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Mr. Lee Richardson

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● (1535)

[*English*]

The Chair (Mr. Lee Richardson (Calgary Centre, CPC)): Ladies and gentlemen, I call to order meeting number 49 of the Standing Committee on Natural Resources. Today we continue our discussion on our study of the greening of electricity consumption in Canada, on the use of coal and towards a clean technology.

Appearing from the Department of Natural Resources today, we have Graham Campbell, director general of the Office of Energy Research and Development; and John Marrone, who is director general of the CANMET Energy Technology Centre here in Ottawa.

Also appearing will be George White, chairman of the Coal Association of Canada, and maybe I'll give Sherritt International Corporation a plug too while we're at it. From the Canadian Clean Power Coalition, we have David Lewin, chairman.

I think we'll begin with the department. Sharing the first 10 minutes will be Graham Campbell, and we'll begin with John Marrone.

John, go ahead, please.

Mr. John Marrone (Director General, CANMET Energy Technology Centre - Ottawa, Department of Natural Resources): Thank you very much, Mr. Chair.

Honourable members of Parliament, ladies and gentlemen, it is my pleasure to be here today, along with my colleague from Natural Resources Canada, Graham Campbell, who, as was mentioned earlier, is the director general of the Office of Energy Research and Development.

Together, our organizations are the main engines of energy, science, and technology at Natural Resources Canada. As you can see from the slides, this has been going on for quite some time. This is our 100th anniversary of energy, science, and technology, serving the government and people of Canada.

We are here at your invitation to talk about the exciting and emerging topic of clean coal and how it can help to green Canada's electricity supply.

I'd like to get right into it. Why clean coal? If you look at the first slide, I have come up with five points. One is that at present, Canada has almost 17,000 megawatts of coal-fired electricity-generating facilities located in six provinces. We depend on coal to provide a large percentage—18% of our national supply of electricity—and coal is an important part of the energy mix in all of these provinces, but especially in Alberta, Nova Scotia, and Saskatchewan, where coal is the dominant fuel for electricity generation.

Another reason is that Canada has large proven reserves of coal. By one estimate, we have over 200 years' worth of proven coal reserves, and maybe even 1,000 years' worth.

The third point is that it's inexpensive and that the price of coal is much less volatile than, let's say, natural gas.

The fourth point is that this huge resource presents a major challenge, however. Conventional coal-fired power plants contribute significantly to emissions that cause smog and acid rain. With clean coal technology, this fuel can be used in an environmentally acceptable manner.

Finally, the Canadian Electrical Association expects that over the next 20 years, Canada will require 20,000 megawatts of new capacity per decade to meet load growth and replacement of the retiring generating units. So it is important that clean coal technologies be developed in time to replace the existing capacity.

What is clean coal? Modern coal-fired power plants using today's commercially available technology are already much less polluting; however, in light of climate change, clean coal power generation requires that CO_2, carbon dioxide, generated during combustion is also captured, compressed, and safely stored deep in geological formations. When we speak of clean coal, we are referring to capturing nearly all of the greenhouse gases and the remaining emissions from coal-fired electric power plants. We call it near-zero emissions.

Several transformative technologies have been identified in our technology road map to achieve this, including post-combustion capture, which is the capturing of carbon dioxide from flue gases using an absorbing material to selectively absorb the CO_2. The relatively pure CO_2 is later released from the absorbing material when the material is heated. The CO_2 is then compressed and stored.

The second major technology is oxy-fuel combustion, which is burning fuel in oxygen instead of air, resulting in a highly concentrated stream of CO_2 that is then compressed and stored.

The third main technology is pre-combustion capture, or integrated gasification combined cycle. This involves conversion of coal to a synthetic gas. That synthetic gas is composed of hydrogen and carbon dioxide. The carbon dioxide is separated through a high-temperature filter and compressed and stored. The hydrogen then goes on, of course, to be burned in the gas turbine, which is a turbine very similar to an airplane engine. Steam comes out of that, which pushes a steam turbine. So both turbines generate electricity.

Clean coal research is ongoing throughout the world, but the focus has not included the utilization of low-ranked coals, such as the Canadian sub-bituminous and lignite varieties. An opportunity exists for Canada to take a leadership role with respect to these types of coals, to provide utilities with a powerful option to meet Canada's energy needs and create a highly exportable technology. Canada's development of these new technologies not only improves our own air quality, with all the related health benefits, but also contributes to the global effort to reduce greenhouse gas emissions.

NRCan has been working with industry for over 13 years to develop the basic technology for oxy-fuel combustion of coal, coal gasification, and the new technology you may have read about recently, thermoenergy integrated power system, or TIPS for short, which is a new form of oxy-fuel combustion. Our scientists are the world's leading experts in developing clean coal technologies.

Ultimately, this technology is expected to produce not just electricity, but also a panoply of chemicals, including hydrogen, all from coal and all with low emissions.

Regardless of the technology that is chosen to capture the CO_2, this gas will have to be safely stored in geological formations. Do we have enough capacity in Canada to store all this CO_2? The answer is that we have plenty of capacity. We have up to 800 years' capacity at today's rate of production.

NRCan's leadership in this file extends to CO_2 capture and storage as well. Our sister laboratory in Devon, Alberta, has been supervising the federal investment in the Weyburn-Midale CO_2 monitoring and geological storage project in southeast Saskatchewan, where we are studying the injection aspects of geological storage in scientific detail.

We have also recently completed Canada's clean coal technology road map, which identified clean coal technology pathways for capturing CO_2. I brought copies with me today for your convenience, but it can also be downloaded from our website.

This road map represents the collective wisdom of over 120 stakeholders and practitioners, including the technology suppliers and the utilities as well as government stakeholders. It defines the most likely technology pathways to achieve Canada's need for clean coal by 2025.

I would like to conclude my portion of the presentation by saying that our department has already started to move forward on this technology road map. Canada and Alberta have established the Canada-Alberta ecoENERGY Carbon Capture and Storage Task Force, an external panel of experts, to assess the economic, technical, and regulatory hurdles that lie on the road to large-scale implementation of this technology. This technology is necessary for clean coal. They will report back with recommendations later this year, in November.

● (1540)

Mr. Graham Campbell (Director General, Office of Energy Research and Development, Department of Natural Resources): Thank you very much, John.

On slide 7 I'll pick up the briefing from there, Chair.

[*Translation*]

While there are certainly incremental gains to be made in the performance of today's technologies, we believe that a fundamental change in technology is needed to make significant progress toward meeting the green challenge. We see our science and technology vision as an emissions-free electricity sector in Canada. Our mission is to develop and demonstrate new integrated technology solutions to eliminate all pollutants from fossil fuel-based applications, including power generation, oil sands operations, hydrogen production and cogeneration facilities.

Our approach at NRCan is to work in close partnership with industry, the provinces and research institutes across the country. And, since only a small fraction of the world's research and development is done in Canada, we also work internationally through the International Energy Agency and international partnerships such as the Carbon Sequestration Leadership Forum.

[*English*]

On slide 8, we talk about NRCan leading much of Canada's work in clean coal R and D, providing funding, providing support for networks, and mobilizing the R and D capacity in NRCan's CANMET Energy Technology Centre, other federal and provincial departments, and research institutes and universities.

We invest annually on the order of $5 million in clean coal and $8 million in CO_2 capture and storage. These are important areas for us, making up 13% of our total portfolio.

There are three broad areas of research we're pursuing now. The first is to maximize the amount of energy generated per unit of coal, in other words, maximizing the overall generation efficiency of the system. Second is reducing and eventually eliminating emissions from the overall system, with our long-term vision and goal that of zero-emission systems. Third is maximizing the careful handling and productive use of the by-products in order to drive economic benefits from the process overall, such as using the captured CO_2 for enhanced oil recovery or capturing the hydrogen produced by the system for transportation purposes. This requires an approach that takes account of the fuel itself, the core technological process, the emission products, and also the valuable by-products in a fully comprehensive manner. In this regard, we have closely followed the advice of the national energy panel on the sustainable S and T strategy to adopt an energy systems approach for the purpose of designing our research and demonstration programs.

The government recognizes that one of Canada's most important challenges, and also an opportunity, is to be a clean energy superpower. This means we must use all forms of energy efficiently, recognizing that the greatest source of untapped energy is the energy we waste; that we need to increase our use of renewable energy in all forms; and that a concerted effort is essential to develop new technologies to make conventional energy cleaner.

To help achieve this goal, part of the new package of ecoACTION initiatives announced recently provides targeted funding for new technology. The ecoENERGY technology initiative, announced in mid-January, will provide $230 million over the next four years to support the search for long-term technology solutions, thereby reducing and, hopefully, eliminating air pollutants and GHGs from energy production and use. The goal is to foster development and demonstration of the next generation of clean technologies to break through to emissions-free production in energy end use.

Funding for further work on clean coal and CO_2 capture and storage has been earmarked in the clean electricity portfolio within this package. Our priorities there include important areas for Canada, such as clean coal and CO_2 capture and storage, as we've already mentioned, and also distributed generation and next generation nuclear systems.

On slide 9, we talk about projects.

● (1545)

[*Translation*]

The power utilities in Canada are also pushing ahead with studies to look into the next generation of clean coal technologies that are well-matched to quality and properties of Canadian coal.

[*English*]

The Canadian Clean Power Coalition, for example,

[*Translation*]

a group of power utilities in Alberta led by EPCOR Corporation, is doing a feasibility study of technologies for converting Alberta's sub-bituminous coal through gasification to combustible synthetic gas other by-products, with CO2 capture built into the process.

