Legislative Assembly of Alberta

The 27th Legislature
Second Session

Standing Committee
on
Resources and Environment

Public Presentations

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Prins, Ray, Lacombe-Ponoka (PC), Chair
Blakeman, Laurie, Edmonton-Centre (AL), Deputy Chair

Berger, Evan, Livingstone-Macleod (PC)
Boutilier, Guy C., Fort McMurray-Wood Buffalo (PC)
Drysdale, Wayne, Grande Prairie-Wapiti (PC)
Griffiths, Doug, Battle River-Wainwright (PC)
Hehr, Kent, Calgary-Buffalo (AL)
Mason, Brian, Edmonton-Highlands-Norwood (ND)
McQueen, Diana, Drayton Valley-Calmar (PC)
Oberle, Frank, Peace River (PC)
Webber, Len, Calgary-Foothills (PC)

Alberta Council of Technologies Participants

Robert Fedosejevs	Scientific Director, Canadian Institute for Photonic Innovations
Perry Kinkaide	President, Alberta Council of Technologies
Axel Meisen	Chair of Foresight, Alberta Research Council
Allan Offenberger	Professor Emeritus, University of Alberta

Support Staff

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Melanie Friesacher	Communications Consultant
Tracey Sales	Communications Consultant
Philip Massolin	Committee Research Co-ordinator
Stephanie LeBlanc	Legal Research Officer
Diana Staley	Research Officer
Rachel Stein	Research Officer
Liz Sim	Managing Editor of *Alberta Hansard*

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6:35 p.m. Monday, March 9, 2009

[Mr. Prins in the chair]

The Chair: Good evening, everyone. I'd like to welcome everyone to the meeting of the Standing Committee on Resources and Environment for Monday, March 9. I call this meeting to order. I'd like to start out by just introducing the table here, and maybe the presenters can introduce themselves as well as we go around. My name is Ray Prins. I'm the chairman of the committee and the MLA for Lacombe-Ponoka.

Ms Blakeman: My name is Laurie Blakeman, and I would like to welcome everyone to my fabulous constituency of Edmonton-Centre. In particular, I noticed there are a number of fans at the back today, so thank you so much for coming out.

Mr. Boutilier: Thank you. My name is Guy Boutilier. I am the MLA for Fort McMurray-Wood Buffalo, the oil sands capital of the world.

Mr. Chase: My name is Harry Chase. I'm subbing in for Kent Hehr today. I look forward to contributing my fuel pellets of wisdom, and I'm sorry that I won't be able to cast the deciding vote should such occur tonight. Thank you.

Dr. Massolin: Good evening. I'm Philip Massolin. I'm the committee research co-ordinator, Legislative Assembly Office.

Mrs. Kamuchik: Good evening, Louise Kamuchik, clerk assistant, director of House services.

Dr. Meisen: I'm Axel Meisen, the chair of foresight at the Alberta Research Council.

Dr. Fedosejevs: Bob Fedosejevs, professor at the University of Alberta and also scientific director of the Canadian photonics institute.

Dr. Kinkaide: I'm Perry Kinkaide, the president of the Alberta Council of Technologies.

Dr. Offenberger: Allan Offenberger. I'm a retired professor from several years back but trying to mentor this fusion into existence.

Mr. Berger: Hi. Evan Berger, Livingstone-Macleod MLA.

Mr. Drysdale: Hi. Wayne Drysdale, Grande Prairie-Wapiti MLA.

Mrs. McQueen: Welcome. Diana McQueen, MLA, Drayton Valley-Calmar.

Mr. Oberle: Good evening. Frank Oberle, MLA for Peace River.

Mr. Griffiths: Doug Griffiths, MLA for Battle River-Wainwright.

Mrs. Sawchuk: Karen Sawchuk, committee clerk.

The Chair: Thank you very much. Just a little note here. I see some cellphones on the table. When they go, they'll actually buzz and make a noise, and I've been told that *Hansard* can't understand what we're saying when those things are going off, so we'll just ask you to put them in your pockets.

There's one additional item that's on the agenda; I don't think it was notified earlier. That is the budget estimates, and it's here for information. With that, I would like to have a motion to approve the agenda with this new item. So moved. All in favour? Opposed? That's carried.

Then we have a number of minutes attached to our agenda that were from meetings in the past. We need to adopt these minutes, and we'll get a motion to adopt the September 4, 2008, minutes first. I'm sure everybody has read them. Wayne. All in favour? That's carried.

Then we have the minutes from September 26, 2008. Evan moves that one. All in favour? That's carried.

The minutes from October 1. I see Doug is reading those, and he's moving them. All in favour? Carried.

October 9. Guy. All in favour? They're carried.

That brings us to our presentation by the Alberta Council of Technologies on the establishment of an Alberta-Canada fusion energy program. They have requested to appear before this committee. What I would like to do is just welcome these presenters. I think what I'll do is turn it over to Perry Kinkaide. You'll introduce the subject, turn it over to your fellow presenters, and I will be keeping a list of people that want to ask questions. I'm not sure exactly how long you're going to be, but we have, should we say, limited time, so we'll make the best use of our time. I'll just turn it over to you.

Thank you.

Alberta Council of Technologies

Dr. Kinkaide: Thank all of you for joining us this evening. This is indeed the culmination of many, many years of anticipating an event like this. We're going to in the course of the next 35 minutes provide you an overview of how we believe Alberta could be positioned as both an energy and an environmental leader well into the future and capitalize on the reputation that it so well has deserved in recent years. Our presentation will highlight some of the extraordinary economic benefits to Alberta, why it is that we believe that fusion is imminent and is, in fact, the power of the future, and some of the implications for Albertans, for our environment, and for our economy.

Dr. Offenberger, professor emeritus from the Faculty of Engineering at the University of Alberta, has been a student and a researcher of fusion for many years. Robert, to my left, will provide some highlights on the milestones of this initiative and the budget, and Axel, to the far left, will provide some insights on the economic implications over time.

This is not something that will occur overnight. There are many milestones yet to be covered, but we truly believe and believe that the evidence is there that fusion is, in fact, imminent. If it is, in fact, imminent, it represents a revolution in the production of power for the world in terms of the amount, the cost, and the ease of distribution. I won't get into the specifics; I'll leave that with Allan.

Allan, why don't you tell them a little bit about the science of fusion and why we believe that this is the next generation of power?

Dr. Offenberger: Okay. Let me get this one up, and we'll get started. Thank you for the opportunity to address you this evening. Occasionally, over your heads I'll point this green pointer, but I'll make sure that I don't get anybody in the eye with it as long as we're on the sidelines.

We appreciate the opportunity to talk about what we think is an absolutely compelling opportunity for the province of Alberta in fusion. First of all, I'll just make a couple of pages of general remarks, and then I'll go on and give you some background and context and more detail in terms of how this thing could flow forward.

This one I want to highlight because of its very important messages. Imagine an energy source that is abundant, clean, and universally available, and that's what fusion is. For the first time when fusion becomes a reality, you're going to have a fuel that won't be subject to geopolitics because everybody will have equal opportunity of access to it around the world. That'll be a profound change. Abundant because it is virtually unlimited in availability. We'll talk about that a bit more. And it's clean because it works on constituents from water and soil, but mostly water, and the output ash is helium. That's relatively unique in the world of potential fired burners.

Imagine, then, that using a particular technique – and we'll talk about the conditions we need for fusion, but it's high temperature, basically – short-pulse laser beams, that could raise the temperature of the fuel to get the fuel ignited and burning and that we will see that fusion ignition experiment appearing within a couple of years. Beyond that, imagine that we're working on the enabling technologies, which a lot of people around the world are, that could see us leading to a test demonstration of power production within two decades. Now, that becomes a time scale that a lot of other energy and other options are working on, too, as you well know, so we're looking at something that's got more imminence than heretofore thought. Now let's imagine Alberta. We're an energy province. We've generated a lot of wealth from it. Let's think about reinvesting some of that wealth today in order to ensure that we're an energy superpower in the middle of the century and beyond. Those are the pieces that we want to keep in the background.

