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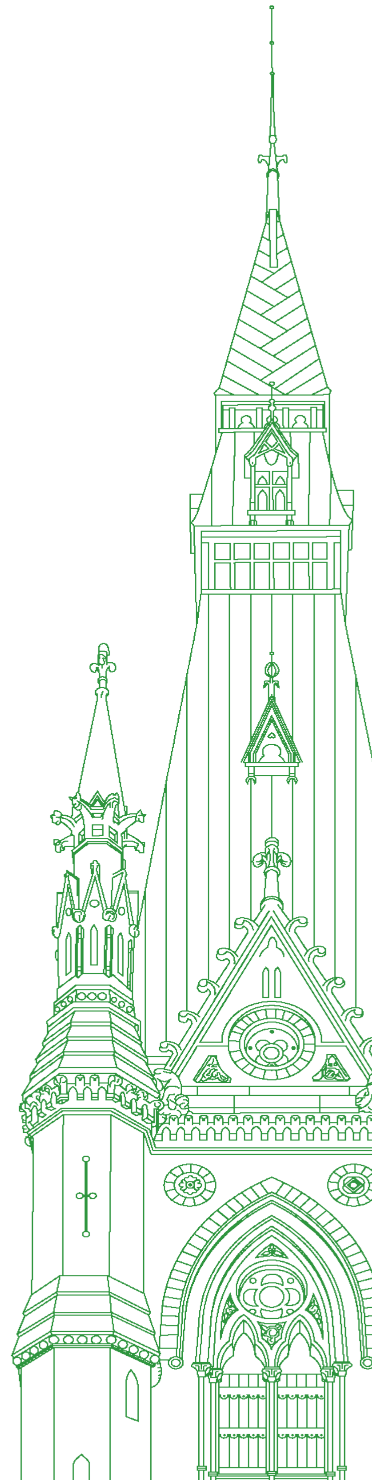

Chair: The Honourable Kirsty Duncan

Standing Committee on Science and Research

Thursday, June 16, 2022

● (1830)

[*English*]

The Chair (Hon. Kirsty Duncan (Etobicoke North, Lib.)): Welcome, everyone. Good evening.

I'd like to begin by welcoming our witnesses to our committee. We're delighted to have you.

[*Translation*]

Welcome to meeting number 16 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.

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 places during proceedings.

Please contact our excellent clerk for further information on preventive measures for health and safety. As the chair, I will enforce these measures and, as always, I thank our excellent colleagues for their help.

[*Translation*]

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

[*English*]

There are 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 the screen you may choose to hear 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 and we will maintain a speaking order.

Colleagues, we are delighted to have our first panel tonight.

We have, as an individual, Professor David Novog. From McMaster University, we have Dave Tucker, who is the assistant vice president for nuclear research. Welcome to you both.

From Ontario Power Generation we are really pleased that Ken Hartwick, who is the president and chief executive officer, can join us.

We'd like to welcome you all. We hope you have a good experience today. You have an interested committee.

Each of you will have five minutes to speak. At four and a half minutes, I will hold up a yellow card. It lets you know you have 30 seconds to wrap up.

With that, we will begin with Professor Novog.

The floor is yours for five minutes.

Dr. David Novog (Professor, As an Individual): Good afternoon, distinguished Chair.

I want to thank the committee for inviting me here today to speak. It is my honour to do so.

I want to take the opportunity to also thank the clerk and the staff for their support in getting me here.

As background, I'm a professor in nuclear engineering, and I lead a multi-university, multi-million dollar small modular reactor training program. As part of my tenure at McMaster, I have taken students to the very top-performing nuclear reactors in the world, and I've taken them to the Chernobyl and Fukushima sites as well. It's all in an effort to improve their understanding of the technical and social implications of their work and their research.

I have presented on the topic of climate change at many international events and for all levels of audiences. Until recently, many of these talks focused on the almost insurmountable challenges that climate represents to our society. Some economic forecasts predict that because of climate deterioration, the quality of life of today's kids will be less than that which we enjoy.

I would like to provide a quote from James Lovelock, the famed inventor of Gaia theory, which describes the relationship of humans with the planet. He's also a member of the Most Excellent Order of the British Empire, and he is 102 years old. He said recently, “I would say the biosphere and I are both in the last 1% [of] our lives.” One of the most pre-eminent inventors and scientists of our time does not like our chances and, for many years, I agreed.

In recent years, though, I have changed. I have rediscovered that my job as a professor is to be inspiring, to elevate students to learn, and to help them succeed in meeting these kinds of challenges. The objective has been to convince them to not give up, that we have hope and that there is a solution—to stop the paralysis that can occur when a problem seems too difficult to solve.

Today, I truly believe there is a solution.

It is a solution that has been proven to cut CO2 while improving GDP. An excellent example is a nuclear energy-based solution in France during the 1970s, which showed that a country can reduce its greenhouse gas emissions by over 50% and simultaneously increase its GDP by 50%. Such a solution, combined with hydro and new technologies like wind, solar and electric vehicles, is a portfolio that can absolutely meet the challenges posed by the climate today.

In Canada we can be leaders, because it is a technology well suited to our geography and our expertise. Small modular reactors can aid in electricity generation, but they can also be an enabling technology to allow remote communities the opportunity for agriculture, desalination, education and quality-of-life improvements that do not exist today.

Counter to this are public concerns related to waste, safety and the economics of small modular reactors. These ongoing concerns highlight the need for a robust national dialogue on nuclear energy. Such a campaign should not only provide the public with a fact-based analysis, but also assess the impacts of not acting on this climate-friendly energy solution.

This campaign could also address the fundamental needs for human talent by expanding the opportunities for training and development of young people. For example, this week at McMaster, we hosted a small group of young graduate students for hands-on training on our reactor. This was funded by NSERC as part of a training program that I run on SMRs.

I am frequently asked, however, by other universities and other young people throughout Canada, why they are not included in this program. The simple answer is that even with the $2.5 million of funding I have in this program, I can dedicate that to only a relatively small cohort of people who can participate. Thus, to establish a robust SMR university environment, a coordinated and sustained program is needed beyond our existing funding opportunities.

In closing, there is no magic technology that will provide us with relief from the climate problem, but that does not mean we are hopeless. There are solutions to climate issues, and elements have already been proven at the scale that we need. By expanding the investments necessary in the technologies and in the universities to help deliver the human capacity for these projects, I think we can have hope.

● (1835)

The Chair: Thank you so much, Professor Novog. We really appreciate your being here.

We will now go to Dave Tucker, who is assistant vice-president at McMaster University.

Mr. Dave Tucker (Assistant Vice-President, Nuclear Research, McMaster University): Thank you, Madam Chair.

Good evening and thank you all so much for the invitation. It's an honour to appear here.

McMaster is Canada's nuclear university. It's home to the McMaster nuclear reactor, which is the largest research reactor in the country. Our reactor is not a small modular reactor—our output is not energy; it's neutrons for research and isotope production—but it's similar in size to small SMRs and has been a central part of our campus for over 60 years.

The McMaster nuclear reactor supplies 60% of the world's iodine-125, a medical isotope used to treat prostate and other cancers. Every year we produce enough to treat more than 70,000 patients around the world.

This five-megawatt research reactor is the only research reactor in the world that does not rely on government funding to operate. It operates on a self-sustaining, cost-recovery basis through commercial operations, and serves as a key economic driver, supporting industry and resulting in multiple spinoff biopharmaceutical companies.

These unique strengths, coupled with the co-location of other cutting-edge nuclear research facilities, make McMaster extremely well equipped to be a partner in the deployment of SMRs. It's with that in mind that McMaster was pleased to contribute a chapter to the government's SMR action plan, which noted that we would be exploring the potential of hosting an SMR on or near our campus. This would represent the very first community demonstration deployment of an SMR in Canada.

Just a few weeks ago, McMaster announced that we would be taking the next steps to scope this potential development in partnership with Global First Power and the Ultra Safe Nuclear corporation. This would involve a micro modular reactor—a very small SMR—as the heart of an integrated community energy and harvesting system.

As this committee well knows, significant hurdles lie ahead of us as Canada seeks to realize the promise of secure, clean, reliable and flexibly deployed power through SMRs. Pressing issues include research and development needs, as well as workforce capacity building.

On the R and D front, McMaster has unique facilities capable of testing materials under irradiation and at high temperatures, as well as providing support in the manufacturing of items with novel materials. We're working with SMR vendors such as Westinghouse on getting our facilities and experts to work on development areas, including material testing, fuel development, safety analysis and waste disposal relevant to SMR deployment. In fact, we're currently seeking federal support for increased availability of neutrons for neutron beam research and irradiations that will further enhance our ability to support SMR development.

As an academic institution whose primary mission includes the education of the next generation of scientific talent and professionals, we of course host nuclear training programs and have developed curricula to ensure that Canada has the necessary expertise. For example, McMaster is home to the nuclear education, skills and technology initiative, which is part of the OECD's Nuclear Energy Agency and which teaches practical skills related to SMR development and management. We also deliver the small modular advanced reactor training program—the SMART CREATE program.

This sort of training and skills development will become even more critical as Canada not only successfully develops and deploys SMRs, but also operates and maintains them long term. We need to do more and we need to move more quickly across Canada to enable SMRs to play their vital role in achieving net zero by 2050.

To that end, I want to take a moment to mention that we have been pleased to see the focus that governments at all levels have been putting on SMR development to date. These actions demonstrate a clear commitment by governments to developing SMRs. They are to be commended, but as we look to deliver on the promise of this technology, McMaster proposes that next steps should involve efforts to leverage existing nuclear assets, such as the McMaster nuclear reactor, more effectively.

A comprehensive research and development plan that bridges government facilities with private and institutional laboratories, utilities, vendors, suppliers and academia should be put in place to facilitate the coordinated efforts needed to achieve these objectives. Similarly, it's essential that we begin now on a pan-Canadian strategy to begin building the workforce of tomorrow, which will deploy, operate, maintain and regulate the SMRs of the future and their associated infrastructure and clean energy systems. It's important that these be pan-Canadian efforts and that they be funded to ensure that national efforts yield national results.

● (1840)

With that, I thank you very much for your attention, and I look forward to answering your questions.