Saskatchewan Power Corporation has studied an oxy-fuel system which uses oxygen in place of air for combustion of Saskatchewan's lignite coal, also with effective capture of the CO2.

If projects such as these go ahead, Canada will take a world-leading position in the latest development in clean coal and CO2 capture technology.

[*English*]

Let me briefly wrap up our opening presentation today by underlining a few key points.

First, our goal is to work towards eventually achieving near-zero emissions from coal-fired plants, including all pollutants. Excellent progress is being made by Canadian researchers on the technology front through the development of next generation technologies, which are well suited to the needs of Canadian coal. If the results of the feasibility studies I've mentioned are positive, then there are emerging demonstration projects that will move Canada to the leading edge of clean coal technology, positioning our companies well to take advantage of commercial opportunities abroad.

Lastly, technology development is definitely a team game, and we highly value our partners at home and abroad.

[*Translation*]

I hope that we have addressed the committee's needs for an update on the exciting developments in clean coal technology and our initiatives underway now in the Department to move Canada ahead toward our long-term environmental goals of emissions-free electricity production.

We thank you for the opportunity to meet with the committee today and we look forward to any questions you may have or any follow-up information you may require.

Thank you very much.

[*English*]

The Chair: Thank you, Mr. Campbell and Mr. Marrone.

I note that you've attached several charts, graphs, and further information with your submission. That will be very helpful. I thank you. It's hard not to be looking at that while I'm listening to the questions here.

We'll begin with Mr. Tonks.

Mr. Alan Tonks (York South—Weston, Lib.): Thank you, Mr. Chairman.

Mr. Marrone and Mr. Campbell, thank you. You've given a more scientific and technological overview; I'm going to bounce some political questions at you, and you can digest them and put them back in terms of how you would like to steer this committee in the direction of higher utilization of clean coal technology.

My first question is related to the situation in Ontario. As you know, the premier has announced that they're looking at nuclear alternatives with respect to phasing out debilitating present technology, coal-fired power generating plants. From your perspective, is there a serious acknowledgement on the part of Ontario of what you are doing, and could those plants be retrofitted? Could a new paradigm, based on your research, be used to factor clean coal science into the strategic solution that the Ontario government seems to be pursuing? I don't mean to take the Ontario government as the singular example, but it's the one I'm most familiar with, Mr. Chairman.

● (1550)

Mr. John Marrone: Thank you for the question.

The feasibility of retrofitting was one of the first things we looked at. In all cases of all these major technologies we described, it would require a major change in how the plant works—major changes in equipment, of space that was never conceived for things to go to.

We commissioned a study to actually look at what it would cost. It just becomes infeasible with the old plants, so we started focusing our technology on new plants. With new plants it's feasible, but with retrofitting old plants it's very difficult. If you can imagine, it's not just capturing a few percentages of one gas or another; it's taking virtually everything that's coming out of that plant and doing something with it, so it's a major change in the way they work.

Mr. Alan Tonks: So you don't think there's any percentage of the present plant capacity that can be retrofitted? It's got to be new plants?

Mr. John Marrone: I think the plants today can be retrofitted to capture, say, SOx and NOx particulates—all these things that are in relatively small quantities in the gas. If you're asking them to also capture carbon dioxide, it would really be very difficult to do.

Mr. Alan Tonks: Okay. I'm going to move from that, Mr. Chairman.

In the United States there is what is called FutureGen, a strategic process through private enterprise and I think the federal government. It's the generation of electricity, but also the production of hydrogen, which I think is important in terms of the next threshold, which is preparing for the hydrogen technological generation. How does the FutureGen process compare, and what stage is it at in terms of where your research is?

Mr. Graham Campbell: Thank you, Mr. Tonks.

We've been following the FutureGen project very carefully since its beginning. Just a thumbnail sketch, it's essentially a project to generate hydrogen for the purposes of furthering the hydrogen economy plus electricity. It includes CO_2 capture and storage.

You're correct to say that the sponsors are the U.S. DOE, plus a consortium of U.S. power generation utilities and coal companies that have come together around the project.

Clearly, that's a project well matched to U.S. needs and purposes, and there may well be some opportunities for exchange of information and collaboration, and so on. But when scarce resources present themselves, it's important that we dedicate and aim our resources where they're best suited. We think the focused initiatives, either that are running in our labs or that are running in the projects that I briefly talked about today, are certainly important, top-of-the-page considerations.

The news from FutureGen just recently too—I heard last week—is that there has been some cost escalation in the project beyond what was originally anticipated. So I think this is challenging the moving forward. It sounds as if it is moving forward fine, but I think cost escalations are part of the current lexicon, if you like.

There are four sites that have been selected for pre-screening, two in Illinois and two in Texas. The process over the course of the next few months will be to try to make a choice, difficult though it may be, out of those four candidate locations that are on the books now.

We're monitoring very carefully. We're in contact with our colleagues in the U.S. Department of Energy. At this time, we're keeping an eye on it in the hopes that it will mature and that we'll be able to learn something from it in due course.

It's a very important project for the U.S. electricity industry, and for the hydrogen side of the equation as well.

● (1555)

Mr. Alan Tonks: Good.

I have one final question. Are the two approaches looking at the same type of coal that we have in Canada and the United States?

Mr. Graham Campbell: I should have mentioned that. I apologize.

Typically, they're looking at a better quality coal that they have to work with in the U.S. And the core technology to the FutureGen project is gasification technology. So there are similarities, certainly, to our interest in gasification that we're working on in Canada, but the coal properties are somewhat different in terms of their resource versus ours.

Mr. Alan Tonks: Good.

Thanks.

The Chair: Great.

Thank you, Mr. Tonks.

We're going to start with Monsieur Ouellet today.

[*Translation*]

Mr. Christian Ouellet (Brome—Missisquoi, BQ): Thank you, Mr. Chairman.

The technology for liquefying coal to ensure better combustion, from which CO2 can be recovered, is not new. I remember when I was giving classes at Concordia University, 15 or 20 years ago, this was already on the drawing board. People have been talking about this for 15 or 20 years.

How much time do you think it will take to be ready to build the first prototype in Canada? I am talking about a prototype.

Mr. John Marrone: I didn't understand the first part of your question.

Mr. Christian Ouellet: I was saying that it already exists. This type of project has been on the drawing table for the last 15 or 20 years. How long will it take us to be ready to build a prototype in Canada?

Mr. John Marrone: If I understand correctly, you're talking about polygeneration.

Mr. Christian Ouellet: I'm talking about combustion of liquefied coal to produce electricity.

Mr. John Marrone: Okay. We believe that this will be possible around 2015. That is what the clean coal technology road map indicates.

Mr. Christian Ouellet: In what year do you think that this kind of technology will mushroom? The prototype will be there for five years. So, this takes us to 2020. In the meantime, we will continue to build dirty coal power plants.

Mr. John Marrone: First, typically, the decision is made between five and seven years prior to construction. They are now well placed to make such decisions. At last two companies have decided to test two different types of technologies that will be in place around 2012. It can't go much quicker than that. This is simply the time needed to do the environmental studies and all the other things that need to be done prior to construction. However, immediately after that, the companies will easily be able to make the decisions, once they will have studied and tested all the technologies on a large scale, to reproduce this in all the other plants that will be built.

Mr. Christian Ouellet: Starting from 2020?

Mr. John Marrone: Starting in 2020, yes.

Mr. Christian Ouellet: So why is such a small amount of funding allocated to research? Each year, NRCan invests $5 million in clean coal research. Five million dollars is nothing. Why?

[*English*]

Mr. Graham Campbell: What I've indicated as well in the deck, sir, is that it's roughly 13% of our total portfolio, which tries to cover renewables and end-use technologies in three broad areas: transportation, industry, building, etc. It's a question of allocation of resources over a number of very important areas. If you combine the clean coal and CO_2 capture and storage, it's roughly 13%. We're hoping to increase that sum, but it's a question of trying to balance the portfolio across a number of very important areas.

Let me return to the answer my colleague offered you a moment ago. He mentioned, I believe, that we will try “as new plants are built”. In the meantime, we'll be using technology that isn't quite as good as it needs to be. We're telling the committee today—

● (1600)

Mr. Christian Ouellet: We could even say awful or very bad technology.

[*Translation*]

Mr. Graham Campbell: Not necessarily as clean as it could be.

[*English*]

We're telling the committee today about a couple of technologies, gasification and oxy-fuel, that have long-term potential.

But there's been recent construction in Canada of an intermediate step along the technology pathway. It's called supercritical technology. That plant has been constructed in Alberta at a location called Genesee 3. It is a significant improvement on the technologies that exist today.

I just wanted to mention that there are some intermediate steps that can be made today, and our utilities are making those steps when they have a chance to rebuild and to replace existing technology. So to your basic question about share and so on, there are a number of important areas.

[*Translation*]

Mr. Christian Ouellet: I'd like to come back to the $230 million over four years. This works out to $57.5 million per year for research under the EcoAction Initiative. Could you break down this amount for us? There is clean coal, CO2 capture and storage, etc., but also passive and active solar energy, geothermal energy, wind power, really, all clean energies. Also, $840 million is being spent to support nuclear energy. Could you break down this $57.5 million for me, meaning break down the portfolio for clean energy?

Mr. Graham Campbell: We don't have the figures here today.

Mr. Christian Ouellet: Could you provide them?

Mr. Graham Campbell: Yes, we could provide them to you.

Mr. Christian Ouellet: I want to come back to a question raised earlier. Could you tell me why only $5 million has been allocated to clean coal energy? Is it because you never asked for more money or is it because the government is refusing to give you more? Five million dollars for research is nothing. We could spend that amount on an electric light bulb. However, we are spending this amount for huge power plants producing a lot of electricity with coal, a very abundant resource in Canada. Why is only $5 million being allocated for this?