This picture down below captures it very nicely in the sense that fusion is the source of energy in the universe. It powers our sun. It powers all the stars. It's the source of everything that we think of as the norm of renewable on the face of the earth: solar and wind. It's ubiquitous.

Now, the coupling with the electric is twofold. One is, of course, that when we harness fusion, we're not going to have to build a new way of distributing that power because we'll use existing electrical grids. More importantly, this is a clean fuel with very small waste as we'll show in a slide or two. In fact, you could site the fusion reactors in the middle of any city and therefore start to obviate the need for transmission lines in the first place. So there's going to be a very dramatic change in the future that will reduce the need for transmission.

Let me give you the proposal right up front so you can be chewing on this while we're going through some of the background details. What we're proposing is that Alberta grab ahold of the opportunity to make it a priority in this government to see it realized as a program starting up in Alberta – and I'll say just the context here – but eventually moving into a national program.

6:45

The reason that we're picking a phase 1, phase 2 is that the phase 1, that we'll principally talk about today, is pitched at a three-year ramp-up phase for two or three reasons. The first is that it's a lot less costly than getting into the second phase. Secondly, it allows us to build our scientific team that's going to be needed when we're up and running. Thirdly, it allows us to reach what I'll be referring to as the proof-of-principle phase of experiments internationally so we've got that extra measure of confidence before jumping into phase 2. Fourthly, with Alberta funding this initial phase, it would give time, then, to negotiate with the federal government to put in place phase 2 as a joint provincial-federal undertaking, which is what we want to see in the long run so that we really have a national program emerging. The funding is referred to there at the bottom. It's $21 million over three years. The first year is $4 million.

Now I'm going to do the presentation of the background material. I've called it Issues: Challenges & Opportunities. I'm going to go through those items one after the other. Let me highlight a few important points here as we go.

First of all, energy units. You can think of terawatt hours. You can think of gigajoules or quads or anything else. A gentleman who happens to be the head of the physical sciences activity at SRI International made a presentation last fall and introduced this new unit, one cubic mile of oil. It's a much simpler number for all of us to remember, but I think it's very graphic and tells us quite a bit; namely, you take the current oil consumption annually, which is something over a trillion gallons, and you convert that into what turns out to be a volume of oil about a mile on a side.

If you then ask what the total energy used annually is right now, it's about three times that, so call it three CMO. If you project the growth over the last 25 years or so up to the middle of the century and ask how much integrated energy we are going to need, the answer is about 270 of these units. Now, that exceeds the known carbon fuels, first of all, so right away you know that we've got to come up with alternatives. More dauntingly, if you ask how we could come up with all of those units, if you look at the different possibilities now, demonstrated on the bottom half of the slide, to get one CMO not per year but one CMO in 50 years, you can see the list of things you have to start thinking about doing. Whether it's coal-fired, nuclear-fired, solar, wind, and so on, you have to start building an awful lot of power plants in order to have a chance of meeting the needs of that amount of energy over the next 40 years.

Notice just for reference – I did this one yesterday – that to take the oil sands number in the sense that if it, too, were asked to contribute to one of these units, what would it take? The answer is about what we're doing today, about one and a half million barrels a day would end up after 50 years giving you one CMO. Not 270 of them; just one of them. So the first issue is that we've got real energy problems, and we've got to come up with solutions.

The second part is that electricity is our clean currency that we use for everything now in our modern society, and it's going to become an even bigger demand with the electrification of transportation as well. If you look, again, forward at sort of the growth rates for electrical power plants, by 2100 we're going to need about another 40 terawatts. Now, what that number translates into is building 40,000 power plants of about a thousand megawatts each. That's an enormous number of power plants that have to be built. This is where fusion will become very important.

When you add on top of that the issues of climate change, carbon fuel limits, that we've already alluded to, what it says is that we really have to start planning and doing things now for what the world is going to need in energy in the upcoming decades. It really will take time. We have limited options, and we have to really start doing a lot.

Down at the bottom I make the point that in terms of noncarbon fuels there are really only three: fusion, fission – not fission as we know it with ordinary nuclear reactors because, in fact, that's a finite fuel as well; we're going to have to breed the fuel if we want fission reactors to be a longer term source of energy than the regular nuclear plants – and then there are renewables through solar and so on.

Let me pick up a couple of more points here. Not only do we have the demand and the need for electricity, but the sheer processing of material in order to cope with this is really nicely demonstrated where I take a 1,000 megawatt plant and I look at just one day's consumption, so the fuel in and the waste out. This is taking a mean energy, if you will, for coal because, as you know, there is higher and lower energy coal. It could range up to 20,000 tonnes or lower. We have to process an awful lot of coal, and we get a lot of emitted wastes. Besides the greenhouse gases we've got a lot of toxic wastes as well that have to be handled. For fission you have a lot less material to handle, but there you still have the radioactive waste to deal with. For fusion, on the other hand, we're talking about a kilogram a day for fuel, and it's basically helium as the ash coming out. Well, advantage, clearly, fusion.

Let's turn to the other challenges. First of all, fusion: what it offers, and then how do we make it work. Well, the reason we mostly like it, of course, is because it very efficiently converts mass to energy. This nice little descriptive comes from our colleagues at General Atomics in San Diego. The laser fusion express: if I take that standard 100-ton coal hopper and fill that with coal, that would fuel a 1,000 megawatt plant for 10 to 20 minutes, depending upon the quality of the coal. If I fill that with pellets of inertial fusion targets, that we'll talk about later, that would power the plant for seven years. We're talking about very dramatic differences in terms of that mass-to-energy conversion efficiency.

Well, there are a lot of reasons why the world likes it. We've already referred to the abundant fuel supply. There's absolutely no risk of a nuclear accident. You could never have a nuclear runaway. You'd never have to have a public evacuation in the vicinity because there's not enough energy in the system at any one time to ever represent any kind of a hazard, explosive or otherwise. It really is a risk-free zone, if you will, for those reasons. As we've already alluded to, there's no greenhouse gas or air pollution, no radioactive products – I'll show you the products in a minute – and there's no chance for production of weapons material. That's a very big issue going into the future. The bottom line refers, again, to the fact that that mass conversion efficiency means you have to mine and process a lot less material.

Well, why is it important? It's primarily because we have the need for central power electric generation. Coming back to the issue of what can fuel it, it's principally coal now around the world, as you know. Fusion is the one thing that is sustainable, clean, and can do everything. To make fission work, you have to have fuel breeding because we don't have enough fissionable material. The renewables, solar and so on, depend upon where you live in the world: cold, warm, sunny, et cetera. It's good for a lot of diffuse applications, but it's not going to be the mainstay of your central power plant distribution. We have a real need for that, and that's where fusion fits in.

What are the uses of this? Well, obviously, baseload electric generation is an important one. I've highlighted the top three here, Alberta-relevant. It's the power generation, the fact that you can get your hydrogen and synthetic fuels from this as a power source, and chemical processing with heat and so on. So there are important reasons.

Let me turn now to fusion. If it's so good, why haven't we got it already? Well, the answer is that we have to replicate some of the conditions in the interior of the sun, and that's not trivial. It's taken decades of scientific learning, but people have learned, and now there's a lot of confidence and knowledge in order to proceed.

Let me highlight the two things you really have to do. The first is to get these particles. The particles that are reacting in fusion are isotopes of hydrogen. In the sun it's just H, like H_20 in water. On earth it's a more efficient reaction if we use a second or a third isotope of hydrogen, called deuterium or tritium. That makes it a bit easier for us to do it. We're talking about deuterium and tritium fusing to produce neutrons and helium as your output. The neutrons you would absorb into a lithium blanket to capture the heat for power plant production, and you would also use it to breed the tritium fuel because tritium is not a natural fuel on the face of the earth, so you'd breed it to feed back in. To make it work, you need 100 million degrees temperature. The upshot of that is that once you've got the reaction over, in fact, the helium coming out has a lot of energy, too, and you would use it to help sustain the fuel burn, in effect.