The Chair: Thank you very much, Mr. Tucker. We're pleased to hear from you tonight.

We will now go to Ken Hartwick from Ontario Power Generation. He's the president and chief executive officer.

Welcome. You have five minutes.

Mr. Ken Hartwick (President and Chief Executive Officer, Ontario Power Generation Inc.): Thank you, Madam Chair.

Good evening. Thank you for the invitation to participate in this important conversation around small modular reactors.

As mentioned, I'm the CEO of Ontario Power Generation, one of the largest clean-energy generators in North America. We have a very diverse portfolio of assets that include hydro, nuclear, solar, biomass and natural gas, spanning Ontario and certain parts of the United States.

All of OPG's generating units and facilities are located on indigenous traditional or treaty lands. For example, our Darlington small nuclear reactor is located on the shared traditional treaty territory of the Chippewa and Mississauga Anishinabe, collectively known as the Williams Treaties First Nations. OPG has committed to working further with indigenous communities and stakeholders in order to incorporate indigenous and traditional knowledge into the project, further understand the potential impacts of the project, and strengthen assessment and decision-making.

In April 2014, OPG burned its last piece of coal to generate electricity in Ontario. The transition away from coal remains one of the largest actions to fight climate change in the world. Now, we are focused on becoming a net-zero company by 2040 and enabling a net-zero economy by 2050.

Our climate change plan outlines a range of initiatives, including our $13-billion Darlington nuclear refurbishment project—which remains on time and on budget—hydrogen development, hydroelectric upgrades and additional capacity, transportation electrification, and energy storage. It also includes SMRs, which are central to our efforts. In setting our goals, we intend to grow prosperity for Canadians, Ontarians and indigenous communities while delivering more clean energy. We believe that by doing this, we can provide a blueprint for others to follow and achieve similar goals across the energy sector.

OPG has also released our reconciliation action plan, which will guide our work with indigenous communities, businesses and organizations to advance reconciliation in a meaningful way.

This SMR study is being undertaken at a critical time for Canada and Canadians. The worsening climate crisis is now further impacted by geopolitical, economic and energy risks related to the Russian invasion of Ukraine. Climate change and energy security are interconnected and need to be addressed together.

Without doubling or even tripling our clean electricity supply, Canada will not be able to meet its climate change targets. Nuclear and small modular reactors are essential for meeting and addressing these climate and energy security needs. That is why OPG has been working with industry partners, including those at this table, to develop and deploy SMR technologies. There's a clear need for an energy transition in which multiple technologies enable various regions to meet their common goals.

I like to call this the "all hands on deck" approach. Let me give you an example. I think we've all heard the saying, "The wind doesn't always blow and the sun doesn't always shine." That's why we need baseload power from nuclear or hydro.

However, let's understand this a bit further. Some people will say, "Well, let's just build more wind and solar, distribute it and add battery storage. It will all work out fine." The analysis we did for Ontario suggests that the need for baseload generation is required and will allow for a more efficient and cost-effective system for ratepayers, taxpayers and, ultimately, the climate. Our analysis recognizes that all forms of technology will be required in order to optimize carbon reductions and costs for all involved.

This Ontario analysis shows that the lowest-cost option with maximum carbon reduction is a mix of these various tools: renewables, nuclear, and even a little gas during peak capacity a few times a year. We aren't the only ones who have concluded this. Worldwide, the countries we talk to, such as the United States, France, the United Kingdom and Poland, have also explicitly identified nuclear and SMRs as being critical to their energy and climate needs. I'm sure more countries will follow.

Let me get to what the key takeaways from this need to be.

First, Canada can do this, and in Ontario we are doing this. The most cost-effective path to net zero is a mix of different technologies, somewhat dependent on province and location. More nuclear is required in at least some provinces, and SMRs are a good fit for several provinces.

● (1845)

Nuclear power has been demonstrated to be good for the economy. Building this new nuclear will bring tens of thousands of jobs and billions in electricity benefits. Canada can lead the SMR enablement across the world, and we need to start now and move faster than those around us. With this, we would need federal support, such as what we've had to date, to enable nuclear to accelerate as part of the clean energy economy.

The Chair: Thank you, Mr. Hartwick.

To all of you, again, welcome and thank you.

We're now going to hear from our members. You have a really interested group of people here.

We're going to begin with our six-minute round. Tonight, we begin with Mr. Tochor.

Mr. Corey Tochor (Saskatoon—University, CPC): Thank you for being here tonight.

I'm going to start with Mr. Hartwick. It sounds like the company has looked at the business side of things and come to the conclusion that nuclear has to be part of the mix. I want to unpack that a bit. What were some of the analyses? You said that the cheapest one that is going to lower emissions is nuclear. What would be the second one?

Mr. Ken Hartwick: We looked at the Ontario system, and in order to hit the climate targets, you need to at least double the size of it, so I don't think there's one technology. We think nuclear is relevant, new hydro is relevant, and solar and wind are relevant—assuming gas has played its role and will not be that big for Ontario. You really need them all if you're going to double the size. I would say probably hydro would be next, solar would be next, and wind doesn't really work in Ontario that well, so it is a distant fourth.

Mr. Corey Tochor: When you say doubling, is it because of some of the new uses or increased use for EVs and other sources?

Mr. Ken Hartwick: I'd say there are three main sectors: the transportation sector, which is buses, heavy trucks and cars; heavy manufacturing, so steel mills, which I think, too, have announced they're going to convert to electric arc furnaces; and then the building sector, so the decarbonization of our buildings. For those three sectors, if you start to do the math on trying to hit our climate goals that we've set out as a country, the system will need to be at least double as those sectors transition to electricity as their primary energy source.

● (1850)

Mr. Corey Tochor: On the building side, would that be to heat and cool residential and office buildings?

Mr. Ken Hartwick: Yes, that is correct.

Mr. Corey Tochor: I'd just like you to unpack a little more about the flexibility, and how you can have an SMR that you can plop down into the area of your province or part of the country where you need it to be. It's a little different from hydro, where we have to be gifted with being near a great part of our country that would have water running and enough of a drop that it would make sense to dam that river. There are limited spots like that left, I've been told. Can you tell us a bit more about how SMRs fit in, being as flexible as they are?

Mr. Ken Hartwick: I think there are two parts to the SMR technology. I'd call one a grid scale, which is what we are setting out to build at our Darlington site. They're about 300 megawatts in size, which, roughly speaking, would electrify 300,000 houses, give or take a few. We will ultimately put four of them at our Darlington nuclear site. The community is very used to nuclear in Clarington-Durham.

The second application, which was referenced a little earlier, was really the microreactors, and these are the smaller ones that you might put at a mine site or in a remote community, places where you need less load—they might be five or 10 megawatts relative to 300—and go from there.

The two different applications will move into two different spots.

Mr. Corey Tochor: On the support from the federal government, outside of direct money, what would be an ask of the federal government that would help get more SMRs out the door?

Mr. Ken Hartwick: There are three items. The first is continued support of our regulatory environment. The Canadian Nuclear Safety Commission is our regulator, which the government gave funding to in the last budget, so continued support is important.

The second is the environmental impact assessment process, which will need to be continually examined and streamlined in order for communities to go through it on a timely but fair basis.

On the financial side, I think the support has been set out in the budget, largely with the Canada Infrastructure Bank and other mechanisms to support the nuclear industry. That's a good starting point. As more provinces join this, it will need to be expanded.

Mr. Corey Tochor: If you wanted to increase the nuclear footprint in Ontario with, say, a $100-billion expansion into nuclear, how much incentive would you need, if any, from the federal government to justify that?

Mr. Ken Hartwick: That sounds like an interesting ask, Madam Chair.

To me it is less about the direct support and more about the process around it, like the environmental assessment process and working with indigenous communities' support to accommodate them and to build it. Like I say, at OPG, for the site we are going to build, we will fund that ourselves, with the support really being around the other elements of it versus needing direct government support. That can vary by province. The other nuclear provinces—Saskatchewan, New Brunswick and Alberta—are looking at it. I think the funding requirements will vary depending on how mature their nuclear program is. Ours is very mature.

Mr. Corey Tochor: If we have a design that we're going to go with, say, in Saskatchewan's example, with the same design that was approved at Darlington, most of the time that it would take is more on the site selection and the consulting on the site selection. Once one is set, the regulatory framework around the design and the build should be less. Is that your—

Mr. Ken Hartwick: Correct. We will go first. We will have our first unit operational in late 2028 or early 2029. That's our target. Saskatchewan is probably two or three years behind that. They want to follow us and pick up our learnings, which I think is great, and they need to do work on site selection and the environmental process to get a qualified site to locate the reactor on.

The Chair: Mr. Tucker.

Mr. Ken Hartwick: I would say, from start to finish, 12 years.

The Chair: Mr. Hartwick, I'm sorry to interrupt.

Mr. Corey Tochor: I'll have another round later.

The Chair: Perfect. Thank you both for being so generous.

We will now go to Mr. McKinnon for six minutes, please.

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

I'm going to direct my questions to Mr. Tucker, I believe.

I want to delve into the underlying science here. Most of the reactors that I'm hearing about seem to be basically steam-driven processes. We're using novel materials, high pressures and so forth, based on novel materials and so on and so forth, but it seems to me that it's fundamentally the same technology we've had from the industrial age, except instead of cooking the tea kettle with coal or wood, or some other chemical process, we're using nuclear. It's still a tea kettle, though.

I'm wondering if there's any inkling of any other way of extracting the energy from nuclear fission other than.... Perhaps there's a non-thermodynamic kind of process. I wonder if you could help me out there.

● (1855)

Mr. Dave Tucker: I will start and then, if you don't mind, I will ask Dr. Novog to add in.

Fundamentally, generation of electricity through turbines is achieved by boiling water and making steam. That's true. Having a very clean, reliable, secure source of energy through SMRs to do that is an important transition for our energy sector. There are evolving usage and deployments of SMRs to capture that energy that's produced much more efficiently and effectively. One example of it is the ICE harvest system, the integrated community energy harvesting system, developed at McMaster in partnership with other universities. Our researchers are working now on modelling the evolving SMR designs to much more efficiently capture the waste heat and utilize that in building heating and cooling.