[*English*]

Mr. Graham Campbell: I think I'll leave the answer I had previously, sir, and that would be that we have to balance. We have balanced, and that's the amount of money we've decided to allocate.

We had promised to provide you figures on the different proportion across the other areas. If the committee needs more at that point, we'd be happy to come back.

[*Translation*]

Mr. Christian Ouellet: If I understand correctly — and I thank you — you are going to provide us with the details of the entire clean energy portfolio. You are going to provide us with all of the expenditures in this area for a total of $57.5 million.

Thank you.

[*English*]

Mr. John Marrone: I want to point out that when we invest $5 million, that's just the federal share. In fact, we do a lot of this work with industry, and typically we never fund more than 50% of the cost. Sometimes it's one-third, sometimes it's up to 50%. It's deceptive to just look at the $5 million. It's really more like $10 million or $15 million worth of research that gets done with that kind of money. I just want to point that out.

[*Translation*]

Mr. Christian Ouellet: It's important, yes. Thank you.

[*English*]

Mr. Graham Campbell: We call it the leverage, and it's typically between 3 and 3.5 to 1.

[*Translation*]

Mr. Christian Ouellet: Thank you.

[*English*]

The Chair: Thank you, and thank you, Mr. Ouellet.

Welcome, Mr. Stoffer.

Mr. Peter Stoffer (Sackville—Eastern Shore, NDP): Mr. Chairman, it's a pleasure to be here, and thank you very much.

Gentlemen, is this technology available now anywhere in the world? Is any other country using this or moving toward this technology? If so, can you explain which ones, and if not, I'm thinking of other countries like China, Asia, Russia. Is anybody using this?

● (1605)

Mr. John Marrone: Maybe I could just start by saying this is a relatively new field of research. Anybody who has coal is interested in it, so lots of countries are doing work right now in oxy-fuel and gasification and so on.

For instance, if this feed study from SaskPower allows them to go forward with that technology, that will be the first oxy-fuel clean coal power plant in the world. Although a lot of people are looking at it, it's brand new.

Mr. Peter Stoffer: Thank you.

Sir, you started off your presentation by talking about environmentally acceptable manners or standards. Who sets those standards?

Mr. John Marrone: It would be the provinces and the federal government setting standards as to what the emissions ought to be. In my case, what I was referring to is zero emissions, so that should meet standards.

Mr. Peter Stoffer: Okay, great.

Mr. Graham Campbell: Could I add to your first question, sir? We're aware of six gasification projects operating at the moment across the world, none of which operate with Canadian coals and none of which have capture and storage with them.

In terms of oxy-fuel, there's a German company called Vattenfall, which is doing a small-scale oxy-fuel demonstration project at a location just outside of Berlin in Germany. This will be one of the leading examples of use of oxy-fuel technology, but it too doesn't have CCS attached to it. Attempts are certainly being made around the world to move these technologies ahead, but not necessarily with Canadian coal quality nor with CO_2 capture and storage. So we think the integrated approach we see in the offing in Canada is a significant opportunity.

Thank you.

Mr. Peter Stoffer: You say you hope this should kick in around 2015. Is that correct?

Mr. John Marrone: Around 2012 to 2015.

Mr. Peter Stoffer: So in that time these older plants will still continue to operate. Is that correct?

Mr. John Marrone: Up until the end of their useful lives. They typically have a 40-year useful life. Some of them will come due before that date, so utilities will have to make some decisions as to what they would like to use then.

Mr. Peter Stoffer: But Canadians will still be benefiting from the hazards of their waste, won't they, in terms of asthma, air pollution, and everything else? You say it's very difficult to retrofit these plants, therefore these plants will still continue to operate until their life is over, so Canadians will still be suffering from their effects. Is that correct?

Mr. John Marrone: If they're going to be on, then they will continue operating as they are now.

Mr. Peter Stoffer: What do you mean by “next generation nuclear”?

Mr. Graham Campbell: If I might, just before we go on, slide 15 in your deck is the schedule of what we call “retirement” or “replacement” of coal technology. So the utilities are facing this curve, in other words, and as this capacity comes off line, it will have to be replaced. So as John has said, the middle of that curve is about 2015, 2020, and as a consequence, it will have to move along to replace the capacity that was there before.

You asked a question about next generation nuclear. If you look at the current CANDU system, it's essentially a generation two or a generation two-plus of technology. The technologies referred to as “next generation” are those that will come on stream in 2025 to 2030. So these are technologies of an advanced nature. They often involve combinations of features that we don't have at this time.

Canada is participating in an international collaboration on these technologies, of which six have been chosen. We're participating in two of the six. We're leading on supercritical water reactors and we're working with the community on very high temperature reactors.

The program is built on a national basis. Certainly, Atomic Energy of Canada Limited is the leading performer. But we've also reached out to a number of universities and research institutes across Canada and government as well to try to build this knowledge toward the nuclear technology that will be put into practice at that time.

Mr. Peter Stoffer: I notice you just put that in there, but there's no indication of what may or may not happen in the future with nuclear waste. Will the next generation of nuclear proposals deal with the waste of nuclear—

The Chair: Excuse me, Mr. Stoffer. Could I ask you to stick to coal today? The only reason I mention it is that we have dedicated our meeting on Wednesday to an in-depth discussion of the very point you're on. You're welcome to join us.

● (1610)

Mr. Peter Stoffer: I'll go back to another coal question then.

In Nova Scotia we're traditionally referred to as the tailpipe of North America. We can't blame the rest of the world for the problem; we burn enough coal on our own to cause our own problems. Our lakes suffer, and our children have tremendous amounts of asthma, etc.

I'm concerned that these older plants you talked about may be around for quite a while. They're expensive to retrofit, so they'll continue on their present course if nothing changes. My concern is what Canada's reaction will be. Having the new ones 10 or 15 years from now sounds great, but we have to deal with the now. What would you suggest to deal with the now? What do we tell our constituents about what's happening with their environment in this regard, if the older plants are allowed to continue? As well, if any new plants are built within, say, the next two years, as you said, they're not going to have the technology of 10 years down the road.

Mr. John Marrone: It's hard for me to comment on a specific plant, except to say that for all pollutants other than carbon dioxide it is possible to bring down the emissions.

It is something each jurisdiction would have to look at. It's a trade-off. It would probably increase their rates; are the citizens willing to make that trade-off? It is possible for particulates, for instance, and for mercury and other pollutants.

The Chair: Thank you very much.

Thank you, Mr. Stoffer.

Mr. Gourde is next.

[*Translation*]

Mr. Jacques Gourde (Lotbinière—Chutes-de-la-Chaudière, CPC): Thank you, Mr. Chairman.

Natural Resources Canada is conducting active research into a cleaner use of coal. We can think, among other things, of the clean coal technology road map. In your experience, what is the future of coal? In the long term, will clean coal be able to coexist with new renewable sources of energy?

Mr. John Marrone: One of the problems with renewable energy sources, with the exception of hydroelectric power, is their variability. Wind energy and solar energy are examples of this. Power companies must have a base-production capacity in order to meet a certain demand for power at all times. They have few choices: large-scale hydroelectricity, nuclear energy, coal and natural gas. I don't know whether there are any others, but these are the energy sources that big power companies use to ensure a reliable supply of electricity.

In that context, I think that coal has a future, particularly if it is clean.

Mr. Jacques Gourde: Besides developing clean coal technologies and CO2 capture, could you talk about other research projects that you are working on to make energy production and consumption greener?

[*English*]

Mr. Graham Campbell: One area of interest to our group is the integration of renewable energy sources into grid supply. In the province of Quebec, for example, wind energy has come on in large measure. It is used in combination with hydro. When the wind is blowing and the generation is there, you save the water behind the dam, and, as a consequence, when the wind is not blowing, you've got stored energy, if you like, in your reservoirs for use.

So we're very much interested in the integration and combination of renewable energy sources.

Another issue, though, is that bringing those intermittent sources into the grid can cause difficulties. First of all, they are intermittent, so you can't necessarily predict in detail when they'll be available. You need to have back-up systems and supply that's ready to be dispatched instantly when the wind is no longer available. Bringing these renewable sources into the grid is another area we're interested in.

Thirdly, many remote communities, which are not located on-grid, rely on diesel generation for the purposes of making their electricity. Not only is it expensive to bring diesel into the community, but there's also a local emissions consequence of using diesel for power.

One project that we have in the province of Newfoundland, with which we're very pleased, is the integration of diesel with wind energy that's generated locally. There are six small turbines that are used in combination with a diesel generator to use wind to the greatest extent possible. The next stage in that project—we're into the third stage of it now—is not only to use the wind and diesel, but also to produce hydrogen for the purposes of storing energy and using the hydrogen, then, in place of diesel in the long term.

So my message is that we're working very hard on trying to integrate these renewable resources into the grid to the greatest extent possible, and we're very much interested in a variety of configurations that make sense and can be suited to local circumstance.

Thank you.

● (1615)

[*Translation*]

Mr. Jacques Gourde: In Canada, 17% of our electricity is generated by coal combustion. Will clean coal technology help alleviate problems in such countries as China, where 80% of their energy is coal-generated?

[*English*]

Mr. John Marrone: As I mentioned a bit earlier, it is advantageous for Canada to be among the first countries to be working on this, because the export market is quite high—and China comes to mind, of course. The Chinese are going to be adding—I don't know—some 500 power stations in the next 20 years, according to one prediction. That's a lot of power stations, and most of them are just going to be using the older technologies for coal, unless, of course, they have access to the clean coal technologies. This is where we hope to have some Canadian offering as well by then.

