HOUSE OF COMMONS
CHAMBRE DES COMMUNES
CANADA

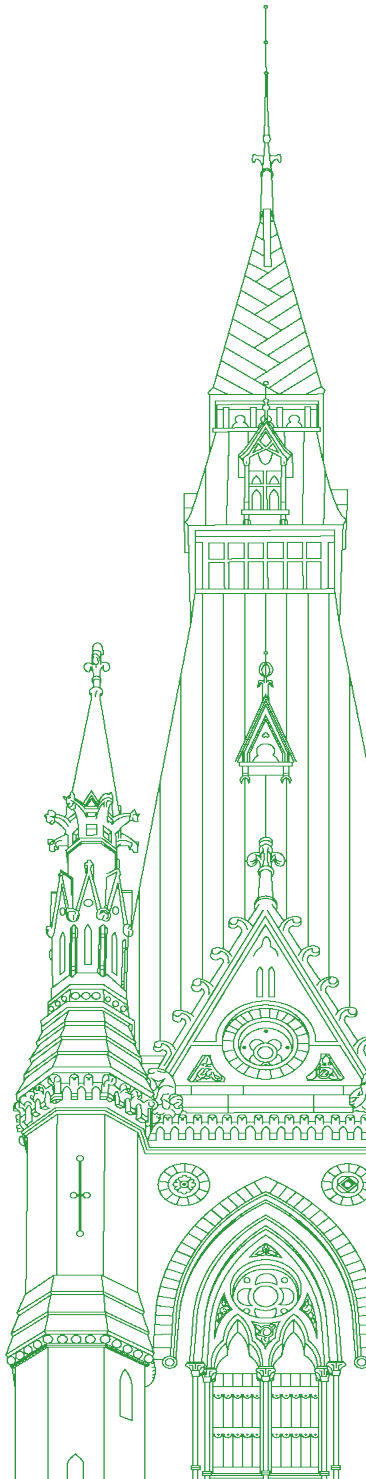
44th PARLIAMENT, 1st SESSION

Standing Committee on Science and Research

EVIDENCE

NUMBER 024

Monday, November 28, 2022



Chair: The Honourable Kirsty Duncan

Standing Committee on Science and Research

Monday, November 28, 2022

● (1830)

[*English*]

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

Welcome to meeting number 24 of the House of Commons Standing Committee on Science and Research.

Today's meeting, as you know, is taking place in a hybrid format, pursuant to the House order of June 23, 2022. Members are attending in person in the room and remotely using the Zoom application.

Tonight, based on Standing Order 108(3)(i) and the motion adopted by the committee on Monday, September 26, 2022, we are continuing the study of the international moonshot programs.

I would like to make a few comments for the benefit of the witnesses and members.

Please wait until I recognize you by name before speaking.

For those participating via video conference, click on the microphone icon to activate your mike, and please mute yourself when you are not speaking. With regard to interpretation for those on Zoom, you have the choice, at the bottom of your screen, of floor, English or French. Those in the room can use the earpiece and select the desired channel.

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

Members in room, if you wish to speak, please raise your hand. Members on Zoom, please use the “raise hand” function. The clerk and I will manage the speaking order as best we can, and we appreciate your patience and understanding in this regard.

In accordance with our routine motion, I am informing the committee that all witnesses have completed the required connection tests in advance of the meeting.

I see tonight that we have Mr. Powlowski, Mr. Williams and Mr. Garon joining us. Welcome to you all.

Now I'd like to welcome our witnesses.

We have Dr. Art McDonald, former Gray chair in particle astrophysics, professor emeritus at Queen's University and, of course, a Nobel Prize winner. He is appearing as an individual.

We also have, from the Gérard Mourou Center for Ultrafast Optical Science, Dr. Brandon Russell, who is a research fellow.

I would like to welcome you both. Our committee is very excited to hear your testimony. You will each have five minutes to present. At the four and a half minutes, I will hold up this green card, which lets you know there are 30 seconds left. We aim to be fair, so please wrap up your discussion to be within the five minutes.

With that, I welcome you again.

Dr. McDonald, the floor is yours for five minutes.

Dr. Arthur McDonald (Gray Chair in Particle Astrophysics (Emeritus), Queen's University, As an Individual): Thank you very much for the opportunity to speak to you this evening.

I want to let you know that Canada is in a position to compete at the very forefront of the fields of particle physics and astrophysics internationally through the presence of SNOLAB, which is the lowest radioactivity laboratory in the world, two kilometres underground near Sudbury. SNOLAB experiments are addressing questions that are also the strong focus of the largest accelerator facilities in the world, including the Large Hadron Collider at CERN, Fermilab in Chicago and the J-PARC accelerator in Tokyo. In the future, the results of these experiments at SNOLAB can have as great a scientific impact as we had with the Sudbury Neutrino Observatory, for which a Nobel Prize was awarded in 2015.

These questions are absolutely fundamental to our very existence and to our knowledge the composition of our universe and the way in which it has evolved. They're the top of every list of scientific questions internationally.

First, what is the nature of the dark matter that holds our galaxy together and appears to have five times as much mass in the dark spaces between the stars as in the stars themselves—and us, of course—in ordinary matter? We have a very remarkable and complete picture of how the universe has evolved since the big bang, which was about 13.5 billion years ago. The gravitational effects of dark matter are essential for an understanding of that, which has now reached a complete nature, with the exception of, “What is the dark matter?” It's completely unlike any of the particles or any of the matter that we have identified on earth in any of our experiments to date.

The Large Hadron Collider is trying to produce them for the first time here on earth, hoping that they have as high energies as are necessary and as were available in the original big bang to do it. We know that those dark matter particles exist in our galaxy. We are moving through them. With our experiments at SNOLAB, we are creating an ultralow radioactivity environment to get rid of everything else, except perhaps signals from those dark matter particles hitting our various detectors.

We've made considerable progress on the development of detection techniques already at SNOLAB. There are major international collaborations, in some cases, with more than 400 scientists from 90 institutions and 14 countries that have designated SNOLAB as the location for larger-scale experiments such as ARGO. It'll push the sensitivity for dark matter detection by factors of hundreds of times greater than today's sensitivity, to the point—ironically, for me—where the only interfering background in the experiment will be neutrinos.

Such experiments will cost upward of $300 million, with substantial contribution, however, from international partners. A lot of those contributions are being spent here in Canada. At least one of these will be seeking funding within the next 10 years.

Secondly, from a physics question, it appears that the big bang produced equal numbers of particles and antiparticles, such as positrons, the antiparticle to electrons. Almost all of those antiparticles have decayed away, leaving us a universe dominated by the ordinary matter from which we and the stars are formed.

There's a theory as to the fact that that decay in the early universe was dominated by processes involving neutrinos. The experimental programs at Fermilab in Chicago and J-PARC in Tokyo are dominated by searches for properties of neutrinos that are needed in the theory in order to understand how the antimatter decayed in the early universe. These are multi-billion-dollar programs with strong, international participation.

A further part of this theory is explored by the ultralow radioactivity measurements at SNOLAB. Neutrinoless double-beta decay is the rare radioactivity we seek.

The two foremost international experiments of this type, each of them in excess of $300 million, have declared that SNOLAB is their location of choice for their site. We may also need an expansion of SNOLAB, which could cost in excess of $200 million in order to accommodate these future large experiments.

● (1835)

These are moonshots, building on Canadian leadership in one of the most fundamental and internationally visible areas of science, and we have the stepping stone to that through SNOLAB, although, granted, going two kilometres down doesn't exactly seem like a moonshot.

SNOLAB was created by a CFI program in 2003 that was designed to bring international scientists to Canada to work with Canadians—

The Chair: Dr. McDonald, I am so sorry to interrupt. You're giving us such interesting material.

However, to be fair to everyone.... I know our colleagues will have many questions for you. I apologize for interrupting.

If I could go to Mr. Russell now, for five minutes, the floor is yours.

Mr. Brandon Russell (Research Fellow, Gérard Mourou Center for Ultrafast Optical Science): Thank you. Hello, everyone.

I would first like to thank the committee for inviting me to discuss the research that is being performed in the field of plasma physics at the Gérard Mourou Center for Ultrafast Optical Science. My name is Brandon Russell, and I am a research fellow at the University of Michigan, where I recently completed my Ph.D. in electrical engineering.

Although I am currently working in the United States, I grew up in Alberta and attended the University of Alberta for my undergraduate degree. During my time at the University of Alberta, I was initially involved in research in the field of nanotechnology. However, through an internship at the Stanford linear accelerator national laboratory in California, I was introduced to the field of plasma physics. This is an extremely exciting and impactful field of research, and I have been passionate about it ever since.

My graduate studies were focused on progressing the high-energy frontier of this field, wherein large ultra-intense lasers are used to create extremely energetic plasmas. My current research is focused on creating the theoretical framework needed to design experiments for the next generation of laser facilities that are currently being constructed around the world, including the extreme light infrastructure, ELI, in Europe and the ZEUS laser system at the University of Michigan, which will be the focus of this speech.

Prior to the funding of ZEUS in 2019 by the National Science Foundation, the University of Michigan had the Hercules laser system. Hercules was a mid-scale laser system, taking up several standard laboratory spaces. This laser was built under the leadership of Gérard Mourou, using the technology of chirped pulse amplification for which he jointly won the Nobel Prize in 2018. This technology allowed the laser to reach extremely high intensities, large enough to accelerate electrons to a significant fraction of the speed of light. In fact, the Hercules laser held the Guinness world record for the most intense laser in the world. Many experiments were run on this laser, both by students and researchers at Michigan and by external collaborators. These experiments studied a diverse range of topics, including particle acceleration, X-ray generation for medical and materials studies, and the study of magnetized processes relevant to astrophysics.

Since then, many similar laser systems have been constructed throughout the world, including many more powerful lasers called petawatt laser systems. For reference, the United States power grid operates at around one terawatt, a thousand times less than the power of the laser pulses generated by these petawatt laser systems.

In North America, many of these laser systems belong to LaserNetUS, a network of laser systems that researchers can apply to for time to run their own experiments. Although the majority of these lasers are at U.S. institutions, the Advanced Laser Light Source in Quebec also belongs to this network.

These mid-scale laser facilities allow us to tackle scientific problems with a significant impact at the level of fundamental science and with the potential to have great societal impact. Some of these problems include accelerating electrons to energies comparable with those of conventional several-kilometre-long particle accelerators, creating compact X-ray sources for diagnosing advanced materials and ultra-fast medical imaging, proton acceleration for cancer therapy, and nuclear fusion as an alternative energy source.

However, it should be noted that nuclear fusion experiments are generally performed at large-scale laser facilities, including the National Ignition Facility in California. Recently, there has been an international push—largely in the United States, Europe, and Asia—to develop a new generation of multi-petawatt lasers that can access an extremely energetic regime of physics where strong-field quantum-electrodynamic processes can be studied. These processes that appear in this regime are theorized to occur in the most extreme astrophysical environments, like those surrounding black holes and highly energetic stars known as pulsars.

Given a high enough laser intensity, we could access this regime by simply shooting a laser into a vacuum. However, such intensities are far outside the reach of current laser technology. Instead, we can achieve similar results by colliding a high-energy electron beam head-on with a laser beam. Several facilities around the world are currently racing to apply this concept, including the University of Michigan, where the ZEUS laser has been purpose-built for this concept.

The ZEUS laser was funded by the National Science Foundation to be a user facility where researchers can apply to run their own experiments. The facility recently ran its first experiment, successfully demonstrating operation of the first components of the laser system, and it is expected to begin operation at full power in late 2023. At that time, it will be the most powerful laser in the U.S.

This facility has already brought together talented scientists and students for the design and construction of the laser, and it will continue to bring in researchers internationally to perform experiments. Collaborating on novel, highly impactful experiments at this facility will allow students to receive a unique set of skills and gain useful connections for their future careers.

For these reasons, I believe the work being done at the University of Michigan and generally in the field of plasma physics is in line with the motion adopted by the committee. I hope that what I have talked about can give insight into how laser-plasma physics, which already exists at a few institutions in Canada, may be expanded upon to bring in talented researchers.

I would, again, like to thank the committee for giving me the opportunity to speak about this work being done at the Gérard Mourou Center for Ultrafast Optical Science at the University of Michigan. I am happy to take any questions.

Thank you.

● (1840)

The Chair: Thank you very much, Dr. Russell.

We're delighted to have you and Dr. McDonald here tonight. I know that our committee is eager to ask both of you questions.

We will now hear from our members. We begin with a six-minute round.

Tonight we begin with Mr. Soroka. The floor is yours.

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

Thank you to the witnesses.

I'd like to start off by asking my nephew Dr. Russell a question. He was invited to be here tonight. There's a little bit of nepotism there, I guess you might say. Now you can understand why I don't understand what he's talking about half the time.

Voices: Oh, oh!

Mr. Gerald Soroka: You did have to leave Canada to go to the United States for plasma physics. What do you think we can do to improve and have better research or have a better understanding of plasma physics here in Canada?

● (1845)

Mr. Brandon Russell: That's a very interesting question.

I think this is generally true for all fields of science, including what Dr. McDonald talked about. I believe that Canada needs to develop some sort of unique facility with unique capabilities that bring an international interest so that people trained elsewhere can come to Canada to work or Canadians will have a place to work.

Such a facility should be strongly advertised, provide internships to graduate and undergraduate students and provide clear long-term career paths so that you could stay in the field of plasma physics and continue contributing to it while staying in Canada. This is effectively the model of the national laboratories in the United States, which hire a significant fraction of graduate students from many areas of science.

Mr. Gerald Soroka: With that, are you saying that a lot of other countries are coming to the States simply because of the facilities they have, or is it just the amount of money they're contributing to it?

Mr. Brandon Russell: It's definitely the facilities. There are a significant number of facilities in the U.S. LaserNetUS, which I mentioned, was developed around four years ago and was developed for this purpose of bringing more people to the U.S. and creating a united effort in developing plasma physics.

They were falling behind Europe and Asia, which were developing far ahead of the U.S. They have multi-petawatt facilities that are being created, such as the ELI, the extreme light infrastructure.

Mr. Gerald Soroka: With the ZEUS laser system being built in Michigan, do you have a dollar figure to give us an idea of what that would cost us here in Canada?

Mr. Brandon Russell: Yes. The initial funding from the National Science Foundation was around $16 million U.S. There have been some operating costs that have been added on to that since.

Mr. Gerald Soroka: Through this ZEUS laser system, what is the primary thing you're hoping to accomplish? What is the moonshot thing that you're hoping to develop from this system?