The future of SMR deployment is not only the energy generation of the future; it's also the energy utilization and harvesting of the future. My colleague, Dr. Novog, could probably elaborate on it, if that's acceptable.

Mr. Ron McKinnon: Dr. Novog, please, if you wish.

Dr. David Novog: I teach a course to 200 thermodynamics students, and you can't beat thermodynamics. I would say that some of the reactors, like the one Global First Power is proposing to develop in Canada, actually use a gas cooling system and an energy storage system that is really unique. We haven't had anything like that before whereby we can harvest the energy from the reactor, store it for times when there's peak, and then harvest the energy out. It may not be beating thermodynamics, but it is making sure that we're getting the energy on the timelines we need it.

Those are the exciting things that are happening in SMRs. That's what gets my students moving. They enjoy seeing new applications and changing the paradigm from just producing electricity to producing heat, storing heat, moving heat around, and then taking it out when you need it.

Mr. Ron McKinnon: I'll ask either of you if there is any inkling on the horizon of any other theoretical techniques for extracting the energy—something more direct, I'm thinking. I understand it's probably pie in the sky, but is there such a thing out there?

Dr. David Novog: I think the closest we would have are reactors that are gas cooled, or molten salt reactors that can drive very high temperatures and make use of a Brayton cycle, completely removing the steam and the kettle component out of it and using more of a gas turbine technology to get much higher efficiencies.

There have been prototype reactors like that in the past. I think some of those technologies to really move the bar in terms of efficiency are there. They're more advanced than the reactors we've built before.

Mr. Ron McKinnon: Do we need to be putting focus and energy—and money, frankly—into those more than we are now?

Dr. David Novog: You should never ask a professor that question.

I tried to allude to it in my notes. I think having a coordinated national program.... There are people who can add to this conversation who are used to running gas turbines, for example, in Alberta. There are people who are used to energy storage systems in British Columbia and on the east coast.

What I would advocate for is a national program that links the universities together. That could really distribute the knowledge effectively and move the research forward in an organized fashion.

● (1900)

Mr. Ron McKinnon: Okay, thank you.

I have 50 seconds left, so I'm going to throw this back to you, Doctor. I'm very interested in micro SMRs and the expanded opportunities they can be used for.

Is there some theoretical minimum size that we can foresee for reactors, so that we can expand that even further?

Please go ahead. We have 30 seconds.

Dr. David Novog: I will do it in 30 seconds.

When we look at a community's energy needs, not just for electricity but also for heating and the things you can do with that heat, the five-megawatt reactor size is really appropriate for a very wide range of communities, because they can make use of the heat for many processes. They can use the electricity when they need to, and they can store it when it's not needed.

This is kind of the typical smallest range, the two-megawatt to five-megawatt community-sized reactor.

Mr. Ron McKinnon: Thank you very much.

The Chair: Thank you to all of you for those answers.

[*Translation*]

Mr. Blanchette-Joncas, you have the floor for six minutes.

Mr. Maxime Blanchette-Joncas (Rimouski-Neigette—Témiscouata—Les Basques, BQ): Thank you very much, Madam Chair.

Welcome to the witnesses joining us this evening.

Dr. Novog, I've obviously heard about your project at McMaster University. To be profitable, the small modular reactors will have to be produced in large quantities in order to help offset the gargantuan investments that will have to be made to launch the design and production.

Based on the information available to you, how many of these micro reactors will need to be sold to achieve profitability?

[*English*]

Dr. David Novog: This is a very good question. On the premise of how many we need to build, I don't run my own business, so I don't know the profitability line, but, historically, when we start building six, eight or 10 reactors of the type we have at Darlington and so on, we certainly improve and learn as we go.

I would estimate that once we start reaching 10, 12 or 14, we will learn enough that we'll be able to do it effectively. We'll be able to move it into communities. That's one of the reasons McMaster, or the Darlington site, is really well suited for some of these early builds, because we already have the site. We already have the infrastructure and the radiation protection people, so we're really well posed to be a first deployment and solve some of those early issues that come up.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Dr. Novog.

According to your data, how many remote communities and mine developers in Canada are likely to be able to afford a modular micro reactor?

[*English*]

Dr. David Novog: This was addressed in the SMR road map, created and issued, I think, in 2018.

The number of sites is quite large—in the range of hundreds—and, when you look at the cost, the CO2 cost involved in providing diesel, flying it in or ice-roading it in or however the diesel has to get there, the footprint of the diesel energy being produced in these communities is really substantial. I think, when we look at not just solving this climate issue but also using it for water purification and for local agriculture, we can really do a lot of good.

[*Translation*]

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

How does the price per unit of energy of a small modular reactor, or SMR, compare with the price of mature renewable energy?

[*English*]

Dr. David Novog: I think the end goal is to make nuclear the lowest-cost option available, because that's what you need for baseload. Mr. Hartwick was mentioning that really what nuclear's needed for is baseload, because it provides a base of electricity at the lowest cost available while the other forms of electricity aren't in service.

When we look at the cost structure, certainly that's what the end goal has to be. Any plan we have to develop SMRs should have a clear target on the price of electricity that can set it up to be baseload generation.

[*Translation*]

Mr. Maxime Blanchette-Joncas: From what I understand, there is really no fixed price per unit of energy.

I'm trying to get my head around this. We're looking at this technology. The industry is asking for tens of millions of dollars in financial support. However, we don't have any evidence that this technology will be cost-effective, since we don't yet know the price per unit of energy.

In these circumstances, how should taxpayers and the government consider a new technology for which we do not necessarily have specific evidence?

● (1905)

[*English*]

Dr. David Novog: Actually, I'd just like to refer back to the SMR road map that was produced by the government in collaboration with industries. It was led by Natural Resources Canada but OPG, Bruce Power and local utilities in Saskatchewan and in the north all provided input. In there, they provide a range of values of the cost per unit of electricity that they were looking at. I don't have the numbers here with me today, but I'm happy to follow up afterwards. I can provide even just the table and figure numbers that you could consult.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you very much, Dr. Novog.

I also noted that McMaster University has signed on to the Canadian action plan for small modular reactors. We can find this plan on the Internet. So McMaster researchers will therefore address broader issues related to SMRs, including cost-benefit analysis, the advantages and disadvantages. They will also look at what the use of small modular reactors means for taxpayers, both in host communities and in neighbouring regions.

I think these are all critically important issues.

Could you tell me what conclusions you've reached so far?

[*English*]

Dr. David Novog: I'll turn it over to Dave Tucker, who's been running that feasibility study and the incipience of it to answer that.

Mr. Dave Tucker: That is the feasibility study, the launch of which we have just announced. We're at the very beginning of that, but I think it's a very important step for the country to look at us as a model for community deployment. If we're going to realize the value of SMRs in remote communities and remote industrial sites, we need to start with a willing and experienced host, and McMaster is that host.

That will give us the opportunity to answer the questions and demonstrate the technology, so that a community that's considering it can come, look, see, touch, get the experience and find out how we've done with ours—

The Chair: Mr. Tucker, I'm sorry.

[*Translation*]

I'm sorry, but your time is up.

[*English*]

Thank you, all.

We're now going to go to Mr. Cannings for six minutes.

Mr. Richard Cannings (South Okanagan—West Kootenay, NDP): Thank you, Madam Chair.

I'll just let Mr. Tucker continue on with that line, because I'm curious to know what the answer is, especially with your just having started the feasibility study, which would give us the answers that we really need to know before we jump into the deep end here.

What are the timelines on that feasibility study? For instance, when will we know when it will be economically feasible for a small community or a mine site to say, “I want an SMR,” rather than, “I want renewable energy,” or, “I want to continue on with diesel.” When will we know those answers?

Mr. Dave Tucker: The feasibility study for our deployment will run for about 18 months, and that will answer some of these general questions. The most important question it will answer will be on the pathway to a campus deployment or a near-campus deployment for the university, which will let us start building experience with this relatively new technology and start introducing it to communities and getting our economists, our business school and our social scientists involved in the project of seeing how an SMR works in a community.

It is a new thing, so it's going to take some time. We don't have the answers, but in the meantime, it's moving forward and there are other ways to move forward, like building micro modular reactor-ready energy-distribution systems in communities, so that as the experience comes in, as we're ready, we can replace the greenhouse gas-generating combined heat and power plants that are at the heart of those with small and micro modular reactors.

Mr. Richard Cannings: Thanks.

I will move on to Mr. Hartwick in terms of what.... These are difficult questions about casting ahead into the future with a brand new technology, but what are your projections for the role that SMRs will play by, say, 2030, 2040 and 2050?

The Canada Energy Regulator report last year, “Canada's Energy Future 2021”, showed a rather modest contribution or modest increase in nuclear until 2050.

How many communities and mine sites will have SMRs by 2050, realistically?

● (1910)

Mr. Ken Hartwick: Let me start with.... The one premise at Darlington is that we plan to have the first reactor operational in 2028, so it's not too far away. We will have done the refurbishment of our Darlington reactors in 2026. The cost of those is a little over eight cents per kilowatt hour. They are highly competitive with any other form of technology for the baseload.

What we will then do concurrently is begin to work with communities on both the grid-scale SMRs and the micro SMRs to determine which communities are relevant and want to participate and build that over time.

One of the key things that was touched on—and I agree with the premise—is that once you get to about 10 microreactors, we are going to have something very feasible, and we're going to be able to see it. We see it at Darlington right now. We're spending $12.8 billion. As we've refurbished the four reactors, they're coming in around 12% to 15% cheaper as we go from one reactor to the next. That's just learning, knowledge, efficiency and the skill of our workforce in Ontario, which is amazing.

Mr. Richard Cannings: On the eight cents per kilowatt hour, was that the legacy reactors, the big reactors, or was that—

Mr. Ken Hartwick: Those are the big reactors. We would anticipate on an SMR level for grid-scale SMRs that they're probably in or around the 10 cents range.

Mr. Richard Cannings: Is that after you build 10, or...?

Mr. Ken Hartwick: We will do that at our Darlington site. We are working toward achieving that level of cost.

Mr. Richard Cannings: Does that include the $12 billion...?

Mr. Ken Hartwick: It's separate and distinct. It's $12.8 billion to finish the four big reactors—

Mr. Richard Cannings: Okay.