So the answer is yes, it would help China.

[*Translation*]

Mr. Graham Campbell: In my presentation, I spoke about our international ties with other countries, particularly China, India and South Africa. These are countries where economic activity and electricity consumption are growing rapidly. That is why we are very interested in sharing with them information and ideas and developing business opportunities. We are also quickly expanding their electricity supply. Consequently, it might be useful to examine how they use modern electricity technology in order to broaden our knowledge.

Mr. Jacques Gourde: You said that Canadian clean coal R&D could help all countries develop greener and more competitively-priced electricity, which would impact positively on the environment.

Mr. Graham Campbell: That's right. At the same time, Canadian businesses could tap into those foreign markets.

Mr. Jacques Gourde: Is Canada a world leader in terms of research? Is our technology a couple of years ahead of that used in other countries, in emerging economies?

● (1620)

[*English*]

The Chair: Mr. Marrone, please make sure you speak into the microphone. The translators aren't getting it.

Just tap the microphone over towards you.

Mr. John Marrone: We have better coal technology than we have microphone technology, that's for sure.

On the question about our technology, the answer is yes. We are right now at the forefront of this technology. We have been working on it with our industry for 13 years now. Although there are gasification plants and one oxy-fuel demonstration, none of which have CO_2 capture and storage, we have Canadian companies saying they're willing to take the business risk of trying this new technology before anybody else. I would say that bodes very well for this type of technology in Canada.

The Chair: Good. Thank you.

Thank you, Monsieur Gourde.

We're going to try to make a second round of questions, but we're going to have to be brief. I'm going to ask you to try to keep questions and answers to about three minutes, if you can.

We'll start with Mr. Bagnell.

Hon. Larry Bagnell (Yukon, Lib.): Thank you.

I have two quick questions.

Maybe I could have a short answer so I can get my second question in. You talked about us having leading scientists in the world on coal, which is great, and the wind energy and the other renewables to get rid of diesel hydrogen. Have we been working on that for more than two years?

Mr. Graham Campbell: The project I referred to, Mr. Bagnell, is in Newfoundland. I believe it started in 2004. It has moved into its second phase, so I think the answer is yes. Our investment in clean coal research goes back two decades probably. The integration of renewables into the grid is more recent. We have been working on that for three or four years.

Hon. Larry Bagnell: Good. I just wanted to get the good work of the previous government on the record.

My main question concerns sequestration and the 800 years we can put it underground. Is it in the west where the sedimentary basin has room for that? What about the carbon dioxide that's created in, say, Toronto? I don't think there's a spot to store it underground, for instance, in that part of Ontario or in Quebec.

Mr. Graham Campbell: We put a map in the very last slide of the deck, Mr. Bagnell. It's slide number 22. That indicates what we think are the best locations for CO_2 capture and storage. The Toronto area is not included. There are two reasons for that. One is that the sedimentary section is very thin there. There are no deep, thick geological reservoirs that we could use. There is a spot in the extreme southwest of the province, in the Sarnia area, that opens up into the Michigan Basin. Unfortunately, that would take a lot of pipelining to get the CO_2 into a suitable geological circumstance.

What we're showing you on this map are the best locations in Canada. The very, very best location in the world that we know of for CO_2 capture and storage is the western Canada sedimentary basin, where there are not only sources, but also a thick sedimentary section in which to store it.

Hon. Larry Bagnell: Thank you.

Thank you, Mr. Chair.

The Chair: Thank you, Mr. Bagnell.

Madame DeBellefeuille.

[*Translation*]

Mrs. Claude DeBellefeuille (Beauharnois—Salaberry, BQ): Thank you, Mr. Chairman.

You spoke about the commitment by Canada and other countries to two research protocols on next-generation nuclear energy.

I suppose that research on nuclear energy also deals with nuclear waste management. It seems to me that you cannot develop a next-generation nuclear energy system without addressing the issue of waste management, which remains the greatest problem of nuclear energy use.

What can you tell us about the production and management of nuclear waste?

Mr. Graham Campbell: Thank you very much.

You are correct, the international partnerships deal with such things as nuclear energy storage and waste.

The committee will be briefed on that issue in the coming days. I would prefer letting the experts answer that question.

● (1625)

Mrs. Claude DeBellefeuille: How do publicly-funded capture and storage technologies help create wealth in Canada? How would wealth be created if we could export our technology to other countries? What are the estimated economic spinoffs for Canadians?

[*English*]

Mr. John Marrone: I'd like to start, perhaps, and then you can continue, Graham.

Many of the first applications of carbon dioxide capture and storage will be for use in enhanced oil recovery. What happens there is they're using the carbon dioxide to actually pressurize older wells and extract even more oil, oil they would not have been able to extract, so that is another form of wealth for the country.

Following that, we're developing technologies to extract methane out of coal seams that are not mineable. They're not accessible, and if you can pressurize that, you could actually extract natural gas, which is a very useful fossil fuel and a relatively clean fossil fuel. There are some benefits to Canada from carbon dioxide capture and storage.

Mr. Graham Campbell: I'll add briefly that as our companies get better experience, they basically offer the services and the knowledge to other countries that are also growing rapidly and also developing power. This match works best if the coal quality or the coal type in that country matches well with Canada's. Several countries have that characteristic, so there are some opportunities to reap in the long term as well.

The Chair: Thank you very much.

Thank you, Madame DeBellefeuille.

Mr. Allen, do you want to wrap it up?

Mr. Mike Allen (Tobique—Mactaquac, CPC): Thank you, Mr. Chair.

Thank you for your presentations.

I've got a couple of quick questions. I want to pick up on the theme that we can't clean anything up that we have. That concerns me more than a bit.

Are you aware of the Phoenix technology? It's based on the technology that captures the emissions from the space shuttle as it takes off. It's written by NASA. We had a presentation from them, and it would seem to me that they're a long way toward reducing more than 90% of the emissions. They can also do carbon dioxide capture; they do it in a very small bolt-on to a plant. They're looking to try to test this in some smaller coal plants of 100 to 200 megawatts.

Are you guys familiar with that kind of technology?

Mr. John Marrone: No, we are not familiar with that technology, but we will note that and look into it.

Mr. Mike Allen: I'll get you the information. It just concerns me that we're throwing our arms up in the air and we can't do anything to replace it with this kind of technology out there.

Second, what are the practical limits when you look at where carbon dioxide can be stored? What is the practical limit for transporting it to any particular area?

Mr. John Marrone: We transport natural gas from all the way out in western Canada to eastern Canada. We're actually thinking of eventually using such an infrastructure to transport carbon dioxide, but the other way. I don't know of any limitations in terms of distance. These, of course, would have to go through.... It's just a question of money, and repressurization plants and so on, to keep it moving to the storage site.

Mr. Graham Campbell: The most costly part of this whole system we're talking to you about today is the capture of the CO_2. Transporting the CO_2 is conventional pipeline technology, and it's well established. Areas in the United States, for example, have been using CO_2 pipeline technology for decades to support enhanced oil recovery in their fields. It's really not seen as an impediment.

The challenge in Canada, particularly in western Canada, is that the CO_2 sources are in a particular location and the places you'd want to use it for enhanced oil recovery or for deep sinks are in other locations. We need transportation infrastructure to connect up the sources and the uses of CO_2, but that's in the area of capital investment, not in the area of technology, in terms of the challenges before us. Really, the transportation is not an issue for us.

● (1630)

Mr. Mike Allen: Thank you.

The Chair: Thank you, and thanks to the committee.

Before you leave, we'll have to have at least one more little speech from Monsieur Ouellet.

[*Translation*]

Mr. Christian Ouellet: Mr. Allen has just asked an extremely interesting question on the rational for capturing CO2. In Quebec, there are smoke stacks that help eliminate and precipitate CO2. You are no doubt aware of those smoke stacks, because the technology received a number of awards.

Could such technology be used in traditional coal-fired plants?

Mr. John Marrone: If my understanding is correct, you are referring to post-combustion capture. Certain materials help absorb carbon dioxide and then release it. However, the technology you are referring to is used in the pulp and paper industry, that is on a much smaller scale than what is being studied here. Very large vessels are needed to modernize a conventional plant, such as the one in Nanticoke.

Mr. Christian Ouellet: Is that question of interest to you, Mr. Chairman?

[*English*]

The Chair: Oh, yes, that's why I came.

Thank you, Monsieur Ouellet.

I'll have to have him repeat the answer.

Thank you, gentlemen. That is the limit of our time for our discussion with the representatives of the Department of Natural Resources. So I'll thank Mr. Campbell and Mr. Marrone for their time today and for responding to the questions of the committee.

Thanks very much.

While we are waiting for the next witnesses, I am going to ask the committee about some other business that came up.

We received an invitation from the National Research Council. You'll recall that they appeared before the committee, and there was some interest from some of the committee members in looking at the gas turbine plant at the NRC. Despite that interest, it would be somewhat difficult I think to arrange this in the time we have. It involves going through the same process we'd follow if we were going to Churchill Falls, just to go to the turbine here in Ottawa. Unfortunately, that's the case with regard to moving equipment and translators and things. I just want to raise that with the committee.

Unless there's a strong demand from the committee to pursue it, I think I'm just going to thank them for the invitation and respectfully decline. I think first we just don't have the time. If individuals would like to go on a tour, I'm sure that could be arranged, but as a committee I think it would be somewhat prohibitive at this point to include it in our agenda.