Mr. Brandon Russell: The ZEUS laser facility's primary or flagship experiment is this colliding beam experiment, which will allow us to access a new regime of physics that nobody has really been able to look into previously.

However, there are so many diverse and vast research areas that you can go into in plasma physics by using this laser. Specifically, even on the HERCULES laser system, we've had many spinoff companies come from that, including a form of LASIK eye surgery. We also have the ability to study things like nuclear fusion, medical imaging and cancer therapy on the facility.

Mr. Gerald Soroka: Thank you for that.

I'd like to now ask some questions of Dr. McDonald.

You mentioned the SNOLAB. You want an expansion of it. Is this an increase in size or just an increase in the research that you're planning on doing there?

Dr. Arthur McDonald: It's potentially an increase in size, possibly generated by the fact that the scale of these experiments in the areas of both dark matter research and neutrinoless double-beta decay may be larger than the cavities that presently exist.

I think there are a couple of stages that could be accommodated within the existing facility, but over the next five to 10 years there need to be plans made, because basically the world is saying that this is the place they want to come for these frontier experiments. They are, in a sense, the other half of the sorts of things that are being studied at these major billion-dollar accelerator facilities around the world. Canada has an opportunity to step forward with support for SNOLAB to attract the world and significantly large experiments, which may within the next five years or so require an expansion.

Mr. Gerald Soroka: Basically, this is one of those facilities that Dr. Russell talked about that we need in Canada and that we actually have here. How many other facilities around the world are similar to SNOLAB?

Dr. Arthur McDonald: Well, there are facilities that are similar, but they are not as deep and they are not as clean. When you come to the ultimate experiments that are pushing the frontiers of science and trying to get those questions that have not been answered yet in terms of the model for how the universe has evolved, you want to have the best.

Canada is basically the best right now, and that's why these major multi-million-dollar experiments supported strongly by other countries are targeting SNOLAB as their location. Canada has an opportunity to step forward by recognizing that we have unique opportunities here. Fortunately, Vale, the mining company, has provided the depth to us on an ongoing basis. We have eliminated cosmic rays to a greater degree than anyone else in the world. It's the only laboratory that has also made the entire laboratory free of dust that contains radioactivity, and it is therefore an advantageous place to site these big experiments.

● (1850)

Mr. Gerald Soroka: Basically, this is our moonshot program here in Canada, and if we don't continually keep investing in it, we're going to lose what we have here. What kind of—

The Chair: Mr. Soroka, I'm sorry to interrupt. That was such an interesting exchange among you all. Thank you, Mr. Soroka.

We're going to go to Mr. Collins for six minutes, please.

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

Thank you to both of the witnesses for their appearance tonight. I'd like to start with Dr. McDonald.

Sir, I know that the province made a substantial investment in the SNOLAB program just over a year ago, and I believe our minister was in Sudbury this past summer to make a very large investment. I think it was in the area of about $100 million. There seems to be cross-jurisdictional support from both levels of government to support, in your case, SNOLAB.

How would you suggest that the federal government deal with provinces as it relates to making investments in moonshot projects across the country? Do you have any suggestions for working with the provinces and territories in terms of making public investments into moonshot programs?

Dr. Arthur McDonald: Well, in testifying to the Bouchard committee on the future of scientific funding in Canada, one of the topics that I was asked to speak about was in fact the major research facilities. They shared with me the plans that have been put forward by the government, which I think go a long way towards addressing how Canada deals with what are really national labs, even though they're essentially university labs in a number of cases. I certainly would like to see more government involvement and overview of these laboratories.

I think one thing that was completely omitted in any of the documentation I've seen so far is the role of the provinces in such situations, and there certainly have been situations in the past in which a smaller province has sited a major national facility and has been asked to come up with substantial amounts of funding. I think the existence of this major research facilities committee and overview on such national labs should lead to a dialogue with the provinces. In some cases, it may be inappropriate for the degree of matching that's been asked for in the past to be included. I think it's a topic that needs to be on the agenda, along with the establishment of such committees.

If I may, the types of projects I was talking about are international projects for experiments, as opposed to facilities, as opposed to something that is expected to house maybe multiple experiments, but they're large-scale on the Canadian scale, certainly. It would be appropriate to consider seriously whether this structure that's being set up for the overview of facilities should be expanded to consider international programs of this scale that are being situated here in Canada—the experiments I'm talking about.

Mr. Chad Collins: Thank you for that answer.

That leads me to the next question: How does the government prioritize the moonshot programs that are out there? What would you suggest?

We don't have a specific fund right now that is a moonshot fund, so if we're creating policy around making strategic investments, as we already have—I referenced the $100 million that Minister Champagne provided to your organization—and if the government's looking at coming up with a program, how does it establish or create criteria in relation to making strategic funding investments across the country?

Dr. Arthur McDonald: I will answer, but let me start by pointing out that the money recently awarded was in fact for the operation of the SNOLAB facility over the next seven years. It was not capital investment. It was matched, in fact, by the province, to a substantial degree.

How do you set priorities? It's very difficult. I don't envy you in terms of the advice you're going to give the government. Many things come into this. You want Canada to be doing the things that are important in science and that will have a short-term benefit for the Canadian public in health and in areas where you clearly want to be a world leader in order to provide the appropriate support to a Canadian populace.

However, I think it's important for Canada to also be a leader in basic science in certain areas where it has natural advantages. Obviously, in SNOLAB we have a natural advantage. We should be building on that, because we can be a world leader in natural sciences as well.

I would point out that the people we educate in Ph.D. degrees, for example, in very basic sciences, go on to a wide variety of other occupations. We did a survey 10 years after the SNO experiment stopped taking data. We found that 75% of people educated in the process of doing work on the basic science experiment were in a wide variety of other jobs. Twenty-five per cent of them were in academic positions. I'm pleased to say that 35% of them were women, which is high for physics, and it's increasing.

The other 75% worked for J.P. Morgan, the government and medical research laboratories. Basically, they were trained in evidence-based decision-making, which is needed in all aspects of our society. We could attract them because we had things at the frontier of science. They were trained in such things, including the frontiers of technology. They have gone out into society and are making contributions across the spectrum.

● (1855)

The Chair: Thank you, Mr. Collins and Dr. McDonald. We're so grateful for both of our witnesses.

Now we're going with Mr. Garon tonight. The floor is yours.

[*Translation*]

Mr. Jean-Denis Garon (Mirabel, BQ): Thank you, Madam Chair.

Good evening everyone. Thank you to our two witnesses for being here.

I'm going to start with Professor McDonald.

Society places a lot of value on applied research, which results in direct applications that can quickly be turned into consumer products that generate profits. I feel, though, that basic research tends to be the prerequisite for the development of major industries. Genome sequencing comes to mind, as does all the basic research that the University of California, Berkeley does, research that led to the creation of Silicon Valley.

I believe that basic research is a public asset first and should be largely funded by the government. What do you think? On the whole, does Canada recognize that basic research is a public asset that must be publicly funded?

[*English*]

Dr. Arthur McDonald: I certainly agree that it's very important that there be a balance.

What Canada needs is strong support for basic research. I think the funding councils require strong support. Another topic on the table is adequate research funding for individuals at the faculty, post-doctoral and student levels, right now. I was on the committee chaired by David Naylor. We certainly, at that time, found that levels of funding were lower than required. They have increased, but they are still in difficulty within the basic sciences.

I think that needs to be balanced with a recognition that there is also a need for Canada to be technologically and commercially related to that and actively involved in the latest technology. In a number of instances, this comes from basic science. In fact, the type of people I was describing, who go into industry even though their degree may have been in basic science, are of value to industry because they are able to look across the horizon, beyond Canada, at that new idea that came up in Germany or wherever. They know what it means. It is basic science that creates the understanding of when the technological breakthrough is going to be.

Canadian industry needs people trained in applied science and basic science, in order for them to be able to access the latest in what's happening internationally when it comes to innovation. Balance, from my point of view, is what's important.

● (1900)

[*Translation*]

Mr. Jean-Denis Garon: Thank you.

My next question is for Mr. Russell.

It's important to attract talent and researchers to Canada, and for that to happen, a certain number of conditions have to be in place.

During the Trump administration, immigration was a major issue. A number of countries went to great lengths to set themselves apart from the U.S. and to attract researchers. Australia and New Zealand seem to have done a pretty good job of that, but Canada had trouble turning the situation to its advantage even then.

As far as student scholarships and research funding go, does Canada have what it takes to attract young researchers and talent, when the conditions are ripe?

[*English*]

Mr. Brandon Russell: I think that's very tricky. I don't work in Canada right now, so I don't know what kind of funding exists for professors, for example, but the faculty positions that exist in my field are few and far between in Canada. Actually bringing researchers to Canada is very difficult in my field.

If you were to build an institute on top of that, you would need to bring people in, so you would already need experience. I think the funding does not exist, which is partially why I've come to the U.S. instead of staying in Canada. The funding does exist here for me to pursue a Ph.D. and post-doctoral studies and then have a career in the field, whereas that does not really exist in Canada, or at least only for a minority of people.

[*Translation*]

Mr. Jean-Denis Garon: Thank you very much.

My next question is for Mr. McDonald, who has seen a whole lot of students in his career.

We've talked about the Natural Sciences and Engineering Research Council of Canada, NSERC, and the Social Sciences and Humanities Research Council. For the most part, their federal scholarship and grant amounts are still exactly what they were 10, 15 or 20 years ago.

Clearly, we want to be involved in moonshot projects; we want to fund them and carry them out. We also need to have a pool of researchers trained here, in Canada.

In addition to making sure we can carry out moonshot projects, do we need to do more when it comes to graduate student funding, so those students stay in Canada?

[*English*]

Dr. Arthur McDonald: Certainly I have been emphasizing major experiments. It's what I am involved in. It's what SNOLAB is good at. It's how SNOLAB can make a place for Canada and train extremely good people with, but I think it's very important to have perspective on the entire funding system.

I think that the question of what is or is not happening with the granting councils in terms of adequate support to attract and retain graduate students across the disciplines is very important. I think we certainly addressed that in the previous fundamental science review and I think it's being addressed by the Bouchard committee. Right now I'm very hopeful that this will be helpful.

[*Translation*]

The Chair: Sorry, Mr. Garon, but you're out of time.

[*English*]

I'm really pleased that you could join us tonight. I hope you are enjoying being part of the committee.

With that, we will now go to Mr. Cannings for six minutes, please.

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

Thank you to the two witnesses here before us today. This is a very interesting study, and I'm learning a lot, as usual.

Dr. McDonald, I'd like to start with you. SNOLAB has obviously been a big part of your career, and I'm just wondering if you could tell us, when you started this whole SNOLAB project, did you have in mind these things that you're talking about now—the spinoffs that it might accrue with the kinds of experiments that it would attract and that Canada can build on with these big science projects?

● (1905)

Dr. Arthur McDonald: I started back in 1984 with the SNO experiment, and we had a single thing in mind. There was a big question in science to be answered, and fortunately, with the support we got in Canada, we were able to do so.

SNOLAB itself, as I said, was created in 2003 with a program that was led by David Sinclair and Carleton University. I was still involved in the SNO project, although I was actively involved in the ideas that went into SNOLAB. All of us who were working on it recognized that there really had been a change as a result of the measurements that had been made with respect to neutrinos in terms of understanding where those neutrinos fit into the overall model of elementary particles and how that influences how the universe evolves.

The fact that the dark matter was not neutrinos means that we now have other particles to look for that are different from anything that has been seen. That was a program we could see; it was in the proposal to CFI, and it could be a substantial program going forward.

As I've said, there have been smaller-scale experiments that have been taking place in this area. The demonstration that SNOLAB itself functions extremely well and is the best place in the world to do these types of experiments has triggered international interest.

Yes, it was in our mind as we started out, and we were fortunate at the time. The existence of CFI is an indication of how Canada has progressed in its funding. It did not exist when we were trying to get SNO funded, and we had to go through a variety of different hoops, let's say, in order to get it funded. The existence of a single funding agency that can deal with infrastructure in Canada was a real addition to the scene.

Mr. Richard Cannings: Thank you.

You're involved in particle physics and those kinds of questions like astronomy. They tend to be a part of science that, at least I think, involve big science because of the questions you're asking. You have to get particles moving very fast and you have to look far distances.

There's always this balance when I think of policies around funding big science versus smaller science, I guess you could say—basic science versus applied science.

Do you have any advice on how you would weigh that? Maybe you're biased. I'm biased, but we're faced with this. As a committee, as a government, as decision-makers, we want to make science flourish here in Canada and take advantage of the things we have.

Dr. Arthur McDonald: Again, I think it's a question of balance. There needs to be balance between applied science and basic science in the funding decisions. There also needs to be some fraction of the budget that goes into—sorry—moonshots. You want Canada to be capable of hitting on the world's scene in a way that it has credibility when its industries go out there and say that this is a technologically literate country. Also, you want to educate students.

I think it is a controlled fraction of the total budget. That's where the balance comes in. There, I think you want to pick situations in which Canada has some natural advantage in terms of your choice of moonshots. In our case, we had the deep mine and the capability of running it totally cleanly. In other cases, you want to look for similar advantages.

Mr. Richard Cannings: I want to bring up CHIME, the Canadian Hydrogen Intensity Mapping Experiment, which is part of the radio observatory near my home town of Penticton. It's a National Research Council facility. Considerable expense went into that, and it's discovering things already that are far beyond what we initially thought.

Dr. Arthur McDonald: CHIME is a wonderful example of Canadian ideas that basically revolutionized radio astronomy in certain areas. Instead of focusing a telescope on a small fraction of the sky, you look at the whole sky, and you use very sophisticated data analysis techniques to be able to extract extremely good information from it. It has made a tremendous difference in understanding a number of very extreme astronomical objects. It's a great Canadian success story.

● (1910)

Mr. Richard Cannings: I think I'm out of time. Thank you very much.

The Chair: You are out of time, Mr. Cannings. I'm sorry.

This is a really good discussion. We're very grateful to our witnesses this evening.

We will now go to the second round. This will be a five-minute round. We'll start with Mr. Lobb tonight.

Mr. Ben Lobb (Huron—Bruce, CPC): Thank you very much, Madam Chair, and good evening.

Last week we had Governor General David Johnston, and today we have two distinguished persons, including Mr. McDonald in person. I think it's quite an honour for our committee and a testament to our clerk and analysts for getting such top-quality people to come out to this study.

First, there's been a great discussion here tonight, but could you give me an indication of how SNOLAB works financially? I know that there are financial contributions from the federal government and also the provincial government. If there are projects or studies that want to be conducted, do they pay a fee to the SNOLAB to be able to have the right to practice there, or does the SNOLAB welcome people to do the research there? How does that work?

