining in Saskatchewan, those fabricating the fuel in Ontario and operating nuclear power plants, and those in construction, as well as the building trades council of Ontario. It's really the whole gamut.

I know that the building trades are very engaged in trying to look forward to determine how many people are going to be required. They're looking at all nuclear projects and all major infrastructure projects, trying to get an idea of how many people will be required in the future, and making sure that they're working with their employers to recruit and train those people.

I do know it's been identified as an issue, especially welders, and there is a lot of work being done in that field.

Mr. Corey Tochor: What do you think your members would say if a political party were to say that we shouldn't consider nuclear, because of the shortage of some of the skilled trades?

Mr. Robert Walker: I can't imagine anybody saying that.

We're always looking for good employment, and this is good employment. All we have to do is forecast those opportunities so that we're training people for them.

I would hate to think that anybody would not pursue an opportunity because we don't have enough skilled people. The answer is to get our people skilled.

Mr. Corey Tochor: Would you want your offspring or family members, hopefully, to work in nuclear?

Mr. Robert Walker: That's a great question. My wife is not here, so she can't stop me from answering it.

My son works in a nuclear power plant. She didn't want me to say that to people, because she didn't want it to look as if I got him the job, but I can honestly say that I didn't. He got the job himself. My son works at the Bruce Power nuclear power plant. My nephew works as an operator at OPG's Darlington plant, so I do have family who work there.

I'm extremely happy for them. I was so happy when they got their jobs, because I know how safe it is. Everyone wants their children to work somewhere safe. I know that they have safe jobs, and they are good jobs.

Mr. Corey Tochor: Great.

There are some who would want to transition oil and gas workers to different opportunities. Would the pay be similar, or less than in the oil and gas sector, if you were working in nuclear? Or would it be above average or comparable?

Mr. Robert Walker: I don't have the details, but off the top of my head they're probably very comparable. Skilled trades, whether in Alberta, Saskatchewan, or Ontario, are paid very comparably.

A skilled worker in the oil and gas sector in Alberta or Saskatchewan is probably paid very close to that of a tradesperson working in nuclear in Ontario or New Brunswick.

● (2100)

Mr. Corey Tochor: Some believe we need a $15 minimum wage in the country, and some would argue that it's already there. Do you have any members who start at minimum wage, by chance?

Mr. Robert Walker: No.

This is a huge industry, with people having all different types of jobs. The lowest paid occupations that I'm aware of would be the cafeteria workers at the nuclear power plants, and they make more than that.

Mr. Corey Tochor: With regard to the makeup of the workforce, what percentage is male versus female? I'm assuming it would be large. Is the vast majority male, or is it more of an even mix?

Mr. Robert Walker: If you had asked me that question when I first started, I would have said that the vast majority were males. That's changing. It has been changing for a long time and continues to change.

We're seeing a lot of women in engineering, in STEM occupations, in civil-type jobs, and we've seen a lot of women in the nuclear operator positions.

Where we're really behind is in the trades. We're not seeing as many women in the mechanical and electrical trades as we'd like to see, but there's a lot of work going on to try to improve that. I've gone out myself and brought tradespeople with me to schools to talk to people about what these jobs really look like. People think these are dirty jobs, but they're not.

If you saw a skilled tradesperson at work, you wouldn't know what they were doing. It's a high-tech job; it's a high-skilled job and a very rewarding job. When we take young women in the trades out to talk to women in schools about their occupation, they get excited about it and they're interested in it, so we need to do more of that.

Mr. Corey Tochor: Quickly, do you keep track of turnover rates? What's the typical lifespan of an employee at a facility?

Mr. Robert Walker: I've known a couple of people who have moved a long distance to start jobs like those at Ontario Power Generation, for example. Sometimes at the very beginning of their career, they leave because they want to go home. Other than that, I'm not aware of anybody leaving. These are jobs that people want to hold onto.

Mr. Corey Tochor: Quickly, could I get a written response from Dr. Root about the importance of medical isotopes to our hospitals across Canada?

I believe I'm out of time right now.

The Chair: Yes, Mr. Tochor, I'm sorry, but thank you for the questions.