Mr. Ken Hartwick: —and then, for our smaller modular ones, which we are building beside the big ones, we think they will ultimately come in at that 10 cents to 11 cents range.

Mr. Richard Cannings: How much time do I have left? I forgot to....

The Chair: You have a minute and a half, Mr. Cannings.

Mr. Richard Cannings: I'll ask the two Daves here about training.

How much training is involved in operating an SMR, say, if it's in a small community or a mine?

Dr. David Novog: It takes a large number of engineers and operators at the Darlington site to run a unit. I think one of the major goals in SMRs is a simplification of the design and operations, so that the load of people you need to manage that reactor on a daily basis is much reduced and can be accomplished by training a local workforce that will be on shift and gainfully employed in the operation of the reactor.

The complement of people will be lower than at a large site, but will still be appreciable. I don't have a formal number or an assessment from any vendor, but I would imagine you'd need six or 10 people to be around to do the checks, check out equipment and do those kinds of things. That's the type of direct employment.

When we look at studies at McMaster, for example, what we would really like to use is the waste heat. We would like to see large agriculture attached to these reactors to be able to utilize that waste heat to grow strawberries in a climate in which you can't grow strawberries.

Mr. Richard Cannings: Quickly, though, what's the—

The Chair: I'm sorry, Mr. Cannings. Would you like to ask for a written response?

Mr. Richard Cannings: I wanted to know what kind of training is needed for those six or eight people.

The Chair: I hate to tell you, but you've come to the end.

Would you like a written response?

Mr. Richard Cannings: Maybe if I can get my two and a half at the end—

The Chair: Thank you, Mr. Cannings.

Thank you to you all. It's a good discussion.

We're going to go to the five-minute round. We're pleased to welcome Mr. Van Popta tonight.

I understand you're going to be splitting your time with Mr. Tochor. The floor is yours.

Mr. Tako Van Popta (Langley—Aldergrove, CPC): I have one quick question. I'm from British Columbia, where, as you will all know, we generate a lot of electricity using hydro.

I think this is for Ken Hartwick. I'm wondering what the economics are to compare small nuclear reactors to large hydro dams, which require hundreds of kilometres of transmission lines from the Peace Country to Vancouver.

It's a wide open question. Compare the two.

Mr. Ken Hartwick: The way we compare it is that for the next new development in Ontario—this was one of the questions from a member earlier—it'll be further north, and therefore you have to build transmission to bring it south, where most of the load is required. You're probably looking at 15 cents a kilowatt hour to bring it, because Niagara Falls is already developed.

That's why we say that nuclear is very competitive with baseload, but I also think we need all of it. There is no one technology that solves this problem: It is every technology, if Canada is going to achieve its goals.

● (1915)

Mr. Tako Van Popta: Thank you.

Mr. Corey Tochor: Thank you to my colleague, and thank you, Madam Chair.

Going back to Mr. Tucker, I'd like to talk about McMaster and how we become a leader in nuclear on the international stage. What are your plans, currently?

Mr. Dave Tucker: We think that an extremely important role in enabling the country to move forward with the adoption of SMR technology is to run our community demonstration deployment, as we have announced plans to do. If we are successful in our timeline, that will be one of the first demonstration deployments in the world, and it will happen at McMaster University.

The planned reactors currently under way are, appropriately, at Darlington and at Chalk River in Canada. We want to be the first to show how that can translate to a community deployment and benefit a community, and we want to create the training associated with that.

The second thing we can do to be leaders is to utilize that experience in training the next generation of professionals and scientists that will operate, maintain and support those reactors and their deployment in the unique ways that Dr. Novog elaborated on.

Mr. Corey Tochor: Are there any trade schools in the neighbourhood that are partnering with the SMR program?

Mr. Dave Tucker: There are not currently, but absolutely, our hope is that this will become the heart of a training program for nuclear engineers and also for the tradespeople and technologists that will feed this industry.

Mr. Corey Tochor: Do you have any association with trade unions representing members that work currently in nuclear—either a support panel or a union or a labour input mechanism to the work you guys are doing?

Mr. Dave Tucker: We don't have a direct relationship, but, for example, there was a benefit to being part of a workshop sponsored by the Canadian Nuclear Association, chaired by one of Ken's leaders, the VP of new nuclear, on workforce development. That was very pan-Canadian and included all sectors of the workforce that are needed to do this. The conversation has started, and we will absolutely welcome them into this project as we see how we can use it as a pivot for training.

Mr. Corey Tochor: I'm going to pivot a bit, just because of something Ken said earlier. I'd like some clarification.

It is all of the above. I get that approach, and in your words, it can't be just nuclear, but we can't succeed unless nuclear is at the table. Is that fair? We could do without solar if we had more wind in that kind of equation, but there's nothing out there that has baseload capacity like nuclear.

Mr. Ken Hartwick: That's correct, and it's very regionally dependent. Some provinces are blessed with more power—Quebec, B.C. and Ontario have a fair amount—but to double the size of a system, every technology needs to play a bigger role, including nuclear. I think we need to think of it that way, versus any one thing being the answer.

Mr. Corey Tochor: Just on the business side of things, there were questions posed, such as whether or not this would be profitable. I wouldn't want the federal government getting into the building and regulating or the building and operating of nuclear facilities across Canada, but I would like organizations or companies like yours and other private or Crown corporations that are currently in the business to do so, so that it's really a business decision that's up to you, rather than what we feel should happen—

The Chair: Mr. Tochor, I'm sorry to interrupt. Do you want a written answer?

Mr. Corey Tochor: If you agree with that statement, put it in your words and write us your response.

Voices: Oh, oh!

Mr. Ken Hartwick: Okay—

The Chair: Perhaps you could send a written statement, Mr. Hartwick.

Mr. Corey Tochor: If you do—

The Chair: Thank you, Mr. Tochor.

We'll now go to Monsieur Lauzon.

[*Translation*]

You have five minutes.

[*English*]

Mr. Stéphane Lauzon (Argenteuil—La Petite-Nation, Lib.): Thanks, Madam Chair.

[*Translation*]

I'd like to thank the witnesses for being with us today.

Dr. Novog, you've seen the evolution of nuclear reactors over the past 10 years. You've been there from the beginning. You've seen them change, and they will change again. You probably remember the first one that was created, and you can compare it to what exists today.

I know you don't have a crystal ball, so you can't predict the future, but I'll ask you anyway: when will we succeed in creating a functional, measurable, productive and environmentally friendly system?

• (1920)

[*English*]

Dr. David Novog: It's an excellent question.

Right now, I think 100% of my students usually end up at OPG or at Bruce Power, on projects related to either refurbishment or the new nuclear builds that OPG is pursuing. A great deal of effort is being focused there on this first success. It's important to have a first success. It gives confidence to the public and also to the private sector, to invest and to continue investing.

I think that 2028 is a great target date for the first SMR. I would hope that the second, the third and the fourth.... I would like to see the 10 to 15 SMRs that it takes to really reach a point of cohesiveness by 2033 to 2035, because then it should be a fully commercial operation.

There shouldn't be a huge role for government, except in regulation. Whether the reactors are accepted by the community or not.... I mean, they have their own decisions to make with regard to energy and other issues.

That's the time frame I look at to have a number. Just to have a target date, I would like to see it by 2033 to 2035.

I know that Saskatchewan is looking at three or four reactors, as is New Brunswick. Ontario's OPG is looking at four. By the time we finish just the builds that are being discussed within that time frame, I think we will be in a very good position. We'll be in a good position, not just nationally, but internationally, to play a leading role as other countries start pushing in that direction.

Mr. Stéphane Lauzon: You tell us that you don't own the company. Are you in line with different corporations or companies that are ready to work on nuclear systems?

Dr. David Novog: We have some research projects that are sponsored by some of these vendors that are proposing the reactors. It's not just me, but other researchers at Mac.

My SMR training program is funded solely by the federal government, through NSERC. In that respect, the training is kind of technology agnostic. We don't try to say which technology is better.

We're trying to talk both about the nuts and bolts of the reactor, but also about new things, which Ken mentioned, like indigenous engagement, social awareness, and even some stuff on finance, which engineers typically don't like to talk about but still need training on. We're starting to create more well-rounded engineers in that training program, people who maybe have a wider vision than engineers might typically have when they graduate.

Mr. Stéphane Lauzon: Okay. Thanks.

[*Translation*]

Mr. Tucker, you are in the process of evaluating this technology over 18 months. That piqued my interest. I know you can't predict the future either. However, can you tell us whether the results may benefit remote regions?

I'm a member of Parliament from a remote riding. It's always more difficult to supply our industrial establishments with high-voltage power because Hydro-Québec's lines don't necessarily reach those regions.

Are we able to consistently provide 600-volt power to attract industry to remote areas?

Is your primary goal to provide this energy to the regions first and foremost?

[*English*]

Mr. Dave Tucker: I believe there are huge benefits that come with energy abundance and energy wealth in terms of the spinoffs that can be achieved beyond just keeping the lights on in the community.

Dave Novog mentioned the ability to have agriculture in greenhouses in some climates, to produce local food. Powering industry is certainly part of that equation. An optimally deployed micro modular reactor, where you're generating electricity, using the heat and storing the energy for when you need it, we believe, will have many spinoffs for the community.

I don't have a crystal ball, but I certainly believe passionately that this is an important pathway forward for this country in achieving greenhouse gas reduction and energy prosperity.

• (1925)

The Chair: Thank you, Mr. Lauzon, and thank you, Mr. Tucker. We appreciate the good questions.

Now we will go to Monsieur Blanchette-Joncas, for two and a half minutes, please.

[*Translation*]

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

Mr. Hartwick, you mentioned in your opening remarks that, in order to achieve the government's net-zero targets, it will be critical to implement and use this new technology, namely, small modular reactors currently in development.

Do you have any data to share with us on this, including the potential to achieve net-zero through this technology?

[*English*]

Mr. Ken Hartwick: The work we've done for Ontario, which I'm glad to share with the committee, if appropriate, looked at what the load would be for Ontario if you electrified all the things I talked about, the three big sectors. Then you just simply back into how much new hydro can be built, how much solar can be effectively put in place, then how much nuclear you need.