Dr. Arthur McDonald: It has been the norm in particle physics for a particular country that hosts a major facility, such as Fermilab in the United States, for it to pay for the activities at the facility, and for it and other countries who come in to build big experiments to share the costs of such experiments.

For example, SNO, which did not have a facility—it was a single experiment and a hole in the ground, basically, before SNOLAB existed—was shared between the various countries. It's an experiment. These experiments I'm talking about that would be situated at SNOLAB are ones that would be shared in terms of the costs of such experiments in coming to SNOLAB. The facility itself would predominantly be run by Canada. Although there would be charges for obvious things associated with the electricity associated with running the facility and so on, running the hoist to get people there and things of that nature would be a responsibility of the funding that comes through major science initiatives from CFI at the present time and, in the case of SNOLAB, shared by the Province of Ontario.

Mr. Ben Lobb: In these endeavours that are very complex, and the breakdown of the way it would work, specifically on human resources, it seems to me.....

Can you tell the committee whether more people are now getting into these sciences? Is there a need for more to get in? Where is the state of the day with these highly educated individuals?

Dr. Arthur McDonald: There's certainly a significant continuing interest in these fields.

We were very fortunate, for example, in the field of particle astrophysics, which is related to SNOLAB very strongly, in being successful with a Canada first research excellence fund. In the process of that fund, which has been in existence for about five years, there have been 15 faculty members across the country recruited, and the equivalent number of faculty members in addition have been attracted to the universities that have built up programs in this area. This area of particle physics has become very interesting. Canada is one of the leaders in it. In addition, hundreds of students and post-doctoral students—I don't know the numbers—have been educated over the last five or so years just in connection with that program alone.

That's an example of the fact that not only are individual scientists interested, but scientific departments across the country have also been very pleased to move forward with new positions. These positions are picked up by the universities now that the Canada first research excellence fund will finish in two years' time.

● (1915)

Mr. Ben Lobb: Let's say you were at a Tim Hortons coffee shop in Sudbury, just talking to a guy or a gal, and they asked you, "What the heck do you do there? What's the significance to the Canadian public for what you do?"

I mean, I understand it, but there are a lot of tax dollars going into it. I understand that there are some great results. How would you describe it to Joe Public at Tim Hortons who's curious about what goes on there and the benefit of it?

Dr. Arthur McDonald: I would say, "Do you know how this universe we live in came about? Do you have a feeling for how it all started and how it developed to the point that we have the things we have around us? That's what we're studying."

We have this tremendous description of a big bang 13 billion years ago and the way in which things evolved to the present time. It's an understanding of our history at a very profound level. It's how everything started and how it got to be the way it is today for the whole world.

The Chair: Thank you, Dr. McDonald. It's not easy to say that in 30 seconds.

Thank you, Mr. Lobb.

We will now go to Ms. Diab for five minutes, please.

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

Thank you so much to both of our witnesses. We're truly honoured in this committee to have the calibre of witnesses we're getting, particularly on a topic that is, as Mr. Lobb indicated, a new one for many Canadians. It certainly is for us. I think we're learning quite a bit, which is part of what we're doing in this committee. That's why it was struck. I think part of it is to increase our knowledge as parliamentarians so that we can better understand it ourselves and be able to make policies accordingly.

Dr. McDonald, I read with interest that you hold a degree in physics from Dalhousie University. I'm a Nova Scotian and I went to Dalhousie, and so did all my kids. They're all still there.

You talked quite a bit about SNOLAB, and it is fascinating. I think some of us on the committee might be looking forward to attending that facility. Maybe we'll see you there. You also talked about how Canada should be looking at where it has a natural advantage, and that we need recognition in the world. I cannot agree more with that.

Where else can you point us to? From your perspective and with all the experience you have, what else should Canada be looking at, and where?

Dr. Arthur McDonald: I'll answer you, but of interest, one of my first summer jobs was working at the steam plant in Glace Bay that produced the steam for the reserves of Canadian heavy water that we used in the experiment. I'm from Sydney originally.

I think Canada has a significant advantage in artificial intelligence in quantum devices and quantum computing. It may be in that sequence of quantum devices first, followed by quantum computing. Geoff Hinton and his colleagues in artificial intelligence have made a major shift in the capability of artificial intelligence. I think that's an area that's very important to be supporting.

In the health care area, I have been waiting for some time to see the effects of learning about the human genome starting, essentially, in the year 2000. We now have an understanding of genetics. We also have the ability to use genetics to make quick diagnoses. I think we're going to have a revolution in medicine as we go forward. I talked to my colleagues, such as the head of the department at Queen's, and he tells me what he's looking for is personalized medicine. That is a way you can attempt to tailor your treatment based on the genetic information you obtain, and obtain quickly, going forward.

Those are a couple of areas that I would target.

● (1920)

Ms. Lena Metlege Diab: I hate to leave the questioning, but I have a colleague right here who's itching to get a question in. I'm going to let Mr. Powlowski have the last minute and a half.

Mr. Marcus Powlowski (Thunder Bay—Rainy River, Lib.): There's not a lot of time to ask this question and get a response. It seems to me that in this committee, which is very interesting, there's an extreme gap between what we're talking about and what you know and what we know.

I have a bachelor's degree in biochemistry. I'm a medical doctor. I have no idea about what dark matter is about. I have no idea about what plasma is. I can certainly understand the fundamental importance of this kind of knowledge in understanding the universe. I can also understand this may lead to benefits, ultimately, in terms of medicine and energy. In various ways, we can see a benefit from it.

Are you frustrated with the fact the people who know about the field of research, and what is important....? There's a gap between them and their ability to get the people who have the money and make the policy to understand the importance of this field and where the money should be going.

I know there are people in NSERC and CFI who presumably have some expertise and can say we should be putting our money into this or that, but is that enough?

How can you talk to the people who ultimately have a source of money—which is us—and convince them that this is something we ought to be putting our money into?

The Chair: Mr. Powlowski, since that's the time, perhaps you would like to ask Dr. McDonald if he would give you a written answer on that.

Dr. Arthur McDonald: You're what my wife refers to as a real doctor.

Voices: Oh, oh!

The Chair: Thank you, everyone, for the good questions and the good discussion with our excellent witnesses.

We will now go for two and a half minutes. I believe it's Monsieur Garon.

[*Translation*]

Mr. Jean-Denis Garon: Thank you, Madam Chair.

In the spirit of comity, Mr. McDonald, if you can answer my fellow member's question in a minute or less, please go ahead.

[*English*]

Dr. Arthur McDonald: I'm very sorry, but I'm not fast enough on the controls. Would you please repeat that?

[*Translation*]

Mr. Jean-Denis Garon: I said that, in the spirit of comity, I would let you answer Mr. Powlowski's question if you could keep it to 45 seconds or less.

[*English*]

Dr. Arthur McDonald: Well, fortunately, there's another McDonald, named Bob, who helps a lot in some of these things.

What you say is very understandable.

I, of course, know very little about your expertise. I think peer review is a very important process in all of the decision-making that happens in Canada. There is peer review at various levels. The peer review that happens for individuals with the granting councils is important. You also have to escalate that when you're trying to make your decisions on your moonshots.

At the time of the fundamental science review, there was a recommendation by a major overview committee for the government, with representatives of academia and industry together, giving an overall perspective for how science and technology should be carried out in this country, and a road map for that sort of thing. I think it would be of great advantage to your committee if such a committee of experts, coupled with government experts, were in fact in existence.

[*Translation*]

Mr. Jean-Denis Garon: Sorry to interrupt, Mr. McDonald.

Madam Chair, I would like to have the 30 seconds I lost because of the interpretation added back to my time. It would be most gracious of you to give me that time back, but I realize you don't have to.

Mr. McDonald, can you give us examples of moonshot projects that Canada, but specifically Quebec, could undertake right now? That would give us some food for thought.

Obviously, we aren't making any promises.

● (1925)

[*English*]

Dr. Arthur McDonald: There's one project, CHIME, as an example—not in Quebec, as it turns out—that is asking for additional resources. They have a new idea that came from Canada that has a major effect on radio astronomy in terms of trying to understand that field.

I don't have other specifics.

The Chair: Dr. McDonald, I have the worst job. I'm forever interrupting, and I'm sorry.

Monsieur Garon, thank you.

Now we will go to Mr. Cannings for two and a half minutes, please.

Mr. Richard Cannings: Thank you.

I'm going to continue with Dr. McDonald.

You mentioned the human genome project, which I was going to bring up anyway, but you did it on your own, as well as personalized medicine.

I know Pieter Cullis at UBC has written a book on that subject, on things that have flowed from these moonshots, these big science projects.

As I understand it, that human genome project involved a lot of co-operation and sharing of data. My experience in the science world was somewhat the opposite. While a lot of scientists are doing their projects, until they publish, they don't share information.

Do you have any sense that we have to change that paradigm and encourage more open collaboration, and that these moonshots have to involve teams of scientists working together and sharing ideas and data throughout the project?

Dr. Arthur McDonald: There's no doubt that these moonshots are of such a scale that Canada can't do it alone. There has to be international co-operation. By its nature, these large international co-operations involve the sharing of data very freely among hundreds of scientists.

It's very important that data is not released before it has been properly assessed by the experts, so you have to have the mechanisms whereby there are these opportunities for two experts in that field to come together and come to a conclusion, even if it's only preliminary. They can then be helped by others. There has to be a certain degree of internal work before you release it to the general public or you won't have the peer review on articles that is very necessary as well.

I think that all of these moonshots are, by their nature, international because they are of a scope where the particular topic is something that will be of interest across the world.

I should also point out that these major research projects also push technology right to the frontier. I mean, we're working on things with our projects right now that will result in improved detection devices that will, for example, reduce the dose you need to use in positron emission tomography. There are different things in different areas, but there are effects of pushing technology or even pushing companies to improve their technology that result in immediate and helpful new things.

Mr. Richard Cannings: Thank you. I think I'm out of time again.

The Chair: I'm afraid you are, Mr. Cannings.

Dear colleagues, seeing as we're at 7:29, it's my honour to thank both our witnesses. Dr. Russell, we're very grateful that you would join us from the States tonight and we wish you good fortune and good wishes with your research. Dr. McDonald, it's always lovely to see you.

We're grateful for both of your expertise, your time and your effort. I've hope you've had a good experience and that you will want to come back to our committee. I know all of us are very grateful.

With that, we will suspend before we go to our next panel.

● (1925)

_____(Pause)_____

● (1935)

The Chair: I call this meeting back to order.

Colleagues, I'd like to make a few comments for the benefit of our new witnesses, and we welcome them tonight.

Please wait until I recognize you by name before speaking. For those participating by video conference, click on the microphone icon to activate your mike, and please mute yourself when you are not speaking.

For interpretation for those on Zoom, you have the choice at the bottom of your screen of either floor, English or French. For those in the room, you can use the earpiece and select the desired channel. I remind you that all comments should be addressed through the chair.

I would now like to welcome our witnesses.

Appearing as an individual is Dr. Banerjee, a research scientist and adjunct professor from the Vaccine and Infectious Disease Organization at the University of Saskatchewan. From the Stem Cell Network, we have Cate Murray, president and chief executive officer, and Dr. Michael Rudnicki, the scientific director. From the University of Saskatchewan, we have Dr. Baljit Singh, vice-president of research.

We'd like to welcome all our witnesses. We're grateful that you would join us tonight. We're eager to hear from you.

Each group will have five minutes to present. At the four-and-a-half-minute mark, I will hold up this green card. It will let you know that there are 30 seconds left. I aim to be fair, so if you could wrap up after that time, it would be much appreciated.

We will go to the testimony now, and we will begin with Dr. Banerjee.

The floor is yours for five minutes.

Mr. Arinjay Banerjee (Research Scientist and Adjunct Professor, Vaccine and Infectious Disease Organization, University of Saskatchewan, As an Individual): Thank you, Madam Chair.

Madam Chair and members of the committee, thank you for inviting me to this discussion. This session is my first time, so I'm nervous and excited.

I'm joining you from the Vaccine and Infectious Disease Organization. We are based at the University of Saskatchewan, which is situated on Treaty 6 territory and the homeland of the Métis.

I just had the privilege of coming back from the Royal Society of Canada's G7 One Health research summit at Lake Louise last week. At the meeting it became very clear that we need to focus on perhaps two things to protect the lives of Canadians from infectious diseases. The first is to identify and address the drivers of emerging infectious diseases—and this includes lots of factors, including climate change, land use change and deforestation—and the second is to develop countermeasures and policies to protect human lives and the lives of our livestock from emerging microbial threats.

If I may draw your attention to some statistics, greater than 70% of emerging infections have an animal origin, and we've only sampled and identified a fraction of microbes, including viruses, that exist in our wildlife. We know even less about their potential to infect livestock species and humans. Even for pathogens that we do know exist and that can infect, vaccines and therapeutics remain unavailable.

Some of these pathogens, unfortunately, have civilization-devastating potential. If we look at Nipah virus, we see it has a 40% to 70% mortality, so 40% to 70% of people who are infected are likely to die. MERS coronavirus, a very close relative of SARS-CoV-2 that we've all heard about—and it's a living reality for all of us—can kill 35% of the individuals it infects. You could always have the novel flu. Just as a reminder the 1918 flu pandemic, the Spanish flu killed about 2.5% to 5% of the global population at the time.

Multiple studies by my colleagues have now shown that anthropogenic factors, meaning activities that *Homo sapiens*, or humans, like doing, cause habitat loss and climate change, which directly lead to animal migration and nutritional deficiencies in animals, which then directly impact the pathogen spillover from these animals.

Emerging infectious diseases pose a multi-faceted, complex problem which, in my opinion, will require—and perhaps some of my colleagues would agree—a multipronged, state-of-the-art interdisciplinary and multidisciplinary approach with nationwide and international collaborations.

I hope that perhaps now we have more appreciation of how quickly novel pathogens can emerge and impact humans, including fellow Canadians. Countermeasures remain unavailable, largely due to lack of funding to research pathogens that are not a problem yet. Prioritizing pathogens of importance and of threat will require AI modelling, so this is not just a health problem; we can also include quantum and modelling to identify microbial risks for tomorrow.

While we need to build intelligence through modelling on emerging pathogens, we also need to test and archive vaccine and drug candidates that can be rapidly deployed in the event a pathogen emerges. For example, if we look at COVID-19, even with the fastest timeline in the history of vaccine development, we see that over 6.5 million lives were lost globally—and these are only reported numbers globally—including over 47,000 fellow Canadians.