6:55

The second thing you have to do besides heat it is keep it away from the surface, not because you're worried about melting things but because you want to not quench what you went to a lot of trouble to heat up in the first place. In effect, you have to confine that hot fuel for a long enough time that you get more energy out than you invested in the first place to heat it up. That comes up with the so-called Lawson criteria, that says that you must have the fuel density confined for a certain time that must exceed a certain parameter number.

Well, there are two ways to do this. You can work with low density and a long confinement time, which is the basis of the magnetic fusion work that's going on in the world. The biggest device on that is called a tokamak, a Russian invention. They're building a big international tokamak in France at the present time. The other way is to say: let's go to high density and a short confinement time. That's what we'll refer to as inertial and what we're going to talk about here, looking to achieve very high density in a very short confinement time. The premise there is that if you can put energy into the fuel, for example with lasers, so fast that you can heat it up, get the fusion reactions over with, and capture the energy before the fuel has had a chance to go anywhere, then you've obviated the need for confinement, in effect. We call it inertial confinement, but really it's no confinement at all.

There are two pathways to do it. The first is to take a pellet of fuel, irradiate it symmetrically with radiation. Lasers are what we're talking about here. When those high-power lasers hit the surface, they instantly heat the surface. They produce a rocketlike blow-off. That provides the compressive force to drive the pellet in the other direction, leading to compression. The longer you feed the energy in – we're still only talking billionths of a second – then you eventually lead to a compression, with the hot core in the middle reaching ignition temperature. At that point the fuel ignites and burns, and helium, being one of the products of that burning, self-heats to ensure that you burn up the entire pellet. The final output is heat and helium. The neutrons that have come along, as I say, would be used to generate more tritium fuel. Well, this is the conventional approach, what we'll call central core ignition. I'm going to talk about this because very big lasers are being built right now in the world to test that approach at full scale.

There's a new approach that we'll refer to as fast ignition. In this case you don't do it all the way down the upper pathway. You stop with a bit of compression, and you bring in a very short laser pulse. It's like bringing a match up to the side of the fuel to ignite it. Then you go on to induce the fusion reaction. The reason that we're interested in this approach is that it turns out that the overall energetics are five to 10 times more favourable. So when it comes to the ease of building things or the design modularity, smaller versus larger power plants, all the other attributes, fast ignition is a very desirable way to go. After the central ignition demonstrations, the world at large is going to be pursuing fast ignition.

This map shows some of the current facilities around the world that are engaged in laser fusion, or inertial fusion research. I won't stop to talk about all of them, but let me pick up LMJ in France and

NIF on the California side of the world. Those are the two biggest lasers in the world being finished. In fact, NIF, the national ignition facility, at Livermore in California is commissioned. It's operational as of this month, March 2009, so we all sit here at the time that the full laser system has been put together for the first time. The one in France is about a year behind, before it'll be completed. It's a completely equivalent scale, a totally independent program.

Japan, through ILE, the Institute of Laser Engineering, has been one of the major centres internationally in this work, and I'll say more about that in a minute. They are really helping to push the fast-ignition science.

There are many other supporting institutions. Let me highlight one in Europe. There is a pan-European initiative called HiPER – and this is important for our purposes along with NIF and ILE – to go after a very large fast-ignition laser fusion program. They were officially funded by the European Union plus the nation-states last October to start their detailed design phase. It's being led by a group of scientists at the Rutherford Appleton Laboratory in the U.K., but it really is a pan-European initiative. We've been invited. In fact, Bob and I have participated in the previous couple of years of design leading up to it, and we've been invited to become part of it if we get a Canadian program going. It's already gone to Brussels for discussion and approval.

Let me highlight this as a measure, now, of the progress. This is a slide from the ILE in Japan, and it measures this confinement parameter. I mentioned that density confinement time is one parameter and temperature the other. So there's confinement on the upper scale, temperature on the lower scale, and a hundred million degrees, right here, is the magical number. You can see a succession of experiments that we're riding out here where they had lasers of a few kilojoules in energy. Then they moved up, the bigger round dots in between, with a few tens of kilojoules of energy and moved closer to the promised land up in this quadrant. Now, FIREX is moving up this line, and the blue dot you see there is NIF. NIF, in fact, is going to be looking to get ignition and real fusion production of 10 to 20 and maybe even up to 30 times the input energy when that experiment is running. The lasers are up now. I've shown the black arrow as showing the direction that you've got to get your laser energies moving.

This is a shot of NIF, the national ignition facility in California. That area is the equivalent of a large football stadium or three high school football fields, in effect, or about seven Oilers ice rinks. It's very large, and that's because it was built with the technology that was there 20 years ago, when they started designing NIF. I'll show you a little bit about that and how that's changing and what we want to become part of in the new technology.

Those laser beams are generated. They come down and across here. There are transporters to take all the beams to that centre point. That's the target chamber that sits at that centre point. That's 10 metres across, so 31 feet across is that aluminum spherical device that was separately built and installed inside NIF. That's a facility just now online, March 2009, 192 laser beams. It's almost two megajoules of energy. It cost $4 billion to build.

Now, that's just one measure of the leverage that we'll get out of a program because we've been invited by our U.S. colleagues to get involved with them in the experiments on NIF and build the long-term collaborations and working relationships because we all want to see fusion working as a civilian energy application and with all of our international colleagues. They're calling it the national ignition campaign. They will be looking to do the proof-of-principle experiments somewhere within the next two years, probably a year to a year and a half, where they will be looking to achieve ignition and burn with the so-called central ignition route. Then they'll look to convert to fast-ignition experiments subsequently, and that would be very good for a Canadian program as well.

I won't go into the details, but Laser Mégajoule in France is an equivalent. They've done some technical differences, but it's otherwise a technical identity to the NIF one.

Let me now highlight where this is going. This is an energy road map done through a working committee of the International Atomic Energy Agency and put together by the HiPER group in Europe. I'm sorry it doesn't show it very large here, but if you look at the scale, we're here at about 2010, 2020, 2030, 2040, and so on. NIF and LMJ are looking to do the proof-of-principle experiments in this time frame. In parallel, we have all the enabling technologies – targets, lasers, materials, reaction chamber, and so on – going on with the idea that in about 10 years, so by 2020, we'd have all of that technology in hand to actually build a test demonstration reactor. That's what we're talking about there. That will inevitably be an international project. If we're involved with it, this could end up being a potential site for it: Europe on the one side and Asia on the other. We're next to the U.S., halfway in between, so it gives us real leverage there. Beyond the test demonstration there then would be the power reactor demonstration after that.

7:05

A power reactor conceptually would have a target factory injecting pellets, a laser driver system to ignite it. There would be lithium blankets to absorb the heat, take it out to heat exchangers and standard steam cycle electric power production.

Let me turn for a minute to the side spinoffs, because evidently in this world of lasers and exotica there's an awful lot of high technology, and certainly this inertial fusion has driven a lot of innovations. I'll just pick out two or three to talk about. High-power lasers is an important one with a lot of applications, and this is one that a program here would focus on. I mention the world of photonics because, in fact, it's superceding electronics. You think of the invention of the solid state in electronics for the last 50 years. Photonics is already overtaking it in commercial value. It's everything from your display, your information technology, your broadband fibre optics, automotive lighting, you name it. It's a very big field, and this has got a lot of commercial possibility. This world of laser fusion lives on nanotechnology, so we've got a real tight coupling to existing programmatic activities in the province. Whether it's on the laser side, optics, targets, chamber materials, it runs on materials in nanotechnology.

