COMMONWEALTH OF AUSTRALIA

Official Committee Hansard

HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON SCIENCE AND INNOVATION

Reference: Geosequestration technology

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HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON SCIENCE AND INNOVATION

Monday, 11 September 2006

Members: Mr Georgiou *(Chair)*, Mr Quick *(Deputy Chair)*, Mr Hayes, Mr Jenkins, Dr Jensen, Miss Jackie Kelly, Mr Price, Mr Tollner, Mrs Vale and Dr Washer

Members in attendance: Mr Hayes, Mr Jenkins, Dr Jensen, Mr Quick, Mr Tollner, Mrs Vale and Dr Washer

Terms of reference for the inquiry:

To inquire into and report on:

The science and application of geosequestration technology in Australia, with particular reference to:

- The science underpinning geosequestration technology;
- The potential environmental and economic benefits and risks of such technology;
- The skill base in Australia to advance the science of geosequestration technology;
- Regulatory and approval issues governing geosequestration technology and trials; and
- How to best position Australian industry to capture possible market applications.

WITNESSES

Committee met at 4.38 pm

HUMPHRYS, Mr Gary, Acting Chief Executive Officer, Stanwell Corporation Ltd

McCONNELL, Mr Chai, Manager, Stakeholder Relations and Strategy, Stanwell Corporation Ltd

MORRISON, Mr Howard, Manager, Emerging Technologies, Stanwell Corporation Ltd

ACTING CHAIR (Mr Quick)—I declare open this public hearing of the House of Representatives Standing Committee on Science and Innovation inquiry into geosequestration technology. The inquiry arises from a request to this committee by the Minister for Education, Science and Training, Hon. Julie Bishop. Written submissions were called for and 40 have been received to date. The committee is now conducting public hearings and informal discussions. This hearing is the second for the inquiry. I would like to call the representatives of Stanwell Corporation—Mr Gary Humphrys, Mr Howard Morrison and Mr Chai McConnell.

Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament and consequently they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as contempt of parliament. Do you wish to make a brief statement in relation to your submission or would you care to make some introductory remarks?

Mr Humphrys—On behalf of Stanwell Corporation I welcome the opportunity to appear before the committee to discuss this very important issue, and the Australian government should be congratulated on holding this inquiry. Stanwell believes that geosequestration or carbon capture and storage, combined with coal gasification, has the potential to be a key technological solution to enable deep cuts in carbon dioxide emissions to the atmosphere.

Stanwell Corporation is a Queensland government owned electricity generator. It is one of Australia's leading generators with environmentally responsible, low cost, reliable electricity with a diverse portfolio of coal-fired thermal wind and hydroelectric power generation facilities. A subsidiary of Stanwell, ZeroGen Pty Ltd, is developing a world first commercial scale demonstration project that combines integrated gasification combined cycle, or IGCC, and carbon capture and storage—CCS—for baseload electricity production. Through this project called ZeroGen, we have gained first-hand experience and knowledge of the issues and challenges that the industry faces in deploying low-emission technologies in Australia.

Leading international agencies, such as the Intergovernmental Panel on Climate Change and the International Energy Agency, support IGCC and CCS as vital in cutting CO_2 emissions for power generation. The Prime Minister's Science, Engineering and Innovation Council report on abatement options for stationary energy, entitled *Beyond Kyoto: innovation and adaptation*, states:

… the production of electricity using coal gasification and sequestration of CO2 in geological structures appears to offer the best chance of large scale GHG—

that is, greenhouse gas—

mitigation.

ZeroGen is seeking to transform this chance into a reality. The project is still in the development phase. Its progress is subject to funding and securing a range of approvals but it will, if it proceeds, examine all stages of the carbon capture and storage system in one location in Central Queensland. This will include the coal gasification plant, carbon dioxide separation and processing facilities, and the infrastructure for injecting CO_2 into deep saline aquifers for safe storage. It is estimated that ZeroGen will result in a net saving of up to 420,000 tonnes of CO_2 per year when the plant is operating at its expected maximum capacity and availability. Importantly, the technology demonstrated by ZeroGen may underpin the value of Australia's coal resources, other minerals and processing industries. The coal industry alone employs approximately 24,000 people, many of whom live in rural and regional communities. The project has undergone extensive value engineering studies and peer reviews and has been endorsed by the world's largest electricity research organisation—that is, the Electric Power Research Institute, or EPRI—based in the United States. EPRI has advised that the ZeroGen project represents a major step towards the ultimate commercial deployment of advanced coal-powered systems with CO_2 capture and storage. This is a key strategic goal for many in the power industry, and government is committed to finding a technological solution to reducing CO_2 emissions.

ZeroGen is supported by leading Australian research agencies in clean coal technologies. These agencies include the CO2CRC, the Centre for Low Emission Technology, COAL21, and the CRC for Coal in Sustainable Development. In addition, the project is supported by key community stakeholders such as AgForce, Queensland's leading rural lobby group, which comprises approximately 8,000 members, and the local governments of the Bauhinia, Emerald, Fitzroy and Rockhampton councils.