What I'm trying to pitch as an international moonshot program is the concept called One Health. It's a concept that recognizes the interconnectedness of human, animal and environment health, and it's not a far-born idea. Sir William Osler, who was a Canadian physician and is perhaps considered by many as the father of veterinary pathology in North America, had deep connections and interests in the linkages between human and veterinary medicine. He went on to become one of the founding fathers of John Hopkins, so One Health was sort of born in Canada, and we are strategically positioned to lead this globally.

Researchers in Canada have initiated globally competitive One Health research programs, including my laboratory that investigates zoonotic pathogens, but these programs remain scarcely funded. It's hard, because we have to split up programs to fit the mandates of existing funding organizations.

I believe that we really have a unique opportunity in Canada to establish an internationally reputable One-Health-themed interdisciplinary and multidisciplinary moonshot program that includes surveillance, intelligence gathering, risk assessment to rank priority pathogens, therapeutics and vaccine development, and outbreak detection mitigation policies. We truly have an opportunity to lead the way in developing a holistic research program to prevent the next pandemic and the next emerging infection.

I will stop at that. Thank you, Madam Chair.

● (1940)

The Chair: Thank you, Dr. Banerjee.

I hope you feel comfortable. This is a group that is genuinely interested in learning from you, so we welcome you.

We will now go to the Stem Cell Network for five minutes, please.

Ms. Cate Murray (President and Chief Executive Officer, Stem Cell Network): Thank you, Madam Chair.

I am joined by the Stem Cell Network's scientific director, Dr. Michael Rudnicki, who is globally known for his work in muscle stem cells and regeneration.

When people are asked to describe what technologies are needed to achieve a moonshot, they tend to reply with artificial intelligence, quantum computing and big data. It's not often that they'll consider the sophisticated technology that resides within the human body. I'm speaking directly about stem cells, the building blocks of each of us.

Stem cells were first definitely discovered by two Canadians, James Till and Ernest McCulloch. Stem cell research is Canada's science, and we have been leading the way delivering game-changing discoveries and therapies that come from this human technology for the past 60 years. Stem cells can divide indefinitely and can make any cell in the body. They are one of nature's ultimate innovations.

It is the human body that presents us with the opportunity to achieve the greatest moonshot of all, the eradication of disease, of illness and of injury. This idea may sound implausible to many, but moonshots, by definition, are meant to be ambitious, audacious and grand.

Stem cells are driving the field of regenerative medicine. To quote from the Council of Canadian Academies , “The appeal of regenerative medicine lies in its curative approach”. It's about repairing, regenerating and restoring function to cells, tissues and organs. It's already delivering advances for heart disease, Parkinson's, muscular dystrophy, type 1 diabetes and even COVID-19.

Let me share a little story with you. Tyler Rabey was an ambitious, athletic young man from Quebec. He had not yet celebrated his 25th birthday when he was first diagnosed with an aggressive form of leukemia, a cancer that defied all standard treatments. Within a year, he was confined to a hospital bed facing a terminal diagnosis . His doctors worked to have him enrolled in a stem cell clinical trial funded by the Stem Cell Network and run by Dr. Sandra Cohen .

Tyler received a stem cell transplant. To generate enough stem cells, they were expanded using a novel technology and a proprietary molecule called UM171, and they were optimized using a bioculture system. The treatment worked and, following months of careful recuperation, Tyler was able to return home, where he met his godson, kissed his girlfriend and returned to his studies.

This innovative therapy is now being further tested across North America via a Canadian biotech called ExCellThera .

Regenerative medicine technology will also have critically important economic benefits as we move forward. Prior to the pandemic, the burden of chronic disease cost Canada $190 billion annually, with the direct cost accounting for 58% of annual health care spending. The costs have undoubtedly escalated. It's a trajectory that must be addressed.

The good news is that investment is strong. Private investors are pouring billions into Canadian life science companies. In fact, in 2019 and 2020, the sector raised $2 billion in venture capital and $5 billion in public equity.

As we all know, investment and commercial success is predicated on world-class science. That's where networks like ours come in. Canada's Stem Cell Network is composed of leading researchers and trainees who are laser-focused on stem cell and regenerative medicine research. We partner with charities, industry and governments to ensure that the science we support is driving next-generation therapies.

● (1945)

Stem cell research takes time. The research started today will result in the personalized medicines of tomorrow. We can envision a future where specific medicines for you will be made in the hospital where you're being cared for. Additionally, right now specialized bioinks are being innovated and will be used for bioprinting of tissues that can be used to patch wounds and restore organ function.

In time, we'll realize a future where treatments fit the patient, rather than the patient having to fit the treatment—

The Chair: Ms. Murray, I'm sorry to interrupt. I'm sure there will be good follow-up with you.

We're so grateful to have had Dr. Banerjee here and to have had you here from the Stem Cell Network, and now we're going to the vice-president of research at the University of Saskatchewan, Dr. Singh.

The floor is yours.

Dr. Baljit Singh (Vice-President, Research, University of Saskatchewan): Madam Chair and honourable members of the committee, I am so honoured to have this opportunity to be in front of you.

When the question came on what Canada's international moonshot could be, I thought of many possibilities, but the one that struck close to my heart, based on what Canada can offer the world, was this world, which is well fed and food secure and where people who have enough food to give their children can send their kids to school. This is a world that Canada always envisions to be a peaceful world all around us.

My idea for the moonshot is a food-secure world that is peaceful. The reason that Canada is potentially the only country in the world that can deliver this moonshot is based on three fundamental ingredients of any moonshot, if we are going to be thinking about that.

It has to be inspirational. Canadians have been inspired by a vision for a world that's peaceful. They know that there cannot be peace without food security everywhere in the world. Canadians have made supreme sacrifices, whenever called upon, for the sake of peace and prosperity in this world. Therefore, Canadians can be inspired when it comes to feeding more than eight billion people today around the globe.

The second component of a moonshot is the credibility. Where does this credibility come from so that Canadians can think about delivering this outstanding international moonshot?

First, we need large pieces of land that we can use in a sustainable way to grow food, whether it is of the plant origin or the animal origin. The second ingredient to grow the food is the water. Canada is endowed with an abundant supply of fresh water, with which we are taking extreme precautions, based on the science, to make it sustainable over a long period of time.

To fuel the production of plant-based food, we need fertilizers. Canada has an abundance of fertilizers such as potash. Yes, there is a need for us to transition away from the heavy use of fertilizers, and that's what Canadian innovation in the fields of soil science and precision agriculture is leading us to. I believe that with the right kinds of investments, Canadian plant science people can deliver the types of varieties that can grow on smaller amounts of precisely applied fertilizers, and we can develop crops that can withstand climate change and global warming.

The last piece is that Canadians have invested significantly in their cluster of academic institutions from coast to coast, which have delivered innovation in all aspects of agriculture. That is the innovation that has made Canada's agri-food production sector the envy of the world. Not only have we created prosperity and new jobs in that sector, but we have also exported the food, which is affordable, nutritious and sustainably produced, and which actually carries the Canadian brand and makes us all very proud. Last is the investment in areas such as Protein Industries, where superclusters have brought academic and private sectors together.

The third ingredient of an international moonshot is imagination. That's where we need to come together as Canadians to be imaginative, to be collaborative and to bring ourselves together. This is the moonshot that we can deliver to create a food-secure world with our efforts in this country.

We need to pay attention to the sustainable development goals of the United Nations. We need to pay attention to the climate change that is occurring around us. We need to understand that large parts of this world are not in a position to produce enough food for their own populations.

This, Madam Chair and honourable committee members, is my idea for an international moonshot that Canada can deliver.

Thank you so very much.

● (1950)

The Chair: Thank you so much, Dr. Singh. We're glad to have you back at committee. It's really lovely to see you.

To all our witnesses, we thank you for being here. We're looking forward to hearing more of your ideas.

We're now going to hear from our members. You have a very interested committee. This will be a six-minute round.

Tonight we will begin with Mr. Soroka. The floor is yours.

Mr. Gerald Soroka: Thank you, Madame Chair.

Thank you to the witnesses for coming this evening.

I have to admit, stem cell research is very interesting to me. I guess the first thing you always think about is cancer research but, as you explained, there's so much more to it.

With $2 billion from the private sector already being invested, are you having an issue getting funding, or do you still need to have funding available to you?

Dr. Michael Rudnicki (Scientific Director, Stem Cell Network): The investments in these companies are for the discoveries that are mature enough to be commercialized. What CIHR does is fund the basic research, and we need that robust foundation of discovery.

Organizations like the Stem Cell Network build multidisciplinary teams from across Canada to move that research along the pipeline, through research and development and clinical testing, and bring it to the point where it can be commercialized. We fund projects that are hare-brained ideas that no one else will fund—such as the project that led to the cure for the patient Cate described—as a small catalyst grant or impact grant, and move it along all the way through to larger teams doing the research and development, all the way through to clinical testing.

We don't fund and forget. We manage these projects in live time. We're very different from the funding councils.

● (1955)

Mr. Gerald Soroka: Thank you.

As a follow-up question, because there are so many different areas of regenerative medicine that you're dealing with, how do you prioritize who gets funding and who doesn't? How do you issue that out?

Dr. Michael Rudnicki: Stem cell research has paved the road for regenerative medicine to enter the clinic, and it is transforming the practice of medicine.

How we prioritize the research is through expert peer review. We bring in a lot of international reviewers to look at our projects. We don't just evaluate the science; we evaluate the composition of the team and we evaluate the stakeholders involved and the training that they're doing. We evaluate multiple aspects of the project. They have to tick the box for outstanding world-class science.

Regenerative medicine research in Canada is, internationally, at the top end. However, ultimately, it's peer review.

Mr. Gerald Soroka: With all the research you're doing, are you finding that you're coming across any barriers, such as either policies or programs, or something the government has initiated? Is there something you're having struggles with that you need help with?

Dr. Michael Rudnicki: There's probably a list.

Certainly the funding cycles that we've faced have made it difficult to roll out support on an annual basis. That's been an ongoing problem.

There are regulatory issues at Health Canada. We're working with all of the stakeholders and Health Canada to help move that along.

We would like to enhance the commercialization of some of our discoveries, but because of our funding agreement, we can't support research in companies. These are very small companies. We have to support the academic aspects.

What else is there?

Ms. Cate Murray: There's immigration.

Dr. Michael Rudnicki: Yes. Attracting people to work in labs and on projects is becoming increasingly difficult. For example, I had a student I was trying to bring in recently. It took six months to get his visa approved. He almost decided to go elsewhere, where it was taking a lot less time.

These sorts of backlogs make it very difficult to bring in people, and it's harder and harder to find people to work in labs.

Mr. Gerald Soroka: That's quite an interesting thing. You said that stem cell research is such a success in Canada. I really thought you would have no problems retaining researchers, keeping Canadian jobs or Canadian researchers right here in Canada, but you're already asking to bring them in from other countries.

Is it still sustainable to have Canadians, or do we need a lot more researchers from around the world?

Dr. Michael Rudnicki: We are absolutely an area of international strength. Many Canadians have gone through our training programs. According to a study that we conducted internally, because of our community and the network we've built, they tend to stay in Canada. The retention rate is very high. However, because we are at the top tier of research, we attract many people from abroad.

I have a post-doctoral fellow who did his Ph.D. in the U.S. He was originally from Sri Lanka. He has applied for his permanent residency. He wants to stay in Canada. He's an outstanding scientist. I've had many other trainees stay in Canada and get positions at universities or work in companies, and so on. He's still waiting to hear about his permanent residency. It's really slow these days.

It is a real win-win for Canada when these people decide to stay and make Canada their home.

Mr. Gerald Soroka: That's good to hear because a lot of times we hear that most are leaving Canada to go to other places, so if they are able to stay here....

I see I'm getting the green card.

My question, then, is for Ms. Murray.

You had spoken about how stem cells can almost cure everything. As the moonshot, is the ultimate goal that stem cells will be able to basically even regenerate limbs? Is that a potential? Do you think stem cells can cure everything?

Ms. Cate Murray: Stem cells have significant potential to treat all sorts of chronic disease, rare disease, illness—

The Chair: Could I rudely interrupt, Ms. Murray? Mr. Soroka's time is up.

Mr. Soroka, perhaps you would like to ask Ms. Murray for a written answer there.

● (2000)

Mr. Gerald Soroka: Yes. I would prefer a written answer to that as well. Thank you.

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

Again, we're very grateful to our witnesses.

We will now go to Monsieur Lauzon for six minutes, please.

[*Translation*]

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

Good evening. Thank you all for being here.

[*English*]

Thanks, everyone.

I will ask my question in French.

[*Translation*]

A number of things you said piqued my curiosity, so much so that I set aside almost all of the questions I was going to ask because now I have new ones.

Mr. Banerjee, you talked a lot about infectious diseases. In my riding, we had a situation involving chronic wasting disease, and thousands of animals had to be killed just as a precaution, because the science couldn't show whether an animal was infected or not.

You mentioned a number of extrinsic factors that may be driving the transmission of pathogens from bats or other animals.

Has your research shown that artificial intelligence could play an important role if we had more specific data in the face of situations like the one in my riding?

[*English*]

Mr. Arinjay Banerjee: Thank you for that question. That's a fascinating question. In fact, there is data as of last week for this, so this is very timely.

My colleague, Dr. Raina Plowright at Cornell, just published a 25-year longitudinal study identifying factors that directly impact pathogen shedding from wildlife species such as bats. It identified migration patterns and nutrition deficiencies in wildlife that trigger pathogen spillover from these animals.

I think that, yes, modelling could predict this, but zoonotic transmissions are very nimble events. They are very rare events. A whole bunch of stuff has to align for the perfect storm for a pathogen to make it into humans. Again, there's a whole body of studies that look at how successful transmission events happen from animals into humans.

Yes, I think data-driven modelling is certainly a good place to start. You can imagine the diversity of mammals on this planet. Where would you sample and what would you prioritize? I think having that surveillance and having that modelling to estimate certain focus points for sampling and monitoring would be a very good place to start.

[*Translation*]

Mr. Stéphane Lauzon: Thank you.

Do you use that data in your research?

How could the government support those types of projects so that they become moonshots?

[*English*]

Mr. Arinjay Banerjee: There are very good surveillance programs in the U.S., and not just within the U.S.—American colleagues are surveilling overseas.

I think what we really lack in Canada—this is through conversations with my colleagues in Canada—is that we really don't do surveillance. We don't have a good surveillance model for our own country. We have very little in terms of surveillance for threats overseas that may come on an airplane into our country. Zoonotic events are not restricted to Canada. These events could happen anywhere on the planet and if it gets on a plane, in less than 24 hours the pathogen could likely show up on our borders in Canada.

