HOUSE OF COMMONS
CHAMBRE DES COMMUNES
CANADA

43rd PARLIAMENT, 2nd SESSION

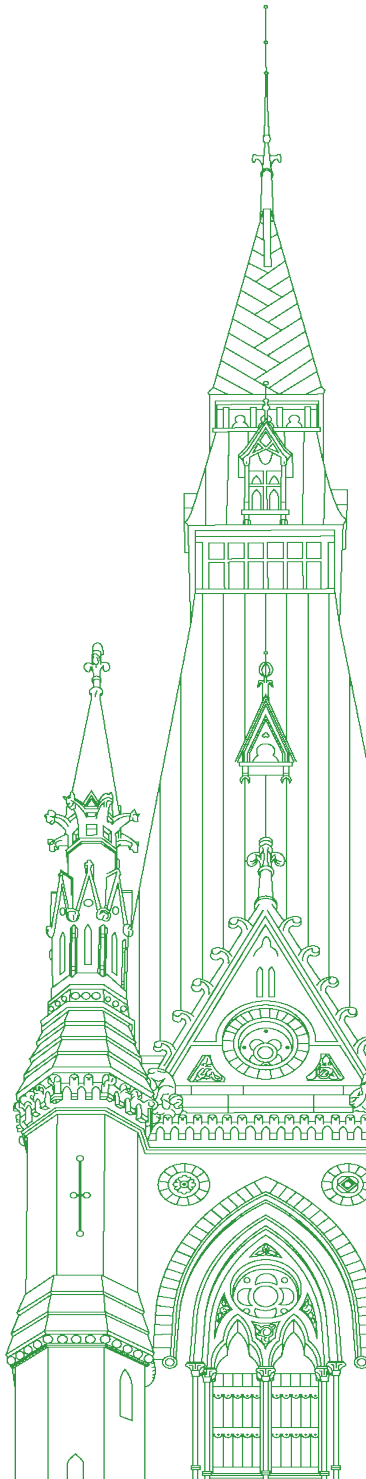
Standing Committee on Natural Resources

EVIDENCE

NUMBER 031

PUBLIC PART ONLY - PARTIE PUBLIQUE SEULEMENT

Monday, June 7, 2021



Chair: Mr. James Maloney

Standing Committee on Natural Resources

Monday, June 7, 2021

● (1105)

[*English*]

The Chair (Mr. James Maloney (Etobicoke—Lakeshore, Lib.)): I call this meeting to order.

Thank you, everybody, for joining us on Monday. Thanks for your patience in getting going. Technical problems are not uncommon.

Welcome to meeting number 31 of the Standing Committee on Natural Resources, which is on low-carbon and renewable fuels in Canada.

I would like to welcome Mr. Brunelle-Duceppe, who is here for Mr. Simard.

Thank you for joining us.

We have three witnesses today. We have Dr. Mark Jaccard from Simon Fraser University. From Hy2gen Canada Inc., we have Cyril Dufau-Sansot, president; and from the Transition Accelerator, we have Dr. David Layzell, who is in 40 centimetres of snow, I'm told, in Banff today.

Welcome, all three of you. Each of you will be given up to five minutes to make your opening remarks. Following that, we'll open the floor to questions from the members.

You can speak, and are encouraged to speak, in either official language, or both. You have translation available at the bottom of your screen. If there are any problems, please let us know.

Five minutes is a hard stop for your opening remarks, and then each of the members has a time limit as well.

I will start with Dr. Jaccard.

Dr. Mark Jaccard (Distinguished Professor and Director, School of Resource and Environmental Management, Simon Fraser University, As an Individual): Hello. Thanks for inviting me. I'll get going.

In my remarks I focus on two challenges related to your study. Because of the tendency of some people to let perfection be the enemy of good, you might have heard strongly negative statements about biofuels and biofuel regulations, but I caution you to discount such extreme positions because evidence supports a more nuanced view. I explain things like this in my latest book, *The Citizen's Guide to Climate Success: Overcoming Myths That Hinder Progress*. That's the kind of focus I bring to your committee today.

It's actually a simple challenge that we have and a simple solution. We have to use carbon pricing and regulations to replace the open burning of coal, oil and natural gas. It could be with renewable energy, some nuclear power and even still using fossil fuels with carbon capture and storage.

I focus the first part of my remarks on false negative claims about emissions of liquid biofuels. In my 30 years working on the energy transition, I've encountered some extremely negative views on biofuels. Even if unintended, these views can help people who would keep us on a fossil fuel-burning path. One hears that consuming biofuels won't reduce greenhouse gas emissions because burning biomass releases CO2. It's true that if we permanently transform a forest into a desert to make biofuels, this conversion will lead to an increase in atmospheric CO2 emissions, but if we produce the biomass for biofuels from sustainable forestry or agriculture, there's no net increase in atmospheric CO2. This is not my personal view; it's the view of the independent scientific Intergovernmental Panel on Climate Change.

One also hears that even if biomass can be a zero-emission source of energy, it's the production processes of converting it into biofuels that cause CO2 emissions. People refer to this as a life-cycle analysis, looking at the emissions in the growing, harvesting, transporting and processing of the biomass feedstocks that we use to make biofuels. However, again, the Intergovernmental Panel on Climate Change argues that this static life-cycle analysis approach is wrong. Biofuels can be produced using organic fertilizers, and with farm equipment, transport vehicles and biofuel processing plants that are powered by sustainably produced biofuels. Life-cycle emissions from the production of biofuels will be near zero when we implement policies that require it.

We can get a contribution from biofuels that might be, I don't know, 15% or 20% replacement of the liquid fuels that we're currently using in transportation. It's not the solution, but it can be part of that solution. This modest contribution in fact can be critically important. Biomass feedstocks then would come from forest and agricultural organic waste, sustainably managed forest plantations, converted marginal agricultural lands and some sustainable agricultural production that improves income and employment opportunities in our rural regions as part of the energy transition.

I focus the last part of my remarks—for as long as I can go on—on false negative claims about biofuel regulations. I'm an economist. I know that humanity could achieve net-zero greenhouse gas emissions with just one economically efficient policy: a carbon tax. It's technically and administratively possible to apply this one policy and keep it rising until emissions fall to zero, but a singular reliance on carbon tax is politically difficult. We all know all about that and I talk about it in chapter 6 of my book.

That's why leading jurisdictions like California significantly rely on regulations to reduce greenhouse gas emissions. We economists can be fine with this, because well-designed regulation can perform like a carbon tax.

