



HOUSE OF COMMONS  
CHAMBRE DES COMMUNES  
CANADA

44th PARLIAMENT, 1st SESSION

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# Standing Committee on Science and Research

EVIDENCE

**NUMBER 023**

**PUBLIC PART ONLY - PARTIE PUBLIQUE SEULEMENT**

Monday, November 21, 2022

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Chair: The Honourable Kirsty Duncan





## Standing Committee on Science and Research

Monday, November 21, 2022

• (1830)

[English]

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

Welcome to meeting number 23 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. Pursuant to Standing Order 108(3)(i), and the motion adopted by the committee on Monday, September 26, 2022, we are continuing the study of international moon shot programs.

I'd like to make a few comments for the benefit of 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. 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 floor, English or French. For those in the room, you can use the earpiece and select the desired channel.

I'll remind you that all comments should be addressed through the chair. For members in the room, if you wish to speak, please raise your hand. For members on Zoom, please use the "raise hand" function. The clerk and I will manage the speaking order as best we can. 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 also see that Ms. Sonia Sidhu is joining us tonight. Welcome.

I would now like to welcome all our witnesses.

We are absolutely delighted tonight to have the Right Honourable Mr. David Johnston, former governor general of Canada. From the Canadian Institute for Advanced Research, we have Dr. Alan Bernstein, president emeritus. From the Climate Emergency Unit, we have Mr. Seth Klein, who is the team lead.

To all our witnesses, we are delighted you're joining us and I welcome you.

Each witness will have five minutes to speak. At the four and a half minute mark, I'll hold up a yellow card. We aim to be fair, so

it's five minutes. They'll let you know when you have 30 seconds left to go.

With that, we will turn it over to the Right Honourable David Johnston for five minutes. Welcome.

[Translation]

**The Right Hon. David Johnston (28th Governor General of Canada, As an Individual):** Thank you, Madam Chair.

I am honoured to be here today and to have the opportunity to speak to the House of Commons Standing Committee on Science and Research.

[English]

One cannot overemphasize the importance of your subject: moon shot innovation. Innovation begins with curiosity and moves to creativity, but very simply it means doing things better.

Given the time limits, let me speak in bullet points.

My recommendation is very simply this: Canada's moon shot is to become the Athens to the new Rome.

We will do so by practising what I call the "diplomacy of knowledge", engaging with the world through international education and research, with students and researchers coming here from abroad and our students and researchers travelling and engaging abroad. We will be global citizens, and our research power enhanced through international collaboration.

I've left with you three documents.

The first is my address in Vancouver on February 16, 2012, to the American Association for the Advancement of Science on the diplomacy of knowledge. The second comes from a chapter in my book *The Idea of Canada: Letters to a Nation*. This was a letter to His Highness the Aga Khan on the importance of pluralism and practising the diplomacy of knowledge. The third is "Canada's International Education Strategy (2014-2019)", prepared for the then international trade minister by a task force chaired by Dr. Amit Chakma, then president of Western University. I recommend that you review this remarkable report—updated—and craft a renewed strategy for the next decade.

In the interest of time, of these three documents I will simply state five propositions that come from my address to the AAAS.

First, in our modern globalized world, the well-being of nations will be defined more than anything else by how well they develop and advance knowledge. Second, the opportunity to share information has never been so ubiquitous and so cheap. Third, communication is so fast and easy—thus so we change. Fourth, ideas are improved when shared and tested through action. Fifth, we must promote independent practices that have served us well, but we must also broaden what and how we learn.

Now let me move to some opinions under four themes on benefits.

Theme one is the benefit of international students recruited to Canada.

First, they pay international tuition fees and spend money while here and support high-quality jobs quite enormously. Second, they comprise Canada's seventh-largest export sector, while in Australia it's the third-largest export sector. We should aspire to make it Canada's largest export sector.

Third, they provide highly skilled labour as teaching and research assistants and are our most desirable source to become permanent residents. One hundred per cent of Canada's population growth comes from immigrants, which we need to support our aging population, and their children outpace young "already here" Canadians in educational and entrepreneurial attainment.

Last, climate change and population dislocation pressures over the next several decades will force more emigration and thus more immigration to this country. Canada, with the world's second-largest land mass and 20% of the world's freshwater resources, will face significant international pressure to significantly increase its current population of 38 million.

Theme two on benefits is about Canadian students being abroad for study, research work or volunteering.

First, they become global citizens with a much broader perspective. From my observation of my five daughters, who began international exchanges as teenagers, that experience is transformative. They become more curious, tolerant, judicious, empathetic, self-reliant, creative and resilient. Seen through broader understanding and their new entrepreneurship, they promote Canadian cultural values and Canadian business abroad.

Second, together with international students here, they promote the intercultural harmony we see in our domestic public education system, where young people from different cultural backgrounds are educated together. As a nation, we can project this Canadian experience onto the world stage as peaceful, collaborative pluralism.

Theme three is on trade investment benefits. International students returning home and Canadians abroad become our best ambassadors and unpaid trade commissioners. The people-to-people contacts and friendships allow Canada to tap into a much broader talent pool. They encourage all Canadians to develop broader, more inclusive views.

Finally, there are the research enhancement benefits.

Research and development are built on enhanced talent pools. International education is a splendid foundation. From this base, col-

laborative partnerships are created and expanded institution by institution, collaborative alignment by alignment and country by country across the globe.