I will leave it to committee members. If they want to go on a personal tour of the gas turbine lab in Ottawa, at the Montreal Road campus, I'm sure they would welcome you to attend.

Is that okay?

Now we'll carry on with the business of the day, which is the greening of electricity consumption in Canada, the use of coal, and towards a clean technology.

We have now, representing the Coal Association of Canada, Mr. George White, chairman; and from the Canadian Clean Power Coalition, David Lewin. David, thank you for attending as well.

We're going to proceed in the same manner. I'm going to ask you to try to keep your initial opening remarks to about 10 minutes. Then we'll proceed with questions until our time runs out.

Mr. White, are you prepared to begin?

All right. We'll ask George White, chairman, from the Coal Association of Canada to begin his presentation.

Mr. George White (Chairman, Office of the President, Sherritt International Corporation, Coal Association of Canada): Thank you, Mr. Chairman, honourable members, ladies and gentlemen.

I think maybe half of what I'm doing today is representing the Coal Association. There'll be a big dollop of Sherritt International here as well. I haven't passed out notes, because I'm speaking from speaking notes. I really wanted to take the time to talk to the committee and follow up on some of the discussion we heard from the previous people.

I'm not as old as I look. I think it's a lot like some of the members of this committee. None of us are as old as we look. I've been in the coal industry for 25 years. I've been working in power plants and in that part of the business for a long time. I think there is a lot to be said about how we have proceeded.

I would like to talk to you a little about clean coal. Clean coal today is not the same as clean coal was 10 years ago. I'd also like to follow up with a bit of the conventional technology, to talk to you about what's taking place using the kind of technology that we still use today. Then I want to talk about some very exciting things that Sherritt International has in place as far as the use of coal and the business strategy behind the use of coal for gasification go.

There's no doubt in my mind that we will make the transition to gasification. I think the leadership will come from industry. It will be guided, directed, and steered by regulators and governments, but the leadership will come from the industry, because there's a business case to do it. Hopefully I can go through that with you.

The kind of technology we use today to make electricity in Canada is not new. It's been around for a long time, but it's improved as time has gone on. The original concept of clean coal was coal that we could burn via combustion in a typical power plant, which didn't produce any acid gases, or reduced the amount of acid gases. Many of us can remember when sulphur dioxide and NOx and those kinds of things were real issues and something had to be done about them. Twenty years ago we started putting technology in, but not all of that technology has been implemented, so we still have acid gases. When provinces like Ontario started talking about clean coal, even in the last three or four years, the original issue was around asthma, and asthma is caused by the acid gases.

Now we've got another issue that's facing us in the industry, and that is the fact that we're also producing CO_2. The solutions for the acid gases could be the same as the ones for the CO_2. Had the problems been reversed, probably we would have a solution by now because we would have chosen a different course. The solution for the carbon dioxide is much more difficult than the one for acid gases.

The acid gases problem presented itself first, and as a result we built retro technologies on existing plants that were capable of doing a lot to improve the acid gas situation. We were able to take the existing problem, develop technology that was basically add-on—so we didn't have to build new plants or make a transition to a brand new technology—and get some success. That happened in the last 20 years, and there has been a lot of success.

Witness the fact that the people who make these power plants in North America have built very few power plants in the last 20 years, and yet most of these companies are still viable and successful. The reason for that is they've been building back-end technology for the old plants that they built a number of years ago. This could be done in Ontario, but they decided not to do it, and there are reasons for that. Nevertheless, when we looked at clean coal 20 years ago, we were looking at acid gases. When we look at clean coal today, we're looking at all the emissions from coal-fired power plants, and because there's so much carbon in coal, the big issue is carbon dioxide.

When I started in the industry, my own personal thought was that it didn't make sense to me that we should clean up the problem at the end of the process. It always seemed reasonable to me that it would be easier to work on a tonne of coal than three or four tonnes of emissions. A tonne of coal is something you can put in front of you and see; the emissions are somewhat more nebulous and difficult to deal with. When we come to the gasification process, that's really what we're talking about. We're talking about dealing with the emission problems before we use the fuel, by creating a new fuel.

We have been building the conventional plants in Canada—and there are lots of them—since 1950, as far as I know. The old Hearn station in Ontario was built in 1950. It's now shut down. Many of the less efficient plants in Canada have been shut down and have been superceded by newer plants.

● (1635)

Every subsequent plant that's ever been built in Canada with conventional technology has been more efficient than the previous one built. I think it goes without saying that the technology has evolved. However, there are some thermodynamic principles associated with this type of technology that make it very difficult to improve, and continue to improve, that technology over a long period of time so that we could get conventional technology to a point where it was actually 100% efficient, for example. That cannot happen, theoretically, because of losses and the thermodynamics of the situation.

I'm sure Dave Lewin will talk to you about conventional plants that have been built in Canada recently, which are 19% to 20% more efficient than the existing fleet. By seeding these new plants into the existing fleet, eventually we could get to the point where we are 20% better, if that's all we wanted to do, and just build brand new conventional plants that are ever more efficient. By doing that, we could probably get between 20% and 25% greater efficiency over the next, say, 25 years, and that would result in 25% less carbon dioxide being produced for the same amount of power. That's one strategy you could use to reduce the carbon dioxide emissions by, let's say, up to 25%.

In Ontario, it appears there are a lot of reasons why we shouldn't just attack the acid gases. So Ontario has decided not to put scrubbers on existing power plants, for example, and has decided to go the nuclear route. But another option would be to build brand new coal-fired power plants that are more efficient than the ones that are there. You'll get as much reduction in acid gases as the technology will allow—which is extensive nowadays—and up to 20% to 25% reduction in CO_2 for the same amount of power produced. That's a strategy that could be developed in Ontario. It's been decided not to do that.

One other point in Ontario is that the mix of existing technologies is very important. A system that is all nuclear is not going to be very easy to operate. A system that is all hydro is not possible because we've used up so many of our hydro sources. So a power or electricity system is very much like a portfolio of stocks and bonds: you don't want to have all your money in one basket. And it's important to maintain that, from the point of view of responsibility for security of supply, and even emissions, over a long period of time.

So that's what I think we can do with conventional plants.

If you look to Europe to see what the Europeans are doing, you'll find that they're not building integrated gasification, combined-cycle-type plants, but they're building conventional power plants, which are more efficient than most of the plants in their fleets and are located in the centres of cities, with lots of acid gas emission reduction. They're improving the efficiency of the plants not just by producing electricity; they're also producing hot water, for example, and they use it for heating and cooling, depending on what time of the year it is.

Now, you also have to remember that in Denmark and Germany and these places, where these things are being done, power rates sometimes are four or five times higher than they are here. So if you want to spend the money on electricity, there's a lot that can be done as far as the technology is concerned.

In Alberta, we have a confluence of circumstances that is really special in the world; there is no place in the world that has the potential for integration of the energy systems that exist in Alberta. We have heavy oil, which requires hydrogen to be upgraded into light oil. We have coal, which we use to make electricity today, but we can also take the coal and gasify it and make hydrogen. We have depleted oil wells that could use carbon dioxide to improve the output of those depleted oil wells. The gasification process and the hydrogen production process produce carbon dioxide as a byproduct, and that byproduct would go into the ground and become a commercially viable byproduct from the whole process.

● (1640)

I mentioned earlier that there is a business case for doing this. The technology associated with gasification is extremely important to our company and to our shareholders. We believe that if you go back and take a look at the oil business in 1910, there was lots of oil in the world, a much greater amount than what was required. As a result, oil in the ground had very little value. So shareholders didn't value companies on the basis of the oil they had in the ground; they based it on the value of the oil that was being produced and sold.

Nowadays, you have to pay $35,000, $65,000 a barrel for oil in the ground, on a yearly basis. So the value of the oil that's in the ground today is recognized by the investment community. The same is true for natural gas. And the same is true for bitumen nowadays. Bitumen in place costs a lot of money. It's not true for coal yet.

But when we demonstrate the technology to gasify coal to turn it into hydrogen, that coal that's in the ground will have value. That is the business strategy for developing gasification within these companies. If you talk to Peabody Energy in the United States—I was talking to one of their vice-presidents a couple of weeks ago—that's what their plan is. They want to make liquids.

They have to make liquids because they don't have an opportunity to make hydrogen the same way we do. We can make hydrogen and we can sell the hydrogen to the heavy oil companies. In the process, we have a business case to perfect the gasification process. By perfecting the gasification process, we can open that process up to the power business, to the electricity business, taking away the risk by working in an integrated fashion with these various different industries. All of this exists in Alberta, and it's my prediction that over the next few years you're going to see this.

Our company, Sherritt International, has taken Alberta coal, we have sent it to Europe, we have put it in a gasification process that exists in Europe, and we've demonstrated that this coal can be gasified. Right now we have a team of about 15 people working on a feasibility study that will be completed by the middle of this year, whereby we will decide whether we're going to go ahead with a commercial gasification project to produce hydrogen in Alberta. We have partners who we're talking to about that process. There are synergies between that process and not just the heavy oil business and the enhanced oil recovery business, or the coal-bed methane business, but also the electricity business.

So that's our story. That business strategy is there. There's a reason for us doing all of this. I think the message I'd like you to take back, more important than anything else, is that the leadership will come from industry. The guidance and the steering, the regulations, will come from the regulators and from government.

Thank you.

● (1645)

The Chair: Thank you, Mr. White.

We'll have an opportunity to question Mr. White following the next presentation from the Canadian Clean Power Coalition, Mr. David Lewin, chairman.

Mr. Lewin.