I think that having some sort of a program that will complement.... I was listening to the previous panel about how moonshots could potentially be international collaborations. For zoonotic pathogens and for emerging infectious diseases, we absolutely need to work with our colleagues overseas. We can't go in and start sampling in countries overseas without collaboration from colleagues in that country.

Data sharing is another critical aspect. If you're trying to identify pathogens, why would somebody want us to surveil their country if their pathogen would have trade implications for them? An example is rinderpest in livestock.

Something we need to be cognizant of when we are designing these studies is empathy. I always use this in the classes I teach. Perhaps we must also identify what is mutually beneficial—not only identify threats, but propose solutions.

Mr. Stéphane Lauzon: Thank you for the answer.

[*Translation*]

I have a question for you, Mr. Singh.

I was quite inspired when you spoke about credibility, imagination and inspirational moonshots. You talked a lot about how we could improve the way we farm.

Recently, the government established living laboratories involving farmers. They will carry out research activities on the soil to support reduced fertilizer use and nitrogen fixation. The idea is to find ways to farm differently to benefit human health.

Could there be more government programs to support new ways of farming?

● (2005)

[*English*]

Dr. Baljit Singh: Thank you very much.

The answer is yes, there could be other ways. The most critical way would be integrating our system and aligning it with the moonshot idea. Right now, we have quite a bit of fragmentation in our ecosystem, coast to coast. That's where the imagination part comes in—to bring it all together.

I think my time is up. I'm happy to send a written note to the honourable member, if he so desires.

The Chair: Thank you so much.

[*Translation*]

Mr. Stéphane Lauzon: Madam Chair, I would like the witness to get back to us with more information. I would greatly appreciate it.

Thank you.

[*English*]

The Chair: Thank you, Monsieur Lauzon.

Thank you to Dr. Singh for the kind offer.

[*Translation*]

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

Mr. Maxime Blanchette-Joncas (Rimouski-Neigette—Témiscouata—Les Basques, BQ): Good evening, Madam Chair. It's nice to see you again for the second hour of today's meeting.

My questions are for Mr. Banerjee.

The COVID-19 pandemic drastically changed how we do things when it comes to funding, research, co-operation and, obviously, scientific communication.

I'd like to hear how things changed for you.

[*English*]

Mr. Arinjay Banerjee: Thank you for the question. I think I'll step back a couple of years.

When COVID-19 showed up, we were one of the first to mobilize. At the time, I was at McMaster University and the University of Toronto. I think the biggest challenge we faced was in personnel. We had no personnel capacity in Canada to work with risk group 3 pathogens. When we were planning to isolate the virus and use it to develop therapeutics and vaccines, the first thing we had to do was start training people. I was fortunate that I had done my Ph.D. on highly pathogenic coronaviruses, so we were able to mobilize people and train teams of experts who could start working with SARS-2.

What's been very fascinating is the amount of collaboration that came out of this. I really think the virology community in Canada, and my colleagues working across disciplines.... Everybody stepped up. Everybody came through. We worked long hours and nights to get this virus out and share it with colleagues who were studying it, in order to help vaccine development studies. I'm a naturalized citizen, so I'm an immigrant to Canada. I was extremely impressed by the hard work my colleagues in Canada, across disciplines, put into studying and understanding this virus. I was very moved.

At the same time, I was also very frustrated that while we were studying the virus, we were also writing research grant applications. I didn't understand why the money couldn't come in to help us identify this pandemic-causing virus. At the time, it was called a “novel coronavirus”. My colleagues and I were all writing grants to keep funding the studies we were doing to help Canadians and the global population.

It is very refreshing for me to see all these major infrastructure investments made by the Canadian government to facilitate studies that require high-containment facilities. At the same time, a part of me worries a bit. Will this funding be sustainable? If we don't continue to train our trainees....

I work in a high-containment lab. It takes us three to four months to train someone so they can competently work without supervision. Each time they graduate or leave, because the program's been defunded, it takes us three to six months, again, to train someone. God forbid a new pathogen shows up. That's just too late. I'm very worried about long-term sustainable funding.

It would be great to keep Canada at peak performance for high-risk pathogens.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you.

Mr. Banerjee, you mentioned funding. It always comes down to funding, as you know.

Canada is the only G7 country that wasn't able to produce its own COVID-19 vaccine. How do you explain that?

[*English*]

Mr. Arinjay Banerjee: I think it has been widely acknowledged that we didn't have biomanufacturing capacity in Canada. Again, for me, it's very refreshing to see that we are making those investments. We may not be as impactful for COVID-19, but COVID-19 is probably on its way to becoming endemic, and we may need seasonal shots.

Perhaps it's not too late for us to develop homemade vaccines to continue with the booster programs moving on, and hopefully the industries will stay. We at VIDO are fortunate to have received funding for a vaccine manufacturing facility.

I think this has been a huge learning step for us, and hopefully we'll continue to build on it and not lose momentum.

● (2010)

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you.

Mr. Banerjee, you said recurrent funding was crucial for research and development.

From what you've seen and experienced, what would you say are the consequences of Canada's current disinvestment in science and research?

The facts speak for themselves. Canada is the only G7 country that has cut its research and development spending over the past 20 years.

In concrete terms, what consequences is that decision having, given what you are seeing?

[*English*]

Mr. Arinjay Banerjee: My colleague previously alluded to a loss of trainees, and I really believe in curiosity-driven science. I'm part of Let's Talk Science and I talk to school kids. You see the spark in their eyes. The children, by nature, are extremely curious. Our kids are very curious. If you take away the ability for them to live on with their curiosity, what would you do? I can't imagine my life in a country or in a world where I can't be curious. I think that's what science enables us to do. We can retain our curiosity.

You wanted some metrics. With regard to the loss of trainees, when we lose trainees, we are losing not just.... I can only speak to virology. I'm a virologist by training. However, every facet of science is dependent on the next generation of scientists.

I only recently transitioned from being a postdoc to having my own lab, so I really know how difficult it is to be a postdoc with the salary we pay our postdocs in Canada. I try to make every effort to pay them a livable wage so that they'll continue their postdoc studies and see science as a career that's possible financially and in terms of having a family life. That's what I'm trying to create within my lab.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you.

Given the facts we just talked about and since you brought up funding, I'd like to hear what you think the federal government's priorities should be. Should it focus on moonshots, new structures or new programs—

[*English*]

The Chair: Monsieur Blanchette-Joncas, I'm sorry. That's your six minutes.

If you would like, you could ask Mr. Banerjee for a written answer.

[*Translation*]

Mr. Maxime Blanchette-Joncas: I would like a written answer, please, Madam Chair.

Thank you.

[*English*]

The Chair: Thank you so much, Monsieur Blanchette-Joncas.

Just let me say thank you again to all our witnesses. You're very gracious. We appreciate your time and expertise.

Now we will go to Mr. Cannings for six minutes, please.

Mr. Richard Cannings: Thank you.

Again, thank you to all the witnesses here.

I'll continue with Mr. Banerjee, especially because I see proudly displayed behind you a book on bats by my friend Brock Fenton and others.

You talked briefly about monitoring. I'm a bird biologist and once actually had funding from a health agency to monitor birds for West Nile virus for one season. It helped us immensely in our work. We were just trying to calculate bird population trends, but as soon as we discovered there was very little West Nile virus in the bird population, they seemed to lose interest.

These moonshot programs are, by their nature, very collaborative big projects that involve different scientists from different aspects. I'm just wondering how you would see something like your project, One Health, organized. Is it international? Is it Canadian? How do you see the organization and the funding of it flowing?

Mr. Arinjay Banerjee: Thank you for the question. It's an excellent question.

This is something we do have an application in for, under the New Frontiers program, the transformation stream, which is about $24 million. It's a big enough program, but it's also extremely competitive, and the program funds only about six grants.

My take on One Health comes from an infectious disease perspective, because that's my bias, but we are also cognizant of the idea that infectious diseases also depend on climate change, animal health, human health and the health of the environment in general. This program, if I were to propose it, would certainly be an international program. We can't do world-class science in silos, but Canada does have an opportunity to lead it. We have all the ingredients in Canada to lead an international moonshot program, starting from surveillance, with what I would perhaps call intelligence gathering and risk assessment—we have colleagues who are exceptional at modelling and identifying which pathogens are likely to be the next epidemic or pandemic—therapeutics and vaccine development.

With Canada's infrastructure investment through BRIFs and CBRFs, we have capacity in Canada to develop vaccines and therapeutics and to test them. Finally, there are colleagues who are very good at developing policies who could come up with outbreak mitigation policies.

An international One Health program led by Canada but would have global impact is what I would see as a moonshot program.

● (2015)

Mr. Richard Cannings: Thank you.

I also want to pick up on something that Mr. Blanchette-Joncas was mentioning and that you were commenting on as well, which is just the basic support for the people in science, especially the students. We've heard before in this committee and in other studies the fact that the amounts for scholarships funded by the tri-council for master's programs and Ph.D. programs haven't gone up since 2003. Post-doctoral fellows are a little better off, but we need to increase the amounts of those and the numbers just to keep students here in Canada so that they can be there for these moonshots and other things.

I wonder if you could comment on the value of this government making those investments.

Mr. Arinjay Banerjee: I fully agree. I'll give you an example. A post-doctoral fellow in my lab was considering moving to the U.S. because they have a K99 fellowship program. The funding from it gives you a much higher salary, and you also get investments to kick-start your own lab. In some ways the government is investing in the top talents to keep them in their country. I'm very glad the CIHR has now come up with a targeted fund that's very similar to the K99 program, but it is still not as broad and wide as we would expect in Canada.

Most colleagues of mine, most post-doctoral friends of mine, go to Boston or somewhere else in the U.S. for a post-doctoral studies, and they find jobs. Why can't we keep them in Canada and offer them competitive salaries so they can kick-start their own laboratories and chase blue sky science? I think there is absolute merit to doing that and to keeping our trainees here in Canada. I fully agree.

Mr. Richard Cannings: Thank you.

I want to turn to Ms. Murray and Dr. Rudnicki to comment on that as well. You're coming from, perhaps, a slightly different space but....

Dr. Michael Rudnicki: I've had students tell me that they're going to write up their master's thesis and not pursue a Ph.D. because they can't afford to live. This is an equity issue. If you don't have parents helping you, you can't pursue a graduate degree. The approved pay for post-doctoral fellows is $42,000 a year from CIHR. Well, if you have little kids at home and you're trying to make rent, you can't live on that in Toronto, and it's very hard in Ottawa. Both spouses have to work, but they're living in a tiny apartment and they don't have a car. It's very hard to live, so people are leaving.

Mr. Richard Cannings: That's right. It's $17,521 for master's and Ph.D students.

Dr. Michael Rudnicki: That's correct. It's below minimum wage.

Mr. Richard Cannings: Do I have much time, Madam Chair?

The Chair: You have 20 seconds.

Mr. Richard Cannings: I will cede my time. Thank you.

The Chair: You're always so gracious, Mr. Cannings. Thank you for that.

We will now go to the five-minute round. This time we go to Mr. Mazier. The floor is yours.

Mr. Dan Mazier (Dauphin—Swan River—Neepawa, CPC): Thank you, Chair.

Thank you to the witnesses for coming out this evening. This is going to be for all of you, and you'll all get a chance to answer this question.

According to a report released by the Vancouver Public Library Skilled Immigrant InfoCentre, 33% of biotechnology and life sciences employers in Canada are reporting skills shortages and 20% have job vacancies in their companies.

How significant is the skilled labour shortage in the Canadian biotechnology industry?

● (2020)

Dr. Michael Rudnicki: It's huge.

We're working very hard to address that with our training programs. We know from talking with companies like Stemcell Technologies that without our programs, they would have a hard time meeting their needs.

We need training. We need a full slate of students and post-doctoral fellows coming up. This is true across the sector, but people are not going into STEM because they think that it's not a way to pay their bills.

Mr. Dan Mazier: Dr. Banerjee, do you want to take it?

No. Okay, we'll ask another set.

When referring to potential solutions to address the skilled labour shortage in Canada, the president of BIOTECanada, Andrew Casey, stated, “I think you've got to look at the suite of things that may influence someone’s decision like the school system, the immigration policy, the tax policy”.

Do you think that if Canada recognized foreign credentials more quickly, we could attract more skilled labour from around the world?

Dr. Michael Rudnicki: I think we have to have accelerated certification programs. Often—

Mr. Dan Mazier: Could you expand on that? What does that mean?

Dr. Michael Rudnicki: A lot of the professionals, and I'm thinking for medical doctors and nurses.... Nurses have to write an exam in every province. That's kind of ridiculous. There should be national certification.

Barriers are put up. If you're a vet from Afghanistan, you may have a hard time getting into a vet school so you can spend a few years getting certified. It's that kind of thing.

For Ph.D.s, it's a lot easier. You find a lab that will host you as a post-doctoral fellow and so on, and away you go. You get your Canadian credentials or get your degree here. However, for foreign faculty, it's very difficult to get a job here in Canada doing research and teaching at a university, for whatever reason.

Mr. Dan Mazier: Very good.

Dr. Singh or Dr. Banerjee, have you anything to offer?

Dr. Baljit Singh: Thank you very much.

The shortage of skilled professionals is occurring across all sectors. In my role as vice-president, I hear form the private sector all the time. There are some mechanisms that we can ramp up in our country. For example, the tri-council funds a training program called the CREATE program, which has six-year-long funding. Dr. Banerjee is a graduate of that program. We brought him from Germany to come to Canada to do a Ph.D. and stay here.

We could also, within that program, create a bridging program for the new Canadians we bring here. Sometimes we do not connect them to meaningful training opportunities to get entry into the workforce.

I think we are a magnet for immigrants. If we could do that last piece of integration, we might have a pretty steady supply to the workforce into all of our sectors.

Thank you.

Mr. Dan Mazier: Excellent.

Mr. Arinjay Banerjee: Mr. Chair, I would just add very quickly that perhaps in graduate studies your future is not very predictable. That's perhaps what affects the ability of students to come to join a graduate program. If you go to a trade course, your future is predictable. If you want to do this—if you want to be a mechanic—this is how much money you're going to make. If you come to do graduate school, everything has a big question mark at the end of it.

How do we convince our future students to come to join graduate school?

Mr. Dan Mazier: Dr. Singh, I wanted to expand a little bit more on what my colleague Mr. Lauzon was talking about on the agriculture moonshot program. That's near and dear to my heart.