I'll give you one quick example. To get to zero emissions in 2050, we must phase out the burning of fossil-fuel diesel trucks, but we don't know if trucks in 2050 will mostly use electricity, hydrogen or biodiesel, and we don't want government policy to send us down what ends up being the more expensive path.

However, guess what? If government implements a regulation that requires a rising blend of zero-emission biodiesel in regular diesel such that by 2050 the only diesel available for sale is 100% biodiesel, government has not picked the technology energy winner. The regulation has simply reached a level of stringency that bans fossil fuel-burning trucks, which is the same outcome as a rising carbon tax.

Under both policies, the future relative market shares in 2050 of electric trucks, hydrogen trucks or biodiesel trucks will be determined by their relative cost and the preferences of trucking firms. The regulation is technology neutral.

● (1110)

I'm going to end there with those two main points. One, be careful of blanket statements about biofuels being bad. It all depends on how we decide to produce them.

The Chair: Thank you, Dr. Jaccard.

Dr. Mark Jaccard: I'm done. Thanks for your attention.

The Chair: Thank you.

Next is Hy2gen for five minutes.

[*Translation*]

Mr. Cyril Dufau-Sansot (President, Hy2gen Canada Inc.): Thank you for inviting me to share our vision of clean fuels and the role we hope to have in that marketplace.

I will start with some background on our company, Hy2gen and its Quebec-based subsidiary. We want to develop companies that produce green hydrogen from renewable power and to expand the use of green hydrogen globally through massive deployment. However, the logistics solutions to transport green hydrogen on a massive scale are not sufficiently advanced, making it extremely costly. Our goal is to produce biofuels using green hydrogen, so green fuels, and leverage existing logistical infrastructure to deploy green hydrogen production on a massive scale globally.

Today, I want to draw your attention to another biofuel, one on the fringes of conventional biofuels such as renewable natural gas, biomethanol and ethanol. I am talking about green ammonia. As one of the main products in the manufacture of fertilizers, ammonia is often associated with agriculture. It is important to note that green ammonia is also a very efficient fuel, allowing an aircraft to exceed Mach 6 for the first time in the 1950s. Green ammonia is produced by combining nitrogen from the air with hydrogen. To date, it has conventionally been made from hydrogen derived from fossil fuels, mainly natural gas. We want to use renewable energy to not only capture nitrogen from the air, but also produce green hydrogen via water electrolysis and combine the two gases to produce green ammonia.

As a fuel, green ammonia holds tremendous appeal for sectors that are very energy-intensive, beginning with marine transportation. One of our shareholders is Trafigura, a top commodity trading company. It is actively engaging international marine authorities to promote green solutions and encourage the world's marine operators to adopt clean fuels, through the implementation of bonus-malus systems, based on the avoidance of CO_2 emissions, or taxes on CO_2 emissions. The idea is to promote clean fuels like ammonia, which holds tremendous potential for the marine transportation sector.

That opens the door to producing large quantities of ammonia in places where renewable energy is readily available and economically attractive, thereby justifying the creation of green hydrogen production facilities. What's more, it is extremely cost-effective, since establishing very large plants on a massive scale has the benefit of a scale effect. The green hydrogen produced provides a widespread-use alternative to conventional fuels and synthetic renewable fuels, which will have paved the way for this transition.

It is essential that regulatory decision-making related to clean fuels take into account green ammonia, which can replace the widespread use of conventional fuels. I mentioned marine transportation, and now I will turn to uses in Canada and Quebec, where we have our first facility, which uses approximately 250 megawatts of electrolysis power to produce green ammonia. Little by little, we are transforming fuel uses to ensure that, in the next 15 to 20 years, the use of green hydrogen will benefit from the amortization of units that have been set up now to support carbon-free transportation across the board, whether by sea, land or air. Aviation fuel is another possibility. Hydrogen-powered aircraft are already being developed.

● (1115)

I felt it was important to share this vision with you today.

[*English*]

The Chair: Thank you. You're right on time. It's always appreciated.

Last, we have Dr. Layzell for five minutes.

Dr. David Layzell (Energy Systems Architect, The Transition Accelerator): Thank you very much. It's a great privilege to be here today.

Low-carbon fuels have been a major focus of my academic career for more than 20 years. Over the past two years, I've been helping to launch the Transition Accelerator, a pan-Canadian non-profit that is focused on achieving net-zero emission energy systems in a way that creates jobs and stimulates the economy.

There is a rapidly growing global consensus that to achieve net-zero emissions, virtually all carbon-based energy carriers, such as gasoline, diesel and natural gas, must be replaced with zero-emission energy carriers, such as electricity and hydrogen. Of course, these energy carriers must be made with little or no greenhouse gas emissions.

This might sound like bad news for Canada, but it is not. Canada is internationally renowned as one of the world's lowest-cost producers of low- or zero-carbon electricity and hydrogen.

Electricity is an excellent energy carrier for personally owned vehicles, for light-duty transportation, and space heating in more moderate climates.

However, I want to focus today on hydrogen as the net-zero fuel of choice for heavy-duty and long-distance transport, essentially those markets that are now served by diesel; space heating, especially in cold climates and for large buildings; and heavy industry, such as steel making.

By 2050, hydrogen could deliver 30% of the secondary energy demand in Canada, and feed a major energy export industry, while adding about $100 billion a year to the Canadian economy, and delivering somewhere between 25% to 50% reductions in national greenhouse gas emissions.

When hydrogen is made from the electrolysis of water with renewables or nuclear energy, it is often called green hydrogen. On the other hand, blue hydrogen is made from fossil fuels, such as natural gas, when the byproduct CO2 is captured and sequestered in geological reservoirs. Both green and blue hydrogen are low carbon, and both will reduce life-cycle emissions by 90% or more when displacing diesel use in heavy transport.

Some provinces are better positioned to make green hydrogen, while others are better positioned to make blue hydrogen. Either way, hydrogen could provide a shared pan-Canadian vision for a clean energy future. This is a rare opportunity for this country.

The challenge with hydrogen is that it is a gas, so it is more expensive to transport and store than liquid fuels, such as diesel or gasoline. Canada can actually make low-carbon hydrogen at about half the wholesale cost of diesel fuel. However, getting the hydrogen to market is only cost-effective if it is done at large scale, serving dozens to hundreds and thousands of users.

How do we get there from here? There are four points I want to make.

Number one is to focus on the entire value chain, linking both policies and public funding to build new energy systems in a coordinated way.