Dr. David Lewin (Chairman, Canadian Clean Power Coalition): Thank you very much for the opportunity to speak to you today.

I have quite a number of slides, so I'll do a quick page flip and try to stay within the time limit of 10 minutes.

There is a presentation outline on page 2. The topic is the current status of clean coal technologies. First of all, I'll give an overview of the CCPC and discuss some results of our early phases one and two, as we call them, provide some insight into projects that were borne out of earlier CCPC work, and then briefly cover off the next step, the phase three plans.

Page 3 indicates that it is no surprise to anyone that Canada has substantial fossil fuel reserves. Coal is by far the significant portion of these reserves, and these reserves will last for many centuries.

Page 4 talks about the Canadian Clean Power Coalition, which was formed in 2000. It's an association of predominantly Canadian, but also U.S., coal and coal-fired electricity producers. There are also participating coal miners. It's also an industry-government partnership, both federal and provincial. The objective is to demonstrate that coal-fired electricity generation can effectively manage all the environmental issues of concern. When I speak of that, there are usually five emissions of concern, and that's NOx, SO_2, particulates, mercury, and also CO_2. An additional requirement was to demonstrate flexible fuel capability, given the range of carbon-based fuels we have across the nation, and our website is there for anyone who wishes to go to it.

On page 5 there's a list of the coalition participants.

Page 6 indicates that government participation to date has been through Natural Resources Canada. I might at this point add my thanks to Natural Resources Canada for funding in the past, and hopefully funding in the future for some of our continued efforts. There's also the Alberta Energy Research Institute, which is the funding arm of the Alberta government, and Saskatchewan Industry and Resources, the funding arm of the Government of Saskatchewan, which has also participated to date.

Some of our early results are shown on page 7. It's a fairly complicated slide, but suffice it to say that we've looked to date at a range of coal types—lignite, which is the lower end of the quality of coal, sub-bituminous, the mid-ranked coal, and bituminous coal—and applying different technologies sort of across those different types of coal: conventional pulverized coal technology as well as coal gasification. The inclusion of CO_2 capture with those technologies increases the cost of electricity significantly in that work and certainly above that of conventional coal without CO_2 capture. However, the results show that both capital costs and costs of electricity are reduced by moving from conventional PC technology to technologies like coal gasification with CO_2 capture included. In all of these cases, we've also included the reduction of NOx, SO_2, particulates, and mercury, reducing those by up to 90% compared with the current pulverized coal technology.

On page 8 there's an idea, in a sense, of the CO_2 storage and utilization options, particularly in the western Canadian sedimentary basin. Of course, capturing CO_2 from these processes requires a pipeline infrastructure and the ability to store CO_2 in depleted reservoirs, all for use preferably in enhanced oil recovery. Both EOR and storage capabilities are available in Saskatchewan and Alberta, and maybe a little bit in Ontario, as we've heard, certainly in the U. S., and perhaps offshore Nova Scotia.

So that's where we got to with respect to our phase one work that we completed in 2003.

Page 9 shows that phase two continued, and, as with all studies, the technology knowledge gaps were identified, requiring further investigation. So phase two of our work began with the objective of answering these knowledge gap questions with a focus on low-ranked coals, particularly lignite and sub-bituminous, which occur in western Canada, and using coal, looking at coal gasification, oxy-fuel combustion, and post-combustion pulverized coal emissions cleanup.

• (1650)

In addition, we've also looked at the merits of what's called polygeneration. I know someone asked the question about FutureGen. FutureGen is an example of a polygen project, which basically is a simultaneous production of not just power or electricity but also other chemical products, like hydrogen, substitute natural gas, diesel, and so forth.

Page 10—the preliminary indications of the phase two work—shows that the phase two work is nearing completion. Preliminary results indicate, though, that through design integration we can improve the efficiency of coal gasification, IGCC, with CO_2 capture, certainly using low-ranked coals, significantly compared to our initial phase one work, and of course that efficiency improves the overall economics.

With reference to the next slide, and the recent cost escalations in terms of steel, concrete, labour, we're actually reworking our numbers on those costs. So those numbers shown on the next slide—page 11—are not available today, but I can make them available when we've completed the work.

It's a relative comparison, and clearly sub-bituminous coal in Alberta, and particularly with CO_2 capture, begins to improve the economics of IGCC and coal gasification, particularly where there's a saleable product, such as CO_2 for enhanced oil recovery.

With lignite coal, IGCC may not be the best current solution. As Saskatchewan Power have decided, they're pursuing oxy-fuel as a solution to their lower-ranked lignite coal.

On page 12, we did actually look at the supercritical plant burning a variety of coals and capturing CO_2 through an oxy-fuel process or amine scrubbing, which is a post-combustion cleanup process.

On page 13, that's the legend with respect to the previous slide.

On page 14, you can see there are significant improvements that can be made in terms, certainly, of CO_2 capture with all of the technologies—oxy-fuel, amine scrubbing, and IGCC, coal gasification.

On page 15, our work to date has really concluded that all emissions of concern—NOx, SO_2, particulates, mercury, and CO_2—can be reduced significantly for coal-fired electricity generation, simply using technology or developing the technology for use.

So what are the next steps towards commercializing clean coal technology? On page 16 I will highlight two spinoff projects that are now under development: first, the SaskPower project; and secondly, the EPCOR project.

The SaskPower project will use supercritical pulverized coal technology and an oxy-fuel, oxygen-rich process. Capacity is about 300 megawatts. It includes CO_2 capture. The fuel is lignite fuel, so a low-ranked coal. The pre-engineering work is nearing completion, and a decision to proceed towards construction is expected this year. The planned in-service date, I understand, is 2012.

The CCPC/EPCOR IGCC project—and by the way, I'm an employee of EPCOR—is a $33 million, three-year, front-end engineering design project. We are now looking at probably around a 500-megawatt coal gasification plant. This is page 18, by the way. It includes CO_2 capture and storage.

The funding is one-third industry, one-third Alberta government, and—we're hoping—we're working with the NRCan people with respect to one-third funding from the federal government.

• (1655)

The fuel is from Genesee in Alberta, sub-bituminous coal. The project commenced in October 2006 because we had enough funding in place to commence the project. The first phase is the technology selection process, as we call it, which is expected to be completed this year. We're looking at four or five different coal gasification technologies at the moment. The idea is to select one, and then we'll base the front-end engineering design on that particular chosen technology. The FEED, the front-end engineering design, is planned for completion in 2009, by which time we would then be in a position to make a decision on construction of that plant.

As indicated on page 19, phase three plans of CCPC are to assess technology improvements on an ongoing basis; evaluate new and emerging technologies; participate with other organizations, either nationally or internationally, on clean coal technology initiatives; and develop an information database to really capture all the learning we have accrued to date.

Those are my comments, Mr. Chairman. I hope I've stayed within the 10 minutes.

The Chair: Well done. Thank you. That's a lot of information to absorb, and I appreciate both of you providing it. It will generate some questions.

Could I just ask a general question first? It's something that keeps coming up at the committee, and we get asked various ways. That is, it seems that there is a general consensus that there's too much emitted today from the burning of coal and there is a direction to reduce those emissions. There are now in place emission standards, and intensity standards as well. Can you give me a general answer as to how the industry is approaching that, and how it proposes to deal with the gap in the meantime between what is proposed to meet these reduction levels and where you are today?

• (1700)

Dr. David Lewin: Certainly, I'll try to do that, remembering that this is a work in progress.

The Chair: Yes, for all of us.

Dr. David Lewin: With respect to my own company, EPCOR, we try as best we can to anticipate the changes in regulation, not only provincially but also federally, that are coming down. That was really what forced us to pursue supercritical technology with respect to the third unit we built at Genesee, starting in 2002. It has been in operation for almost two years now, since 2005. We try to anticipate changing regulation with respect to all of those emissions I mentioned: NOx, SOx, particulates, mercury, and CO_2.

On the CO_2 front, with the supercritical technology, given that it's an 18% improvement in thermal efficiency, you're getting on an intensity basis a reduction of 18% in terms of CO_2. So that's a major improvement with respect to that technology.

With respect to NOx, SOx, and particulates, we were able to take advantage of what we call “best available technology economically achievable”. It's a long phrase, I know, and we refer to it as BATEA. We were able to take advantage of that technology that's available, so we were able to introduce low-NOx burners, and they're working extremely well, way below the provincial standards. With respect to SO_2, we were able to put in a flue gas desulphurization unit, bearing in mind that the coal in western Canada is very, very low in sulphur anyway. It's only 0.2% sulphur, whereas in eastern Canada and the eastern U.S. it's probably around 3%-plus. With respect to particulates, we're able to capture 99.8% of those.

We have been working over the past few years on mercury reduction with the province. As a result of that, there is now a new standard in place that by 2011 we have to capture 70% of mercury.

That has happened with respect to currently available technology. With respect to the future, then, we're focusing our attention, particularly, because of our coal, on coal gasification, because it demonstrates that it can reduce all those emissions that I mentioned down to even significantly lower levels: NOx, SOx, particulates, mercury, and CO_2.

The Chair: I appreciate what you're saying, and I'm going to ask Mr. White if he wants to comment. It's unlikely from what both of you have said in your presentations that you will meet the required standards in the time required. That may be presumptuous, but that appears to be the case. So what are you going to do in the meantime if you can't meet the standards that have been imposed?

Mr. Lewin, I'm going to ask Mr. White.

Dr. David Lewin: Sorry, that was the piece I didn't recall. On the CO_2, for example, in the short term we would have to resort to offsets, so we would have to go to the marketplace to purchase offsets or invest in projects elsewhere that actually reduce CO_2, so we can on a global basis bring the—

The Chair: I'm sorry to interrupt you, but we are running out of time.