Canada is already a collaborative choice. We have less than 2% of the world's population and over 4% of the peer-reviewed STEM articles in the leading scientific journals. More than half of those articles have international co-authors. This expanding base of collaborative talent helps Canada significantly in contributing to and drawing from the research strengths of the U.S.A., with which our bilateral partnership is already the most beneficial in the world. Our ability to bring in other international partners helps to equalize Canada's contribution.

• (1835)

**The Chair:** Sir, I hate to do this.

**The Right Hon. David Johnston:** Bernard Shaw once wrote, "Some men see things as they are and say why, I dream of things that [ought to be] and [ask], why not?"

Thank you.

**The Chair:** Will you forgive me?

I've had the most wonderful conversations at his house, so I feel terrible. I have to be fair to everyone.

With that, I'm going to go to Dr. Bernstein for five minutes, please.

**Dr. Alan Bernstein (President Emeritus, CIFAR):** Thank you, Madam Chair. I'll try to be brief.

First of all, I'll just say at the outset that I agree with what David Johnston just said. Second, I commend the committee for focusing this meeting, at least, on the importance of international moon shots. I say that in light of the ending of COP27, when climate change is very much on everyone's mind.

We all know that the issue of climate change in the world will only be addressed—here I'm quoting Gordon Brown, the former chancellor of the Exchequer in the U.K.—with science and research. Only science and research gives us that hope. In that sense, it's very much like the pandemic that we would like to be through but are still in the middle of. Again, science and research have offered hope, and not just hope, but drugs, vaccines and diagnostics that have really saved the world from this emerging new virus.

Let me go on to a few other things.

I think the pandemic has brilliantly demonstrated what science—working across political and disciplinary boundaries, fuelled by global collaboration and the prior decades of fundamental science—can do in a remarkably short period of time. These RNA vaccines have been unexpected game-changers and have certainly saved hundreds of millions of lives around the world, including probably about a million here in Canada. Climate change will also only be addressed by decades of prior science, powered by global collaboration.

Here, I want to stress the words “moon shot”. Climate change will not be addressed by incremental science. Climate change, like COVID, will only be addressed by moon shot science. That's why I think your choice of that word—to every member of the committee—is commendable. I think it's appropriate.

I want to now address this question: Can Canada contribute to moon shot science? I think this is an important question that this committee and all of us need to deal with. To that, my reply is very clear. There have been two recent moon shots that have changed the world: artificial intelligence and RNA vaccines. I think nobody would argue with those two, actually.

Artificial intelligence, deep learning or reinforcement learning were developed right here in Canada by Geoff Hinton in Toronto with his students and by Rich Sutton and his trainees in Edmonton with his students. The result of that has really transformed the industry of every kind of science and has unleashed trillions of dollars' worth of investments from around the world. That has been a true game-changer.

How did that happen? I know it happened because both Geoff and Rich were working in the States. With regard to your point, Madam Chair, they were thinking of leaving the United States for Canada because of our values, the state of our democracy and the state of our cities. They moved here, facilitated by CIFAR, the organization that I've had the honour to lead for the last 10 years. They moved to Toronto and Edmonton, respectively.

I'll go back to a point that David Johnston made.

Toronto, Edmonton and Montreal—because Yoshua Bengio was one of the trainees that Geoff trained—are now booming as a result of the artificial intelligence boom that was created by the fundamental science that was funded by the federal government through CIFAR and then through NSERC back in the early 2000s. I think there's an important lesson there in terms of what we're capable of and the role of government in catalyzing that moon shot.

The second one is RNA vaccines, and perhaps this is something that committee members are not aware of. Let me go through four really pivotal contributions that Canadians have made to these vaccines.

The Oxford-AstraZeneca vaccine—which has been administered to more individuals on the planet than any other COVID vaccine—and the Johnson & Johnson-Harvard vaccine used an adenovirus vector technology. That technology was developed by Frank Graham when he was a professor at McMaster University.

Moderna, the brilliant company that founded RNA vaccines, was founded by Derrick Rossi, also a Canadian. He is also a former graduate student of mine, I'm very proud to say.

Lipid nanoparticles, which are essential for protecting the RNA of an RNA vaccine, were developed by Pieter Cullis at UBC. Every RNA vaccine administered on the planet now uses the patented technology that Pieter Cullis developed in Vancouver.

● (1840)

Finally, how the immune system works and the role of sentinel cells presented by the RNA vaccines—the so-called dendritic cells—were first identified by the late Ralph Steinman, who won his Nobel Prize for that work while working at Rockefeller University.

Canadians are capable of doing it.

**The Chair:** Dr. Bernstein—

**Dr. Alan Bernstein:** I will now stop. I'm happy to try to answer your questions.

**The Chair:** It's the worst part of this job—having to stop listening—but there are great questions they'll want to ask you.

Thank you so much for your testimony. We're so glad to have you all here.

We'll now go to Mr. Klein for five minutes.

Welcome.

**Mr. Seth Klein (Team Lead, Climate Emergency Unit):** Thank you very much, Chair Duncan, for this invitation.

I'm joining you from the unceded territories of the Musqueam, Squamish and Tsleil-Waututh nations, otherwise known as Vancouver.

It's an honour to be in such distinguished company today. In truth, I'm not entirely certain why you invited me. I'm not a scientist or an engineer, although I am indeed interested in the speedy mass deployment of research and technology. I'm a public policy researcher and writer. For 22 years, I was the founding B.C. director of the Canadian Centre for Policy Alternatives. More recently, I'm the author of a 2020 book that I believe some of you are familiar with, entitled *A Good War: Mobilizing Canada for the Climate Emergency*. I believe it's the ideas in this book that prompted this invitation.