Number two is to understand the level of ambition that is required. Every year there are over 5,000 buses and 34,000 heavy-duty trucks sold in Canada. To put Canada on a transition path to net zero, one-third of these, or 13,000 vehicles per year, would need to be hydrogen fuelled by 2030. This is a challenge, since large vehicles of this type will not arrive in Canada until 2022.

Number three is that early investments are needed in pilots and demonstration projects for vehicles, fuelling stations and low-carbon hydrogen production. These are important to stimulate interest and build confidence in a new hydrogen value chain.

Number four is to concentrate investments on hydrogen hubs. Over the next five to seven years, substantial public investments must be focused on a limited number of regions that can bring together low-cost hydrogen supply, efficient transport and substantial demand.

In conclusion, hydrogen is an essential energy carrier in a net-zero energy future. Canada is well positioned to take a leadership role, but we must act now.

Thank you.

● (1120)

The Chair: Thank you very much.

We'll move to our first round of questions.

Mr. McLean, I understand you are going first. You have six minutes.

Mr. Greg McLean (Calgary Centre, CPC): Thank you, Mr. Chair.

We have a great panel here today on the issues in front of us. Thank you very much, gentlemen, for appearing before us today.

The first question is for Dr. Jaccard. He made reference to the blanket statements of biofuels being bad.

Dr. Jaccard, I appreciate that you're an economist. Have you seen the analysis done by Thunder Said Energy? It is a group out of the U.K. It indicated that the life-cycle carbon footprint of biofuels was approximately twice that of the fuels it replaced.

Dr. Mark Jaccard: No, I have not seen that study. I have seen many studies that have claimed that over the last 20 years. That was the point of my opening comments, because I can look at that study, too, and I have known from the 20 or 30 I've seen before this that people have done this using a static analysis. That's what I was referring to: that it's not "How are we doing it?" when we don't regulate the emissions produced when using biofuels but "What is possible?"

If we're talking about hydrogen or ammonia, we're talking about how we regulate something. There are Dr. Layzell's comments about how producing hydrogen from natural gas involves regulations so that you don't do it the way we are now.

The point of my comments is this: If you regulate the life-cycle emissions, what can be the production? I've seen a lot of data with regard to cases where biofuels are made with zero emissions—life cycle.

● (1125)

Mr. Greg McLean: We haven't seen that, actually. We've actually seen a whole bunch of contrary evidence.

Let me ask you even further here, if we go down this path. If you think about a static supply or a growing supply of biomass being used for consumption as food in the world, the consumption of biofuels, as in canola, is going to require a diversion of that fuel or that foodstuff biomass towards fuel production. How do you justify that that's not going to require more land mass as a result?

Dr. Mark Jaccard: I've done a study for all of Canada, in fact, and I'll make it available to the committee. I did it a few years ago.

What I said in my statement was "Here are the processes you would follow." This is what Scandinavia is doing right now. You would make sure that it's sustainable forestry and that you're using forest waste. You make sure that you're using agricultural wastes. You make sure that you're converting marginal lands and—

Mr. Greg McLean: Those are biogases in many respects. Those aren't biofuels. We're talking about creating biofuels here, from fresh stock, in many respects, to get there.

The biofuels industry itself understands that it takes 1.6 units of power to create one unit of power to come out the other end. That, of course, is clean, as we define it, versus hydrocarbon energy.

How does that actually square up as being energy efficient at the end of the day and not creating more actual greenhouse gas as you say the 30 studies you've read have shown?

Dr. Mark Jaccard: These are all static analyses, and it sounds to me like you're giving static analysis as well. It sounds to me like you're refusing to look at some of the ways in which we are producing biofuels.

Again, I am looking at Scandinavia, but I'm also looking at Scandinavia making agreements with people who are providing the biofuels. I'm also looking at Brazil. I'm looking at many cases where we can make—

Mr. Greg McLean: I'm sorry, Mr. Jaccard. We're talking about production here. We're not talking about deals. We're talking, actually, about the CO2 production from biofuels.

I am going to move on. Thank you for your input.

I'm going to move on to Hy2gen, because I am interested in green hydrogen. I'm interested in the environmental footprint of green hydrogen and, actually, steam methane reforming versus electrolysis. Electrolysis is, obviously, much more energy intensive, if you will, at the end of the day.

Can you tell us about the overall environmental footprint of electrolysis versus steam methane reforming, please, Mr. Dufau-Sansot?

[*Translation*]

Mr. Cyril Dufau-Sansot: Yes, it's important to take into account the energy efficiency of water electrolysis from non-renewable electricity, which is of course lower than in the case of methane reforming. That is why I do not recommend water electrolysis using non-renewable electricity.

Conversely, when 100% renewable electricity is used, the environmental footprint is very low because, regardless of efficiency, the electricity is renewable, meaning, it is available and merely needs to be captured. Whatever the efficiency of a wind turbine, a hydroelectric station, solar panels or an electrolyzer—which, might I add, is now nearly 65%—the energy is 100% renewable.

[*English*]

Mr. Greg McLean: Mr. Dufau-Sansot, thank you.

I have a recent study here from Bank of Montreal Capital Markets. It does say that electrolysis uses twice as much water and five to six times more energy than steam methane reforming as green hydrogen.

We accept that we're going to need all kinds of hydrogen going forward here. What we want to do is make sure that we understand the carbon footprint of each of these going forward. With five to six times more energy required for electrolysis versus steam methane reforming, it does seem to indicate that the actual CO2 emissions can be higher.

You're exactly right. The power from wind, nuclear and hydro are the lowest footprint, but you still have a lot of energy here that translates in the end into a lot of CO2. Do you know this analysis?

● (1130)

[*Translation*]

Mr. Cyril Dufau-Sansot: Electrolysis does not emit CO_2, unlike natural gas reforming. When a gas molecule is broken up, the carbon in the gas goes into the atmosphere, but when a water molecule is broken up using electricity, no CO_2 is emitted because it does not contain any carbon.

Of course, it is an energy-intensive process from an electricity consumption standpoint, but natural gas reforming is also energy-intensive given the loss of energy contained in the natural gas. Only the hydrogen energy is recovered when a natural gas molecule is broken up.

I think it's a false argument to draw such a direct comparison between the two methods.

[*English*]

The Chair: Thank you very much.

Thanks, Mr. McLean.

We'll go to Mr. Lefebvre.