Mr. White.

Mr. George White: I have two comments. My initial reaction to the CO_2 issue is that we're trying to solve the problem in one swoop. It's going to be extremely difficult for our industry to do that, and that's going to manifest in what people come to tell you—that the lights will go out if that's what the regulation is going to be. That's true. We cannot do without coal-fired power plants in the parts of the country where we have them now.

My calculations tell me that 50% of the acid gas problem in Ontario is due to emissions from the United States that flow north over the border and 30% comes from the motor vehicle problem. Somewhere between 12% to 15% comes from the point sources—coal-fired power plants. If those plants were refitted with brand-new current technology—and most of them have no technology on them today—that 12% to 15% would be reduced to something like 2% to 3%. We'll never get it to zero, but significant improvements can be made using existing technology. Certain power utilities in the country and in the United States have gone to that kind of technology.

Trying to do without those plants is going to lead us in one direction, and doing nothing with them will lead us in exactly the opposite direction. There is some middle ground here with the acid gas problem.

With the carbon dioxide problem, conventional plants will take us, as Dave has said, to improvements that are 20%, maybe better, on an intensity basis. But proper integration with biomass, alternate fuels, and producing other than electricity at these plants will also have the effect of allowing us to avoid using other fossil fuels. That can then become a credit toward the power plants that are there now.

● (1705)

The Chair: Thank you very much. That's very good.

We'll proceed now to questioning. We'll begin with Mr. Russell.

Mr. Todd Russell (Labrador, Lib.): Thank you, Mr. Chair, and thanks to each of you for being here.

I will say to Mr. White that the rest of them are absolutely as old as they look.

How does coal-fired electricity generation compare to other types of electricity generation in cost?

Mr. George White: In much of the country the price of power is regulated, so we end up with situations where there's a very determined type of approach to telling what the price of the electricity is going to be. That determined approach is based on the mix of various forms of electricity production in the area. It's provincial here.

So if you go to Quebec, it's all hydro that you can build over a long period of time. You'll find that power rates are relatively low compared to the rest of the country. If you go to Newfoundland, where they have to pay a lot of money for their heat and hydro and they have a lot of oil plants and that kind of thing, power is quite expensive. So there are differences between power rates in different parts of the country, even where they're regulated.

In Alberta the rates are not regulated. Power rates there last year averaged something like 8.1¢ per kilowatt hour. That's almost an average for the country. There are places where it's lower and there are places where it's higher. But it depends on the mix of fuels and the mix of generation possibilities available.

Mr. Todd Russell: Is it still feasible to build coal-fired plants?

Mr. George White: Yes, I believe so.

Mr. Todd Russell: Do you still make a healthy profit?

Mr. George White: In a regulated environment, the price of the power would be adjusted to take care of the capital costs or any additional bells and whistles that would need to be put on these plants.

In a non-regulated environment, the power producers would then dispatch into the system at a different price than they would have had they—

Mr. Todd Russell: You said that leadership will come from industry with guidance from government. What's driving the innovation in the industry right now? What has driven it over the last 10 years?

Mr. George White: It has been the price of power.

There's been tremendous pressure on the industry to make sure power rates are reasonable for the country. Canada, as a country, has relatively low power rates. But we compete internationally, and our labour rates are much higher. If you go to China or Japan, power rates are much higher, but their labour rates are lower. So there's a trade-off. We enjoy quite low power rates.

Mr. Todd Russell: But that wouldn't be driving the technological advances in gasification or reducing CO_2 or putting scrubbers on for reduction of NOx or SOx, right?

● (1710)

Mr. George White: Well, on the acid gas emissions, the regulations, in a lot of cases, have driven whether these plants are retrofitted or not.

Right now, we understand that carbon dioxide is an issue. We sell coal. We're not in the power business. But we recognize that our customers do have the issue.

We try to keep our costs down and keep our coal prices within reason. It's a commodity, a long-term contract, within the country. But ultimately, we see being able to assist the industry by making a separate business case whereby we're going to gasify coal for another reason.

Mr. Todd Russell: Mr. Lewin, has your association looked at the recent environmental plan by the Conservative government?

Dr. David Lewin: Yes.

Mr. Todd Russell: Have you looked at the targets and things of that nature?

Dr. David Lewin: Yes.

Mr. Todd Russell: And have you anticipated what's coming down?

Dr. David Lewin: We did our best to anticipate. I must say that we didn't anticipate as strenuous targets as we saw.

We were hoping we would have a little bit more time to change out the capital stock. As you have older capital stock coming up for renewal, it makes sense to put the best available technology in place.

Mr. Todd Russell: With these new plants, with what you say is 20% intensity reduced, would they meet the government standard?

Dr. David Lewin: We're still working with government with respect to their clean fuel standard and the expectations there. So until those discussions are complete and we understand what those numbers are, I can't say. But we're hopeful that they would.

Mr. Todd Russell: These efficient plants that are now being built—your claim is a 20% intensity-based reduction—you say might be able to meet what the government wants.

Dr. David Lewin: I hope so, yes.

Mr. Todd Russell: That means that you would not need to go, if you didn't choose to go, to gasification or some other type of technology if you didn't want to. Is that right?

Dr. David Lewin: With respect, I think we will have to go to gasification. The standard doesn't sit there. Maybe it's okay in the initial years, but the standard is increasing all the time at a rate I think of 2% per year.

Eventually you're forced into making a decision. Do you buy offsets to get down to the standard for the existing technology, or do you move to a new technology, which is gasification?

Being a promoter of going the technological route toward meeting these new targets, I would say that it's absolutely essential for the industry to move toward coal gasification, oxy-fuel, and so on, where you can capture the CO_2, for example, and store it underground and have store recovery, and so on.

The Chair: Thank you, Mr. Russell.

We'll go to Madame DeBellefeuille.

[*Translation*]

Mrs. Claude DeBellefeuille: Thank you, Mr. Chairman.

Mr. Lewin, in the conclusion of your document, you state that electricity can be produced with 90% CO2 capture and removal of all emissions. You indicate that such production is technically feasible, but that it can only become economically viable at certain locations.

What do you meant by that? Are you saying that it is not feasible or not viable in certain locations in Canada?

[*English*]

Dr. David Lewin: It depends on the type of coal you're using, which will determine the percentage of reduction. But generally speaking, using coal gasification, something in the order of 80% or 90% of all of those five emissions, which I mentioned, can be reduced.

[*Translation*]

Mrs. Claude DeBellefeuille: Thank you.

You spoke to us about your project, which will be funded equally by the Province of Alberta, the federal government and the industry.

Are you requesting those $11 million from the ecoEnergy Technology Initiative? Was your funding project submitted to the federal government via that program?

[*English*]

Dr. David Lewin: The simple answer is, yes.

But I suspect it's up to Natural Resources Canada where they find the funding.

Our request is simply for funding for that particular project, for the SaskPower project, and for a Nova Scotia Power project.

Frankly, I don't really mind where the funding comes from, but I assume it's from that eco-fund.

● (1715)

[*Translation*]

Mrs. Claude DeBellefeuille: Thank you.

Mr. White, you told us that the leadership must come from the businesses. If that's the case, what do you expect the government to do to facilitate your adaptation to new technologies?

Mr. George White: I apologize, but my French is not good. I have not lived in Longueuil for a long time now.

Mrs. Claude DeBellefeuille: Well it's certainly better than that of many of the people sitting around the table. Don't be too concerned about it.

Mr. George White: Thank you very much.

[*English*]

How is industry going to lead this whole process? Is that the question you were asking?

[*Translation*]

Mrs. Claude DeBellefeuille: No, my question is more about your expectations. You have demonstrated leadership and you appear to want to adapt so that you can produce electricity in a more ecological fashion. So what are your expectations from the government?

[*English*]

Mr. George White: The most important thing from an industry point of view is that we have some understanding of what's going to unfold, that we see policies and regulations come out with a realistic timeframe, from a business point of view.

What I see in the long run is that a lot of the less efficient plants will eventually close down because they get older anyway. Taking away the capital stock that's out there was what Dave was talking about.

Some of those plants will be replaced with new, modern plants based on the 20% technology. Others will be based on gasification technology that can give us maybe an 80% improvement.

But we don't have total control over that technology train. We can put more energy, time, and effort into doing these kinds of projects, but the technology has to evolve and become more viable and reliable as time goes on. If we can somehow marry the expectations of the regulators and the government with the possibilities and limitations the technology presents, I think that would be the best of both worlds. This is the kind of thing we would look for.

We may need research in certain areas. We need infrastructure in a lot of different areas. When we talk about sequestering carbon dioxide, right now there is no carbon dioxide to sequester, so industry hasn't developed that yet. But if we did have it, there is no infrastructure with which to move it around to where we need to sequester it.

So there is a lot of planning that has to go into the whole process over the next number of years. Industry, regulators, and governments can work together to make all of this happen. I think that's going to be the smoothest transition.

Hitting us with regulations that we can't adhere to is going to cause us tremendous difficulty in the short run.

The Chair: Thank you, Madame DeBellefeuille.

Mr. Stoffer.

Mr. Peter Stoffer: Thank you, Mr. Chairman.

Thank you, gentlemen, for appearing today.

I can't help but think of Judy Garland in *The Wizard of Oz* when she said, “Lions and tigers and bears! Oh, my!” I just think of NOx and SOx and particulates, oh my!

I think we should get Judy Garland to help us out on this one. What do you think? Bring her back from the dead?

The Chair: I think she did the last NDP policy.