Would you, in 20 seconds, expand on that a little bit more? What would that look like, especially here in Canada and working on a North American type of approach?

Dr. Baljit Singh: That is one moonshot idea for which we have literally every ingredient in place in our country. That goes from the supply chain systems to innovation to artificial intelligence to quantum to public policy frameworks and really to the land, the water and the energy.

The question is, can we have the whole country saying what people used to say in the 1960s? It didn't matter who was working on the project; they would say, “I am putting a man on the moon.”

Can we as Canadians really think about that? I am feeding the world. I can bring the pieces together—

● (2025)

The Chair: Thank you, Dr. Singh. It was really good of you to keep that so tight.

Thank you, Mr. Mazier.

Now we'll go to Ms. Bradford for five minutes, please.

Ms. Valerie Bradford (Kitchener South—Hespeler, Lib.): Thank you, Madam Chair.

Thank you so much to all of our witnesses tonight. It's been a very educational and fascinating evening so far.

I had the benefit of attending the Sprott Centre at Ottawa General last week. It's their centre where they focus on regenerative medicine. I'm so happy that you were both able to join us in person tonight.

Ms. Murray, your opening remarks were very inspiring and compelling for all of us.

I wanted to point out that while I was there, it felt like the United Nations. It seemed like just about all of the students were international and had come from somewhere else. I think it's because of the excellent work that you're doing there and your reputation, Dr. Rudnicki, that they want to be here and they want to stay. I certainly hear about the struggles and frustrations with the immigration and visa process to make that happen.

We all know that it takes time to bring these therapies and technologies to market. Can you tell us what the Stem Cell Network plans to do over the coming decade to ensure that the research will be translated and benefit patients?

Ms. Cate Murray: I'm happy to take that.

Stem Cell Network is about following the research and supporting it as it develops. Clinical trials are a key piece of work that the Stem Cell Network invests in. We fund early phase I and phase II clinical trials. We support companies through research projects to ensure that those companies that are at the preclinical or clinical stage can develop the data, validation materials and packages they need to bring investors in on their projects. This is absolutely critical at the translational space. It's not widely done by organizations or networks like ours, and it's absolutely essential for moving research forward.

In fact, two of our projects and programs that we have been working on over the years on type 1 diabetes and premature infants with underdeveloped lungs will now be launching into clinical trials in December. These will be world firsts for Canada.

That's how we're moving things forward.

Ms. Valerie Bradford: That's very exciting. Thank you for that.

We always get down to the affordability aspect when we talk about health care. The affordability of...stem cell and gene therapies are known to be very expensive, because they're customized to the patient. Some would suggest that they could bankrupt our health care system.

What, in your estimation, needs to be done so that they can be effectively integrated in a cost-effective manner?

Ms. Cate Murray: That's a great question.

Access, affordability and cost structures are major conversations for this country to have, and for policy-makers such as you to be informed on and thinking about. Cell and gene therapies will be revolutionary for our health care system. The way that we think about them, where the costs will come up front rather than over a lifetime, is different from how our health care system thinks about these drugs and therapies at this point. We need to reconceptualize that.

We need to understand the values that Canadians have around cell and gene therapies and how to adopt them. We need to think about the tools that decision-makers need to be able to make decisions around what will be adopted by our health care system. This will take a number of years and all sorts of different voices at the table, from industry to academia and regulators.

The Stem Cell Network in our next strategic plan is proposing to do exactly that and bring those parties together so that by the time we get to 2030, we have the path forward in place. We'll know how to think about access and affordability.

The science is going to come. It's up to governments and the rest of us to think about how we make that sure these technologies are adopted and not lost to others.

● (2030)

Ms. Valerie Bradford: Speaking of others, there seems to be a lot of interest in travelling to locations outside of Canada for stem cell treatments.

Why do Canadians need to go outside of the country to locations like Mexico? Is it safe for them to do so?

She's flashing a card, so you'll have to be tight on that.

Dr. Michael Rudnicki: It's called stem cell tourism. If it sounds too good to be true, then it's often too good to be true. These can be very dangerous. Some of these patients have died. They have sprouted tumours and have had other adverse effects.

This has been an area of active study for many years in Canada, led by the Stem Cell Network. We're internationally known for this type of research and the dissemination of the dangers of these sorts of clinics.

Ms. Valerie Bradford: Thank you. I think the regulation in Mexico is not the same as here.

Thank you very much.

The Chair: Thank you, Dr. Rudnicki.

Thank you, Ms. Bradford.

Unfortunately, we've come to the end of our time for this panel.

I want to thank all our witnesses. Thank you for your testimony, for your answers and for your expertise. You've given the committee a lot to think about, and we hope that it's been a good experience and that we will continue to see you at the committee.

We will say thank you and we will briefly suspend before our third panel.

Thank you all.

● (2030)

_____(Pause)_____

● (2035)

The Chair: Dear colleagues, I'm going to call us back to order.

I'd like to welcome our witnesses.

I would like to make a few comments for the benefit of the new witnesses.

Please wait until I recognize you by name before speaking. For those participating by video conference, click on the microphone icon to activate your mike, and please mute yourself when you are not speaking.

For interpretation for those on Zoom, you have the choice at the bottom of your screen of either floor, English or French. For those in the room, you can use the earpiece and select the desired channel.

All comments should be addressed through the chair.

I'd now like to welcome our witnesses. We're delighted to have, from General Fusion, Amee Barber, director, government relations and business development, and, from the University Health Network, Dr. Kevin Smith, the president and chief executive officer.

We're grateful to both of you for joining us and we're eager to hear from you. You will each have five minutes to present. At four and a half minutes, I will hold up this green card, and it lets you know that you have 30 seconds to finish.

With that, we will now go to the testimony.

Dr. Smith, we will begin with you. The floor is yours.

Mr. Kevin Smith (President and Chief Executive Officer, University Health Network): Thank you, Madam Chair. It's a pleasure to be back with your committee.

My name is Kevin Smith and, as the chair said, I work at the University Health Network. I have the good fortune of working with literally thousands of researchers and research staff. I'm here this evening to enthusiastically support moonshot opportunities.

We have great infrastructure in Canada, thanks to investment. We have great science in Canada and remarkably talented scientists. The question before us is, how do we harness that talent and potential to solve the world's most pressing problems and provide answers to Canadians and policy-makers?

I'd like to recommend to the committee the moonshot program work done by the Brookfield Institute. I will quickly identify five policy recommendations the institute made for successful moonshots.

First, define a clear, grand challenge anchored in unaddressed real-world needs.

Second, facilitate policy innovation by giving delivery agencies lean, agile and independent governance structures.

Third, create a portfolio of moonshot projects that are truly cross-disciplinary, cross-sectoral and inclusive, and that embrace a range of different risk levels.

Fourth, support the full innovation continuum and value chain, from invention and basic science right through to manufacturing and commercialization.

Last, but certainly not least, focus on clear, central metrics that matter to the success of the grand challenge; in this case, show value to Canadians.

In 2019, we saw an important moonshot innovations publication called “Wishful Thinking or Business-as-Usual?” that truly helped us understand how moonshots are about imagining a desired world we may never eventuate.

I'll take us back to President Kennedy, who in 1961 mentioned we would get a man to the moon—or a person to the moon, in today's language—before the end of the decade. Eight years later, that was achieved. Few of us believe the microcomputer revolution that came out of that literal moonshot would have occurred, but it truly and fundamentally changed our economy, quality of life, scientific integrity and every facet of human society. Think of a world without microcomputing, if that moonshot had not been undertaken. Investment in discovery research fuelled an explosion in microcomputing and other important endeavours.

I hope the same will be true should the Government of Canada pursue a moonshot. Advances like these have created unprecedented opportunities to address society's most important challenges. Realizing these opportunities, of course, requires selection, development and targeted investments in breakthrough technologies focused on delivering rapid and transformative change.

At UHN, we envision a national strategy—one set, in large part, by your group—as the path forward to meaningfully advancing areas in this work. A national strategy would provide the necessary structure to select, enable and deliver on key areas of focus where Canada can and should lead. This is already happening in many other areas around the world, and it is also badly needed for Canada.

I would recommend a number of areas that immediately come to mind for me and my colleagues at University Health Network.

The one we talk about most frequently is a sustainable, universally accessible health care system—the one before us each and every day—that is adequately staffed as a moonshot that truly focuses on what is likely to be our next pandemic: antimicrobial resistance.

We talk about an opportunity to partner with our United States colleagues, with whom we do so much work together in science, to truly conquer cancer in our lifetime.

Last, but certainly not least, we talk about a moonshot that deals with brain disease and the scourge of dementia affecting so many Canadians.

If I could, I'd also encourage, in that moonshot thinking, understanding the basic science theme of inflammation, which spans almost every major chronic disease, and I'd also encourage reinforcing how moonshots rooted in basic science bear the most fruit of all.

In my mind, there is opportunity in looking at a structure that once existed in Canada in the early days of the Canada Foundation for Innovation, which I had the privilege of chairing for a period of time. It shows us a structure that can be extremely helpful to us. This would be separate and discrete from the importance of the tri-councils and CFI, which can and should continue to focus on funding investigator-driven, appropriate research questions.

● (2040)

I saw the green book go up, Madam Chair, so I will wrap up.

We at UHN are enthusiastic about the opportunities to champion moonshots that will affect all Canadians and indeed all citizens of the world, enabling the best of Canada to collectively focus and to bring the greatest challenges of our generation to resolution.

Thank you for the opportunity to address your committee.

The Chair: Thank you so much, Dr. Smith.

I hope the committee will not mind me saying this. I'd like to thank you for your work over the last two years particularly. Thank you for your life-saving work, from you and your colleagues, and thank you for your testimony today.

I'm delighted that we will now hear from Ms. Barber, the director for government relations and business development at General Fusion.

The floor is yours.

Ms. Amee Barber (Director, Government Relations and Business Development, General Fusion): Thank you, Madam Chair.

Thank you for having me this evening. It's an honour to be able to discuss a visionary moonshot program with an all-party committee. I appreciate your time so late in the evening.

The problem that General Fusion seeks to solve is environmental. Our technology will produce electricity with zero emissions. By 2050 there will be a 265% increase in global electricity demand. In that same year, 33 countries, including Canada, have pledged to reach net zero in electricity production.

Although progress has been made introducing decarbonization strategies, the International Energy Agency reports that 50% of the reductions will likely come from technologies that have yet to be commercialized. This makes sense. We haven't had a new clean energy source introduced to the grid in a very long time.

A Canadian moonshot program should focus on bringing forward new energy sources, such as fusion. Fusion is the energy that powers the stars, when two hydrogen atoms fuse and release a neutron and helium. To harness that energy, we need to replicate the conditions of the sun on earth to achieve net energy.

There are primarily four reasons that fusion energy is hailed as the holy grail of energy.

One is that fusion fuel is abundant and energy-dense. Fuel is extracted from seawater. One kilogram of fuel is equivalent to 10,000 tonnes of coal.

Fusion is also carbon-free. There are no harmful atmospheric emissions from the fusion process.

Fusion can provide utility-scale energy on demand as well, making it an excellent complement to renewables and to battery storage.

Finally, fusion energy is also low risk. Fusion is the opposite of fission in many ways. It has a risk profile that is akin to medical isotopes and is both well understood and well regulated. It does not use special nuclear material; it does not have long-lived radioactive waste; and it does not have risk for criticality accidents.

Because of these benefits, our company, General Fusion, has been pursuing fusion energy since 2002. Since then we've secured over $300 million U.S. We currently employ over 200 people in Vancouver and have over 150 patents.

I'm not a technical expert, but I'll tell you how our technology works. We inject magnetized hydrogen plasma into a steel vessel that is coated with liquid lithium metal via centrifugal force. From there, high-powered pistons compress the liquid metal around the plasma into a perfect sphere, creating high temperatures and pressure. At that point, fusion occurs.

Our real game-changer and our competitive advantage compared with many of the other players is our proprietary liquid metal liner. This allows the machine to be protected from spinoff neutrons. At the same time, those neutrons interact with the liquid metal wall and produce tritium, which in essence is producing our own fuel supply. Third, the hot liquid metal then runs through a heat exchanger and produces electricity. Lastly, our use of mechanical compression with this liquid metal wall avoids the need for expensive magnets and high-powered lasers to sustain the fusion process. This results in a cost of electricity that is equivalent to coal.

Over the past 20 years, we have proven the core components of our system. We're now at the stage to assemble these together into our fusion demonstration program. In partnership with the UKAEA, we will build a prototype plant that will be 70% the scale of a commercial plant and located next to the record-breaking Joint European Torus at the Culham Centre for Fusion Energy.

At the same time that we build this plant, our brain trust in Canada will remain busy building out the commercial maturation program. Our objective is to put energy on the grid by 2030. Within the past two years, a significant number of factors have converged that will make us very—

● (2045)

[*Translation*]

Mr. Maxime Blanchette-Joncas: Madam Chair, sorry to interrupt the witness, but the interpretation has stopped.

[*English*]

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

I'm sorry to interrupt, Ms. Barber.

[*Translation*]

Mr. Maxime Blanchette-Joncas: The interpretation stopped a few seconds ago.

[*English*]

The Chair: Thank you so much, Monsieur Blanchette-Joncas.

Could we try to see if we have translation now, please?

Ms. Barber, would you like to try talking to see if we have translation, please?

Ms. Amee Barber: Sure.

The Chair: Thank you.

Ms. Amee Barber: In the past couple of years, a significant number of factors have converged, which makes us confident that we can achieve net energy by 2030 and on the grid—and the fusion industry in whole.

First, significant private investment in the fusion industry has increased by 163% in the past two years, and 40 companies are now competing in the race. National governments are also following suit with their public investment. The U.S. government spends the most, with $600 million U.S. to $700 million U.S. per year, and the Inflation Reduction Act is to authorize $280 million U.S. as well for fusion energy. Similarly, the U.K. has invested 400 million pounds.

The Canadian government's investment lags far behind. The existing grant programs have been critical to our success so far, but they are not sufficient to sustain the type of growth for the commercial scale that we are at and this stage in our development. For this reason, we've put a request before the Canadian government for $250 million over five years in exchange for warrants from which the government can make a direct return on its investment, proportionate in many ways to the private investment, and a commitment for us to maintain our headquarters in Canada.

A Canadian moonshot program that directly invests in General Fusion would leverage private sector investment, position the Canadian government as an equity partner—

The Chair: Ms. Barber, I'm sorry to interrupt.

Ms. Amee Barber: No, that's good.

The Chair: You're very gracious. Thank you. You have a very interested committee. They will follow up with questions.