When it comes to the climate crisis, and to borrow an apt phrase, “Houston, we have a problem.” I am not the first person to equate the urgent need for dramatic action on the climate emergency with the moon shot. David Suzuki has frequently done so. Just last week, a Guardian editorial directed at the world leaders gathered at the COP meetings in Egypt, running in 30 media organizations across 20 countries, stated the following:

Time is running out. Rather than getting out of fossil fuels and into clean energy, many wealthy nations are reinvesting in oil and gas, failing to cut emissions fast enough and haggling over the aid they are prepared to send to poor countries. All this while the planet hurtles towards the point of no return—where climate chaos becomes irreversible.

Then, they wrote this:

Solving the crisis is the moonshot of our times. Getting to the moon succeeded within a decade because huge resources were devoted to it. A similar commitment is needed now.

Let me speak specifically to the Canadian context.

As a country, for the last 20 years, and despite all our climate pledges and commitments, the best we have managed to do is plateau our emissions at a historic high. We have failed to actually bend the curve. The last year for which we have GHG data is 2020, and we did see a notable decline that year. However, recall this was the year of lockdown, with so much travel and economic activity suspended. Most analysts predict we will see an increase again in 2021, when data becomes available.

The federal government is now taking climate action, but that action is nowhere close to the speed and scale the crisis demands. I think we will, in coming years, see a slow bending of the curve of our carbon pollution, but not nearly at the pitch and pace the science demands. The federal government's climate policies will be modestly successful, but not moon shot successful. There's no comfort in that. As the great climate writer Bill McKibben said, to win slowly on climate is to lose.

Why have we seen so little progress on this task? One of the key reasons, I contend, is this: If you survey our federal and provincial climate policies to date, what they almost all have in common is that they are voluntary. We remain stuck trying to incentivize our way to victory. We encourage change, offering price signals, rebates, tax cuts and credits, but we do not require change and are not driving change through direct government investments.

The government's flagship climate policy remains the escalating carbon price, which, it hopes, will cajole private investment in the right direction. To be clear, I support carbon pricing. However, as a focal point, it is a strategy that will see us condemn our children and grandchildren to lives of profound disruption and catastrophe. This is no way to prosecute a battle for our lives.

My book seeks to excavate a historic story from another time, when we faced a civilizational threat: the transformation of Canadian society and the wholesale retooling of our economy, in order to prosecute the Second World War.

I want to quickly share some lessons from that precursor moon shot with you. When I'm giving talks and interviews, I'm invariably asked, "How do you know when a government gets the emergency?" In reflecting on our wartime experience, and now also on our pandemic experience, I've distilled my answer to what I call "the six markers of emergency". These are the markers that indicate—or when you know—that a government has shifted into genuine emergency mode.

First, it spends what it takes to win. Second, it creates new economic institutions to get the job done. Third, it shifts from voluntary and incentive-based policies to mandatory measures. Fourth, it tells the truth about the severity of the crisis and communicates a sense of urgency about the measures necessary to combat it. Fifth, it commits to leaving no one behind, and sixth, it centres indigenous leadership rights and title, as these, too, are vital to success in our context.

● (1845)

During the Second World War, the Canadian government hit the first five markers big time. Likewise during the first year of the pandemic emergency response, our government for the most part passed the first four markers, but with respect to the climate emergency, so far at least, our governments are failing on all six counts.

I welcome any questions. I'm happy to elaborate on any of these emergency markers.

Thank you.

● (1850)

**The Chair:** Thank you, Mr. Klein. Thank you so much.

Again, thank you to our witnesses. We're delighted to have you. We're now going to go to our questions. You have a committed, eager committee.

Tonight we begin the six-minute round with Mr. Mazier.

The floor is yours.

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

Mr. Johnston, I read the remarks you gave in Vancouver. You mentioned the ability to develop and advance knowledge. It will be the new currency and the new passport to success. You went on to discuss how easy it is to share information in today's world through the Internet. You said, "This sharing is made possible by the communications revolution brought about by the rise of the internet".

Can you expand on the importance of the Internet and cellular connectivity in advancing knowledge?

**The Right Hon. David Johnston:** First, it's a dramatic change in how we communicate. What brought western Europe out of the dark ages into the industrial revolution in the 15th and 16th centuries was the development of the printing press. Other nations had it. China had it. Islam had it. That printing press transformed western Europe into democracies, into people who learn by reading and studying and so on, but it took three centuries for it to reach the majority of the populace in western Europe.

The Internet, which does all of that and more, reached the majority of the world's population in less than a decade. It's a dramatic change in how we communicate, and it really is a wonderful period in history because we have so much opportunity to share our knowledge so widely.

The other thing I would say is that what I'm recommending today has to do with the culture of innovation. It's a cultural thing.

I remember John Evans, that wonderful university and other leader, saying to me one time as two fellows who enjoy hockey, "David, do you think we could ever get Canadians as interested in research as they are in hockey?" I said, "John, that's probably a bridge too far, but it's worth trying."

That's what I'm driving at, that education is the foundation for moon shots, and I mean education on an international scale. Canada has the moon shot to be the best in the business in that kind of thing, by using the new digital revolution to permit us to lead as certain countries in western Europe led with the printing press.