Voices: Oh, oh!

Mr. Peter Stoffer: I think so, yes. Right on.

I just wanted to say that Canadians are obviously watching all of us and industry on how quickly we move forward. The figures given by the previous witnesses of 20, 20, 20, 30, are they realistic?

Mr. George White: Take a look at the existing projects that are out in the world today. Most of them were built seven to ten years ago. None of them has operated totally reliably. They were demonstration projects, and they were designed to be such. They tried different things. The ones that have survived, four or five of them—three in the United States, say three in Europe that I know about and have visited—are viable operations today, but not without a tremendous amount of difficulty in getting going.

Now we're into the second phase of building what we would call demonstration plants for the gasification technology. It's not without risk. We can build those plants for capital costs that are somewhat higher than the existing technology, maybe 20% or 30% higher, but that's not the problem. The problem is with the reliability of the plants in the early stages of their life. You can build a plant, but it has to start operating pretty much immediately. If we look at Genesee 3, it started up and I don't think it's ever shut down really. It has been a very reliable plant based on a lot of technology that's out there and proven. These new plants will probably not behave that way, and as a result, industry is very often reluctant to get involved with things they know are going to lose money in the beginning years.

● (1720)

Mr. Peter Stoffer: Thank you.

Sir, you indicated in your slide that the Canadian Clean Power Coalition also has U.S. coal and coal-fired electricity producers as part of the association. Are they being asked in any way to assist in payment of the one-third, one-third, one-third? Have they been asked?

Dr. David Lewin: They have. And to date they are participating, but they're not putting in funding. They're providing expertise, knowledge, and so forth, particularly the people from EPRI, the research institute in the U.S. They're providing, basically gratis to the project, a lot of expertise.

Let me back up on your previous question that George was answering. I was down in Tampa last week visiting the pulp plant there that Tampa Electric have had operating now for 10 years. Granted, that was built with some Department of Energy money in the U.S., and it's gone through its teething problems and so forth, but that's the kind of technology we can learn from, build upon, and improve upon when we build our own Canadian technology.

I asked what was the most challenging part of the whole system. It wasn't so much the technology of gasification or the turbines where they've had some challenges; it was mostly on treating water that comes out of the plant and getting it down to the state levels and so forth. They've learned an awful lot. Again, through people like EPRI, that kind of feedback of information is available to us.

Mr. Peter Stoffer: In the two countries, gentlemen, how many coal-fired plants do we have? A ballpark figure.

Dr. David Lewin: I'm not sure how many we have, but in Canada about 17% to 20% of our total electricity is provided through coal. In the U.S. it's about 52%.

Mr. Peter Stoffer: How many physical plants, though? Are there 30, 60, 100, 200?

Dr. David Lewin: There are hundreds.

Mr. Peter Stoffer: How many would be slated to close down, say, in the next 15 years? I guess the question is, what's the average lifespan of these plants that are there now, with the hundreds that are out there?

Dr. David Lewin: The lifespan is usually around 30 to 40 years. In Canada, for sure, there's a significant number: something like 20,000 megawatts is due for retirement between now and about 2020 to 2025. There's a real opportunity to change out that capital stock with the best available technology.

Mr. George White: There are very few coal-fired plants that have been built in the United States in the last 10 years. They've all been gas plants, and that's why the price of gas is so high.

Mr. Peter Stoffer: Thank you very much.

The Chair: Well done.

Mr. Peter Stoffer: There's nothing wrong with munchkins, by the way.

The Chair: Mr. Trost.

Mr. Bradley Trost (Saskatoon—Humboldt, CPC): Thank you, Mr. Chair.

Just to understand a little bit more, we're talking here about unit capital cost, etc. To get back to roughly where Mr. Russell was at least starting to go, we have the whole cost question. Let's be blunt: there are a dozen different ways out there to generate electricity. Some, like solar, are ridiculously expensive. Coal is very inexpensive.

With all these scrubbers or gasification or other technological changes, what sorts of cost hikes are we looking at if this goes through as planned? I realize there's a range, but at what point does it become uneconomical? I realize if you're producing with coal, you have to compete against other producers. I realize that for some, like nuclear, there are huge infrastructure costs, and for some, like natural gas, the fuel cost is very different, and there are base power prices and peak and so forth. With all those caveats slapped on there, at what point does it start to become uneconomical? Will it be the cost that stops us from using these technologies that we're trying to implement or will it just be the science and technology problem?

● (1725)

Dr. David Lewin: Maybe I can kick it off.

Our initial work, through the CCPC, found that were we to go to coal gasification, we could see a generation cost price hike of something around 50%.

Mr. Bradley Trost: Fifty?

Dr. David Lewin: Five-zero.

Our subsequent work has sort of brought that down a little bit, but our current work on the EPCOR IGCC project is targeting somewhere in the region of a 20% hike.

There may well be cost-of-electricity increases due to other things in the intervening period. We certainly couldn't build a unit like this until probably around 2014 or 2015. But that's the sort of cost escalation we're targeting, in terms of what we feel is still a viable project.

Now, in Alberta we have a deregulated—

Mr. Bradley Trost: So even with a 20% increase, you would still be competitive with competitive technologies, with other technologies, other fuel sources, etc. Is that what you're saying?

Dr. David Lewin: Well, I think so, but that remains to be seen.

Mr. Bradley Trost: We can't predict natural gas prices—I know that—but that would be the expectation as of right now?

Dr. David Lewin: In Alberta, we have a deregulated marketplace, so a real test will be whether the investors invest in a project of that nature knowing that the returns are whatever they are but that the energy going into the power pool would likely be maybe 20% higher than the current pulverized coal-fired power plants.

Mr. George White: I agree with the numbers from an Alberta and Saskatchewan point of view. For Ontario and Nova Scotia and New Brunswick, provinces that also burn coal, their cost of fuel is significantly higher than it is in Alberta. Ontario buys its coal from the United States, from Appalachia, and from Powder River Basin. Nova Scotia and New Brunswick buy it from South America, so they have transportation costs. Seaborne coal's a different marketplace. Their fuel costs are higher, so therefore their power rates would also be higher. The capital costs would be the same, but because of their fuel costs, their operating costs would be higher.

Mr. Bradley Trost: So they would be starting at a higher base cost to begin with—

Mr. George White: Yes.

Mr. Bradley Trost: So even if the cost came up the same amount, the percentage increase would actually be less, then?

Mr. George White: Well, take Ontario, for example. If Ontario decided to go with an IGCC power plant, the cost of that energy would be above the 50% mark, in my opinion.

Mr. Bradley Trost: Okay.

Do you have any suggestions—we're ultimately going to produce a report here to come out—excluding direct subsidies? What sorts of ideas, from a government perspective, could you see being useful, positive, to help with the transition from old coal to new coal? Do you have any ideas? There's capital cost stuff that we can play around with, and maybe regulatory stuff. Are there any ideas that either of you gentlemen haven't presented, things that you'd like to throw out that maybe we could suggest?

Dr. David Lewin: The only thing we're asking for right now, as a coalition, is a contribution to the front-end engineering design work on the Genesee project, as well as the SaskPower and the Nova Scotia Power projects. Really, that will help us get through this initial period, and then we can decide as a coalition, as individual companies, what the industry is prepared to invest in.

The whole idea is to make the IDCC, for example, commercial. So right now we're not proposing subsidies and so forth. We'd like to see that those projects stand on their own feet and are economic.

In terms of regulation, I think we're seeing the guidance from the federal government in terms of their expectations around targets, particularly NOx and SOx and also mercury, as well as CO_2. So I think from an industry point of view, we need to have certainty around those targets, so we know what the rules are, how we're expected to meet those targets and so forth. It's a matter of giving the industry certainty and then we can get on with it.

● (1730)

Mr. George White: I can think of a number of things.

I think liaison between the people who are already successful in these industries.... Contrary to maybe the impression the committee got earlier, I don't believe that China is lagging in this, nor that India will lag either. The Chinese are building some pretty good technology. They have a lot of old technology as well, which they're not taking out of service, but the fact is that in many cases their environmental issues are so desperate that they cannot do anything except build the best technology that's available. They have many gasification plants, and I already know that NRCan is working with people in China to try to transfer the technology to that kind of thing. So that's one thing that could be done.

Support for the industry is another. The industry that is supplying these particular pieces of equipment is different from the industry that supplied the traditional coal-fired power plants. Companies like General Electric in the United States and Siemens and Shell are the companies that are supplying the gasification technology, or are looking at developing the technology, whereas the traditional power plant suppliers haven't picked up on the technology, mainly because gasification is more of a refinery type of process than it is a combustion type of process. It's different, so it's rooted in a different process.

The South Africans, for example, have the Sasol plants. South Africa, during the time of apartheid, were not allowed to buy oil so they produced their own oil. They used coal to do that. The technology is not transferrable to Canada, but many of the processes associated with their technology are transferrable to Canada: how to use the coal, how to deal with some of these effluents and problems that are created by this technology.

So there's a lot of goodwill that can be generated between the existing users and the people who have been successful in the industry and what we need here, including the United States, who really feel that their solution to the problem, I believe, is that we're not going to be able to stop the third world and developing countries from using coal, so we should develop the best technology here and then transfer that technology to those countries.

The Chair: That does bring us to 5:30, and it concludes that round of questioning. I'm sorry we didn't have time for a further round.

I very much appreciate your candour and your comments this afternoon. Thank you for bringing that to the committee.

With that, ladies and gentlemen, we will adjourn.

Before I close, again I want to thank Mr. White and Mr. Lewin and bid you a good afternoon.

The meeting is adjourned.

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