Now we're going to go to Mr. McKinnon for six minutes.

Mr. Ron McKinnon: Thank you, Chair.

I'm going to direct my questions to Dr. Rayner.

We've heard a lot of concern from the public, both here and out in the world, about nuclear power. People's minds typically go to things like Three Mile Island, Chernobyl, or Fukushima. I think when we're talking about small nuclear reactors, small modular reactors, and those that are even smaller, such as micro and very small, we're dealing with quite a dissimilar kind of situation, and I suspect that the risks are rather dissimilar as well.

Can you speak to us, if you're able to, about the nature of risks, the nature of the potential for environmental catastrophe such as with Three Mile Island or Chernobyl, in relation to small modular reactors and similar smaller units?

Dr. Jeremy Rayner: Certainly. I think you are, of course, correct that in terms of the amounts of fissionable materials and the amounts of radioactivity that might be released and so forth as the result of an accident from a small reactor, the advocates of small reactors are quite correct that they are very different from what we would see with a very large reactor.

What I think we have to consider with small reactors, as I mentioned in my remarks, is that we have, for the reasons we talked about already, we tend to build large reactors away from people. We tend to build large reactors if we can't build them a long way away from people, with very large exclusion zones to protect people from the consequences of an accident.

If small modular reactors are to fulfill their promise for the various applications that are being proposed for them, they will have to be very close to people.

I'd like to ask the members of the committee here to consider a thought experiment. I walked to the meeting this evening through the massive construction that's going on everywhere, as you do, I'm sure, every day. I walked past a shipping container that was humming slightly. I imagine it had some air conditioning in it or something of that kind, and I thought nothing of it. Imagine if that was a small nuclear reactor of the kind we heard described in the last session that would fit in a shipping container and that it was on an Ottawa street, as some proponents of small reactors have proposed, and propose, I think, in very interesting ways. I think there are things that SMRs can do for us that big reactors can't do.

There, I think, we would have to consider very carefully not just the objective risk of what's in there and what would happen if there was an accident but also the subjective perceptions of people who would be asked to walk backwards and forwards around that every day.

● (2105)

Mr. Ron McKinnon: As you heard, the person from Westinghouse spoke of a microreactor that comprises three storage containers. Is that where we're heading, or might they be even smaller with, say, microreactors going down the road that we could use on ships, trains and so forth?

Dr. Jeremy Rayner: Again, one of the very interesting things about SMRs, which I'm sure this committee has gone into in some detail, is the huge range of applications, from pushing the envelope of an SMR with over 300 megawatts to put on the grid and putting it on a site that's already licensed for nuclear and so on, down to those that are very small. In those, for example, we might deal with some of the very energy-intensive needs of future urban development by having SMRs in that urban development as new SMRs, as the development grows.

If we're going to power electric cars and have connectivity on the scale that advocates are talking about, we'll need electricity, and we'll need lots of it.

I think what's really interesting about SMRs is not that they can replace large nuclear or large baseload power capacity, but that they can find all sorts of different kinds of applications. Those different applications, I think, ought to cause us to ask hard questions about risk and risk perception.

Mr. Ron McKinnon: Excellent. Thank you, Doctor.

I know we're going to be short of time tonight, so I'm going to defer the rest of my time back to the committee.

The Chair: That's very generous of you, Mr. McKinnon. Thank you for that.

We will go to Monsieur Blanchette-Joncas.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Madam Chair.

I welcome the witnesses joining us for the third hour of our meeting.

My first questions are for Mr. Rayner.

Mr. Rayner, I noted that you're currently conducting a comparative study on the development and implementation of small modular reactors in Canada and the United Kingdom. Can you tell us more about your findings?

[*English*]

Dr. Jeremy Rayner: Certainly. Thank you for the question.

The U.K. and much of the rest of Europe are also interested in SMRs, and for the same reason as Canada. They have mature nuclear industries, they have a great deal of expertise and they had very little prospect, until recently, of very large new nuclear builds. SMRs were an obvious way of keeping that scientific expertise active and alive, and recruiting new people into it. It fits that innovation agenda and the science establishment agenda.