**Mr. Dan Mazier:** Excellent.

We're talking about an all-of-Canada kind of approach as well, but unfortunately, as you know, many rural and remote Canadians have no access to the Internet to speak of. In fact, the report by the Canadian Internet Registration Authority found that urban Internet speeds are 380% faster than rural speeds, not to mention that the rural price they pay is exorbitant compared to Canadians who pay for Internet and cellular services as well. This prevents many rural Canadians from participating in the economic growth opportunities that you mentioned.

I think actually a good moon shot program for Canada would be for Canada to connect all Canadians with reliable Internet services. What do you think?

**The Right Hon. David Johnston:** I had the wonderful privilege of looking at that over 20 years ago when I chaired the information highway advisory council with two reports, one in 1993-94 and the other in 1994-95. John Manley was the minister. Kevin Lynch was then deputy minister of industry, and Mike Binder was the associate deputy minister of spectrum. It was the best public task force thing I've ever done. We established the goal of Canada being the leader in the world in using digital communication. Extending it for equality of opportunity in all corners of the country was a very fundamental objective because Canada is a country that stands for equality of opportunity, especially with respect to educational opportunities.

Our report was filed and a number of recommendations followed. That one came along but has come along far too slowly. I think if Canada is to fulfill my great belief that we can have equality of opportunity and excellence too, we really must make those communication devices available to all corners of the country. When we don't, we miss a great opportunity.

**Mr. Dan Mazier:** Thank you.

As you know, the U.S. is being very aggressive with their moon shot program.

What are your thoughts on how we—as Canada, their neighbour—compete for a moon shot program? What should we do as a government to move forward and act competitively?

• (1855)

**The Right Hon. David Johnston:** The first thing we do is recognize what an important resource it is to be living side by side with the United States. So many of us had our education in the

United States. So many of us have had the opportunity to work on joint research projects with them. So many of our institutions have benefited from Americans who have come north, such as two of the individuals whom Alan cited just a moment ago. That's a great privilege.

I would say that we continue to establish those research partnerships with the great American projects, moon shots or not, as we develop our own. We will have our own moon shots. Alan gave us an illustration of what's happened with respect to the development of vaccines. Canada played a big part in that kind of moon shot.

My suggestion is a broader moon shot. It has to do with bringing innovation to the minds of all Canadians, beginning with very young people. For me, the single easiest thing to do that is relatively inexpensive. It's bringing international students here and sending our young people abroad. Build from that a pool of talent in which excellent research comes along and we'll develop a series of moon shots.

**Mr. Dan Mazier:** Mr. Bernstein, is your organization doing any research on new technologies that have the potential to connect rural and remote Canadians with quality Internet and cellular services?

**The Chair:** Your time is at the end. I'm sorry, Dr. Bernstein.

Mr. Mazier, perhaps you'd like to ask Dr. Bernstein if he would be willing to table that.

**Mr. Dan Mazier:** Please table that, if you have a response. That would be great.

**The Chair:** Thank you.

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

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

Through you, to Dr. Bernstein, I was so pleased that you mentioned McMaster University and their involvement and their contributions to the creation of the vaccine. I recently toured McMaster and their new mobility solutions area. I looked at the AI studies that they have ongoing and the autonomous vehicle programs that they're looking at.

It struck me during my tour that it didn't seem like the federal government was playing a role as it relates to funding. There were private sector investments, the university had its own money and I think there was even money from the U.S. government. My question to you would be what roles you see the universities playing as it relates to moon shot programs.

As a supplemental question to that, what role does the federal government play in terms of supporting those programs when the university picks up the torch?

**Dr. Alan Bernstein:** First of all, I think that's a really excellent question, Mr. Collins.

If you look at the history of innovation of all kinds—certainly in more recent times in terms of the pandemic and in terms of other advances—a vast majority started from fundamental research carried out by our universities and funded by federal governments.

I would just point out that the recent CHIPS and Science Act that was passed in the United States has a huge amount of money—I don't remember the exact amount right now—for a fundamental research in the United States. The reason for that is exactly what we're talking about. It's the strong belief that the engine of innovation starts with university research and with fundamental research. It starts with training those young people who are going to have that entrepreneurial spirit that Mr. Johnston has been talking about. It's that culture of innovation.

For example, I'll give you a real-life example. A young woman, Raquel Urtason, trained with Geoff Hinton on artificial intelligence. She now has a company in Toronto that employs about 50 with Ph.D.s in artificial intelligence who are developing self-driving, semi-autonomous vehicles, starting with trucks. There have been a number of articles in the "Report on Business" in The Globe and Mail on her company.

That research and that company all started from fundamental research started at the University of Toronto. It has now moved into the marketplace. She's raised, as a result, close to a hundred million dollars from the private sector to start her company, which is called Waabi. That's an example.

I take your point about McMaster. There's a huge amount of fabulous research going on at McMaster, which is leading to exactly the kind of innovation that we're talking about this evening.

It's not that I'm driving for fundamental research at universities, per se. The history lesson, if I could put it that way, is that only governments can fund fundamental research. The timelines and the risks are too high. That's why the U.S. CHIPS and Science Act explicitly recognizes that. What President Biden is saying is that he will invest in that fundamental research, but he also expects industry to then pick up what comes out of those universities and take it to the next stage.

That's something the U.S. does well. It's something that we still have a lot to learn about from our colleagues and friends south of the border in terms of how to do that better, including the great research that's going on at McMaster, which you referenced. I could give other examples of research at McMaster that I think is really fabulous.

• (1900)

**Mr. Chad Collins:** Thanks, Dr. Bernstein, for that answer.

Madam Chair, I think I have about two minutes left.

I'm going to cede the rest of my time to my friend and colleague, MP Sidhu.