We've done this work. We very openly share it, and we don't believe Ontario can get there without a significant build of nuclear to complement the other technologies we have.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Mr. Hartwick, there are plans to build a small modular reactor at the Darlington site, which could be connected to Canada's electricity grid.

Do you have any data to share with us on the reduction in greenhouse gases that this will represent?

[*English*]

Mr. Ken Hartwick: Yes. We have a report we can provide on the big Darlington refurbishment and the carbon impact of bringing, basically, 3,600 megawatts of nuclear back onto the grid.

Secondly, we have carbon- and jobs-related data related to what we are going to build on the small modular reactor site, all of which I'm glad to share with the committee, again if that's appropriate.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Mr. Hartwick, in its record of decision issued in July 2020, the Canadian Nuclear Safety Commission notes that the purpose of the micro modular reactor project at the Chalk River Laboratories lacks clarity.

What are the specific purposes of this project?

[*English*]

Mr. Ken Hartwick: The Chalk River one, which we do through GFP, is really to demonstrate and improve the technology that would be applicable to some of the remote communities and a mining site. It is to build that specific non-grid scale technology and to demonstrate that we can do it effectively.

I think, then, that would give certainty to your earlier question around when you get cost effective on these. I agree with the commentary. It's in the—

The Chair: I hate to do this. Gentlemen, I'm sorry to both of you, but to be fair to Mr. Cannings, we'll give him the last two and a half minutes.

Mr. Richard Cannings: Thank you.

Quickly, Dr. Novog, perhaps you could just answer that last question I was trying to get out. What is the training needed, say, in a community of those six to eight to 10 people who will be maintaining a facility?

Dr. David Novog: I know the training requirements for an operator in existing power plants, and it's about four years beyond their usual education. For SMRs, because of the simplification, I think we hope to do better, to provide the training and the experience necessary in a shorter time frame.

Mr. Richard Cannings: Okay.

I'd like to move to Mr. Hartwick just to finish up.

You mentioned the importance of first nations consultation and involvement, and I think you implied that it could be something that would make things take longer, if not done right. We have a situation where the Ontario chiefs have come out against SMRs. We have a case in Chalk River where the first nation there is showing some deep concern about nuclear on its territories.

I'm just wondering what you have been doing with the Ontario chiefs, in particular, to allay their suspicions. I'm not talking about individual communities. I'm talking about the first nations chiefs as a group.

Mr. Ken Hartwick: Your wording was really good around "if not done right". I think what we are doing at Darlington for the new site is being done right. Our Williams Treaties First Nations group, and then the broader group, have been part of the conversation from the beginning, and that's a step I think a lot of companies miss. Maybe we've missed that in our history as well—so it's not that we've done everything right.

I see a growing consensus that if climate and carbon are the problems, we are going to have to do a better job with certain technologies, ensuring they're part of it, in nuclear. I think support is building in some of these sectors. We'll see more of it as we move forward, if we do it right.

● (1930)

Mr. Richard Cannings: I've probably run out of time, so thank you.

The Chair: Thank you, Mr. Cannings.

Thank you to you all. We appreciate your time, your experience and your expertise. You've all been very gracious and forthcoming.

Dear colleagues, with that, we will suspend briefly before we begin our next panel.

The meeting is suspended.

● (1930)

_____________________(Pause)_____________________

● (1930)

The Chair: Colleagues, I am going to call us back to order, if I may.

Dear colleagues, we have a second panel, and to be fair to all of you so that you get your time, I'm going to keep us on time.

Welcome back, everyone.

We'd like to welcome our second panel tonight on our study on small nuclear reactors.

Appearing as an individual, we have Dr. Ramana, professor, School of Public Policy and Global Affairs, from the University of British Columbia, and we'd like to recognize that this is very early in the morning for Dr. Ramana, as he is appearing from India today.

From Creative Fire, we have Dazawray Landrie-Parker, director, nuclear sector.

Welcome.

From Ralliement contre la pollution radioactive, we have Dr. Ginette Charbonneau, physicist and spokesperson.

I would like to welcome all of you. You have a very interested committee. You'll each have five minutes to present. At four and a half minutes, I will hold up a yellow card that lets you know you have 30 seconds left to wrap up.

With that, I say welcome again, and we're looking forward to hearing from you.

We will begin with Dr. Ramana for five minutes.

● (1935)

Dr. M. V. Ramana (Professor, School of Public Policy and Global Affairs, University of British Columbia, As an Individual): Thank you for providing me with this opportunity to speak with you.

My name is M. V. Ramana. I teach at the School of Public Policy and Global Affairs at the University of British Columbia. I carry out research on various technical and policy challenges associated with nuclear energy and small modular nuclear reactors.

I will focus my remarks on three topics: potential markets for SMRs, the potential for manufacturing and job creation from SMRs, and the impacts of investing in SMRs on climate change mitigation.

At the very outset, I would like to emphasize that SMRs cannot solve all the problems confronting nuclear energy, especially the inability of nuclear power to compete economically with alternative sources of energy such as electricity. SMRs will be less competitive because they will be more expensive per unit of generation due to the loss of economies of scale.

Second, because of the adverse economics, there is little demand for SMRs. Russia's KLT-40S design, China's HTR-PM design and South Korea's SMART design, which was licensed for construction about a decade ago, have attracted no customers. In the United States, many utilities have exited the proposed NuScale project due to its high cost.

Although many developing countries claim to be interested in SMRs, none have invested in the construction of one. Good examples are Jordan, Ghana and Indonesia, all of which have been touted as promising markets for SMRs for years, but none of which are buying one.

Niche markets—for example, remote mines and communities—are very limited. My research showed that even in a best-case scenario, remote mines and communities in Canada cannot provide the minimum demand necessary to justify investment in the factories needed to build these reactors.

A frequently heard argument for SMRs is that they will lead to jobs. This is misleading. The real question is whether such investment creates more jobs than would be created by investing the same amount of money in other low-carbon energy technologies.

The literature is unambiguous that nuclear reactor construction generates comparatively fewer jobs than renewables like solar and wind energy per dollar invested. Based on one recent study, I estimate that investing $1 billion U.S. in solar energy would create roughly 17,000 job-years of construction-related work. The same investment would create between 1,200 and 3,000 job-years in onshore and offshore wind energy and, finally, less than 1,000 job-years in nuclear energy. To the extent that SMRs are different from conventional large reactors, they will actually reduce the number of construction jobs created by adopting processes such as modernization and factory manufacture.

Finally, investing in building a product that has few customers can never lead to sustained employment.

SMRs will set back efforts to mitigate climate change for two reasons. First, there's an economic opportunity cost. Money that is invested in SMRs would save far more carbon dioxide if it were invested in renewables and associated technologies.

Second, no SMR will be constructed for at least another decade. This compounds the problem of the economic opportunity cost, in that the reduction in emissions from alternative investments would be not only greater but also quicker.

I'm happy to provide references for these statements, either from my work or that of others. I'm also happy to answer any questions.

● (1940)

The Chair: Thank you so much, Dr. Ramana. Again, we thank you for getting up so early in the morning.

We will now go to Creative Fire, and we will hear from Ms. Landrie-Parker.

Mrs. Dazawray Landrie-Parker (Director, Nuclear Sector, Creative Fire): Thank you for the opportunity to join you tonight. As mentioned, I'm the director of the nuclear sector for Creative Fire. I'm also a Métis woman, a Ph.D. candidate in public policy and an instructor in indigenous governance at Yukon University.

My research and my practice are really focused on indigenous inclusion, economic participation and engagement in the nuclear industry.

Many of the communities in Canada's northern and remote areas are still reliant on diesel. The high cost of energy, infrastructure challenges and the harsh climate indicate that Canada's north is facing an energy crisis.

In order to reduce this reliance on diesel, we will need to explore other options to produce clean and reliable energy for these communities. This is challenging, given the vast distances between these communities that make a connected grid cost-prohibitive, so one solution is to add nuclear to the energy mix.

As we heard earlier tonight, the history of development with our indigenous communities adds a layer of complexity, as it contains many examples of conflict, controversy and lack of local control. This complexity only becomes greater when we start talking about nuclear development.

In the past, many uranium developments have been in close proximity to indigenous lands. However, indigenous people had a minimal presence in the energy sector. Some of these developments have even resulted in adverse environmental, social and health consequences for these communities.

Currently, however, indigenous people have become much more involved in the sector through engagement, employment and even as direct investors, but the conflict of the past has created a trust deficit, and this trust deficit still runs deep in the community memories and shapes the community's assertion for meaningful and transparent engagement in development projects, including nuclear. It looks for active involvement in the decision-making process and a consistent recognition of indigenous self-determination over traditional resources.

There is a need for increased indigenous energy sovereignty. These communities need to be empowered to own and operate their own energy systems. UNDRIP, modern treaty agreements and recent court cases all provide frameworks or avenues for increased recognition of this indigenous energy sovereignty. It will be of the utmost importance that these indigenous nations have their free and prior informed consent on these development projects recognized.

Indigenous participation is integral in driving the decisions about the future of Canada's energy mix. SMR development in Canada will not happen without the support of the indigenous communities. Engagement is iterative and ongoing. It's rooted in information sharing, trust, and relationship building, and successful engagement employs numerous methods. It needs to be adaptable to be able to change from group to group, and it includes multiple framing of related energy issues in addition to just the development of nuclear energy. It will need to be adapted to recognize and to mitigate the trust deficit that exists in our indigenous nations, by including some key elements to increase the opportunity for forming new and positive relationships.

This increased indigenous participation in Canada's energy decisions will have a positive economic benefit. This includes the value add of indigenous involvement, from the incorporation of traditional knowledge and traditional ecological knowledge to strengthen the technical assessments, but also of the local knowledge and lived experience to help guide the engagement process.

Early training and mentorship of the indigenous workforce is also key. As we heard Dr. Novog say earlier, this can take quite a bit of time, and this process really needs to start immediately.

Finally, there's realizing the economic benefit of the intentional inclusion of indigenous businesses in the procurement process, as well as deliberative partnerships with indigenous-owned businesses.

To summarize a few of my key takeaways here, SMR implementation is dependent on community support. A poorly executed engagement could jeopardize the overall implementation and adoption of SMRs, and this will hinder Canada's reduction of GHG emissions. We need to remember that indigenous nations are self-determining nations, and local control will need to be central to the implementation and success of these new developments.