I'd like to thank both Ms. Barber and Dr. Smith for joining us.

With that, we will go to our first round of questions. They are for six minutes, and we begin with Mr. Mazier tonight.

The floor is yours.

Mr. Dan Mazier: Thank you, Madam Chair.

Is it Dr. Barber or Ms. Barber?

Ms. Amee Barber: It's doctor.

Mr. Dan Mazier: It's doctor. Okay.

The Chair: Is it Dr. Barber? My apologies, Dr. Barber. My heartfelt apologies.

Mr. Dan Mazier: There you go.

The Chair: Thank you, Mr. Mazier.

Mr. Dan Mazier: I get a restart, right?

Voices: Oh, oh!

The Chair: Absolutely, you do, and a huge thanks.

Mr. Dan Mazier: My questions are for you tonight, Dr. Barber.

I have read some articles on fusion technology and investment in the United States. It seems there's quite a bit of private money going into the U.S. economy. Commonwealth Fusion Systems announced it has more than $1.8 billion in funding for commercialized fusion energy. Helion Energy secured half a billion dollars for fusion technology, with another $1.7 billion waiting. TAE Technologies has raised $250 million in its latest funding from investors like Chevron and Google.

Why is most of the private investment into fusion technology going into the United States instead of Canada, and how can we attract more investment here?

● (2050)

Ms. Amee Barber: We have actually attracted a significant amount of investment into our company. We are one of seven of the 40 companies that have obtained over $200 million U.S., and we are the only Canadian horse in the race.

I do believe that we can attract more funding by demonstrating at-home support—that being government funding—and sustained, continued patient capital. Some of the questions we receive from investors include “Where and to what extent is your government support, and how is the government at the table?” I think that would definitely incentivize investment.

Particularly to this committee, I also believe that we need to strengthen our investment in the academic institutions that are pursuing fusion. We've received over 17 letters of support for our recent budget proposal from academic institutions that are extremely excited to build out their fusion capabilities and the unique challenges and spinoff effects that it would produce for the economy. I think a commitment to see and to build talent at home would definitely also attract international investment.

Mr. Dan Mazier: The Fusion Industry Association's 2022 report noted that out of 33 private fusion technology companies in the world, 21 were in the United States. Only one, your company, was located here in Canada.

The Americans don't have a carbon tax, but they have a lot more money flowing into their country for this clean technology. Why is this?

Ms. Amee Barber: Do you mean in terms of public or private investment?

Mr. Dan Mazier: I mean private.

Ms. Amee Barber: In private investment, I do believe that we are attracting quite a bit of attention proportionately. Again, I think it comes down to the public sector endorsement of fusion energy.

The White House, in 2022, just this past March, released what's called “a bold decadal vision for...fusion energy”, in which they've endorsed fusion as part of the future energy mix and committed to seeing its development. Again, the $280 million was for the construction of pilot plants.

If there were a framework that offered that kind of certainty to investors, we might see more private funds coming. We are confident in our capacity to raise funds, but we would like to see a greater government commitment. We believe that would pave the way for more.

Mr. Dan Mazier: Has the Canadian government endorsed fusion energy?

Ms. Amee Barber: It's in the process of doing that, and we are confident. There are regulatory engagements and engagement at all ministerial levels, but we are hoping for a national declaration and endorsement of fusion energy.

Mr. Dan Mazier: How many years have you been doing research on this?

Ms. Amee Barber: We've been doing this for 20 years.

Mr. Dan Mazier: General Fusion is planning to build a $400-million demonstration energy plant in the United Kingdom. Four hundred million dollars is a very significant amount of investment. Why isn't this investment being made here on Canadian soil?

Ms. Amee Barber: It's a good question.

As I mentioned, our research and our labs will remain within Canada as we're building out the fusion program there. We did receive support from the United Kingdom Atomic Energy Authority for capital expenditures, which is something that is limited within our existing grant programs in Canada, particularly for research-based capital expenditures.

On top of that, as I mentioned, we are going to locate our demonstration program adjacent to the Joint European Torus, which holds the longest record for net energy reaction, so we have access to their concentration of talent. We also will have access to a supply chain, and that space is actually already regulated for fusion energy and inviting to it.

Mr. Dan Mazier: Has the U.K. endorsed fusion energy?

Ms. Amee Barber: Yes.

Mr. Dan Mazier: I guess, then, that probably because Canada has not endorsed fusion energy, you decided not to build here.

Ms. Amee Barber: Also, there is no current regulation for fusion energy. We are very eager to see an opportunity to build out our first commercial site within Canada and have struck a number of partnerships with entities like Bruce Power and the Canadian Nuclear Laboratories to—ideally—bring that here.

● (2055)

Mr. Dan Mazier: Okay.

You mentioned in your submitted remarks that—and I quote—"...Canada's well-known commercialization gap is what could hamper the potential for these disruptive technologies to be delivered to market." That's a very troubling statement. If this government fails to address a "well-known commercialization gap"—

The Chair: Mr. Mazier, I'm sorry. That's the time. Perhaps you would like to ask Dr. Barber for a written response.

Mr. Dan Mazier: Yes. That would be good.

The Chair: Thank you.

Mr. Mazier, I will also thank you for correcting the honorifics for Dr. Barber.

It is really very important that we get this right, so I'd like to say thank you, and I would like to apologize to Dr. Barber.

Thanks to both of you.

We will now go to Ms. Diab for six minutes, please.

Ms. Lena Metlege Diab: Thank you very much, Madam Chair.

Let me start by thanking both Dr. Barber and Dr. Smith for being here today. We're really honoured to have both of you here with your talents and expertise.

Let me direct my question to you, Dr. Smith.

We're here to study ambitious research goals that we hope will solve some of Canada's and the world's biggest challenges. I'm really happy that you ended with giving us your input in terms of what national strategy you believe Canada should be leading on in a number of areas.

You talked about sustainable health systems adequately staffed, and I'm very interested in the area of brain disease and dementia that is affecting so many Canadians. Can you tell us a bit more about that, and what government can do, what we can do as parliamentarians, what researchers can do and how you and others as well can help to move this along?

Mr. Kevin Smith: Thank you for an excellent question and the privilege of talking with you.

Speaking of dementia and brain disease, organic brain disease is particularly a disease of aging. While Canada is still a young society relatively, we are, of course, an aging society. We also look at the expenditures of health care, which provincially approaches 50¢ on every tax dollar during COVID and around 42¢ pre-COVID. It's by far Canada's most expensive social program and, I would suggest, possibly the most valuable.

When we look at dementia, we see remarkable basic science with great understanding of the underlying issues of dementia and disease. We see wonderful clinical trials and fantastic infrastructure around better understanding population-based research as it relates to dementia and dementia care.

Of course, there's more and more interest from philanthropy. Generous donors are investing $250 million per year in research and education through the two foundations of the organization that I work with, the Princess Margaret Foundation and the University Health Network.

We bring together the remarkable scientists who are aligned around dementia care. I would encourage you to also look more broadly into the technical disciplines as we think historically about traditional research teams. Traditionally, they wouldn't have included AI scientists, data experts, data lakes or all sorts of remarkable engineering colleagues and academic engineers.

We truly are at the cutting edge in Canadian science, literally across every discipline. It can be brought together for a true moonshot on brain disease and particularly dementia, which we know is what most Canadians identify as one of their greatest fears of aging.

Ms. Lena Metlege Diab: Thank you very much for that.

My colleague has a question as well. I'm going to let Dr. Powlowski ask it.

Mr. Marcus Powlowski: I have a question for Dr. Smith.

I think, if you were to ask Canadians what would be, in their judgment, the greatest moonshot, it would be a cure for cancer.

If we look at how both in Canada and globally we responded to the pandemic and how well we did, how quickly we came up with a vaccine, it really showed what was possible.

Is the same thing possible for cancer? Is it a matter of having the political will and being willing to put the money in? Could we come up with a generalized cure or a cure for individual cancers within a reasonable amount of time if we are willing to put the money and effort into it?

● (2100)

Mr. Kevin Smith: I absolutely believe that we can dramatically improve the journey. Cancer patients in Canada have come a long way. Cancer has become, in many cases, somewhat of a chronic disease with a recurrence of cancers and people's mortality being dramatically reduced. When I look at childhood leukemia particularly, it's almost eradicated.

Absolutely, we have the capacity to do that. I also think that the declaration by the United States and President Biden that cancer is their moonshot offers a North American consortia of cancer care and cancer research. It also allows us to stop the brain drain. All of our most remarkable cancer scientists will be potentially drawn to the United States with an unknown investment in cancer prior to this commitment. By aligning ourselves, because science knows no borders, as you folks know, we really and truly are able to leverage the investment of multiple economies. I would absolutely and enthusiastically endorse cancer as that moonshot.

Mr. Marcus Powlowski: If I still have time, you may want to use this opportunity—

The Chair: You have 45 seconds, Dr. Powlowski.

Mr. Marcus Powlowski: Are there any projects at UHN cancer research that you think are particularly promising?

Mr. Kevin Smith: I think one place where the provinces and the Government of Canada can come together as a first in the world is the Princess Margaret Cancer Centre and the broader Toronto cancer community. We do not have the number of facilities we see arise in the United States and other parts of the world, carbon ion facilities and beyond. As we think about new treatment approaches that are proving less damaging to surrounding tissue and giving more positive outcomes, I think we absolutely can focus again on new therapies and new treatments. Canadians currently have to leave the country for proven technologies.

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

As you can see, you have a very interested committee. We're all very grateful for you both being here.

We'll now go to Monsieur Blanchette-Joncas for six minutes.

[*Translation*]

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

I want to give you a heads-up that I'm going to take five seconds at the end to speak to my motion, which was put on notice today.

My first question is for Mr. Smith.

The University Health Network conducts cutting-edge research in multiple health care fields, in order to develop new expertise and identify new therapies that will benefit human health. Cardiology, neurosciences, oncology, infectious diseases and genomic medicine are just some of the network's research fields. The needs in health care are, without question, tremendous.

With that in mind, I'd like to hear your thoughts on how the government should allocate health care research dollars.

[*English*]

Mr. Kevin Smith: It's a great question, Monsieur.

I think the challenge, obviously, is whether we're going to focus the moonshot and be very purposeful about outcome, metrics and measurement, or whether it will be a continued investment through the tri-councils and beyond, including industrial research.

My own personal view is that it has to be both or all of the above—philanthropy, the tri-councils, investment by provinces and investment in infrastructure.

Then it really will come back to a strategic plan within each of the institutions and across collaborative institutions, which will talk about what kind of investment they're receiving and what kind of results they're expecting. It will then bring together evaluators to ensure that Canadians are getting the greatest value for money, whether that's a traditional research measurement—high-impact journals, highly cited work or work that translates into patents and discoveries that can then generate an economic benefit—or whether it provides results in a more traditional academic environment through the creation of basic science that can be exploited.

My own view is that we have a healthy research ecosystem in Canada, but we have vulnerability. We're seeing other nations invest a great deal more. We're seeing, as an example, that at the National Institutes of Health, the current U.S. administration is offering a $10-billion increase, which is actually the collective investment we make in the tri-councils.

To me, it means keeping pace with other nations' investments and ensuring that the brain gain we enjoyed 10 to 20 years ago continues and that researchers see Canada as a bright and vibrant place to remain.

● (2105)

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you, Mr. Smith. That was very clear.

Moonshot programming channels a lot of money into a small number of projects. As you know, support is desperately needed in a number of health care fields. If we pour a lot of money into expensive moonshots, are we likely to overlook other equally important research projects?

[*English*]

Mr. Kevin Smith: It does require us to discuss what a healthy ecosystem looks like. What does the continuum look like? Does it need to be a disease-specific moonshot, or could it be an underlying scientific theme that we understand has relevance to many disciplines and many diseases, and hence my comment on the inflammatory response?

Where I work, the focus for almost all of the diseases is on inflammation and repair. Be it heart disease at the Peter Munk Cardiac Centre, organ transplantation at the Ajmera Transplant Centre or brain disease at the Krembil Brain Neuroscience Institute, the underlying theme is truly inflammation and repair and the sequelae of inflammation. A moonshot that would benefit almost the entire scientific ecosystem as it relates to health and human well-being would be a very fundamental basic science investment. My own personal view would be that it should be inflammation.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Thank you.

Leading-edge science is a highly international playing field, so the competition is very fierce. Countries have to compete with one another to keep their best and brightest and attract talent from elsewhere. Canada is struggling to compete with other developed nations. Canada is actually the only G7 country where the number of researchers per thousand people dropped over the past six years.

I'm eager to hear your view. Why do you think Canada is having such a hard time attracting and keeping scientists?

[*English*]

Mr. Kevin Smith: For researchers, obviously their first loyalty is to their science and finding the antecedent conditions for success. That means availability of research funding and availability of funding for students—and your previous panel spoke about this—and availability of a livable wage for those undertaking fellowship training and beyond.

It's the opportunity for the expensive infrastructure that many research endeavours require, not unlike what the Canada Foundation for Innovation invests in. There is, of course, unlimited demand for tri-council funding. There is a very large amount of excellent science that we are unfortunately unable to fund.

Then there's the international competitiveness.

However, I don't think it has to turn us off or down. I see the green book, Madam Duncan, and I'll be quiet.

I have just a quick thought. Looking at international science, I don't believe we have to bring everyone to Canada. I think we can look at models like the Canadian Institute of Advanced Research and buy pieces of the very best researchers anywhere in the world, and they would come to Canada for periods of time. If COVID has proven anything, it's that we can collaborate around the world without movement, and nowhere more so than in science.

The Chair: Thank you so much.

[*Translation*]

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

Madam Chair, I'd like to discuss my motion, as I mentioned earlier.

[*English*]

The Chair: Monsieur Blanchette-Joncas, that's six minutes. Perhaps we could do that on a different round. I'm sorry.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Excuse me, Madam Chair, but I'd asked you to stop me when I had five seconds left so that I could move my motion. Did you miss that?

[*English*]

The Chair: Monsieur Blanchette-Joncas, I did it at the 30-second mark. Can we wait to do this in the next round?

[*Translation*]

Mr. Maxime Blanchette-Joncas: Unfortunately, not, Madam Chair. I might not get a turn in the next round.

You may not know, but when you hold up your card, I can't see it on the screen.

[*English*]

The Chair: Okay. Please be very quick, Monsieur Blanchette-Joncas.

[*Translation*]

Mr. Maxime Blanchette-Joncas: Here I go with my motion, then, Madam Chair. I'll be super quick.