**Ms. Sonia Sidhu (Brampton South, Lib.):** Thank you, Chad.

Madam Chair, I just want to ask a question of the Right Honourable David Johnston.

Dr. Johnston, I'm from Brampton, which is the home of many innovative and world-renowned companies. We have MDA, with the

help of the federal government. MDA is based in Brampton and is developing leading-edge technologies from the iconic Canadarm3.

Can you expand on how strategic investment in Canada's space sector is advancing ambitious research and innovation? What can the impact be?

You also talked about the global citizen program. What role does diversity and inclusion play in generating bold and ambitious research?

**The Right Hon. David Johnston:** Let me focus on the Canadian Space Agency specifically. I could say several things. One is that what impresses me is the international collaboration that has come from Canada's participation with a number of nations, including some who are not necessarily the most friendly nations, with respect to great projects. I think that's really a great triumph of coming together in a scientific endeavour.

When I was at McGill, we had the privilege of the Institute for Air and Space Law, which was created at McGill because it was a centre for international air traffic regulation and association. It was taking advantage of the talent that was there. Developing the new laws that would govern outer space, including where we put space stations, was a very important international collaboration too.

I'm very encouraged by the fact that Canada has been able, in a number of areas of space exploration and development, to really punch above its weight by assessing the talent we have and by being prepared to work in a very collaborative fashion. For me, that's the big response coming from the Space Agency and what we do.

It's not huge amounts of money by comparison with some of the other nations, but it's been very thoughtfully directed, I think, to make an out-of-proportion contribution.

**The Chair:** Thank you, Mr. Collins. Thank you, Ms. Sidhu.

Thank you to the witnesses. This is so interesting.

Now we will go to Mr. Blanchette-Joncas.

[*Translation*]

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

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

I want to welcome the witnesses who are with us for our study this evening.

Mr. Johnston, it's a pleasure to welcome you to the Standing Committee on Science and Research.

In your remarks, you told us about a strategy aimed in particular at encouraging innovation. The strategy would bring international students to Canada and send Canadians students to study outside the country.



I am trying to understand the way you are describing the situation. What I see is based on the following facts. Canada is the only G7 country that has reduced its investments in research and development between 2000 and 2020. It is also the only G7 country that has lost researchers over the past six years, who are potential students. In addition, graduate scholarships for foreign master's and PhD students have not been indexed since 2004. How can you ride a bicycle, if you are missing a wheel, or if you don't have a bicycle at all?

**The Right Hon. David Johnston:** Canada is in a very special position. A survey comparing various cities around the world in terms of student life saw Montreal come out on top, which is good. But it is not just Montreal. A welcoming and quality-oriented spirit is evident in Quebec and in Canada.

We must work very hard to encourage student exchanges with other countries. I believe it is important that we make an extraordinary effort to make Canada the first choice for international students looking for a place to grow.

• (1905)

**Mr. Maxime Blanchette-Joncas:** Thank you for your thoughts.

You will understand that, for Canada to be a welcoming, positive and interesting place to study in, there need to be winning conditions. However, when we compare Canada's R&D investments to those of other countries, it is a fact that Canada is not at the top of the list, but instead near the bottom.

In your remarks, you mentioned international students many times and, in your answer to my question, you talked about the welcoming spirit in Canada and about people's openness.

Let me tell you about a very specific situation in Quebec right now. In Canada, there are supposedly two official languages, with one of them being French. Of course, Quebec can welcome foreign students who speak French. We are seeing, however, an abnormally high number of student visa applications from francophone African countries being rejected.

The federal government even revealed recently that racism and discrimination are evident in the practices, policies, programs and handling of applications at the department of immigration, refugees and citizenship.

Do you have any comments on this? What do you think of the fact that the Canadian government is clearly displaying racism against francophone African students?

**The Right Hon. David Johnston:** One of Canada's very significant assets is that it has tremendous francophone and anglophone institutions. Students therefore have a choice, which influences those who want to study in French or in English and attracts them to Canada. That is extremely valuable.

**Mr. Maxime Blanchette-Joncas:** So I understand that you are not condemning those practices. You have no opinion on the fact that the government has adopted discriminatory practices.

**The Right Hon. David Johnston:** I do not really have anything to add.

**Mr. Maxime Blanchette-Joncas:** Okay. That's fine.

Mr. Bernstein, the Canadian Institute for Advanced Research, or CIFAR, coordinates the Pan-Canadian Artificial Intelligence Strategy, which was launched in 2017. As you know, this strategy is based on three hubs, which are located in Edmonton, Toronto and Montreal. At our last meeting, we had the opportunity to hear from Mr. Yoshua Bengio, a world expert in artificial intelligence, professor at the Université de Montréal and Canada-CIFAR research chair in artificial intelligence.

Some people have argued that the Pan-Canadian Artificial Intelligence Strategy has certain characteristics that could help it qualify as an international moonshot program. What are your thoughts on this?

Which features might make it possible, or not, for it to be designated an international AI moonshot program?

[English]

**Dr. Alan Bernstein:** Thank you for your question.

Artificial intelligence is something that computer scientists have dreamed about since computers were first developed after the Second World War. They dreamed of having machines that could, in big quotation marks, actually “think” and do some things on their own, as opposed to whatever we program them to do. They would learn by experience as opposed to by rote.