Let me highlight one significant thing. I mentioned that NIF was using old technology, that was there 20 years ago, when they started designing and building 10 to 15 years ago. Those are flashlamps. They're like your camera, a xenon flashlamp, only these are very much bigger. They're about two meters long, and they are used as the optical pump to excite the laser media. In this day and age we have solid state lasers, and by comparison, if I can stabilize this enough, the little units are about a centimetre by two centimetres, and that's about seven of those units high and four across. So you take that modern solid state laser: it's (a) more efficient and (b) a lot smaller volume of material.

If you want to know what it looks like, that is an array. Let me show my laser pointer here, in fact. Those chips that are in there – and there are just hundreds of them – are something that's very much like what I'm holding in my hand. I happen to have two batteries in this to power this thing, and that takes up most of the space. There's a little electronic driver circuit behind it, but the actual laser emitter up front is something that's microns by millimetres in dimension. It's very small. The devices that you're looking at in those diodes there are, in fact, just a whole array of what are ultimately very small little sources for the laser radiation. Well, they have the efficiency, and they have the scale of them.

Here's something else that the fusion program has driven. We all like our china because it takes high temperature. In the laser world, where you want to handle higher laser power, too, you'd like to have ceramics. But heretofore it has always been opaque, as you know. Well, here people have learned for the first time how to make transparent ceramics, so these can now be doped and optically pumped and made into laser media. They are capable of handling a lot higher power and, therefore, are crucial to the advances of where we want to go.

This looks like a big object. It's two millimetres in diameter. That's a target that's going to go into the laser fusion experiments. I have to point out that while it looks very simple and straightforward; in fact, it's a multilayer target inside. It is built to 10-nanometre precision. So you've got a perfect sphere there that has been fabricated to a few parts per million in perfect sphericity. It's a measure of what the nanotechnology world is called on to do and can do for this activity.

Okay. Let's turn to the Alberta side of the story, then. What we need to make the point on first is that Canada had a very low-level contribution in fusion going back 15, 20 years ago, and then it was basically terminated. Quebec and Ontario had started small programs in magnetic fusion and tritium fuels, and it was disbanded. So we're starting fresh. We don't have a national program at the present time; in fact, we're the only developed country that doesn't have it. There are many underdeveloped countries that have gotten into fusion research but not Canada.

Coupled with that, our links with Europe, Japan, and the U.S.A. have basically given us an open door to get involved with them, to access everything they've done so far in the technology and to work forward to bring fusion to reality. This is a tremendous opportunity and very big leverage, obviously. I'll bring that up on the next slide. In fact, when you couple the fact that Canada is not there, that we have the chance to get in with a very quick entry – obviously, for Alberta, as you are well aware, we're taking a lot of flak at the current time in terms of our energy and environment issues – it seems to me that if we were to get this program started, we'd have a very big selling point to the world that, yes, there are a lot of things we have to do in the current time, but we're working on the long-term solutions, too, that are going to be there for everybody.

It's a matter, then, that what we're looking for is Alberta to take the leadership in the national sense, to come forward and say, "Yes, we're going to do it" and then get the federal government side to come along as well in the long run. The leverage is extremely important. When you add up – and I don't know the total number – all the programs in the world, it's billions. If you take the lasers in California, now at $4 billion, comparable to the French system, you take all the other systems that have led up to where we are and then the operational money annually, it's probably of the order of $10 billion that has been expended. So whatever investment we put in is going to get a great deal of leverage in connecting with the international program.

Clearly, you either get in or you stay out, and that's the decision for Alberta and Canada to make. This is a sophisticated technology. You can't come along long after the fact and say: well, now we'll jump in. This is a case where you need a long learning curve, so you either want to get in now at the pre-major-engineering phase or not bother. The opportunity is there to do it now effectively. There are a lot of economic possibilities – I referred to them a couple of slides ago – and we can talk about them in our discussion. I'd mentioned about the potential site for a program.

Let me just pick two numbers out. In the course of putting together a white paper back last year, we were asked to do an economic impact study, and Bob has compiled the information on a couple of curves here. One is to look at that it does have impact on jobs. This is the growth of the jobs, starting from now through to 2100, under the assumption that Alberta and Canada at the end of the day would get about 2 per cent of the international global market. You can clearly see that you're into the hundreds of thousands of jobs that would be generated in this century. The economic value restricted by that 2 per cent is up into the hundred billion dollars as an annual figure at the end of that time. So these are just meant to demonstrate some of the sheer impact of these technologies, and those documents are available.

Incidentally, we're going to leave a CD with you. Apparently, you put everything on the web after, so we've got the white paper, the economic impact study, executive summary of the program, and today's presentation. It will all be there for you.

Okay. Moving forward, what we're asking for is that Alberta take the initiative to provide the leadership and say: we're getting involved with fusion. We're looking for first-phase funding of $21 million as an Alberta start-up so that we don't waste time at this point. We need quick decisions because if we're going to participate with NIF in the national ignition campaign, we really need to get people going down there this year. The start-up would be a three-year $21 million, $4 million in the first year. During that time you'd build your team, participate in the experiments internationally, and then get ready with your planning for the implementation of the phase 2, which would be running at about $40 million. We've done a full plan on this, incidentally. It's there in the background as well. That's where we'd look for the joint funding, so $20 million provincially and federally.

7:15

Well, what we'd look to achieve in this first three-year phase: we'd look to see the critical mass generated; we'd have core facilities to support our people that are working and collaborating in other labs; we'd be participating in the national ignition campaign to give us visibility there. "Bring your instrumentation down, put a Canadian flag on it, and share in the glory," are the words that the director of the program told me. We'd be looking for information to help our decision-making for phase 2, obviously. Importantly, with the emphasis on the laser side of things, we'd be looking to see the photonic sector established.

Well, here's my last slide. The proposal, then, reiterated, is to request Alberta support to establish the program. We're saying that the combination of what fusion offers in solving our long-term problems in energy, environment, and economic opportunity is so overpowering that it's an opportunity not to be missed. We're asking explicitly for a quick decision on getting the three-year ramp-up started so we can post the people to these international centres and get started and then do the planning towards that phase 2, when the major activity is undertaken.

Now, let me just make an additional comment about the third point here. We've already had discussions, in fact, with Lawrence Livermore National Lab. That is a U.S. national lab funded through the Department of Energy. It's a multibillion dollar activity every year there, and they have responsibility for the laser fusion. We've already discussed with them about getting a protocol in place. Insofar as the Obama administration, as you know, putting a lot of emphasis on energy/environment, this is something that I think we could play to real advantage given that we've got the participating lab in the U.S. willing to work through Washington on our behalf to put this in place. All we need is the Canadian side – it could be done directly from Alberta or through Ottawa – to put a protocol in place and make that a joint activity.

I thank you for your time.

Dr. Kinkaide: Thank you, Allan.

I think we'll go directly to questions.

The Chair: Thank you very much for that informative presentation. We do have a couple of questions. I'll start with Laurie.

Ms Blakeman: Thank you very much. That's a lot of effort that's gone into that presentation and a lot of talking on your behalf, so thank you very much for being so patient with us.

I actually have a series of questions, so I'll ask to go at the end of the list, but I'll start with two, an environmental one and a financial one. The economic one is: if we are first in as long-term investors in this as a province, what could we expect as our royalty share, as our payoff, as first-in investors? I understand that's not part of exactly what you're pitching here, but when I go back to my constituents – you may see some of them walking down the street out there – and try to explain to them why the province is funding this to the extent that you're asking us to, what's their payback? What do they get out of this?

Dr. Offenberger: Axel, would you like to have the first run? Then I could add to it.

Dr. Meisen: I will try and answer the question. I think you saw the slide that Professor Offenberger put up in terms of the economic return. Our initial investment would be $21 million, and if you project it out towards the end of this century, assuming that Alberta would only take 2 per cent of the technological returns on the investment, we're into the hundreds of billions of dollars. So the leverage is very large. Now, these are big assumptions in terms of the multipliers, but those are the best estimates that are currently available.