The motion I am putting on notice, which the honourable members already know about, reads as follows:

That the deadline for the submission of briefs in relation to the study of research and scientific publication in French be extended to 5:00 p.m. on Thursday, December 22, 2022.

The members of the committee know that I have raised this issue before. In a nutshell, we are waiting for the Minister of Innovation, Science and Industry, François-Philippe Champagne, to appear. I've already invited him. In addition, the parties had reached an agreement on October 31.

The minister is expected to appear before the committee soon. The last I heard, he should be here on December 12, and I very much hope that's the case.

Many witnesses have told me that they want to wait until after the minister's appearance to submit their briefs. As per the agreement, we were going to extend the deadline for the submission of briefs by 10 days, to take into account the minister's appearance.

That's the purpose of my motion.

● (2110)

[*English*]

The Chair: Thank you, Monsieur Blanchette-Joncas.

Is there any discussion?

[*Translation*]

Mr. Stéphane Lauzon: Could we vote on the motion, please, Madam Chair?

[*English*]

The Chair: Thank you, Monsieur Lauzon.

Is there agreement to call a vote?

Mr. Dan Mazier: Yes.

The Chair: It looks like there's agreement. Mr. Clerk.

(Motion agreed to: yeas 11; nays 0)

The Chair: Thank you very much, Mr. Clerk, and thank you, Monsieur Blanchette-Joncas.

Now we will go to Mr. Cannings for six minutes, please.

Mr. Richard Cannings: Thank you to the witnesses. As usual, it's a very interesting discussion.

I want to start with Dr. Smith.

I just want to clarify something I thought I heard you say, and maybe I misheard it. Was one of the moonshots you were talking about a "sustainable health care system", or were you talking about a "research system"?

Mr. Kevin Smith: No, I was actually talking about a sustainable health care system and thinking about how we would create that, which would include basic research as well as pedagogical or educational research.

Mr. Richard Cannings: That's good. I was a bit surprised to hear that, but happily surprised, because I think 100% of Canadians would say they would be very interested in hearing about a sustainable health care system.

Perhaps you could expand on that with a bit of background. I remember one of the first things I read when I was getting into politics 10 years ago was a book by Jeffrey Simpson. I forget what it was called—"chronic care", or something like that. It was about Canada's health care system. He went through various ideas about how we could improve the system and make it more sustainable. It ended with the fact that if you look at the health care systems of the world, you see that those with the best outcomes for the money spent were those more or less in northern Europe where they invested in people up front. They made sure that they were well educated, didn't fall into poverty, stayed out of hospitals and stayed out of jail—all those things that are the social basis of health. Then they had a good health care system that could run properly, but it took that upfront investment.

I'm wondering if you could comment on whether that is still one of the pillars of a sustainable health care system.

Mr. Kevin Smith: Absolutely, Mr. Cannings.

When you think back to the chamber in which some of you are sitting, you may remember that it was Monsieur Lalonde, I believe, in the early 1970s, who really introduced the health of the population to Canadians. That really means not only an illness care system for when people are sick, but recognizing that education, housing, food security, eradication of poverty, and good drinking water are incredibly important components of health. Of course, for illness care it means strong delivery mechanisms.

We know currently that one of the greatest challenges facing our health care system is adequate health human resources. That challenge is not unique to Canada; it is around the world. When we think about the economics of health care, we realize it is one of the most expensive social programs, yet of course one of the most important, although I am a tiny bit biased.

That said, if we really want to look at the effectiveness of the system, often we need to look at the incentives that we've put within it.

I could think of a moonshot looking at the sustainability of a health care system, but would it include economists thinking about how we can better fund the system and better align our incentives to the outcomes that we're hoping for? Would it include thinking about data scientists and artificial intelligence experts who can help Canadians make better individual decisions? Would it include thinking about digital health that allows people with chronic diseases like congestive heart failure or chronic obstructive pulmonary disease to be able to be managed at home using downloadable, wearable devices, which are actually made right here in Canada by remarkable companies that are actually often more attractive on the international market than on our own Canadian market?

Last, but certainly not least, who are the extenders of physicians and nurses and therapists who we know could and should be brought to the health care system to make that health human resource issue get much better? We could easily think about a science-social, science-economics model of care by which we would bring together truly the most interdisciplinary team we could imagine to address both population health and the health care system of those who are ill and require treatment.

● (2115)

Mr. Richard Cannings: Thanks very much. I'll leave it at that, because we could talk about this for days, I'm sure.

I want to turn to Dr. Barber.

We just did a study on small modular reactors. The government, I think, has come up with almost $1 billion in funding to support these reactors, yet they don't seem to be supporting fusion at the same level.

In the time remaining, I wonder if you could compare where fusion is versus small modular reactors. You say you'd be on the grid by 2030. What are the ongoing costs of that? How would the costs of fusion energy be compared with SMR energy?

Ms. Amee Barber: We do have a timeline to be on the grid that's relatively comparable. We have received government funding in terms of SIF, IRAP and SDTC, but again, we are seeking a larger strategic partnership in contributions, say, with the government. We have proposed a structure whereby it would be warranties, which would position the government as an equity partner, as part of a large “raise” that we're currently in, much like the one that has just been awarded through Ontario Power Generation, and in partnership with the provinces.

We are seeking opportunities like that—federal government in partnership with other national governments, such as the U.K., and/or with provincial partnerships. Our timeline for development and deployment is approximately the same.

Yes, that's what we are seeking, and we do hope for support and endorsement.

The Chair: Thank you, Dr. Barber.

Thank you, Mr. Cannings.

Thank you to both our witnesses tonight.

Now we're going to go to the five-minute round. I see we have Mr. Williams.

It's lovely to have you back, Mr. Williams. The floor is yours.

Mr. Ryan Williams (Bay of Quinte, CPC): Thank you, Madam Chair. It's lovely to be back.

Thank you to our witnesses here today.

I want to start with Dr. Barber. It's very fascinating. It does seem that this is a definite moonshot.

I want to start by asking why you think Canada has the potential to be a leader with fusion.

Ms. Amee Barber: We have here all of the components we need. We have the labs. We have the fuel source out of Ontario, with the Canadian Nuclear Laboratories. We have utilities that are interested in the transition. I was just in Alberta, and they would have transitioned away from coal much earlier, and I'm sure they would transition away from the intermediate source of fuel even sooner, if something like this would be available.

We have a history of energy development and leadership. We're climate leaders as well internationally. We have an excellent reputation. We would be a politically safe source from which to export this technology, particularly in light of the current crisis and geopolitical energy security challenges.

Again, we have the academic institutions. I'm constantly coming across people who work for, say, the University of Alberta, the University of Saskatchewan or UBC who have a background in plasma physics or particle science or materials science or mechanical engineering.

We have all the constituent components. We just need to bring them together into a formalized and committed program and have the policy commitment to underpin that.

● (2120)

Mr. Ryan Williams: I know you might be a little biased, but if you were going to rank this technology compared to hydrogen or compared to small nuclear reactors, where would this technology be in terms of prominence? You discussed the target of almost three times our energy needs in the next 20 years. Where would you put your technology?

Ms. Amee Barber: Well, we are completely carbon-free with no atmospheric emissions, so I think that goes to say where it would be in terms of priority.

However, as I mentioned at the beginning, there's room for all of these technologies to meet our future energy needs. We say that really the only competition right now is the status quo if we're going to get to where we need to be.

Mr. Ryan Williams: One of my colleagues was asking about the commercialization gap. We are going to be studying this very soon, so we might ask you to come back.

When it comes to commercializing your IP, your intellectual property, what do we need to do? What recommendations would you make for us?

Ms. Amee Barber: I would reinforce our ask for the government to be an equity partner through warrants, and to invest in a long-term program that is stable and that takes us outside of traditional grant requirements that seek to limit capital investment in research and development, but I think it's also a question of keeping the talent here and then building out the manufacturing capacity and the supply chain.

In Canada, we're really good at seed financing and we're really good at producing RIP, restricted intellectual property, but when you look at.... I think it was the C.D. Howe Institute that looked at how much the copyright or the licensing of that IP gets taken away by other countries.

We don't want that to happen with our technology. We want to be able to manufacture the kits here. We are a technology provider in the sense that we don't plan to own or operate our plants, so that gives us opportunity to build them out here, but it also gives us opportunity to export our technology and to make government revenue from that.

Mr. Ryan Williams: The U.S.A. is our biggest competitor. The U.S. energy board has Earthshots, through which they are investing heavily in hydrogen, energy-storage carbons, geothermal and wind, so when I say moonshot, it seems as though we finally have a differentiator. We have something that Canada can excel at, but the Inflation Reduction Act in the U.S. has a lot of money compared to what we have. We're looking at European nations that are looking to bring their green power to the U.S. They are investing $391 billion in green energy. That would be equivalent to $39 billion for Canada.

Is it just money, though? I guess my last question would be what else we need to be a differentiator. You mentioned a couple of things—commercialization, research and development. What do we really need to ensure that Canada is the world leader in fusion?

Ms. Amee Barber: I think we have to consider creative partnerships like the one we put forward in terms of strategically partnering with the U.K. as an equity partner, leveraging the private interest in fusion and considering the fact that the Canadian government would get direct returns on its investment that way.

Mr. Ryan Williams: Madam Chair, I think I'm all done. Thank you very much.

The Chair: Thank you, Mr. Williams. It is lovely to have you back today.

With that, we will go to Ms. Bradford for five minutes, please.

Ms. Valerie Bradford: Thank you so much, Madam Chair.

Thank you again to Dr. Barber and Dr. Smith for being here with us tonight.

To get it on the record, I want to clarify a point with you, Dr. Barber. The Canadian government has made substantial investments in your company. Is that right?

You're saying yes. Do you want to review what the dollar value is of that?

Ms. Amee Barber: Approximately, if combined, it equals about $100 million over the 20 years. We are very grateful for that. That funding will come to a close at the end of 2023.

Ms. Valerie Bradford: Great. At least it shows that the Canadian government recognizes—

Ms. Amee Barber: Absolutely. It's been critical to us.

● (2125)

Ms. Valerie Bradford: —the technology and that it has a great future.

Dr. Smith, I have a couple of questions for you as well.

Moonshot goals are supposed to be extremely ambitious goals. How can the government help mobilize the research committee and the general public behind trying to solve some of the biggest issues of our time?

Mr. Kevin Smith: I think identification of what exactly the goal looks like and feels like, and the timeframe to get there....

I think the most successful moonshot goals first identify what the problem is and what percentage or proportion of Canadians would agree that of all of our social pressures and of all of the most challenging issues for Canadians, it ranks in their top one, two or three.

We'll then be looking at the kinds of resources that Canada already enjoys. In the case of research, the resources are a very strong research community and the opportunity to leverage investment and a strong commercial presence, be that in either of the topics that I or my colleague presenter this evening have talked about, of health care or energy.

Last, but certainly not least, it's productive analytics that allow us to show Canadians that we're making progress on the world stage. I think few Canadians are interested in saying, “I'd like to have the best cancer system or the best energy system in Canada.” They want the best cancer system or energy system in the world. How can we demonstrate that Canadians will enjoy that with these investments?

Ms. Valerie Bradford: Thank you. That's a very inspiring, inspirational and aspirational goal.

Here's a question that you might find coming a bit out of left field. I know that you're a professor with the department of medicine at McMaster University, and I am aware of the bat lab there. Bats have been a topic of conversation tonight. I don't know if you were following the previous panels.

Can you tell me, to your knowledge—I'm sure you're aware—what kind of research they're doing in the bat lab at McMaster? I find it quite fascinating.

Mr. Kevin Smith: I'm going to embarrass myself a bit, because it's not an area that I know well.

In my history—I was full time at McMaster before coming to Toronto—there was a remarkable man named Dale Buchanan, who was known as “bat man”. Much of the research looked at three things within the bat colonies. One was the saliva of bats and its conditions for the prevention of blood clotting. The other that I know of is the spatial array that bats have in terms of the equivalent of the most advanced sonar known to man, and looking at geospatial positioning.

Beyond that, I would be happy to follow up with a note to you and speak to my colleagues, who are much more knowledgeable.

Ms. Valerie Bradford: That would be great.

This is my final question. You'll leave on a high note with me.

In 1961, JFK challenged the nation to put a man on the moon before the end of the decade, and eight years later mankind was on the moon.

If we fast-forward to eight years from now, what would you like to see Canada achieve? I think you alluded a bit to that earlier, but where do you think we could be in eight years?

Mr. Kevin Smith: I think, selfishly, any of the above that we've discussed.

I personally think the most important thing that Canadians are struggling with today is access to high-quality well-being in health care. Therefore, I would say I'd love to see that Canada has the world's best health care system, realizing the best outcomes and the highest health of the population.

I'd also love to see that our health care workers are among the most satisfied and rewarded in the world. At the moment, we're challenged, but I have every confidence that all of the antecedent conditions are there. If we were to make that an objective, we could realize that goal.

Ms. Valerie Bradford: I agree. Affordable and accessible health care seems to be a current challenge right now, but it's definitely one that we're focusing our efforts on. It probably is a moonshot at this point from where we are, but thank you so much.

I don't know if I have any more time, but I'll cede it to whomever, Madam Chair.

The Chair: Dear colleagues, I'm afraid we've come to the end of our night together.

Our first order of business is to thank our two witnesses, Dr. Barber and Dr. Smith.

We're grateful for your time and for coming and sharing your expertise. We are very grateful to you both. With that, you are welcome to leave. We have some committee business. I would like to once again thank both of our witnesses.

With that, dear colleagues, I have a little business to do with you.

Are we good to go, Mr. Clerk?

● (2130)

The Clerk of the Committee (Keelan Buck): Yes. We are in public, but we're good to go.

The Chair: Thank you very much, Mr. Clerk.

Colleagues, first of all, thank you for a great discussion tonight.

We have an order of business we have to get through tonight. The clerk has kindly distributed the latest version of our proposed travel budget for the trip that is currently planned for February 19 to 25, 2023. This is based on the information received from our committee and the sites that will be hosting us.

As you know, today's meeting is the last chance to adopt a budget for our planned trip before the deadline for submitting it to the SBLI committee.

Are there any questions, or can we entertain a motion to adopt this budget?

Mr. Richard Cannings: I would be happy to move a motion to adopt the budget.

Ms. Lena Metlege Diab: Mr. Cannings moves it, and we all second it.

The Chair: Is there agreement in the room?

Ms. Lena Metlege Diab: Yes.

(Motion agreed to)

The Chair: Thank you, Ms. Diab.

Thank you, Mr. Cannings.

Thank you, Mr. Clerk, our translators, analysts and everyone who supports us.

With that, dear colleagues, we're adjourned.