What Dr. Hinton, Dr. Bengio, Dr. Sutton and their colleagues and students developed was a transformative technology, a transformative science, that in some ways mimics, in a naive way, the way we think the brain works, which is by learning and by experience, to change—

• (1910)

**The Chair:** Dr. Bernstein, I'm sorry to interrupt. I hope that others will pick up the questioning.

I'm sorry, Monsieur Blanchette-Joncas, but your time is over.

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

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

I'd like to thank the witnesses today. We always have interesting witnesses, but it seems that this evening we are really blessed with a wonderful set of people to question.

I would love to talk to Mr. Johnston about his ideas around education and academics. I come from that world as well.

Dr. Bernstein, I'd love to ask you questions about my friend, Pieter Cullis.

However, I will turn to Mr. Klein.

You talked about World War II as an example of what Canada can do and has done when faced with the real demand for a moon shot kind of program.

Could you expand on the scale of military production and economic transformation that Canada did during that time? How did they do it, and how can it inform us today about climate change?

**Mr. Seth Klein:** Thank you for your question.

The military production scale in World War II, of course, pre-dates the moon shot, but I think it is an example of a “moon-shotesque” program.

Consider this: At the outbreak of the Second World War, Canada had virtually no military production to speak of, yet during the war, the Canadian economy and its labour force pumped out a volume of military equipment that is simply mind-blowing. During those six years, Canada, with a population of less than a third of what it is today, produced 800,000 military vehicles, more than Germany, Italy and Japan combined, and 16,000 military aircraft, ultimately building the fourth-largest air force in the world at the time.

Here, in my province and your province, where we seem to struggle to build a single B.C. ferry anymore, we produced about 350 ships, again from a basis of virtually nothing. Naval architects had to be imported from the U.S and the U.K, and an entire workforce needed to be recruited and trained up. The Vancouver ship-builders union local went from being a small local of 200 guys to being the single-largest local of men and women in the country.

To give you a sense of the scale, from a population of about 11 million Canadians at the time, over one million Canadians enlisted, and over one million were directly employed in military production.

Most of this transformation occurred under the leadership of C.D. Howe, the most powerful minister in Mackenzie King's wartime government. Interestingly, Howe was an engineer turned politician. He made a lot of money in the private sector before running for office. He became seized with this task. I describe him as an engineer in a hurry. Remarkably, under Howe's leadership, the Canadian government established, during those wartime years, 28 Crown corporations to meet the supply and munitions requirements of the war effort. Howe's department also undertook detailed economic planning and carefully coordinated supply chains in order to prioritize wartime production needs.

In response to the climate emergency, we have seen nothing of this sort. If the government really saw the climate emergency as an emergency, it would, like C.D. Howe did, quickly conduct an inventory of all of our conversion needs to determine how many heat pumps and solar rays and wind farms and electric buses we are going to need to electrify virtually everything and end our reliance on fossil fuels. Then, it would establish a new generation of public corporations to ensure that those items are manufactured and deployed at the requisite scale.

That's the lesson.

**Mr. Richard Cannings:** How would you comment on what we need to do on the interplay between what the government has to do, what industry has to do and what private industry has to do, the spending that needs to be happening there, and how that interplay works out?

As you were saying, we're not winning right now, and we have to put in a lot more effort. I'm just wondering what the government has to do and what role they have to take. I think you hinted at it in your last answer, but can you just expand on that?

**Mr. Seth Klein:** We need both government and the private sector, and both have an important role, but in an emergency—I think this is one of the key lessons—we don't allow the private sector to determine the allocation of vital resources. Let me give you an American example from that war story. Consider this: Pearl Harbor happened in December of 1941. In February of 1942, two months later, the last civilian automobile rolled off the assembly line in Detroit, and for the next four years their production and sale were basically illegal.

Those factories were busy and all of those workers were employed, but they were doing something else. They weren't doing that through the voluntary goodwill or patriotism of the big three automakers; they were doing it because they were ordered to do it.

We saw this in the Canadian wartime story as well. We saw over 100 prominent Canadian business leaders in the Second World War become C.D. Howe's dollar-a-year men. They played an instrumental role heading up some of these Crown corporations, serving as what they called controllers of these supply chains. Interestingly, they abandoned their private sector posts to become Howe's dollar-a-year men. They understood that to achieve speed and scale in a time of emergency requires state leadership. I think that's true again today.

We are losing today. We're not spending anything close to what we need to be spending. Sir Nicholas Stern argues that—

• (1915)

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

Mr. Cannings, that's your time. Again, I would like to recognize our witnesses, their time, their expertise and their generosity in being here.

With that, we're going to go to the five-minute round.

We go to Mr. Lobb, please.

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

In our last meeting we had, we had a good discussion. One of the points I made was that for a lot of where we need to go, we just don't have the ability to get there at this current juncture. I know our professors are talking about the Herculean efforts of World War II, etc.

This is for you, Mr. Johnston.

You're from a university environment. Think of the case of, say, health care, with our nurses and our doctors. I hear stories all the time from people in my riding whose kids, grandkids or whoever get way over 90% in high school. They got into university, and they got way over 90%. We need family doctors in rural areas, and we need emergency room doctors all over the place. They can get into university, but they can't get into medical school to be a doctor.

Can you give us an idea—I know you have worked almost your whole life in the university environment—of how this is happening?

**The Right Hon. David Johnston:** Very simply, it happened because provincial governments decided they did not want any more medical places, and equally so with other health disciplines. In fact, when I was at McGill, we were in a position of contracting the number of places. McGill went from 160 down to 101 placements in medical school.