However, as people began to investigate what SMRs could do, people have become genuinely interested, as I said, in these different applications from power grid-level SMRs. We see, for example, in Finland, interest like there is in Canada, for northern and remote applications of very small reactors. We see it in France, which began, in fact, by being very opposed to the idea of SMRs and stuck with the large reactors they have. Again, there's an interest in SMRs because of the different things they can do.

I think there are many reasons why people in Europe are interested in SMRs.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Rayner.

Suppose Canada chooses to pursue the development of small modular reactors. In your view, what changes should be made to the legislative framework around them and, more specifically, to the governance of their radioactive waste?

● (2110)

[*English*]

Dr. Jeremy Rayner: Yes, the nuclear waste question is a very interesting one, because as we know...until now, we have stored nuclear waste on site. When you have relatively few relatively large reactors, that is a solution for a long time. The question then of how we will deal with the waste that is dispersed across a wide variety of smaller sites is problematic.

We heard Westinghouse talk about just removing its modules and taking them back, but they still have to dispose of what's in there. Moving that waste to.... Let's assume that in Canada we are successful, as I hope we are, in having a deep geological repository for waste, moving the waste there is going to raise some very interesting covenants and policy questions, not least the indigenous questions that I mentioned, and not least the fact that New Brunswick waste would have to travel across Quebec in order to get to the repository in Ontario.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Rayner.

In your opinion, is Canada currently doing enough to protect its citizens from the dangers of nuclear waste, and how does it compare with similar countries?

[*English*]

Dr. Jeremy Rayner: I think we have a reasonable record in terms of protection. Again, the Canadian Nuclear Safety Commission has worked on this. I myself have done some work on the dangers of low levels of radiation, and policy and regulation around that are quite strong.

Remember, of course, that radiation does not just come from nuclear power or the waste from nuclear power. It is experienced every day by technicians who are doing medical treatments, by people working in dentists' offices and so forth, and we have, I think, a well-developed regulatory scheme here. What we have to do, I think, is not give way to the suggestion that the need for speed in the deployment of SMRs should allow us to relax or change the regulatory framework.

In my mind, that's the danger. It's not the danger that what we have is not enough. The danger is that we may be tempted to reduce the protections we currently have.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Rayner.

I would like to know what you think of the arguments in favour of small modular reactors, specifically the economic model. By simplifying their design and standardizing their components, they could be mass-produced. That would make it possible to achieve economies of scale.

Do you know how many small modular reactors it would take to achieve economies of scale and get a return on initial development costs? I know that several other countries, such as the United States and Russia, will want to develop this technology and sell it abroad. It's going to be difficult for Canada, whose diplomatic strength might not be enough to win against highly competitive countries.

[*English*]

Dr. Jeremy Rayner: That's a very important question and, you know, I'm neither an economist nor do I have access to the information that companies have about costs. In fact, they don't even have very strong information right now until they build one.

The Chair: Might I interrupt and make a suggestion, Monsieur Blanchette-Joncas? Since that's the end of your time, would you like Professor Rayner to give you a written answer?

[*Translation*]

Mr. Maxime Blanchette-Joncas: Yes. Thank you very much.

[*English*]

The Chair: Okay, thank you, Professor Rayner.

Thank you to you both.

We will now go to Mr. Cannings for six minutes.

The floor is yours.

Mr. Richard Cannings: Thank you to all of the witnesses.

I'd like to continue with Dr. Rayner just to follow up on his comments on the need for good public engagement, in particular around the free, prior and informed consent that you mentioned with first nations.

We have a situation, for instance, at Chalk River, where the Kebaowek first nation is.... I don't want to speak for them, but they clearly seem very, very concerned about what's going on at Chalk River without their consent. They want a complete, new review of how nuclear waste is dealt with in Canada. They have really made the point that they have not been adequately involved in the past nor in the present in this. We have the first nations Chiefs of Ontario coming out with a very strong statement against the use of this narrative of using SMRs on remote first nations communities as one of the first uses of this technology.