Mr. Paul Lefebvre (Sudbury, Lib.): Thank you, Mr. Chair.

[*Translation*]

Thank you to the witnesses for being here this morning. What they have to say is extremely informative, especially since the topic of our study is an issue of significant concern.

[*English*]

I'm going to start my questioning with Dr. Layzell.

You talked about what we need to do with the value chain, which is to be ambitious, make early investments and create these hubs. You then said that we must act now.

Some of the big items that you're talking about.... There are certainly the top four things that we need to do, but for the purpose of our report, we sometimes like to have specific granular suggestions as to how we accomplish all of these.

What can the federal government do to act now to ensure that Canada has a chance to be a world leader in the sector and to take advantage of these opportunities? You talk about these financial opportunities and this transition. That's the name of the group you're with, Transition Accelerator.

This is very important to our country, so I want to hear more in depth for about a minute. Perhaps you could get really specific with us as to what you would want to see the federal government do to really help to accelerate this transition.

Dr. David Layzell: Certainly.

I think the Canadian hydrogen strategy that came out just before Christmas identifies a lot of very specific recommendations. We certainly had a lot of input into that, but we weren't the authors of it. I would point you to that.

In terms of specific things that are needed, I would argue that we need to start getting out there and running pilots for hydrogen for both green and blue hydrogen production in concentrated areas where we need vehicles. Bring in hydrogen-using vehicles, especially in the heavy-duty fleet—buses and heavy trucks—and try them out. Put them through paces and see how they operate under Canadian conditions.

We need to be doing the kind of detailed techno-economic analysis that basically starts to design a new energy system that will actually be capable of achieving net-zero emissions by 2050. Obviously, it's complex. We're talking about building a new energy system essentially from scratch. We don't want to see a lot of stranded assets, so we want to actually figure out how we go from the complex energy systems we have today—carbon-based—to carbon-free energy systems, both with different green and blue hydrogen production and with whole new value chains. We have to figure out how to build those. Resources are needed in order to make this happen, both in demonstrations and in hydrogen hubs.

Mr. Paul Lefebvre: I'll let Mr. Jaccard talk about that as well.

I'm interested as well, Mr. Jaccard, in this whole notion that you raised about static analysis versus fluid analysis. It's very important that we have that in our report. There certainly is an opinion out there that it's just as expensive to create one or create the other and the effect of greenhouse gas emissions is the same.

I'd like to hear you on the opportunities and on the static analysis piece that you mentioned.

Dr. Mark Jaccard: The economist in me is neutral in terms of the points about hydrogen, how it's made, where it comes from and what it's potential is, especially in transportation, of course, and likewise for electricity.

I still am of the opinion that we should make sure not to pick the winner, but, of course, government does, and hopefully your report talks about how government might create conditions that are favouring certain things. David Layzell talks about how, if we're going to have hydrogen, we need to do some of those. Government needs to step in, and I agree with him.

My point is simply that, if you're getting to zero emission, the world gets a lot simpler, because it means, not only in the end-use combustion of something are you thinking about CO2, and is it in a closed loop however you're getting it, but you have to think about the entire production process. Just to give you an example, in British Columbia we have a low-carbon fuel standard. It's where people can sell and trade credits for how they are reducing the life-cycle carbon intensity of fuels, ethanol and diesel, that are used in transportation. If you look at the charts, you see producers who are ranked to be net zero in their life-cycle emissions.

My point is simply that our policies have to be right across the economy. When you do that, you will produce some ethanol, and you will produce some biodiesel, and they will be zero emission life cycle. What their cost compared to life-cycle zero emission hydrogen and life-cycle zero emission electricity will be, depending on the end use.... I don't know who will win.

I do know that in Scandinavia right now, 20% of liquid fuels are from a biogenic origin. Some of it's imported; some of it's produced locally, and some of it is really focused on having zero life-cycle emissions.

It's that policy you need, and then I don't worry so much about the outcome.

● (1135)

Mr. Paul Lefebvre: Very quickly on the policy in Scandinavia, are there any lessons to be learned of how they got to 20%?

Dr. Mark Jaccard: Oh, yes. They have a very large carbon tax, but they have also picked certain sectors as well. Government has said, with intercity busing, that they're going to help make sure that they have E85 produced for those buses, and those are the ones they're going to pick as their fleet.

It's a combination, as I say, of government being directive, even in its investments and choices, and they have regulations as well, so regulations and pricing. It's the basic formula that we know. At least in Canada federally and in British Columbia, where I'm from, and in Quebec, we're doing those kinds of things.

The Chair: Thanks, Mr. Lefebvre.

Mr. Brunelle-Duceppe, you're next.

[*Translation*]

Mr. Alexis Brunelle-Duceppe (Lac-Saint-Jean, BQ): Thank you, Mr. Chair.

Today's discussion is extremely important, but above all, extremely beneficial.

Thank you to the witnesses for their input. I will try to ask each of them a question, time permitting.

I will start with you, Mr. Layzell. In your opening statement, you mentioned the different hydrogen colours, or types. The objectives of the hydrogen strategy for Canada are to promote the development and deployment of hydrogen, spur near-term investment, and develop new regulatory measures to achieve a net-zero emissions target by 2050.

As you said, though, if Canada wants to achieve those objectives, does it not need to distinguish between the different sources of hydrogen, grey, blue and green? The development of grey hydrogen could be another opportunity for the hydrocarbon market.

How should the government shape the strategy to foster the development of green hydrogen, first and foremost?

[*English*]

Dr. David Layzell: I think we should preferably get away from the colours and focus on the carbon intensity. That's the factor that we want. We want low life-cycle carbon intensity.

I would argue that—and this is happening around the world—standards are being developed and defined for the carbon intensity of hydrogen, and Canada should insist that life-cycle carbon emissions have to be below a certain level.

There is a European study. It's called CertifHy. It has identified, I think, 36.4 grams of CO2 per megajoule lower heat value hydrogen, and that is the maximum carbon intensity. I think that's a good place to start. I think we need to even lower that carbon intensity that we allow from a life-cycle basis as years go on as we move towards 2050.

Green electricity made from wind, solar or large hydro can meet that standard. So can blue electricity made from steam methane reforming or auto-thermal reforming with carbon capture and storage.

I think what we need to do is set a standard. The Canadian Standards Association is looking at this now, and there is an international committee. I think Canada should be encouraging that and coming up with a standard for quality similar to what has been talked about for biofuels for low-carbon emissions on biofuels. I think that's critical.