At that time, we thought we would be producing enough qualified doctors, including family practitioners and specialists, and we would depend upon immigrants for others. We had difficulty in terms of qualifications with immigrants and so on. I think that's a case where we simply did not respond to the demand of the system and provide opportunities for more young people to have a profession in the health sciences.

**Mr. Ben Lobb:** Thank you.

I think probably we'd all agree that we need to increase funding for health care so it can be used at the provincial level and also the university level.

The question about another moon shot, depending on how you look at it, is foreign credentials and being able to recognize.... You made some mention about international students and so forth. What about recognizing foreign credentials and looking at a moon shot in that, so people cannot be frustrated with the way things have turned out and they get to work in the field they studied in?

**The Right Hon. David Johnston:** We don't do much of a job on that very subject, profession by profession. We do it somewhat, but not nearly enough in having appropriate, sensitive testing of the backgrounds of the individuals who wish to practise their profession in this country, and then providing appropriate experiential learning, focusing on theoretical learning as necessary, in apprenticeships so that these people are qualified to practise in their professions.

I would add that I think we should do a much greater job in inter-provincial qualifications of the various professions. We suffer enormously in this country from having everything focused at the provincial level and not having opportunities for people to practise across jurisdictions. It's just another obstacle that prevents us from having both enough and appropriately qualified people for the needs of the whole country.

● (1920)

**Mr. Ben Lobb:** One other topic, just before my time runs out, is that our professors have talked about clean technology, clean energy and renewable energy. I support nuclear, but if you want to build a new reactor or you want to build a new hydrogen plant, or whatever, there's the length of time it takes to get an environmental ap-

proval and assessment and actually build whatever it is to help the environment. Is that something we need to look at as a moon shot or a task force to find a way to reduce the assessment time for projects?

**The Right Hon. David Johnston:** Yes, we should do a much better job of regulation, of doing it smartly, thoroughly but promptly, all with a sense of dispatch. I write books about this. I'm doing a sixth edition of *Canadian Securities Regulation*. Finding that right balance of regulation, which is necessary but efficient, is a very key challenge.

**The Chair:** You have 20 seconds. Would you like to cede your time?

**Mr. Ben Lobb:** I'll cede my time to my colleagues.

**The Chair:** Thank you, Mr. Lobb.

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

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

Thank you to all three fascinating witnesses and the interesting perspectives you bring to this discussion tonight. I greatly appreciate it.

Mr. Johnston, from your opening comments, I would argue that you're still a university president at heart. You've done many things since, but I think that's still your DNA. It's wonderful to have your perspective here.

We still really miss you in the Waterloo region. We were sad to see you leave the presidency of U of W, but we were taking one for team Canada. You were an amazing Governor General, so thank you for your service. We are reminded of you and your lovely wife Sharon every time we drive by the university and see the David Johnston research and innovation park, which I know you weren't happy about, but it's still a nice daily reminder when we go by there.

We are here to study ambitious research goals that we hope will solve some of Canada's and the world's biggest social and environmental challenges. I know in your opening address you mentioned curiosity and the importance of curiosity. What role does curiosity-driven research play in achieving these ambitious goals?

**The Right Hon. David Johnston:** I think it's the beginning, the middle ground and the end. Curiosity fuels everything, and goes along with the courage to think independently.

I should say this about teaching. In my installation address as GG, it was entitled “A smart and caring nation”. I said if you remember only three words of what I say today, they are “Cherish our Teachers”, because apart from our family they have the most important influences on us. I said if we had three hours together in the Senate chamber I'd tell you 100 stories of teachers, coaches, mentors who have made an influence in my life for the better. That's why I stress so much the business of education as the heart of everything, including in this world when data is available at our fingertips. Curiosity and being able to ask the penetrating kinds of questions, that, actually, is the role of the teacher today. It's not to be the fountain of all knowledge but to provide the methods of inquiry, etc.

This is where Canada, I think, has very considerable advantages. We have a good public education system. It can be better, but we want to make it better. Instilling curiosity and learning how to learn is pretty fundamental. Our number five daughter did her doctorate in educational psychology. She has a learning disability. She works now as a senior research scientist for a company spun off by her Harvard professor, who supervised her thesis on how the mind learns, combining that with the digital revolution. It's wonderful to see how we can develop customized curricula that deal with the specific needs of a specific child, one with a disability and another one who's vitally enriched. For me, that's a wonderful new opportunity opening.

The simple profit from that kind of curiosity, which is at our fingertips and which I've been speaking about tonight, is putting this on an international scale. We gain so much by developing those collaborative networks around the world.

• (1925)

**Ms. Valerie Bradford:** Thank you.

I think everyone who's in the room can remember one special teacher who influenced them. It could be at the grade school level, or whatever. I think that, for each of us, if we think back, there's that one special teacher who made a real difference.

Canada doesn't have a specific moon shot title program. However, much of the funding and policy initiatives align with the characteristics of a moon shot program. What, in your opinion, are the areas where Canada is doing work related to moon shot-type research?

**The Right Hon. David Johnston:** I'd begin with the Canadian Institute for Advanced Research, which Alan has served with such distinction for 10 years. I had the enormous privilege of being chair of that in earlier days. That was a remarkable vision of Fraser Mustard, mainly—with help from people like John Evans—to identify some of those areas that were areas of great need, dependent upon interdisciplinary approaches. They were unusual approaches, not conventional approaches. It reached out beyond Canada's borders to bring the best in the world to be on the advisory committees and so on, do some of the work and be part of the collaboration.