I was interested to hear your comments that we shouldn't rush into this. I keep thinking of how a lot of our previous energy policies were rushed and then delayed because of the lack of proper consultation with first nations in particular. In that rush to get pipelines built, etc., we ended up having them delayed because the courts got involved, and it was found that consultation hadn't occurred properly.

Could you follow up on as to whether we're kind of rushing into this and not putting a good foot forward in the SMR field with regards to first nations especially?

● (2115)

Dr. Jeremy Rayner: Thank you.

Those are very important questions, but I'd like to distinguish between those kinds of questions with respect to first nations that arise because of previous developments. There are legacies of poor engagement. On Chalk River, I'm afraid that I don't know enough to say whether that's the case.

We have to remember that in the past, of course—and this is the case in northern Saskatchewan—uranium mining was undertaken very quickly as a matter of national security in the 1940s and 1950s, and it took a very long time for that legacy to be overcome, but I have to say that Cameco is a world leader in indigenous engagement, and it shows that it is in fact possible to remedy the mistakes of the past and to regain trust from indigenous people.

New projects with SMRs I think are interesting. Some of the work we've done that has been funded by the Fedoruk centre has suggested actually some very significant interest from indigenous people in terms of the energy poverty and energy insecurity that many of those indigenous nations encounter on a daily basis, but they wish to understand more about the technology first. They wish to know exactly what they're getting themselves into and they wish to know, as you say, answers to questions like what's going to happen to this material when it's spent and what's going to happen to the installation if it has to be taken away and so on.

Those are questions that people are attempting to answer, but (a) we shouldn't take our eye off the ball here, and, second, I do think that this is a really important role for the federal government in Canada: to try to make sure that those consultations happen and that appropriate consent is asked for and given.

Mr. Richard Cannings: Thank you.

I'm just wondering, while I've got you here, if you could comment more generally on how you think Canada has done with public engagement and transparency in the nuclear power sphere, especially with moving forward on waste management, because I hear very regularly from citizens and citizen groups that feel that we're not doing a good job. We just heard from a previous witness that we have a whole waste management system being overseen by the industry, not by an independent organization.

Dr. Jeremy Rayner: Yes, waste management is very interesting in that respect. We tried once to do this and did it very poorly and had to start all over again, but when we did start all over again, I actually think that in Canada—especially compared with other countries with which I'm familiar—we've done a very reasonable job.

I think you have to understand that the opponents of nuclear power, whatever else they may think, regard holding up the disposal of nuclear waste as a really important way of putting a damper on the development of the industry, and they will continue to make those sorts of claims even if they're not in fact justified.

● (2120)

Mr. Richard Cannings: Thank you.

How much time do I have, Madam Chair?

The Chair: I'm afraid that's it, Mr. Cannings. It was right on time.

Mr. Richard Cannings: Thank you.

The Chair: Thank you, Mr. Cannings.

Thank you to all our witnesses.

Now we're going to our five-minute round, and we'll go to Mr. Soroka.

Mr. Gerald Soroka: Thank you, Madam Chair.

Witnesses, thank you for coming this evening.

I'll start with Dr. Walker.

As was stated in the April 2022 newsletter of the Canadian Nuclear Workers' Council, “The exclusion of nuclear [power] in the Government of Canada's [recent] Green Bond Framework was extremely disappointing.” Can you please expand on the faults found in this framework?

Mr. Robert Walker: Thank you for the question.

I wrote that myself, so I can speak to it. I was most disappointed just because of the way it was portrayed. I've worked in the nuclear industry my entire life. My father worked in nuclear and, as I said earlier, my son works in nuclear. To take our jobs in nuclear and compare them to gambling, tobacco and the typical sin taxes.... Just the way it was done was very upsetting. I know that the future of the industry will be better if it's easier to access financing, and this will put a damper on that, but the big thing for me was just the way it was done.

Mr. Gerald Soroka: Also, Dr. Walker, it was outlined in the Canadian Nuclear Workers' Council that a multinational research effort is under way to recycle nuclear fuel in CANDU's nuclear technology.

Can you please inform us of some of the most promising updates in this process?