● (1945)

The Chair: Thank you so much, Ms. Landrie-Parker, for your testimony. I know we all wish you good luck with your Ph.D.

We will now go to Dr. Ginette Charbonneau for five minutes.

[*Translation*]

Dr. Ginette Charbonneau (Physicist and Spokesperson, Ralliement contre la pollution radioactive): Good evening.

My name is Ginette Charbonneau, and I am a retired physicist. I am the spokesperson for Ralliement contre la pollution radioactive.

I am asking Parliament today to exercise great vigilance regarding the problems of radioactive waste generated by small modular reactors. It is risky to develop the nuclear industry because, as you know, the waste is accumulating more and more, and the costs associated with managing it are becoming absolutely astronomical.

The federal government is putting a lot of money into SMRs. It's a new fad. However, we sincerely believe that SMRs will be ready too late, so they won't be able to mitigate the effects of climate change and their radioactive waste will pollute remote areas, which is very sad. Most first nations are opposed to the deployment of SMRs on their territory. Many letters have been written about this by first nations people.

In our opinion, the funding should instead be allocated to less expensive green technologies, which are also ready-made. The problem of climate change is a real emergency, and taxpayers' money should not be spent on projects—laudable, but nonetheless unrealistic—put forward by the nuclear industry lobby.

I would now like to point out that every effort has been made to unduly encourage and fund the design and production of small modular reactors, despite the danger of the waste they generate that is never mentioned.

This is not consistent with section 82 of the Impact Assessment Act. This section provides that an authority shall not provide financial assistance to enable a project to proceed on federal lands, unless the authority determines that the project is not likely to cause significant adverse environmental effects.

No one has proven that there are no negative environmental effects. In fact, everything was done to avoid having to prove it. So SMRs were exempted, unfortunately, from the Impact Assessment Act.

The SMR roadmap prepared by Natural Resources Canada included several recommendations, including the odious recommendation to exempt SMRs from all federal legislation. Imagine: no environmental assessment for SMRs. It makes no sense. The limits are important.

Most small modular reactors will therefore not be subject to the new legislation, which applies only to reactors with a power of more than 900 megawatts thermal that are within the licensed boundaries of a nuclear facility, such as nuclear power plants, or small modular reactors over 200 megawatts thermal that are outside the licensed boundaries of nuclear power plants, for example, in remote areas such as small villages.

This means, in practice, that almost all small modular reactors do not have to undergo an environmental assessment under the act. That is outrageous.

The problem with SMRs is that they will be multiplied, while their complex waste is poorly documented. All of the information on SMRs hardly ever discusses their waste, as if it didn't exist. There is so much uncertainty associated with small modular reactors that it is unbelievable that the government has excluded them from the act. Since SMRs are not subject to the Impact Assessment Act, proponents can make unilateral decisions and accept a project.

Furthermore, the waste generated by SMRs is completely ignored. The following is clear proof of this. When the Canadian Nuclear Safety Commission reviews the safety of a newly designed SMR, the waste generated by that reactor isn't considered at all, as if it did not exist.

● (1950)

It's as if we don't have to worry about it. People only talk about how they work. Waste will only be considered during the licence application process—

The Chair: Dr. Charbonneau, I'm sorry.

[*English*]

The time is up. Please forgive me, but you have a very interested committee that will want to ask questions.

I'd like to thank all of you for your testimony. We'll now hear from our members.

What I really love about this committee is the respect and dignity we show each other.

With that, we are going to begin our six-minute round.

Tonight we begin with Mr. Soroka.

Mr. Gerald Soroka (Yellowhead, CPC): Thank you, Madam Chair, and thank you to all the witnesses for coming today.

It's very appreciated when you have different viewpoints. It's quite interesting how everyone has their own opinions and opportunities to bring forward to this group and the committee. That's one of the great things I like about being a member of Parliament, getting to hear from many different sides on this. It's quite unique.

I would like to start off with Ms. Landrie-Parker.

I think it's quite important research and information that you're doing right now. I'm really quite interested in this, because in 2018 you published a report entitled, “Building a Community Engagement Framework for the Nuclear Energy Industry in Canada's North”. We're building trust through education and through community engagement and involvement, and that could strengthen the support for nuclear energy.

I think you mentioned the importance of making sure there's proper consultation.

I'd like you to talk more about that, as well as about the value you place on proper education to encourage nuclear energy as an alternative source of power.

Mrs. Dazawray Landrie-Parker: That's a great question.

Since I published that report, we have been doing quite a bit of energy literacy and tracking. We have seen the support for nuclear in indigenous communities rise throughout the years. That's just a little tidbit of my future dissertation, hopefully.

Definitely, consultation is extremely important.

One of the first pieces of consultation, aside from being out there and building those relationships and addressing some of those trust-deficit areas, is energy literacy, because people have to be able to make informed decisions, whether in support or not in support of it. In order to make those informed decisions, they have to have all of the information.

At Creative Fire, when we start out with an engagement process in nuclear, we start with energy literacy. It is about getting out there and talking about all the different pieces of the energy mix, what goes into it, what the pros and cons are, the benefits and the unique concerns of that community. That's why it's really important to understand what the barriers are for the individual community.

Mr. Gerald Soroka: Through this educational process, are you starting to see a different trend, such that people are starting to say, oh, maybe nuclear isn't as bad as we were led to believe, or what other pitfalls are there with renewable energy?

Are these the kinds of conversations that are coming with this consultation?

Mrs. Dazawray Landrie-Parker: Definitely. We have seen—and I just had a conversation about this today—that when you start putting all the different energy components beside each other—because it really is a mix, and we need a mix of all of these and not just one—and you start to compare them to each other, it starts to make a bit more sense. That's where we start to see people realizing that now that they're comparing apples to apples, they're getting a better idea of what this looks like.

We are seeing perspectives change quite a bit, and that's really what my research has been tracking. Since the 2018 report, we have seen, in 2020, for example, an increase of 10.9% in acceptance of SMRs in Saskatchewan and Ontario.

● (1955)

Mr. Gerald Soroka: Also, throughout your presentation you talked about trust. It's not very hard to believe that our indigenous communities have trust issues, given all the things that have happened with them over the years. It's not surprising.

Do you feel that through the proper consultation process, because they are still years away from when the SMRs are going to be built, there is beginning to be a lot more trust being formed, because they are in it at the ground level?

If you can explain a bit more on this, I'd appreciate that very much.

Mrs. Dazawray Landrie-Parker: I think Mr. Hartwick from OPG said it best. Having that inclusion from the start is really one of the key pieces in creating that trust. You have to be equal players at the table. You have to be involved in those conversations from the very beginning. That includes defining what those processes look like.

Another key component of building that trust—whether you are a proponent, a researcher from the university or anyone within the industry—is having made some real commitment towards those renewed and positive relationships. We see a lot of industry coming forward with reconciliation action plans, OPG being one of them, and that really has demonstrated a commitment to these relationships. That's where the good conversations start.

It's really important to be able to have some of those tough conversations around what happened in the past. When I say meaningful and authentic engagement, I mean it's kind of uncomfortable sometimes, because you have to have those conversations. I think Mr. Hartwick is a great example. He said we haven't done it right in the past, but we're doing it right now, and I completely agree with him.

Mr. Gerald Soroka: I believe that is a big issue. You don't want lip service; you want proper consultation and to make sure it's done properly.

Could you give us any advice? Are there still some areas where we need to improve on consultation? If so, what would they be?

Mrs. Dazawray Landrie-Parker: The conversation has to start early. Indigenous nations have to be at the table early. It can't appear that this is a check box. I know we have a duty to consult and accommodate, and various different regulatory requirements that come into play when we talk about consultation. I talk about engagement being more inclusive than that. We're talking from the very beginning. The minute we start even thinking about a new project, we need to start engaging with those nations and those leaders.

The Chair: Ms. Landrie-Parker, will you forgive me for interrupting? I suspect colleagues are going to want to pick up on this.

Thank you so much, Mr. Soroka.

We're now going to Mr. Collins for six minutes.

Mr. Chad Collins (Hamilton East—Stoney Creek, Lib.): Thanks, Madam Chair. I'd like to start with Dr. Ramana.

Dr. Ramana, you're not the first witness who has raised the comment as it relates to there being no customers for SMRs. We have had a lot of witnesses in front of us, including a public institution here tonight that has sold the merits of the technology. The private companies that have come forward have illustrated that they're willing to invest and have invested quite a significant amount of their own private capital and resources into making the technology work. We were given some very clear deadlines here tonight—guesstimates—in terms of when the technology would be not only ready but in use.

How do you rationalize that in terms of the private sector continuing to put money into this technology and spending its own money to make it happen? I can't imagine a business trying to sell a product when there is no customer at the end of the day to purchase the product.

Can you rationalize that in terms of your study and try to make some sense in terms of what we've heard to date through the first several meetings?

Dr. M. V. Ramana: I have two responses.

First is the fact that most of these private companies are not just investing their own funding; they are looking for public funding. In every country where SMRs are going forward, the United States, Canada or the U.K., they are all looking for public funding for a lot of their research.

The second thing to note is that companies make investments based on their assessments, but their assessments can be wrong. You've seen this time and again in the nuclear sector. Many companies have invested in various designs that have never sold. For example, Westinghouse invested a huge amount of money in what was called the AP600 reactor, which was never sold. It was pursued for over a decade. Subsequently, Westinghouse went through an SMR process called the Westinghouse SMR. Then, in 2014, when it realized the United States Department of Energy was not going to give it any money, it pulled out of that effort. While pulling out, its CEO said that the problem was not with the technology; the problem was that there are no customers.

If you have this question, it is a question private investors can probably best answer. I can't be in their heads to understand what they are thinking.

● (2000)

Mr. Chad Collins: Thanks, Dr. Ramana. I will move on to Mrs. Landrie-Parker.

Thank you for your previous answers. You heard Dr. Charbonneau's critique of the waste and how no first nations communities have endorsed SMRs or nuclear technology to date. What has your experience been with the communities so far, in terms of public outreach and opinions related to SMRs and nuclear?

Mrs. Dazawray Landrie-Parker: Respectfully, I think indigenous communities have spoken in support of that, at least some of the ones I've been in. I think it comes back to one of my previous answers around energy literacy: providing all the information or a full picture, so they can make informed decisions.