If I were to list the things where Canada has the greatest opportunity, then I'd begin by asking Alan. How did you develop your priorities for the programs that you struck over the 10 years that you were there, Alan? Where are you today and what do you see in the future?

Artificial intelligence is a very good example. When Geoff Hinton was working in this area 25 years ago, it was not funded by the granting agencies because it was considered too wild. Mimicking the human brain, how on earth can you do that? Thanks to the Canadian Institute for Advanced Research, which funded him early on because it saw promise in this very unconventional research, it's become extremely important worldwide. Guess what. As we've just indicated, Canada's one of the two or three great leaders in that sphere.

**Ms. Valerie Bradford:** Thank you.

Kirsty's raising the yellow card at us. It's bad in soccer and it's bad for us too.

**The Chair:** Ms. Bradford, your time is over.

I just wanted to know if you wanted to ask Dr. Bernstein to table what...

**Ms. Valerie Bradford:** Yes, that would be excellent.

Dr. Bernstein, if you could answer the question Mr. Johnston referred to in writing, that would be most helpful for our committee. Thank you.

**Dr. Alan Bernstein:** I'd be happy to do that.

**The Chair:** Thank you to all three of you for that.

With that, we're going to go to Monsieur Blanchette-Joncas, for two and a half minutes, please.

[*Translation*]

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

Mr. Klein, I listened carefully to your opening remarks. I found it interesting to hear you say that very little progress is currently being made on the climate emergency, since the government is adopting voluntary and non-binding policies. I also read your book, of course, and it is very interesting. In it, you compare this situation to our grandparents' and great-grandparents' war effort during the Second World War.

What war effort do you think we should be making today to fight climate change, and how can we draw inspiration from moonshot projects to do so?

**Mr. Seth Klein:** Thank you.

[*English*]

I would walk you through those six markers that I gave you.

Spend what it takes to win. I was starting to get at that with the other question. We're not there yet. Sir Nicholas Stern says we should be spending about 2% of GDP to tackle the climate emergency. In the Canadian context that would be about \$56 billion a year. If you were to tally up our spending now on climate infrastructure and climate action, generously it clocks in at about \$12 billion a year. We're not a little off. We're off by a fourfold to fivefold order of magnitude.

Create new institutions to get the job done. I mentioned how C.D. Howe created these 28 Crown corporations. By the way, C.D. Howe was no lefty. He was on the right wing of Mackenzie King's cabinet. Part of what I try to do is apply the same logic by which this fellow said when we actually needed a Crown enterprise to intervene in order to drive change, and then map that same logic onto the present. I can give you a three-page list of what I think those Crown enterprises might be.

The point about mandatory measures is really important. The fact is that we're still stuck trying to incentivize our way to victory. I mentioned carbon pricing. In recent budgets, so much of what we're trying to drive now in the way of clean technology is a 50% corporate income tax cut. The most recent fall financial statement has now offered up a further tax credit for capital. All of these will have some impact. I'm not saying they're not valuable—

• (1930)

[*Translation*]

**Mr. Maxime Blanchette-Joncas:** Could you tell us which countries we can draw inspiration from that have implemented mandatory policies to fight climate change?

[*English*]

**The Chair:** Monsieur Blanchette-Joncas, I'm afraid that's time. Could you ask for it to be tabled?

[*Translation*]

**Mr. Maxime Blanchette-Joncas:** I would like an answer in writing, Madam Chair.

[*English*]

**The Chair:** That's excellent. Thank you.

With that, we will go for two and a half minutes to Mr. Cannings.

Go ahead, please.

**Mr. Richard Cannings:** Thank you.

I was actually planning to ask Mr. Klein that very question in so many words. This is an international crisis we're facing with the climate. Are there other countries out there that are doing inspirational things? If Canada did move ahead, we can only hope, with a real moon shot program, would that be inspirational to other countries? How do we get the whole world to do this? This is just such a big problem that the whole globe is facing.

Are there advantages Canada can gain from taking these steps right now in the global context, in our international trade and so on and in our economy?

**Mr. Seth Klein:** Thank you for sparing me the homework.

I don't see another country hitting all six of these markers, but there are certainly other countries that are doing better than we are. If you look at Canada within the G7 context, our success in lowering emissions is the worst among G7 countries, and interestingly, in the countries that do best—the U.K. in particular, and Germany—this has happened under all political stripes. There has been more of this cross-spectrum commitment.

There are some municipal governments that are hitting the markers. For my city, let me give you an example of what I mean by mandatory measures. I'm in Vancouver. As of this year in Vancouver, no new buildings are allowed to use fossil fuels for space and water heating. This is 10 years sooner than the provincial target or other targets that we've seen across the country. That's driving change. That's driving investments in a way that we are not seeing elsewhere, and I think there's a model there.

**Mr. Richard Cannings:** I'm sorry, but I was just caught off guard there. Just to go back to that last point about Vancouver and no more natural gas in new buildings, those are the kinds of things we need to do. Those are the mandatory regulations you're talking about, or some of them anyway.

**Mr. Seth Klein:** That would be an example of marker three, moving to mandatory measures, yes.

**Mr. Richard Cannings:** Okay. I'll leave things there, then. Thank you very much.

**The Chair:** Thank you, Mr. Cannings.

I'd like to thank all of our witnesses. When you have such terrific testimony, it's hard when the discussion comes to an end. I think everyone was very interested to hear from you. It was wide-ranging. We thank you for your time and your expertise. We hope it's been a good experience and that you will want to come back and join us again.

With that, dear colleagues, we're going to suspend to go in camera.

[*Proceedings continue in camera*]





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