Dr. Kinkaide: Laurie, one needs to appreciate that this initiative is not just about power; it's about additional technologies emerging off this initial fusion world. If the world moves from carbon to a fusion economy – that's the projection because we can't continue; there isn't enough, and the world's demands for energy are so great – everything changes. Your automobiles are driven by electricity. All of the appliances you have today are electricity, and Alberta plays a role in building the manufacturing infrastructure, the knowledge infrastructure to be a part of that world. First in are those that will benefit the most. The figures that we're speculating are pure speculation because it is so extraordinary. You're talking about the building of a brand new economy in essence.

Dr. Offenberger: Just to justify one number. If you take high technology in general and you look at the average return per employee in the high tech field, these numbers range from $100,000 to $400,000. The photonics business, incidentally, right now in Europe exceeds electronics in commercial business, and the average there, if you add up all the people and the economic return, turns out to be about $200,000 per person. So if you use those as generic numbers, they give you a pretty good way of estimating as well.

Ms Blakeman: I may come back to you on that one later. My environmental question is: sometimes the best way to understand things is to look at the worst-case scenario, which I'm sure you've done, so what's the worst-case scenario with this technology? What does something going terribly wrong mean for our environment and for anybody that's nearby?

Dr. Offenberger: If I were to build a reactor out of silicon carbide materials, so we're looking at advanced materials, with lasers as the source of driver energy to make it work, my pellets being injected, there would be no hazard whatsoever. If I were to take that vessel, the reaction vessel, and build it out of ordinary iron steel such that some of the neutrons could get through the blanket and radioactivate the vessel, then you could have a bit of activation that would have to sit in storage, not like fission reactors for a hundred thousand years but for a few tens of years, before you could reprocess it and use it over again. That would be the worst case.

Ms Blakeman: That was my understanding of the exit sign plant that was, I think, in Ontario. That plant ending up leaving a bit of a mess behind.

Dr. Offenberger: Remember, fusion is not fission. They're totally different.

Ms Blakeman: I do understand that. I've read everything you sent me. I got it.

That plant still left a mess, and it was producing tritium, which is exactly what this would end up producing as a by-product.

Dr. Offenberger: But this tritium does not come out because the tritium goes back into the fuel pellets to be reinjected, or you don't have fusion being produced in the first place. This is a closed cycle, that you need the fusion neutron to produce the tritium to go back into the fuel pellet to refuel. There's no tritium left over. You ask: "What's the inventory of tritium? Would it ever represent a hazard?" I think I made one slide where I said that there is no hazard. You'd never have to evacuate anybody outside of a plant for that little bit of tritium that would be internally recycling, in effect, to refuel.

Ms Blakeman: Okay.

Dr. Kinkaide: The worst-case scenario would probably be if the plant were to stop for some reason and all of a sudden you don't have electric power, but that's no different than what you have today when a power plant goes down. The probability of a plant going down, of running out of coal today – the equivalent is running out of these pellets, and that's just not where the future will be. I can't see the risk.

The Chair: I'll go to Evan next, please.

Mr. Berger: Thank you. Maybe you mentioned this. What other governments in the world are already invested in it and to what extent would be the first question.

Dr. Offenberger: Let me go back to this slide right here. That's a map of some of them. There are many other programs in various universities and other institutes as well, but this catches some of the bigger programs. The U.S., obviously, has a number of places involved. Europe has a number of places involved. Russia, Japan, China. In fact, China is mounting a very big effort in fusion research, both in magnetic and inertial because they obviously need energy very sorely. In fact, it's very large. When I mentioned the level of expenditure, I mean, we're in the billions in these facilities, and so on.

Mr. Berger: Okay. The next question was that 2 per cent of global market. Market of what? Selling power or the technology? You prefaced your whole presentation tonight with the fact that this would make power affordable around the world and replace all the other power sources. But at that price tag of setting one up, how would that benefit Third World countries, and how would they afford to produce that power from that technology if they could never afford it when there are that many billions in it for us as a 2 per cent partner?

7:25

Dr. Offenberger: Well, there are the two sides to the question. The first is: let me take the side of the producers. For all the nations who can and will and want to pay for it, what we'd be looking to sell would be intellectual property first of all. It's the design of these reactor system reaction chambers and the laser systems, the targets, or any other part of it. So we'd be looking for the intellectual property. In addition, we'd single out and we've identified for this program that we should really emphasize the laser driver development, that solid state driver development. So you'd be looking to sell hardware as well.

Then there are all the computational things for controls and data handling and, you know, everything else. Just the computer control on NIF: there are like 6,000 control points of data that are being constantly fed to the central information processing, and that's an awful lot of instrumentation and censors and everything else. So you'd be selling a wide variety of software, hardware, and intellectual property into the international market.

The issue about the countries that can't afford it. Once again, as you build more of these things, they'll become less and less expensive with time and therefore more affordable to everybody as you go along. So you'd hope that that's going to work here the same as any other energy system over time.

Dr. Kinkaide: A couple of the participants in the steering committee have seen extraordinary opportunities in the world of engineering and construction as these power plants are looked at around the world. The Stantecs of this world, for example, look at an enormous opportunity to be a leader in engineering of the construction of power plants. The work that we have done with some of the power generators today, the Enbridges and the EPCORs, for example: there's an opportunity for them to also play a leadership role not in power generation from here to Africa but in the building of those facilities.

Dr. Offenberger: Could I add just one more comment to that, too? Over the last couple of years we've engaged with a lot of people in industry here. Let me take two examples. One is from the TransAlta-EPCOR side in the sense that: where is the electrical power generation going to come from, what fuel in the long run? They're saying: yes, we know that by the middle of the century we have to have a replacement for the coal. That's why they support this fusion initiative. When I talked with senior planning people at Enbridge, they said: we recognize that 50 years from now we're not going to be pipelining oil and gas; we're going to be pipelining hydrogen. So there are people that are already thinking into the future as to what new pieces will be there.

The Chair: Thank you. Just a quick question: is industry buying into this? You were just talking about Enbridge. You're looking for money from the government, but is industry also buying into the research and the initial phases of this?

Dr. Offenberger: The comment and the answer to that is that because it's 20 years away, this is too soon for any industry to be anteing the money up. So entirely throughout the world it is all government funded, absolutely every program. But what you try and do in the course of building these programs is bring industry in so they become part of it, and you're getting the technology transfer occurring by virtue of them having a subpiece of all the activity you're doing in this development phase. At some point they'll have the vested interest to then take it, run with it, and invest and market it.

The Chair: Okay.

Mr. Chase: I'm coming at it from two points of view: science fiction and then science. In the Keanu Reeves movie that ended with the information being transferred simultaneously around the world to all nations, indicating how fusion worked and the formulas and so on, the bad guys in that scenario were, you know, the equivalent of our Halliburtons today and the military side. But it was also the oil and the gas lobbies, those who controlled power either militarily or through energy, the whole idea that this would create a world-wide, considerably cheaper form of sustainable energy. That's sort of a comment rather than a question.

But in the science of it when we try to harness the heat and the power of the sun, are we anywhere near having that kind of containment? Then considering that containment, how do we somehow for that momentary point in the fusion reaction allow that pinpoint necessary for the fuel cell to drop in at the appropriate time to keep the process going and not, you know, weaken the chamber at that point? In terms of keeping it constantly going, what kind of materials do we potentially have that can withstand and contain that kind of energy?

Dr. Offenberger: Bob, would you like to have the first crack?