Mr. Robert Walker: Thanks for the question. I really don't feel qualified to answer that question. I need to say one thing. I am not a doctor. My background actually is as a nuclear operator, so I don't feel qualified doing it.

I know there is a lot of work going on. We've heard some discussions already from companies, like Moltex Energy, on what they're doing, and I've talked to companies like Terrestrial Energy.

There's a lot of work going on regarding recycling used CANDU fuel, but I don't know any more than what we've already heard here about where that's headed. Sorry.

Mr. Gerald Soroka: That's okay.

I'll go to Dr. Rayner, please, who's in the room here.

You've also stated that a critical issue of public confidence in small nuclear reactors.... Do you know of some of the regulations this government has in place to address this concern? How do you think we can propose to improve public confidence in SMRs?

Dr. Jeremy Rayner: The first piece that we have in place is an arm's-length regulator. I think that's very important and we should not do anything to jeopardize the independence of that arm's-length regulator.

The CNSC has been involved since 2014 with the International Atomic Energy Agency's SMR working group working through issues around regulation.

My concern with CNSC is they quite rightly don't see it as their role to take part in that process of engagement on behalf of a design or a use or whatever it may be, so we have to ask where the engagement is going to come from that will at least hear, if not address, the concerns that the public may have. I think it's unfortunate that the battle over the Canadian Environmental Assessment Act and its subsequent amendments has raged in the way that it has, because it has tended to take a very narrow definition of evidence that is to be taken into account in an assessment.

If we don't want to reopen that question, it would help if we had some other kind of forum that could discuss that kind of question. Something we discovered in Saskatchewan when we tried to do this with the uranium development committee, again, was this need people have for information they can trust and someone who will answer their questions.

● (2125)

Mr. Gerald Soroka: Yes, it's very important to make sure you can trust the information you have.

Also, you've talked about indigenous engagement, making sure it's very early in the process and how essential it is. What recommendations do you have to advance SMR development in Canada while considering the interests of indigenous and the other vulnerable marginalized communities in Canada?

The Chair: Mr. Soroka, since the time is up, would you like to ask Professor Rayner for a written answer?

Mr. Gerald Soroka: If he could, would he please provide a written answer to that.

The Chair: Thank you so much, Mr. Soroka.

Now we will go to Mr. Collins.

Mr. Chad Collins: Thanks, Madam Chair.

I have the same question for both Dr. Rayner and Dr. Root, if I could, about the whole issue of public engagement that has been talked about already. As a long-time municipal councillor, I had many meetings related to energy from waste, and when the proponent came to town, there was a crowd that attended the meeting, almost a pitchfork and torches crowd that would come out with a high degree of skepticism as it relates to the technology that was being proposed and the impacts it would have on the community when operational.

I listened with interest, Dr. Rayner, to your comments on public confidence. I wonder what your suggestion is or your recommendations are related to the federal government's role in education as well as public engagement. You touched on that extensively on the indigenous side of things, but in terms of your comment that, if transformational, these SMRs need to be built closer to where people live and work, I picture it in my riding.... A prior witness referenced that it's ideal for the steel community, and I'm from Hamilton, so I thought if someone came to town to propose this in my riding, I could guess what the reaction would be from neighbourhoods around the steel company, which already put up environmental nuisances and worse.

Can I get your comment on what role we play in taking that obligation away from the company and the proponent—who's profit-driven—in the face of that level of skepticism from the community, and put some of that onus on us to assist in that process? If these benefits are what people are advertising, we want to see them for various reasons, but when they make their way to communities across Canada, I fear there will be great public push-back.

Sorry for that long question, but I would ask you and Dr. Root to assist with that.

Dr. Jeremy Rayner: Yes, I would quickly give two answers to that.

The first is that I don't think you can get away from having some kind of broad, open engagement, whatever it may be. I started out as a young researcher in forest policy at the time of clear-cutting controversies—as you can probably tell, that was a very long time ago—and at that time, they used to call those public meetings "the last of the blood sports" and we have to get away from that. I think it should be possible, for example, to engage academic researchers, engage universities, engage others who have professional experience in public engagement to do more detailed, more small group.... We've worked with the Fedoruk centre developing citizen jury processes for testing out ideas about different kinds of energy, and they've been, I think, very successful. They're time-consuming, they're expensive, but I think we have to think outside the box about how we'll do that kind of engagement.