● (1140)

[*Translation*]

Mr. Alexis Brunelle-Duceppe: Thank you for your answer, Mr. Layzell.

I will now turn to Mr. Dufau-Sansot.

The committee heard from a witness who said that Canada should put a price on molecules. That would mean measuring the environmental footprint over the production cycle. Turning to cleaner production methods would have an economic advantage. I'm curious to hear your thoughts on that.

Mr. Cyril Dufau-Sansot: I agree with the principle, but a more detailed look reveals two ways to promote clean molecules.

The first is to support their green potential through subsidies. The lower the molecule's carbon intensity, the more financial support should be available. That support needs to foster the development of an industry. In any case, the scale effect generated by the massive deployment of green hydrogen production should render such support unnecessary. If the size and number of plants increases, costs will go down. It's the same with the development of renewable electricity; cost-effectiveness increases. The economic model could be comparable to that of fossil fuels.

The other way to promote it is to penalize the use of fossil fuels, mainly through a carbon tax or a bonus-malus system, whereby those who use clean fuels are rewarded and those who do not are penalized. The idea is to regulate the market to move towards solutions with the lowest possible carbon intensity.

Mr. Alexis Brunelle-Duceppe: Thank you, Mr. Dufau-Sansot.

If I still have time, I have a question for Mr. Jaccard.

I gather from what you said earlier, Mr. Jaccard, that, as an economist, you don't want to say too much about which strategies governments should use. Nevertheless, I would think you have an opinion on certain things.

Department officials told us that the terms of the strategy do not distinguish between the different colours, or types, of hydrogen and that the objective is largely to foster the development of a hydrogen market for all types of hydrogen. Once the demand has been stimulated, low-carbon hydrogen production can then be targeted.

How does the economist in you view that approach?

Dr. Mark Jaccard: That involves a two-step process. The first is just to promote hydrogen, and the second is to monitor the emissions throughout the production process. If I were asked to sign off on the approach, I would say no because it could lead to backwards movement. From the outset, policies have to signal to the marketplace and innovators the importance of moving in the right direction. In the past, a carbon tax and subsidies have been suggested, but more recently, clean fuel standards are being put forward.

Mr. Alexis Brunelle-Duceppe: Thank you.

[*English*]

The Chair: Thank you.

Mr. Cannings, it's over to you.

Mr. Richard Cannings (South Okanagan—West Kootenay, NDP): Thank you, and thanks to all the witnesses for being here today. As usual, it's been a very interesting discussion so far.

I'm going to continue on with Dr. Jaccard, to allow him to go into more detail.

Dr. Jaccard, I want to ask you about the mix of carbon pricing and regulations that you talked about. You used the example of biofuels, and how we needed the regulations to get us to 100% biofuels when we're talking about diesel, for instance.

I assume that carbon pricing also plays a part in that. The carbon pricing on biofuels would be much lower, and the same goes for hydrogen or green electricity. You would have regulations, perhaps, on the number of hydrogen vehicles versus the push from carbon pricing, as well.

I want to give you some more time to speak to that.

● (1145)

Dr. Mark Jaccard: Thank you. I'll be quite brief.

I'm always making the distinction—I did in my comments—about the actions. That's our switching away from high-emission end use or production processes for any energy form that we use. That's the action. What is the policy that drives that?

We are told that we have to have carbon pricing. I say that as an economist, but actually we don't have to. We could do it entirely with regulations. We did that with ozone-depleting chlorofluorocarbons. We could do it all with regulations.

I talked in my comments about having a rising carbon price. It will get to a point where we will be at zero emissions in both the end use and the production of anything, whether it's hydrogen, ammonia, biodiesel or whatever. But if we're going to do it with a regulation, we could do that as well. For your committee, in British Columbia, I talked about a low-carbon fuel standard that we copied from California. For more than five years now, I've been involved in the federal process of designing a clean fuel standard. I didn't like how it was initially designed. I thought it should narrow in on liquid fuels. What it does is regulate both the fuel end use, as defined by the Intergovernmental Panel on Climate Change, which is why I mentioned that, and the production process. It would look at the production process of hydrogen, of electricity, of biofuels. I'm simply saying do that kind of regulation if you don't want to do carbon pricing.

I'll stop there.

Mr. Richard Cannings: Thank you.

I'm going to move to Mr. Layzell now and talk about hydrogen.

You mentioned the possibility of an export market for hydrogen, especially green hydrogen in Canada. When I talk to energy ministers of countries like Germany and Japan, they are very big on export markets or importing hydrogen from other countries that have a clean source of hydrogen. Germany, I remember, used an example of a big mega solar project in Chile and using that to produce hydrogen to move that clean energy around the world.

I was wondering if you could expand on that idea of a possible export market for Canadian hydrogen.

Dr. David Layzell: I think it's actually quite a large market, potentially equal in size, according to our calculations, to the domestic market we have for hydrogen, just as today we export as much oil as we consume in Canada.

The hydrogen could be exported as liquid hydrogen or compressed hydrogen, but probably most critically, as Mr. Dufau-Sansot talked about, as ammonia. The hydrogen produced, either blue or green, could be converted to ammonia to be put on a ship and shipped overseas, or if it's being exported to the United States, it could go into its hydrogen pipeline. There are various alternatives. There are a couple of other technologies as well.

Certainly in western Canada there's a lot of interest in South Korea and Japan. In fact, we're in quite regular conversations with companies who would like to import low-carbon hydrogen from Canada.

Mr. Richard Cannings: Could that link in with Canada's expertise in hydrogen fuel cells, using those fuel cells here in Canada and exporting them?

Dr. David Layzell: Absolutely.

We could certainly export fuel cells. In terms of attracting international investment, a lot of companies around the world are interested in making hydrogen vehicles. We make fuel cells. Those fuel cells could go into those vehicles.

We may actually be able to attract to Canada manufacturing industries that are creating the vehicles that would be used here and also attract foreign investment to produce the hydrogen for export.

Mr. Richard Cannings: Mr. Layzell, you talked about hubs and investing in hydrogen hubs. We've heard that from other witnesses. Perhaps you have an idea of how the government could help create those hubs.

● (1150)

Dr. David Layzell: I think one of the things is to define the characteristics of what makes a viable hub. Our focus in what we're doing is on making sure that any public investment is focused on capital investment and not operational investment. When the public investment stops, one has an economically viable energy system that will keep running.

That's really the metric that we would argue needs to be looked at when we're looking at public investment in hubs.