Dr. Fedosejevs: Basically, the reason that the target chamber is so big is the fact that you distribute that energy over a large surface area. Most of the energy, in fact, is in the neutrons, which don't stop right at the front surface but actually travel a fair distance into this breeder fuel blanket that would actually convert those neutrons through reactions with lithium into new tritium, which you then would extract and put back into your fuel. In fact, it's not as violent as one thinks, but you want to do this 10 times a second so that that energy is basically keeping everything running very hot. I mean, these are, you know, hot temperatures – 1,000 degrees, 900 degrees centigrade – that they would run on continuously. You would have suitable materials. There are lots of materials that can withstand these temperatures, the carbides, et cetera.

To inject the fuel, basically, you would have, essentially, a gas gun. In fact, there's work being done in California in association with the NIF program to demonstrate that the fuel injection can be handled where you'd actually have these pellets fired at 10 times a second through space into the centre of the vacuum chamber so they'd arrive just for the next laser shot.

None of this is trivial. The beauty of this, in part, is that it is so high tech. I mean, it's driving the technology on all fronts in terms of controls, lasers, materials, and as such it has a tremendous payoff in the sense that if you can do this, you're the leader in the world in many of these technologies. That's the attraction of it, that it could make Alberta a technology leader in many of these spheres. That's what you'd sell in the future, the fact that you know how to do this. It's not trivial, and it's not something you can put on a few pieces of paper and send to somebody around the world and they'd be able to do it. It takes a lot of know-how.

Dr. Kinkaide: While you may have the power of the sun or the heat of the sun to propel it, by the time it's dissipated to that 10 metres across, the heat has dissipated to the point that out of that you don't have the high risk that I think we're all afraid of: what am I going to do with 100 million degrees in my communities? It's here, and by the time it dissipates you can use . . .

Dr. Offenberger: Yeah. A hundred million a year and a thousand a year.

Mr. Chase: Thank you.

The Chair: Okay. Thanks, Harry.
Diana next, please.

Mrs. McQueen: Well, thank you for your presentation. It's very, very interesting. Just a question. You talked about the urgency of the decision from government. I'm just wondering: if government can't meet those timelines, at what other stages are there opportunities, whether it's provincial or federal, to get involved? You talked about the one stage, but this is a long process. Maybe if you wouldn't mind just expanding a bit about the different stages that the province could at some point look at getting on board as we progress in this technology development.

Dr. Offenberger: Bob, would you like to take the first crack at that?

Dr. Fedosejevs: Well, I think that, you know, this is really an opportunity. We have very little critical mass at the moment, so we have a lot of building to do. You can't be a player if you're insignificant in terms of the world scale of things, so while there may be other entry points in the future, one would still have to have a much larger critical mass because the stakes are going to keep climbing, and the amount of investment keeps climbing. In fact, in the '70s, when I started my grad studies, I mean, Canada was a player in laser fusion. I was part of it, and Allan was part of it. We were recognized international players at that time because the amount required to be a player was modest, but it has grown since then, and if you want to be a player now, you have to be on a big scale.

The opportunity right now is this fast ignition. You know, this is a new development in the last 10 years that, in fact, makes laser fusion look better and better. It's early days in fast ignition; it's still in the R and D stage. That allows us to get into this new opportunity wave. If we wait another five years, then that will have been addressed. It would be implemented in the HiPER project and NIF, et cetera, and it would be very difficult for us to become a player again.

Mrs. McQueen: Thank you.

Dr. Meisen: Maybe I could add something by way of an analogy. Over a decade ago the decision was made to create an international space station. We're all aware of it. Canada at the time had the opportunity to participate in that, and Canada made the decision to develop the Canadarm. The Canadarm in many respects is equivalent to the ignition laser that we are talking about.

7:35

If Canada had decided not to develop the Canadarm, the space station still would have gone ahead. It would have been very difficult, however, for Canada at some later point in time to make a meaningful contribution to this space station. We could have flown some experiments – that's certainly true – but we would not have developed that particular technology, which is essentially robotics technology and control technology that has now permeated Canadian industry, not so much the energy industry but the manufacturing industry. So you might like to think about that analogy as a useful one.

Mrs. McQueen: That's good. Thank you.

Dr. Kinkaide: I think that from a socioeconomic point of view we must realize as well that what's going on in the U.S. today provides us with a window. The development of energy protocols is not just about today but well into the future. Fusion hasn't yet been brought into that equation. We think the current Secretary of Energy in the United States, who comes with a strong knowledge of what was going on at Livermore, knows what fusion is. It will come on the table. If Alberta is there, Alberta has a leadership position, but we won't have that position coming back again.

The Chair: Thank you very much.
Guy, go ahead, please.

Mr. Boutilier: Yes. Thank you very much. I think your analogy is correct, but I think back to the '50s, when the gentlemen Dr. Karl Clark and Frank Spragins and others at the time had this idea of the oil sands in terms of what is taking place. So don't be dismayed at this point, shall I say, by the numerous questions you have. Obviously, at the end of the day we are a legislative committee and recommend back to the Assembly of Alberta. I'm assuming that you will have had discussions with the government and the relative appropriate ministers on this issue. For instance, I see enclosed in your presentation a letter from the Minister of Energy where he makes reference to the policy of the government.

I guess my question would be this. You're asking for $21 million, for this committee to recommend back, ultimately, to the Assembly, which eventually would be translated back to the government, where the spending and dollars are. Have you made a formal presentation? I know you're being encouraged to make it to the government. Is the $21 million going to be taken from some other area that has already been committed? What area would you recommend the money come from? The pot is only so big.

Dr. Kinkaide: Today is the beginning. Certainly, over the years Dr. Offenberger has had opportunities to speak to many individuals in government. Over the last six months we've had on our steering committee representation from various departments, but this is truly the beginning of the political process. Everything up to this point has been elevating the level of awareness within individual departments. Our primary objective is to help the Alberta government understand the relevance of fusion to its future and to the future, I guess, of future Albertans.

We're not asking for you to give us $21 million. We're asking the Alberta government to undertake a program with fusion as a priority woven into its energy agenda. We're not saying where on the government it should lie. There's a current research and innovation restructuring going on, and we trust that this may well be taken into consideration. Ultimately, where the funds will come from – we've had some discussions with representatives inside Finance and Enterprise. We know that these are tough times. We know that there probably is no worse time to come to government asking for government to make a commitment to its future. However, $2 billion for carbon sequestration is a brilliant strategy to ensure that we don't leak as much in the air. We think it's a more brilliant strategy to think well into the future for $21 million versus $2 billion. Some place in this government there's the opportunity to do what I used to call an R budget when I was in government, and that's a reallocation.

Mr. Boutilier: My supplemental, Mr. Chair, would be: do you intend to ask the government?

Dr. Kinkaide: We would like very much for this committee to give deep thought to the value of fusion for the future and to lead us to the next committee, which is, I believe, your Cabinet Policy Committee on Resources and the Environment. We understand that this is an open process, nonpartisan. Let's get acquainted. If we've been successful, we trust that you'll make a recommendation for this to be heard at the next level.

Mr. Boutilier: Good. Thank you.

Mr. Oberle: Maybe just a little bit more along the lines of what Guy was asking. You're right; there is some restructuring going on. Nonetheless, our Alberta Energy Research Institute has been around for a number of years now. I'm wondering if you've had any contact with them. I haven't heard of this being on their radar screen. Also, wherever the new institute goes and how that incorporates or doesn't incorporate AERI or energy issues, have you had any contact at all with those people, and what have they had to say?

Dr. Offenberger: The simple answer is yes. In fact, the two years of the planning phase were funded by the university and AERI. They pointed out when we started the process that their mandate didn't include fusion and other things, so there would have to be a government policy decision taken as to how and when and where. You know, if the government says that we'll do it through AERI and gives them the mandate, that could happen, but it might be otherwise. It's a matter of which administrative route one takes in the long run.

Dr. Kinkaide: Which area of government and which institute is thinking about the long-term future is the one that will get the agenda for fusion, and it doesn't look like it's been historically allocated. That's what we're looking for. Let's allocate a place for the development of the transition to fusion.

The Chair: Thank you.