Mr. Chad Collins: Dr. Root.

Dr. John Root: The Fedoruk centre has been supporting research on how to do this, how to engage the public in a respectful conversation, and there are a couple of ways to try to do this. We have lots of people in Saskatchewan doing nuclear things—it could be nuclear medicine, materials research, energy policy—and we're trying to make sure, first of all, that we have intelligent people who think about nuclear things and are proud of what they have done and tell their story and familiarize the community, or give opportunities for the community to be familiarized with nuclear just as an adjective, not as an emotional touchpoint.

We've also run, as Jeremy was saying, events that are available to the public to participate with in the form of a talk show. We bring some experts to the front, and they don't actually do a whole lot of talking, but they have a conversation with the audience. It just flows along with the questions in a certain subject. It could be radiation and the environment on one, or another one might be what we do about nuclear waste or something like that. That becomes a human conversation and a respectful conversation, and we haven't seen too much of the pitchforks and torches in that kind of venue. We have also had opportunities to be in the media. When the SMR announcements come out, people want to know what we are, and some examples are talk shows, where we have different points of view—

● (2130)

The Chair: Dr. Root, I apologize for interrupting.

Thank you for your—

Dr. John Root: Can I just—

The Chair: Perhaps Mr. Collins might like a written answer.

Mr. Chad Collins: That would be great, please.

The Chair: Thank you.

In the interest of fairness to all the people who support this committee, all our members and all the witnesses who have been so gracious, I'm going to give Mr. Blanchette-Joncas and Mr. Cannings each a question and then we will finish for the night.

Mr. Blanchette-Joncas.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you very much, Madam Chair.

I'll address Mr. Rayner.

Dr. Rayner, I know you have expertise in nuclear policy. I'd like to hear from you about the Seaborn Commission's unanimous recommendation. It called for creating a nuclear waste management and decommissioning agency, independent from industry and organizations that promote the industry.

[*English*]

Dr. Jeremy Rayner: That's a difficult question. The argument against it is, why should public funds be put to help out the industry? Why doesn't the industry step up and do this? That's what they're doing.

The disadvantage, of course, is that they are not perceived as fair and impartial. We have got some way with the current arrangement. I would not be opposed to revisiting those recommendations and constituting a waste management organization in a different way.

The Chair: Thank you, Professor Rayner.

Thank you, Mr. Blanchette-Joncas.

The last question of the evening will go to Mr. Cannings.

Mr. Richard Cannings: Thank you.

I'd like to direct this to Bob Walker.

Hi, Bob. It's good to see you again.

I have questions about training. A lot of the remote communities I've talked to about SMRs want to have the jobs associated with their energy projects around their communities. What sort of training will operators need to operate SMRs? Is this something that people in remote communities can be trained quickly to do?

How many jobs will there be at an SMR after construction?

Mr. Robert Walker: For the jobs numbers, I wouldn't have a number. It depends on which technology we're talking about. I've heard numbers for the grid-scale SMRs in the 150 range. Construction jobs would be a lot more than that.

When it comes to training, I started my career in Uranium City, Saskatchewan. Eldorado Nuclear shut the mine down. I had to be retrained, so I went to community college in La Ronge, Saskatchewan, where I was trained to work at the new uranium mine at Key Lake. That retraining can happen locally. It happened decades ago with me and that can happen again.

For a nuclear operator, it's going to depend on the technology. The training program for our large reactors is fairly long. Theoretically, they would take people from high school, but usually they take people from college programs and sometimes from university programs. It's a couple of years of training.

● (2135)

The Chair: Thank you, Mr. Walker, and thank you, Mr. Cannings.

I want to thank all our witnesses for sharing with us. It's late at night and you've been so gracious with your time.

I want to thank the excellent members of this committee and everyone who works so hard to support this committee.

We are adjourned.