The 2018 report referred to earlier showed there wasn't necessarily an outright “I don't support this across the board”, but rather “I want more information”. We are now where they are getting more information, and we are, as I said.... I've done numerous surveys across Saskatchewan and Ontario, specifically, over the last couple of years, and we have seen support rising. Those are indigenous community members and not necessarily leadership speaking out, but there have been instances, as well, where leadership has spoken out.

We also have indigenous communities that are not necessarily first nations, or we have Métis or Inuit communities that are still municipal communities but mostly indigenous. They have spoken out in support of nuclear technology as well.

Mr. Chad Collins: Thank you for that answer.

In my previous life, I was a municipal councillor for over 20 years. One of the challenges I always faced, when somebody came to town with a new technology—normally, energy from waste—was convincing the community they weren't guinea pigs. It was always an issue to try to build public confidence.

Does the federal government play a role in terms of education, instilling some sense of public confidence in the technology and assuring people it is a proven technology? We had an institution here this evening—McMaster—that would certainly, I think, vouch for it, and others have been in front of us. What role can we play in assisting communities in making an informed decision, whether it's an indigenous community or otherwise?

Mrs. Dazawray Landrie-Parker: This is where partnerships with indigenous businesses or individuals in this sector come in, whether through research or actual partnerships where they are leading energy literacy programs. That's where it is really important.

Some of the research I've done has been around trusted sources of information on nuclear. It has come out that industry and government are on the lower end of trusted sources, but researchers, scientists and family friends are a bit higher. Again, it comes back to that local, lived experience. Indigenous businesses have that already. They know who the community champion is, so to speak—the person who volunteers for everything and knows how to get people out to a meeting to start talking about these things and holding dialogues.

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

Thank you to the witnesses for those answers.

[*Translation*]

Go ahead, Mr. Blanchette-Joncas. You have six minutes.

● (2005)

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

Allow me to welcome the witnesses joining us for the second hour of this meeting.

My first question is for Dr. Ramana.

Dr. Ramana, thank you for joining us at this very early hour. Proponents of small modular reactors argue that they can be made more cost-effective through economies of scale that can be achieved by mass manufacturing in plants.

During the last few meetings of this committee, we met with several stakeholders in the nuclear industry, but none of them was able to give us an idea of how many small modular reactors would have to be sold to cover the costs of their development, plant construction and approval by the relevant authorities. I know you've been looking at this issue.

Earlier, we got an answer from a representative of Ontario Power Generation, who told us that 10 to 12 would have to be sold. That's the first time we've had an estimate.

What are your comments on that?

[*English*]

Dr. M. V. Ramana: This is a difficult question to answer empirically, because the empirical record on nuclear power around the world has been that costs have actually increased, not decreased, with more construction. In both France and the United States, the two countries with the most nuclear plants, the average cost of the nuclear plant increased as more and more plants were built. There's actually no empirical basis to assume or calculate the cost in terms of how many SMRs would have to be built in order to realize the economies of mass manufacturing and learning.

The second point is that to the extent that there is a limited amount of evidence for decreases in cost in very specific circumstances in certain countries where the same vendor, the same architect, is manufacturing and building multiple reactors, those cost declines have been very marginal. It's an increase of probably a few percentage points. If you were to assume something like 5% to 10%, extremely optimistic numbers, for learning rates, then what you find is that in order for the cost of SMRs on a per-kilowatt basis to match the cost of a large reactor on a per-kilowatt basis, you would have to build somewhere between several hundred and several thousand. In my opinion, 10 to 12 is completely impossible.

Remember that this is for the cost of SMRs on a per-kilowatt basis to come to equal that of large reactors, but large reactors themselves are not economical. If you're trying to compete with other, alternate sorts of energy, you would have to manufacture huge numbers of these SMRs, assume that everything goes really well, and have these very optimistic learning rates. I don't think that's very possible.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Dr. Ramana.

I'd like to talk about another topic, the energy transition, which you mentioned in your opening remarks. Obviously, we are all concerned about climate change. It's a real threat, and it's the most serious one we must face collectively. To reverse this trend, we need to rapidly decarbonize our energy production.

Small modular nuclear reactors are still a long way from being widely commercialized and able to play an important role in the energy transition. We know that the technology is not yet mature.

Can you tell us more about that? If we really want to meet the 2050 target, should we be relying on that technology?

[*English*]

Dr. M. V. Ramana: Small modular reactors are not new. The industry has been talking about this for decades at this point. In 2001 the U.S. Department of Energy commissioned a report that looked at different SMR designs. They concluded that one of these could be operational by the end of the decade, which means 2010. It's now 2022. There is not a single SMR design in the U.S. that is ready for commercial use.

The leading design, NuScale, when it was established as a company, promised to have its first reactors operational by 2015 to 2016. Now it is talking about 2029 to 2030. I think even that is optimistic. When the NuScale design, which was talked about as being very advanced, went to the U.S. Nuclear Regulatory Commission, they found a lot of problems with it. There were problems with the steam generators. There was a problem with a certain kind of reactivity insertion. Those are safety problems that will have to be addressed. It's not clear that NuScale will be able to meet all of those by the end of this decade.

If you look at these kinds of examples and at the other countries I mentioned, where they tried to build SMRs and, when the first one was not successful, didn't follow up, I don't think it is possible that we're going to be able to meet our climate goals by pursuing SMRs.

● (2010)

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Dr. Ramana.

We often hear that investments in the nuclear sector would help create a lot of good jobs and in turn drive the economy.

What do you think about this?

[*English*]

Dr. M. V. Ramana: I mentioned this briefly in my remarks. The analogy I would give is that any investment will create jobs. The question is whether those jobs are sustainable.

Imagine, for example, you invest in a factory that's going to manufacture videocassettes. If you build that factory, of course it's going to create a number of jobs, but when the videocassettes come out, today nobody will be buying those videocassettes. What's the point of building that factory if nobody will buy these videocassettes, or if just a handful of people who like to preserve them for nostalgia buy them?

The Chair: Dr. Ramana, thank you.

[*Translation*]

Thank you, Mr. Blanchette-Joncas.

[*English*]

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

Mr. Richard Cannings: Thank you, and thanks to the witnesses here. These are very interesting conversations.

I'll start again with Dr. Ramana.

Just to pick up on some of the previous comments, you said other countries that had produced SMRs—Russia, China and South Korea—had no customers. I'm just wondering if you could expand on that. Why were there no customers? Were there never any products built? Was the cost too high? Did it not work?

I would just like to know how we can compare that with the situation we're in right now, here in Canada.

Dr. M. V. Ramana: The three countries are slightly different. Both Russia and China did build their first SMRs.

The Russian design was a so-called floating power plant, where the nuclear reactor was located on a barge. It was meant to serve as a way to electrify remote communities in Russia, which were on the Arctic coast. This was built. It was over a decade late. It was about three times as expensive as the initial cost estimates. That's the primary reason they haven't had any customers. There are many countries that would say that they would like one of these things. Indonesia is one that I mentioned. They said they have large numbers of islands and it would be great to have a floating power plant, but when they see the experience and the cost, they don't really want to go there.

In China's case, they actually built a high-temperature, gas-cooled reactor, which was based on earlier experience in Germany. This reactor, too, was about four years late. The cost was estimated to be 40% higher than the cost of electricity from light-water reactors in China. As a result, the plans they had to build more of these high-temperature gas-cooled reactors are being shelved. They talk about trying to make it larger, so that they can try to reduce the cost through economies of scale, which basically means that they are no longer talking about small modular reactors, but of large reactors.

In the case of South Korea, its SMART design was licensed for construction in 2012. They looked around South Korea, and not a single utility wanted to build one of these. Therefore, South Korea is looking for export markets. They're talking about Saudi Arabia and Jordan, but none of them have actually bought one so far.

Mr. Richard Cannings: On the next comment you made, I think you said that niche markets, such as remote mines, were limited.

In Canada, we have lots of mines. Why would that market be limited? Is the time that the mine is operational too short to make it worthwhile? What would make that market limited?

Dr. M. V. Ramana: The main reason is that if you total up all the demand from all of these different mines, even if every mine and every remote community were to purchase one of these reactors, you're talking about a total demand of about 600 megawatts.

If you want to try to translate the 600 megawatts into the number of orders you would get because of that and compare that with what a company ought to be looking at when they are thinking about investing the hundreds of millions of dollars that would be required for setting up one of these factories, it's not clear that they will match. That's the main issue.

The second problem we found is that the cost of electricity from one of these could be as high as 10 times that of diesel. The question is whether a mine is going to say that it will buy power at 10 times the cost it is paying now, even though it may want to get rid of diesel.

Instead, we found that the cheapest way for them to try to reduce their reliance on diesel would be to invest in renewables and lower their diesel demand.

● (2015)

Mr. Richard Cannings: How much time do I have?

The Chair: You have a minute and a half, Mr. Cannings.

Mr. Richard Cannings: Okay, I will turn to Ms. Landrie-Parker.

I believe you are in the Yukon, or you're studying at Yukon University. One of the classic communities in the Yukon that I think of that would benefit from something like this would be Old Crow. It's a remote community where everything has to be driven in on an ice road in the winter, or flown in. It's a completely indigenous Gwich'in community.

What's the process and what is the timeline for going through all the consultation, education and training necessary to convince Old Crow, first of all, that they would need such a reactor, and second, that they could build and operate it themselves?

I must admit I'm just a little skeptical of that whole thought experiment. I've been to Old Crow, and it just seems unlikely.

Mrs. Dazawray Landrie-Parker: When we're looking at very specific communities, they are going to make their own decisions. A community like Old Crow, where they have implemented their own energy systems that they are in control of—and that local control is very important to them—may not necessarily ever be ever in the situation of wanting to see...in this case probably a microreactor in their community. I don't know, because we would have to have those discussions with them, but it really does come down to just empowering them to make that decision.

Again, as you know, Old Crow has demonstrated—

The Chair: Mrs. Landrie-Parker, I'm sorry.

Mrs. Dazawray Landrie-Parker: It's okay.

The Chair: It's the worst part of the day. It is.