Ms Blakeman: Who are we competing with? You indicate that there's been an invitation for Alberta to have a place in the project that's working in California. I'm assuming – and you may, of course, correct me – that if we don't take up this invitation, there's somebody next in line. Do you happen to know who that is, or do you know if we're competing for this place, this position?

Dr. Offenberger: No, we're not competing for it. This research is very much internationally oriented, as you appreciate, so there's a lot of co-operation back and forth between the scientists around the world. Let me back up a bit. This opportunity as well as the HiPER in Europe as well as Japan have come out of some historical associations we've had. So we know each other; we've worked together.

Secondly, in the sense that they were getting bigger programs going, Canada was not involved in fusion, and at the point of getting these discussions going again, the natural question is: how are we going to ramp up and make it effective? With the U.S. and with Japan and with Europe I said: "Look. One of the first things would be a matter of recruiting and getting people brought up to speed quickly to build a team." They said: "We'll work with you any way you want. We'd love to have your people come and get up the learning curve and build those long-term working relationships." It's in part the confidence of people working together and in part everybody recognizing that this is a big, long job, that it's expensive, and we need all the bright people in the world contributing to the solutions we can get our hands on. Canada is not yet there. The U.S., Europe, and other countries are, but Canada is not yet there. There's an opportunity, then, for us to start contributing, in effect.

Ms Blakeman: Okay. Well, as a supplemental, then, and following on Mrs. McQueen's question, you're indicating that time is of the essence here. I'm just wondering when the window starts to close. At what point are we too late to come to the table to be useful? Or if we come to the table with partial support rather than full support, at what point does that window close for us?

Dr. Offenberger: It's a different staging. The first window and the reason we've emphasized getting started this year is because the director at Livermore said: "Allan, we're going to be up over the next year starting to do those experiments. If you want to join with us in our national ignition campaign – bring instrumentation down, add it on, put the Canadian flag on it, and share in the glory – then you need a certain lead time to do it." These are expensive facilities. You don't just bring your bucket of bolts and add it on. It's got to go through a commissioning and everything else. It takes time to get the people, the design, the building, and the commissioning down at the other end. It was recognizing that in the next year to two years would be the critical experiments and that if we were to have any chance of participating in the national ignition campaign, we need people up and running right now.

Dr. Kinkaide: I think that just to add to the point that Allan has made – and I've heard him speak to this many times – we cannot proceed on a token basis. The building of a team is to build a team with sufficient stature that those in the world that would like to work with us and those in Canada that would like to work with us need to know that we're serious. That's partially the justification of the $21 million over three years, to let the world know that we're serious.

7:45

The Chair: Thank you.

Mr. Drysdale: You keep mentioning Canada being involved. Have you made a presentation to the federal people yet? You keep saying Canada and not Alberta, so I just wondered if you'd been there.

Dr. Offenberger: The answer is yes, but only in a briefing sense again. I've briefed NSERC and NRC and Environment and Natural Resources Canada – it goes on at long length – but the discussion has always been that we're trying to get this going in Alberta as the front-running place. They've said: you should get that job finished, and then the two levels of government get together at that point. The federal government is not going to take the lead on this any more than they did with the other fusion programs. When we had the brief programs in fusion, it was Quebec coming forward, putting money on the table and Ontario coming forward, putting money on the table, and the federal government responded. We had a program for about 10 years in those two provinces, but it was never led by the federal side. It was in response to provincial initiatives. That's the reaction again in my discussions. When Alberta is on board, then the serious discussions can start.

The Chair: Thank you.
Harry, please.

Mr. Chase: Thank you. In terms of funding the project, it seems to me that last year, in 2008, the provincial government set aside $100 million for funding research and development. If the government saw the potential wisdom of a project like this, I would think that would be one potential source of the funding.

There has been a problem with regard to energy. One of the major reasons for not having greater hope for, say, solar power or wind power is the storage of the power. It seems to me that fusion – like solar, like wind, like coal – requires a constant reaction to be occurring in order for the power to be produced. Is there any sort of joint offshoot of the science or experimentation that would deal with storage of the power so that we could harness it and keep it for a length of time when we would most need it? Or does it always have to be burning?

Dr. Fedosejevs: Well, there are two points. It doesn't always have to be burning. You can turn it off for periods of time just like you do any generating station, so it's not much different than, you know, any standard generating station. It does have the capability, of course, of generating hydrogen fuel, which we believe will be the fuel economy or part of the fuel economy in the future, so in fact that's your means of storing energy. You can produce hydrogen in excess when it's not required so much and then use that as your energy source in between if you do, for whatever reason, have to shut down the reactor. It's no different than any generating station today. Basically, it's just a turn-on time of probably half a day or so to warm everything up and get it going.

Mr. Chase: Thank you.

The Chair: Guy, please.

Mr. Boutilier: Yeah. Coming back to the Member for Peace River. He mentioned the Alberta Research Council, which I think we can say as Albertans we're all very proud of. I think it was indicated that right now fusion is not on the mandate. Is that correct? Do I understand you correctly?

Dr. Offenberger: It's not on a policy mandate in Canada in general and, certainly, in this province.

Mr. Boutilier: Let me ask you as a member of the Assembly if, you know, that would not be an important step towards the end of the goal that you speak of, of potential recommendation of the government's consideration of a change in that policy to include what is being suggested today. We usually tend to learn to walk and crawl before we learn to run. I'm just wondering if, in fact, that would be a part of the strategy, if you think that would be helpful towards your cause today.

Dr. Meisen: Maybe I can answer this by, first of all, providing a clarification. The earlier comment was in the context of AERI, which is the Alberta Energy Research Institute, not the Alberta Research Council. These are two different entities. AERI is a funding entity in the energy sector.

Now, having said that, the Alberta Research Council is very proud of having participated and supported the development of the oil sands extraction process. The Karl Clark work was all done at ARC, and ARC has an interest in ensuring that Alberta and Albertans have in the long term ample, clean, reliable energy supplies and also that Albertans have the opportunity to sell energy-related technology around the world. So we have that shared interest. ARC is an applied research organization. If it is the wisdom to go forward with this program, and if it is the wisdom to entrust ARC with some of the work because it's professional, scientific work, you can count on ARC being very responsive at that point in time. But there is AERI and there is ARC, and they are quite different entities.

Mr. Boutilier: Thank you. You have answered my question.

Dr. Kinkaide: Mr. Boutilier, if I could just add one additional point. We've talked at great length today about the science of fusion, about the energy economy. There are dramatic socioeconomic implications for the introduction of a fusion economy. There is the strengthening of your electrical grid infrastructure. There are new vocations. There are new jobs. There are new occupations. This can be very disruptive or it can be transformative in a province that has enormous oil riches today and carbon riches of all form: oil, gas, wheat, meat, fibre, timber. It's all there. This is good. This is good news because it's a lower cost source of power for all of our industries.

But it also can be disruptive, and we've put in the budget a small allocation to make certain that we address the socioeconomic, regulatory implications, vocational implications so that we're not naive and simply pushing this as a science play. This is a societal play, and in that respect it's important to think about the people and the communities and the infrastructure and the jobs and the schools and the universities. The hospitals will benefit from fusion. What the lasers will do is not just for power, but there are many parts of our society that will benefit.

I wanted to add that additional point because I think sometimes we get so caught up in the energy implications because of who we are in our province, we forget the family and the community implications.

The Chair: Okay. Thank you very much.
Are there any further questions?

Ms Blakeman: Yes.

The Chair: Okay. Go ahead, please.

Ms Blakeman: One of the criteria that's often used when looking at new projects is the triple bottom line, which you've just sort of referenced, and that is the effect that something is anticipated to have on the environment, on the social structure, and on the economic structure. Is there any final statement you'd like to make on how you think this project would go through that filter, that test, of a triple bottom line?

Dr. Offenberger: I'm just going to break for one minute here to get a slide up.