The Chair: Thank you, Mr. Cannings.

We'll move into round two for five minutes each, starting with Mr. Lloyd.

Mr. Dane Lloyd (Sturgeon River—Parkland, CPC): Thank you, Mr. Chair. Thank you to the witnesses.

My first question is for Mr. Layzell.

The end goal of this entire process is to mitigate the effects of climate change. Everything we're doing is leading to that end, but sometimes I think we get too focused on the goal of achieving net-zero carbon emissions while possibly ignoring the consequences of emissions of other greenhouse gases of varying levels.

I've read that in some places water vapour is a significant greenhouse gas. Water vapour is a byproduct of the combustion of hydrogen, and hydrogen, even in its gaseous form, if it were to escape also does have some impact on the climate as well. I was wondering, what's the evidence around that? Is there an impact?

Dr. David Layzell: When you look at climate change you see it's about how long the gas lasts in the atmosphere. Certainly, burning hydrogen, burning fossil fuels, all puts water into the atmosphere. The time for water in the atmosphere is about two to three weeks, and then it rains out.

What we're talking about with CO2 emissions is they're lasting there for over 100 years, and that really means—

Mr. Dane Lloyd: What about hydrogen gas in and of itself? If it wasn't combusted and much like methane escaped into the atmosphere, are there any consequences to that?

Dr. David Layzell: Yes. It's actually quite interesting. I studied that 20 years ago and did quite a bit of work on that.

Hydrogen is actually pulled out of the atmosphere by soil microorganisms. Essentially, the hydrogen exists in only half a part per million in the atmosphere. When you double hydrogen in the atmosphere, the biology of the biological soils around the world will stimulate the microbial activity and pull the hydrogen back out. Effectively, the work that was done 20 years ago suggested that there's certainly very little problem with some hydrogen emissions. The biological systems will self-regulate in feedback.

Mr. Dane Lloyd: That's positive to hear. It's good to have that information on the record.

You were talking about green hydrogen and blue hydrogen. Canada's a diverse country, as you know. We have provinces like Quebec, British Columbia and Manitoba, which have ample hydroelectric resources and fairly cheap and steady power sources. Then you get the provinces like Alberta and Saskatchewan, where much more electrification was coal and now natural gas.

Do you think it would be better for the government to approach this regionally? Green hydrogen obviously has more economic benefits in provinces like Quebec and B.C., but in western provinces it seems blue hydrogen would be the more viable option. Would you agree with that?

Dr. David Layzell: Absolutely. I think we should let the market decide, but also some of the producers of blue hydrogen are looking for some subsidies for carbon capture and storage. I would argue you need to go and look at the green hydrogen to make sure we haven't tilted the playing field against green. I think both are extremely important. We need both. Blue hydrogen is lower cost at the present time, but green hydrogen prices are coming down. My sense is we don't need to decide. We let the market determine which works.

The problem is moving hydrogen around. You obviously want to produce it close to where it's going to be used, if you can. That's going to have a regional opportunity.

Mr. Dane Lloyd: This leads me into my next question.

Canada has a lot of existing legacy oil and gas infrastructure. What do you think the role of this infrastructure and the workers who build and maintain this infrastructure will be in a hydrogen future? Is that something that can be melded together?

Dr. David Layzell: I think what we're looking at here is an opportunity to piggyback on some of our existing infrastructure. Today across Canada we already make, mostly from natural gas, about 8,000 tonnes of hydrogen every day. We can actually piggyback off of that to, first of all, get the companies to start making that as blue hydrogen instead of grey hydrogen. The carbon pricing that Mark talked about actually really is helping to do that.

Also, we can take a pipeline off and distribute a portion of that hydrogen. Instead of being used as an industrial feedstock the way it is now, that same hydrogen could be used as a fuel.

● (1155)

Mr. Dane Lloyd: Can that hydrogen be blended with the crude or the bitumen in, and then separated at a later stage so that you could run bitumen and hydrogen in the same pipelines at the same time?

Dr. David Layzell: No, not really blended in terms of with oil, but blended with gas is a possibility with natural gas. You can put the hydrogen into distribution networks to decarbonize natural gas. The economics of that aren't as good—

Mr. Dane Lloyd: Yes. I think ATCO is trying that in my area—

The Chair: Thank you, Mr. Lloyd.

Mr. Weiler, we'll go over to you.

Mr. Patrick Weiler (West Vancouver—Sunshine Coast—Sea to Sky Country, Lib.): Thank you, Mr. Chair, and thank you to all the witnesses today for the really interesting testimony already.

I want to pick up on something that my colleague was just mentioning. There's a wide understanding out there that we're going to need biofuels and hydrogen to decarbonize some of the hardest to evade areas, such as freight shipping and others. One area that it's a little less clear on is buildings, where in much of our country we have existing infrastructure to deliver natural gas. Actually, this is one of our largest sources of emissions.

My question is maybe first for Dr. Jaccard and then Dr. Layzell.

In your opinion, are we better placed to introduce low-carbon fuels into this existing infrastructure, or are we better placed to electrify if we're focused on measures that are both most economically palatable to the consumer and that will create jobs along the way?

Dr. Mark Jaccard: Again, you would either continue to have a rising carbon price and then you'd find out if biomethane slowly blending out of natural gas or some combination of that and blue or green hydrogen coming into those pipes was the solution, or if it was more people using electric heat pumps and even waste heat, but electric heat pumps, probably ground-sourced, in much of the country. The policy is that you either have a rising carbon price or you can do what I just described for liquid fuels.

In fact, I'm involved in the Climate Solutions Council in British Columbia, where—I'm pretty sure I'm safe to say, as this has been public now—we're working on a regulation for gas in pipes that is similar to the type of regulation that I've just been talking about with clean fuel. It says we know that you can't be using fossil fuel-derived natural gas in our buildings, so we're going to phase out the content of that in any kind of gas that's delivered by pipe to buildings over a 20- to 30-year time period.

When we do that, as I say, the market will decide if actually biomethane or some mixture with clean hydrogen is what we start using in buildings increasingly or if we move more to electricity. I think we shouldn't care which one we do, but just get the right policy in place.

Mr. Patrick Weiler: Thank you, Dr. Jaccard.

The same question goes to Dr. Layzell.

Dr. David Layzell: I would tend to agree largely with what Mark said, although I think we also have to look at the capability, actually what's capable that we can achieve.