We're now going to go to the five-minute round. We really appreciate all of you for being here.

We begin with Ms. Gladu.

Ms. Marilyn Gladu (Sarnia—Lambton, CPC): Thank you, Chair, and thank you to the witnesses for appearing.

I want to start off by just talking a bit about some of the things that were said. I know there was a concern expressed by Dr. Charbonneau about radioactive waste and the dangers of that, and I want to be clear that we have 32 radioactive waste storage facilities in Ontario. Since their inception there has never been a single incident, so I think that is certainly not a fact-based observation.

The other thing I would like to say is that there was a comment that all of the SMRs are being exempted from environmental assessment. We have had testimony at this committee from people involved in the Westinghouse project and multiple SMR projects, complaining about the amount of time and the delay of three years that is being imposed on them by the environmental assessment process. I just wanted to provide that information.

I have a question for Dr. Ramana. If I look at competitive sources of energy, hydro is 6¢ to 8¢ a kilowatt hour. In solar and wind, unfortunately in Ontario contracts sold for 40¢ a kilowatt hour—very bad—and typically large nuclear is 8¢ a kilowatt hour but these SMRs are probably 15¢ a kilowatt hour. It looks to me like the niche for these is in places where you would avoid having to put infrastructure costs in in order to use this electricity.

In terms of the north, we see that in the Nunavut area we have mining initiatives that are going on and greenhouse initiatives for food security. Do you believe that these technologies have a place if we could prove the technology here in Canada that might boost this platform for use?

● (2020)

Dr. M. V. Ramana: I want to repeat what I mentioned earlier, which is that the total market from mines and remote communities is quite small in comparison with what would be required to manufacture the number of SMRs that would be required to justify building a factory.

The second point, which I didn't bring up earlier, is that if you look at mines and remote communities, they're all very different and they all have different levels of energy needs, so it's very unlikely that the same single nuclear reactor would actually service all of these.

If you're thinking about trying to build custom-built small modular reactors or microreactors for each of these communities, then the cost will go up even further.

The last point I want to say is that the 15¢ per kilowatt hour estimate, I think, is grossly underestimating what it's going to cost. If you were to think about the cost of one of these smaller reactors at a per-kilowatt scale, that can be much higher than for a large reactor, and the 8¢ per kilowatt hour is not the cost of a new large reactor; these are existing reactors where the construction costs have been amortized already.

For a new reactor.... This is why Ontario thought about building one at the end of the first decade of the century and then eventually abandoned it when it saw the incoming tender costs. I think that's something to remember.

Ms. Marilyn Gladu: Good.

If we look at the north.... I was in Nunavut. It's not very sunny there very often, and the wind is intermittent. In terms of power alternatives for diesel there, what are you thinking is a better recommendation?

Dr. M. V. Ramana: That, again, will very much depend on each place. There are areas where wind is strong. Even though it is not very sunny there, there are ways of trying to use solar energy in the winter. I am not an expert on that in colder places. There are also places where there are hydro resources.

I realize that no single one of them is going to fit all of these, and that, I think, is the beauty of renewable energy technologies. There is not one single solution that's going to work in any place. You'd have to look at what the local constraints are and what the local resources are, and tailor your thing.

The last thing I want to say is that technology is something that is evolving quickly in the renewable energy space, unlike in the nuclear space. What the situation will be in 10 or 20 years from now is not something we should be able to confidently predict at this point.

In terms of the total amount of emissions from these small remote communities, it's fairly small. I think we should first focus on developing these technologies for the grid in places where—

The Chair: Dr. Ramana, I'm sorry to interrupt. You got up so early for all of us.

Thank you, Ms. Gladu.

We're going to go to Ms. Bradford now for five minutes.

Ms. Valerie Bradford (Kitchener South—Hespeler, Lib.): Thank you, Madam Chair, and thank you to the witnesses for being here with us this evening—or early morning, as the case may be.

Dr. Ramana, in your 2021 paper, “Small Modular and Advanced Nuclear Reactors: A Reality Check”, you highlight many of the shortcomings surrounding the emerging technology.

What areas of research have to be focused on in order to improve the technology to make it as remarkable as advocates claim?

Dr. M. V. Ramana: There are a number of problems that, I think, are inherent to the technology. There's only so much you can do. One that Dr. Charbonneau mentioned as an example is the production of waste. Small modular reactors are going to produce more waste per kilowatt hour of electricity being generated, compared to a large reactor. That's not something that research is going to solve. That's a given fact. It's because when you go to smaller reactors, there will be more neutron leakage and various other sorts of inefficiencies that will creep in. I don't see this as a problem that research can necessarily fix.

The second point I want to mention is that even doing the R and D required to try to prove that one of these reactors is safe to build is a very expensive proposition. I go back to the example of the NuScale Reactor in the United States. They have spent over $1 billion U.S. at this point, and their reactor design is nowhere near actual completion or ready to be constructed. Most estimates are that they're going to go to about $1.5 billion or $2 billion U.S. This is all the expense that you have to incur in order to run the tests and do the calculations in a careful fashion to show that the reactor would operate in a safe manner under all possible circumstances, including, for example, if there's an earthquake or a fire, or if there's an operator error.

These are not cheap R and D projects. This is why many companies that start off often never move their reactor designs to completion. That's the other thing that I want to emphasize here. If you're going to try to move one of these products to a point where you can feel confident about them being constructed, somebody has to be willing to spend that $1 billion to $2 billion U.S. I don't see the market being willing to do that.

● (2025)

Ms. Valerie Bradford: In the area of nuclear waste, are you aware of any promising research to address the problem?

Dr. M. V. Ramana: The problem of nuclear waste is twofold.

There's the technical problem with nuclear waste, in that some of these substances are going to be hazardous for hundreds of thousands of years. That's an inherent property of these materials. There's no amount of research that's going to change that property.

The second thing is that the way to try to deal with this problem has typically been to try to do what's called “reprocessing”. Sometimes, euphemistically, it's called “recycling”. The problem there is that you cannot get rid of the radioactivity, so what you're doing in reprocessing is moving the waste from one location in a solid form into multiple streams of radioactive waste. All of them have to then be dealt with, so it's actually making the problem more complicated.

I don't see any promising research as such. The only thing that most countries have decided to do is to say they're going to build deep geological repositories and bury the waste there. Most of the research there has to do with trying to understand how you can persuade a community to live with this hazardous product in their vicinity for millennia.

That's not an easy problem. Again, it's like many of the other things you said. Communities are very different, and each community has its own set of concerns that will have to be addressed.

Most of the research in nuclear waste that I see as promising goes in that direction—the social direction—rather than the technical direction.

Ms. Valerie Bradford: I understand that you don't feel that there's a great future for SMRs or that they have a role to play, but supposing they did and that in the future they were effective and used, what challenges would the establishment of supply chains face in producing more SMRs, should the first ones ultimately prove to be successful?

The Chair: Ms. Bradford, you have about 10 seconds. Would you like to ask Dr. Ramana for a written response?

Ms. Valerie Bradford: If you could provide a written response to the committee on that, I'd be most appreciative.

Thank you so much.

The Chair: Thank you so much, Ms. Bradford.

Now we will go to Monsieur Blanchette-Joncas for two and a half minutes, please.

[*Translation*]

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

Dr. Charbonneau, I'd like to hear your comments on the important issue of nuclear waste management.

Can you elaborate on this issue?

Dr. Ginette Charbonneau: One of the main problems with small modular reactors is that they generate reactive waste that is easily ignited. Canada has a long-term project to create a deep geological storage site for waste, but we don't even know if we're going to be able to put the waste from small modular reactors there because it could ignite and set the deep landfill on fire.

No waste management strategy for small modular reactors emerged from the consultation conducted by the Nuclear Waste Management Organization, or NWMO. It's not possible, because the waste from small modular reactors is not well characterized. We don't know what it's going to be. We know that it will have a shorter lifespan and a lower intensity, but that it will be more complex in terms of intermediate and low-level waste. So it's totally unknown, and we don't know what to do with it. There's no strategy.

● (2030)

Mr. Maxime Blanchette-Joncas: Why do you think the government has chosen not to subject small modular reactor projects to environmental assessments?

Dr. Ginette Charbonneau: Humbly, I think it was because it wanted to encourage the deployment of small modular reactors and help the industry develop them.

It was to encourage the development of small modular reactors regardless of the disadvantages. It's like a fad. People want small modular reactors, and they think they will generate profits. However, it would be more prudent to consider all the problems that come with them, because it is likely to be a big disappointment.

The Chair: Thank you, Dr. Charbonneau and Mr. Blanchette-Joncas.

[*English*]

The last two and a half minutes before we suspend go to Mr. Cannings, please.

Mr. Richard Cannings: Thank you.

I'll go back to Ms. Landrie-Parker just to talk about one of my favourite places again, and that's Old Crow. You mentioned that they had their own energy strategy or plan. That's something I'm not aware of, so I'm really interested to hear about what they have done and perhaps what other small remote communities could do based on what they've done.

Mrs. Dazawray Landrie-Parker: Old Crow has a solar farm that they have created and implemented, and it has been quite successful. Again, there are challenges with it because of their climate and their location, but there are definitely some lessons there that can be learned by other communities—not necessarily just in solar but in any energy field—around local control and working with the utility in this case, and working with the government to recognize what is in those modern treaty agreements. That was really interesting.

Just to build on that, the other thing from the other northern communities is about some of the innovative ways they are looking at things like nuclear. Energy is an important part, but they've also looked at food security around the heat a reactor gives off and how they can use that to heat their greenhouses and increase their access to fresh fruits and vegetables, which we all know are hard to get in the north.

There is quite a bit of innovation happening in the north in the ways that they are thinking about energy, around both its use and its ownership and equity structures. I think there are a lot of lessons to be learned there.

Mr. Richard Cannings: Thank you.

I'll cede my remaining time.

Thank you all.

The Chair: Thank you, Mr. Cannings, for being so gracious.

To all our witnesses, we thank you for your time, for getting up in the wee hours of the morning, for being gracious and for sharing your expertise. We hope you've had a good experience. This is a new committee, and it's wonderful to see these conversations happening between research and members of Parliament. Thank you to all.

To our outstanding committee members, we're going to suspend.

[*Proceedings continue in camera*]