Dr. Kinkaide: In terms of both environment as well as energy in the economy overall?

Ms Blakeman: Triple bottom line is environmental, social, and economic.

Dr. Kinkaide: In some ways that's what this graph or this illustration was to try and portray. This moving from a carbon world to a fusion world takes us through a clean environment. We have the potential to reverse climate change, of not putting as much carbon into the atmosphere. Putting less into it enables us to start reversing what many of the carbon-fuelled power plants or coal-fuelled power plants do today. As far as the economy, it enriches the economy through diversification. It has extraordinary implications for sustaining the economy because it has given us an infinite amount of power at a very low cost that's available virtually anywhere.

Does anyone want to add any more supplements? Do you want to go from left to right?

Dr. Meisen: Well, maybe I can comment on the social side, and that is that this technology holds the promise of providing every significant community in our province with its own power source. It's a scalable technology that can be applied for relatively small scale and very large scale applications, so I think that's clearly a benefit.

Another very major benefit is that it's a creation of jobs, a creation of jobs in the case of Alberta in the laser area because that's what these ignition devices are. These are high-tech jobs that can be applied in the fusion sector but also, as was referenced, can be applied in medical diagnostics, materials testing, many other areas. The future high-tech industry will depend to a significant extent on advances in photonics and laser applications.

7:55

Dr. Fedosejevs: Well, that's just what I was going to say. We shouldn't overlook the tremendous spinoff potential here in the laser technology. The major labs, Livermore and around the world, that have been developing laser fusion programs have been the drivers for the leading-edge laser technology in the last few decades. So not just the energy but all of these high-tech areas will benefit, and it will spawn, basically, a new economic sector. Just like nanotechnology is a new economic sector that we are building today, we can now build a photonics sector. Photonics, really, is identified as the successor to electronics. You can do so much with light in all its different forms, and this is the driver for that.

You know, that this is a winner on all the points is the bottom line. For society what it allows us to do is live the comfortable lifestyle that we're used to today without having to cut back and worry about energy consumption every time we turn around. I mean, we will have tremendous energy depth. We can produce as much energy as we would like to use and yet at the same time have zero impact on our environment. Zero. Really, the greenhouse impact is nothing. This is really a paradigm shift in, you know, the energy technology that could be coming, and I think it's a winner on all points on the triple-E bottom line.

Dr. Kinkaide: The only thing I might add is something that we haven't emphasized, but it certainly deserves mentioning. As the world is today already starting to scramble for alternative sources of power, it's beginning to consume large amounts of farmland for fuel. I see that in Germany. I saw that when I was over in Europe this past year, the number of windmills and the amount of farmland now devoted to fuel. That's not what farmland is for. The world can't stand the increases in prices of food, so we've got to find a longer term solution. We think farm should be for food, not for fuel. That's what fusion's promise is.

Dr. Offenberger: And maybe I'll do my little wrap-up comment. I've been retired for some time now. I don't think about my generation. I'm concerned about the next generation, but I'm even more concerned about my grandchildren. The question is going to be: what kind of a society are we going to build in Alberta for our grandchildren and beyond that will give them the comforts that have been alluded to, the opportunity for education, for skilled jobs to stay at home, not to have to leave the province because the opportunities only lie elsewhere? Namely, we're looking for those value-added jobs that make for challenging, stimulating career possibilities, and it's in building this new world that doesn't just rely on carbon fuels, that moves into a very different high-tech world.

We've not reached that critical mass. I think everybody here recognizes that. You've got your Silicon Valleys. You've got your route 128s around Boston. Ottawa has come very close, but that took 50 years of federal government investment through the National Research Council and other things to help build a critical mass that made it possible that when finally the world of optical communications and so on came along, people from here and here and here could suddenly amalgamate and start a whole new little enterprise. We have yet to get there.

We haven't reached the critical mass phase. We've got more building to do, and what we need to do is to build it in the places that are going to be fundamental to the future. Energy absolutely. Photonics is going to be a key one. It'll underwrite all of our manufacturing and information and everything else. These are the things you want to do your investment in in order to ensure that you've got the right circumstances for your grandchildren.

The Chair: Thank you.

Next, Frank, please.

Mr. Oberle: Yeah. Just one last question, I think, on environmental impact. I think I get the technology, but you're talking about generating helium as the only output. How much helium would it generate, and how do you manage that? Are we going to substitute a carbon dioxide problem for a helium problem over time, or are we going to have to listen to Laurie debating in the House with one of those high, squeaky cartoon voices that you get from helium balloons? I'm not sure I'm going to buy into that program.

Dr. Fedosejevs: Well, the bottom line is that there really is no danger from the helium. The amounts are very small. I mean, you're talking kilograms per year. We release much more helium than that in our helium balloons around the world these days already. In fact, we're going to run out of helium in the future once natural gas starts to run down because we just get it as a natural by-product with the natural gas. We won't have any helium. It'll become an exotic material. So it won't be an issue.

The Chair: Thank you very much.

Any further questions?

If there are no further questions, then I just want to thank the Alberta Council of Technologies, the presenters. I want to thank them for coming out and presenting this very, very interesting presentation on fusion energy. We have a couple of options. I guess you're free to go if you want. I think we'll wrap up the meeting fairly soon, but it's up to you. You can watch and stay. You're free to do what you want.

We need to decide what to do with the report. I think we have a couple of options. These people are here because of their own request. This committee asked to make a presentation. What we could do is put together a report and present it to the appropriate ministries. If it had been referred by the Legislature, we would be reporting back to the Legislature. What I'm looking for, maybe, is a motion to deal with the outcome and possibly a motion – go ahead, Frank.

Mr. Oberle: Well, Mr. Chair, I think I hear where you're going. Normally, gentlemen, we would be referred an issue by the Legislature, and we would report back to the Legislature. In this case I think I should move that

> we prepare a simple report, a summary of this meeting, but submit it to the Minister of Energy rather than the Legislature.

The Legislature is not waiting for an answer to a question from us.

The Chair: That's correct. Would you like to add into that the ministers of Environment and maybe Advanced Education and Technology? They would all be affected.

Mr. Oberle: Of course. I would love to do that. Brilliant motion I just made.

The Chair: Okay. Everybody understand the motion? All in favour? Opposed? That's carried. Thank you very much. That means that we will put together a report, and that report will be presented to those appropriate ministries in due time.

That brings us just about to the end of the meeting, doesn't it? Is there any other business?

Mr. Chase: My assumption is that the report is strictly informational. The committee isn't making a recommendation; it's just presenting information.

The Chair: That's correct.

Mr. Chase: Thank you.

The Chair: That's what the motion was about. It's just to report on receiving this information and presenting it to the ministers. We're not recommending one way or the other.

Okay. The other business on the agenda here. It says that the committee clerk has circulated copies of the approved 2009-10 committee budget estimate, which was approved at the February 4, 2009, meeting of the Standing Committee on Members' Services. This is provided for members' information.

Is there any other business that members would wish to bring up?

Mr. Oberle: I see that it falls a bit short of $21 million, Mr. Chair, so we can't help our guests out here tonight.

The Chair: The last item on the agenda is the next meeting. I believe that will be at the call of the chair, and it will probably be a meeting to deal with the estimates after the budget has been tabled, so be prepared for that.

I'm looking for a motion to adjourn.

Mr. Oberle: Can I just ask a question on the estimates process? Is the schedule being worked on or near ready?

The Chair: I think it's being worked on. I have not seen it yet, but I believe that our committee being the committee that also deals with International and Intergovernmental Relations – it's one of the smaller ministries – we're probably one of the first committees to meet after the budget has been tabled.

Mr. Oberle: Okay.

The Chair: What we'll do is poll the members, find an appropriate date as soon as possible, and then we will notify you.

I'm looking for a motion to adjourn. Diana. All in favour? That's carried. Thank you.

[The committee adjourned at 8:04 p.m.]

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