For example, if we're going to move to electricity, especially in colder regions of Canada, once it gets below about -15°C, heat pumps, electricity-driven heat pumps that move heat from outside to inside in the winter, basically don't work very well. Then you have this huge electricity demand in one season of the year, and how do you actually create the electricity in the winter? We have short days; we don't have solar, and we often have a lack of wind resource in the middle of winter. You have a mismatch and you have a real problem with energy storage and distribution if you're using electricity. We've done a fair number of analyses of this, and in our analyses for many parts of Canada, it's pretty clear that we're going to have a real problem in our new energy system, a net-zero energy system, if we try to move it to electricity for space heating.

We have an infrastructure already, a natural gas infrastructure. Our recommendation is to start to look at slowly converting that infrastructure to more hydrogen. In terms of the economics, when you get to about $170 a tonne of CO2, which we're talking about, all of a sudden the price of natural gas and the price of hydrogen more or less meet. We could start to see that shift to hydrogen-based fuels for space heating, and you can store hydrogen and move it around more easily than you can electricity in large quantities.

● (1200)

Mr. Patrick Weiler: Thank you for that. It's much appreciated.

Dr. Jaccard, you mentioned that a carbon tax and flexible regulations can get us most of the way there, or rather, all the way there, to our 2050 target of net zero and we shouldn't be picking winners.

Of course, in Canada, we're living in a globally competitive environment where different counterparts are making significant investments in different low-carbon technologies. Hydrogen is certainly one of them.

Part of this study is on how we advance the development of low-carbon and renewable fuels domestically as industries. How do we ensure that we can develop those industries in Canada and not buy them from other countries if we're not going to be picking winners?

The Chair: Be very quick, please, if you can.

Dr. Mark Jaccard: Okay.

I think I partly answered this. I agreed earlier with some of David's comments, because when you are going down a path like hydrogen, and even clean zero-emission biofuels, government does have a role to play. I'm not denying that. The economist in me, though, says to find that sweet spot. That's what I say when I'm making recommendations to government.

The energy system has a great history of governments putting all sorts of money into failures. What I try to point out is that there are ways to do it where you're letting the market still decide while you're helping out these opportunities. That's my approach.

The Chair: Thank you.

Mr. Simard, I see you're back. We'll go to you for two and a half minutes.

[*Translation*]

Mr. Mario Simard (Jonquière, BQ): Thank you, Mr. Chair.

Mr. Layzell, from what I heard, you said earlier that we should focus not on whether hydrogen is green, blue or grey, but on the emissions generated by the hydrogen production. I read somewhere that producing a single tonne of hydrogen using oil or gas resulted in 10 or 11 tonnes of greenhouse gas emissions, so I assumed oil- or gas-based hydrogen production was not the best way to go.

In your view, does oil- or gas-based hydrogen production have a significant environmental benefit?

[*English*]

Dr. David Layzell: We've done a lot of analysis of this. I'm happy to send reports to the committee, if you'd like.

The life-cycle emissions are about 10 kilograms to 12 kilograms of CO2 for every kilogram of hydrogen. That is grey hydrogen. That is produced from natural gas and just releasing the CO2 into the atmosphere. When that hydrogen is used in a hydrogen fuel-cell vehicle to replace diesel, you still get about a 25% to 30%, even 40%, reduction, depending on the vehicle you're replacing, in greenhouse gas emissions life cycle compared with diesel.

We're saying that's not enough. If we're going to really address climate change, we have to set our target higher. We have to be looking at lower-carbon hydrogen production. When you're making hydrogen from renewables, for example, from hydro, from solar, or from blue hydrogen from fossil fuels, but you're capturing the CO2 from the fossil fuels and you're sequestering it, the carbon intensity life cycle goes down to between around 1.5 kilograms to 3 kilograms of CO2 per kilogram of hydrogen.

That's kind of the range that I think we need to be setting and basically challenge, or have a standard protocol, for how you calculate the carbon intensity life cycle. We're talking about, of course, making the solar panels, putting them on the land, having the land impacts all be considered, and making the cement to make a big hydro dam. That has to be considered in the life-cycle emissions. Overall, we can get about a 90%, even 95%, reduction in emissions relative to the diesel we're replacing when we follow that whole pathway through.

● (1205)

The Chair: Thank you very much.

Thanks, Mr. Simard.

It's over to you, Mr. Cannings.

Mr. Richard Cannings: I'd like to continue with you, Dr. Layzell, and talk about those hubs. I want to get a little more information.

You talked about capital investment being important. When I talk to people in the hydrogen world here in British Columbia, they talk about the capital investment that's needed to create these hubs as being the critical thing they need. These fairly small companies just don't have the capital themselves. It's difficult for them to get it from within Canada. This is the ideal place for the government to really step up and produce the infrastructure to help build the hydrogen sector in Canada.

Could you maybe expand on exactly what type of infrastructure is needed here?

Dr. David Layzell: Initially, probably most of the focus...You have to look at the entire value chain. You have to put public money and attract private money to support different links in this value chain. Like any chain, it's only as strong as the weakest link. One of the weakest links in the problem is that vehicles that use hydrogen are made in ones or twos right now. They're not made in tens of thousands like diesel vehicles are, so they're very expensive.

We're going to need to create opportunities to support the deployment of these vehicles, initially in demonstrations and small pilots, but eventually in hundreds of buses that will be supporting municipal bus fleets, and the deployment of large-scale hydrogen trucks on major corridors. I'm talking about very big transport trucks that use a lot of fuel.

The economics of buying these vehicles is very challenging. The government will need to support those vehicles until the production levels of those vehicles start to go up and the price comes down. Most of the estimates are that within the next eight to 10 years we'll be pretty close to cost parity if we start to really build lots these vehicles and have them deployed.

That has to be coordinated by making sure we have supporting fuelling stations. Ideally, we have to have the infrastructure for pipeline distribution of hydrogen along major corridors.

We have to be focused on where we are trying to be by 2030, 2035 or 2040, and start putting that infrastructure in today. It's not lost money. The money from the federal government could be put in low-cost or zero interest loans. The money will come back to the government as this pipeline starts to get used, and we start to develop this new hydrogen economy.

Those are the kinds of infrastructures that we need to invest in.

The Chair: Thank you, Mr. Cannings.

Mr. Zimmer, we'll go to you for five minutes.

Mr. Bob Zimmer (Prince George—Peace River—Northern Rockies, CPC): Thank you, Chair.

I have a question for Dr. Jaccard, a fellow British Columbian. I'm up in northern B.C. right now.

We certainly like renewables and biofuels, but are concerned about some of the implications of that. I was on the agriculture committee for four years prior to this committee, and some of the effects of some of those food crops being turned into fuel crops....

What do you say to the potential upward pressure of growing renewable fuels as opposed to [*Inaudible—Editor*] and its effects on food prices?

Dr. Mark Jaccard: My point, similar to what I mentioned before, is that when we look at studies that suggest a significant upward movement on food prices, these studies are more of what I call all or nothing, a dramatic movement into biofuels to replace all liquid uses of fossil fuel derived hydrocarbons.

Those are not the studies I'm looking at. Those are not the kinds of outcomes I was talking about in my remarks. I was talking more about something like 20%—

● (1210)

Mr. Bob Zimmer: Doctor, I'm sorry, but time is tight.

A Bloomberg article from May 20, 2021, entitled "Green-Fuel Push Stirs Food Inflation Fears in Rebound From Virus", states:

> Soaring demand for crops has once again raised the question of whether nations should really depend on ethanol and renewable diesel to save the planet from global warming. Corn, soybeans, palm oil and sugar, which are increasingly processed into biofuels worldwide, are part of a staggering commodities rally that's making everything from animal feed and noodles to taco shells and chocolate more expensive, putting central bankers worldwide in a tough spot between fighting inflation and seeking to stimulate battered economies.

How do you speak to that?

Dr. Mark Jaccard: It is the same answer.

As I said in my opening comments, I've seen studies like that for 25 years. If you look at the Intergovernmental Panel on Climate Change, we run scenarios, and look at food pricing when we don't take an extreme case like the quote you were just using from Bloomberg.

What food costs is a serious question. I don't believe, therefore, that biofuels will solve climate, as I think your quote kind of said it would rely on them. It'll be more like in significant niches. We've been talking about the trucking industry, and that's where we're seeing it happen without those kinds of effects.

Mr. Bob Zimmer: Maybe I'll open it up to any other witness here.

The previous Ontario Liberal government was the largest subnational debtor in the world mainly to do with their energy policy and throwing all the money at it. Doctor, you talked about putting money into failures. It's this endless...taxpayers' back pocket. Taxpayers only have so much money.

I think this gets to what Mr. McLean was referring to as well. We talk about the affordability of renewables. This is a big factor to Canadians. It needs to be affordable.

How do you delay those concerns about this push to biofuels and renewables? I just wrote down this quote, which is that we can get to the moon, but at what cost? At what cost are we going to get there? Maybe as a "glass is half full" kind of guy, how do we get to the moon, but with a low cost?

Dr. Mark Jaccard: I could leave it open for others to comment.

My point was you use policies that give you the cheapest possible option and you don't use too much government throwing money at things. I think my comments have been pretty clear on that point. I would argue that any political party that was interested in doing this as inexpensively as possible would agree with the policy recommendations I made in my opening comments.

Thanks.

Mr. Bob Zimmer: Mr. Layzell.

Dr. David Layzell: I'm a biologist by trade. Between 1998 and 2008, I set up and ran the BIOCAP Canada Foundation. It was all about biological solutions to climate change. I was very supportive of biofuels at that time because you could drop in fuels and they could result in incremental movement toward a lower carbon energy system. I must say I am very concerned. Now we are talking not about incremental change; we're talking about getting to net zero.

I have very grave concerns about biofuels. We don't have enough residual biomass to make the biofuels, so we need to plant and grow biomass, which means there are going to be impacts on biodiversity, food production and land use. Canada may be able to do it, but the rest of the world can't. We are a country with huge biological resources.

The rest of the world—most of the world—is very clear that they're not looking at biofuels. You can pick Finland and Sweden and a few other countries that maybe are doing it, but....

A real concern is—

The Chair: Thank you. I have to stop you.

Thanks, Mr. Zimmer.

Mr. Serré, you're going to be the last one. I can probably squeeze out up to three minutes for you.

[*Translation*]

Mr. Marc Serré (Nickel Belt, Lib.): Thank you, Mr. Chair.

I would like to thank the witnesses as well.

Mr. Layzell, I want to follow up on a point my fellow member Mr. Weiler raised. For the benefit of the committee and the federal government, can you provide more details on the recommendations to achieve low-carbon or carbon-free buildings? You mentioned British Columbia.

What specific recommendations were made to lower or eliminate carbon from homes and buildings?

● (1215)

[*English*]

Dr. David Layzell: I would argue that at the start, we need to test different technologies. We don't have an economically viable solution today for space heating that is low carbon.

I would argue that we need to be increasing the carbon taxes on the fuels we use for space heating. We should be encouraging heat pumps in regions where it makes sense. Obviously, they are very efficient and have a lot of opportunity. We can, hopefully, bring the cost down.

We also need to be looking at putting hydrogen into our natural gas, up to maybe 15% or 20%, and using that for moving towards decarbonization. We also need to be piloting some pure hydrogen heating in our building structures.

I think that in the transition pathway to a net-zero future, space heating is probably in the 2030s and 2040s. The real focus and opportunity today is in transport and some of the heavier industries. It's a timing issue.

Mr. Marc Serré: Thank you. I don't have much time. I apologize.

You mentioned increasing carbon pricing. Mr. Jaccard talked a bit about that.

Mr. Jaccard, I probably have about a minute or so left. When you talk about regulation, pricing, policies and moving forward. what would be your recommendations to this committee and to the federal government? Let's say you're the minister of finance and you're preparing the budget for 2022. What would be your recommendations to this committee on how to meet our targets?

Dr. Mark Jaccard: I would offer to the government the suggestion of a rising carbon price or regulations of the kind, if you look through my testimony, that I've been talking about. They dominate in California. Eighty-five per cent of their policies involve the kind of regulations I was talking about.

I'm indifferent. You can do regulations that are about as efficient as carbon pricing. It's fine to be indifferent to that, but you do need to regulate or have a rising price. Otherwise, fossil fuels are wonderful. They'll destroy the planet but they provide fairly high-quality energy. Also, their price is going to fall as we switch away from them. They're going to get even cheaper, so you have to have the regulations in pricing.

The Chair: Thank you, Mr. Serré.

We're going to have to stop here.

I will say thank you to our witnesses. That was a highly interesting panel. Unfortunately, we always have a limit on the time we can spend on these matters, but we do appreciate it.

Committee members, we will suspend. You'll have to log off and log back onto the in camera session.

[*Proceedings continue in camera*]