The project has already achieved some significant milestones. ZeroGen's test-drilling program for safely sequestering CO_2 from power generation is well in advance of other projects in Australia. ZeroGen commenced the drilling of two test wells in the second quarter of 2006 in the Emerald-Springsure region of Queensland. The intent of this program is to confirm the geology suitability and capacity to safely store $C0_2$.

The two wells have been completed, and scientific appraisals are currently being undertaken. The results of this should be known by early 2007. ZeroGen was declared a project of state significance by the Queensland Coordinator-General on 24 July 2006. Only the projects most strategically important to the state receive this support. In addition, on 26 July 2006, the Queensland Premier, Peter Beattie, announced the signing of an agreement with Shell—a global leader in CO_2 sequestration—and Stanwell, for Shell to provide technical support services, as well as an option to take an equity position in ZeroGen.

Through our firsthand experience a number of points have become apparent regarding the commercial deployment of this technology. Firstly, demonstration projects are critical to achieve cost reductions. Demonstration programs such as ZeroGen are vital to the commercial deployment of any new technology through facilitating cost reductions. As a precursor to the commercial development of technologies, it is clear that the earlier we start demonstration

projects, the earlier these cost reductions will occur. This principle is well accepted. As the United Kingdom's House of Commons Select Committee on Science and Technology stated in 2006:

Most of the technology is already proven and available but there is a lack of experience in integrating the component technologies in single projects at the scale required. Multiple full scale demonstration projects using different types of capture technology and storage conditions are urgently needed.

ZeroGen is an Australian project that addresses this global need.

The second point is that technology choices are important when considering early deployment. While there are a range of low-emission technologies, Stanwell sees IGCC with CCS as one of the best technology choices, for the following reasons. As mentioned previously, the technology components are in the main commercially available. Challenges exist with their integration, and this is a key objective of ZeroGen. IGCC is a flexible technology capable of producing a range of energy products, such as electricity, hydrogen, chemicals and liquid fuels such as superclean diesel. Importantly, the technology demonstrated by ZeroGen provides a pathway to the hydrogen economy. IGCC with CCS can generate a range of energy products from a range of feedstock fuels, including coal, tars and other petroleum wastes or biomass. The technologies for CCS have been applied in the oil and gas industry for the past 50 years, and they are available now. A key to deploying this technology will involve verifying the ability to safely contain large amounts of CO_2. Again, as I said before, this is a core objective of ZeroGen.

Thirdly, regulatory and economic frameworks need to align and encourage investment in technology development. A number of studies indicate that this technology can be commercially deployed by between 2020 and 2030. However, this is subject to a range of factors. The present level of regulatory uncertainty regarding the direction of greenhouse and energy policy is influencing investment decisions. This applies to both technology research and development as well as commercial development. There is currently no legislative regime anywhere in Australia which facilitates the transportation and long-term storage of CO_2 for the purpose of mitigating greenhouse gases, although some states do have legislation that supports aspects of CCS. An interim regulatory regime is required to facilitate demonstration projects.

Mr HAYES—You are talking about a national scheme in that regard?

Mr Humphrys—I am talking about a regulatory scheme to enable the sequestration of CO_2 underground—the liability and exposure issues around maintaining it long term; those sorts of issues.

Mr HAYES—You do not attract the NSW NGACs—

Mr Humphrys—No, not at the moment. I am talking specifically about a regulatory regime here that is to support the issues around sequestering underground and the laws around those, the liability issues around those, who is responsible for the long-term maintenance and storage of that. The economic and regulatory frameworks need to encourage the development of a sequestration industry. Complementary assets such as skilled workers are needed, for example, to enable the commercial deployment of IGCC and CCS. It is only through investments in technology development that costs will be brought down.

Fourthly, the management of stakeholder perceptions is critical to the deployment of any low-emission technology and governments play a key role in this regard. The introduction of new low-emission technologies and necessitates an informed, open and transparent debate. The concept of CCS is not widely known, and this low level of awareness enables opponents of the technology to engage in negative campaigns to influence community attitudes. ZeroGen is keen to work in partnership with key stakeholders to inform them about the project and the technologies involved.

A key factor in managing stakeholder perspectives is the role of the government, whom communities entrust with ensuring their interests are protected. Strong government leadership is needed to inform stakeholders in a timely manner that the technology is vital to protecting the energy security of the country and in supporting our way of life today and into the future in an environmentally responsible manner.

In closing I would like to acknowledge the work of this committee as a positive step to promoting the debate on introducing geosequestration technologies into Australia. The path to introducing new low-emission technologies such as IGCC and CCS is always fraught with challenges; however, history has shown that Australia's ingenuity has time and again been at the forefront of tackling some of the world's worst problems. Stanwell, supported by international and national leaders in this technology space, believes that ZeroGen can follow in this proud tradition and make a decisive contribution to addressing the global challenge of climate change. Thank you.

ACTING CHAIR—You state on page 3 of your submission that Australia should conduct its own demonstration projects and not wait for technology to be developed overseas for a variety of reasons. Could you elaborate on that? Are we reinventing the wheel? You mention, for example, that it is very site specific and we have our own unique geology. Not being a geologist, I thought the same geology occurs in various parts of the world in coal, oil and gas.

Mr Humphrys—We are not reinventing the wheel; the wheel has not been invented yet in this regard. However, the integration of technology around geosequestration has been done nowhere in the world today when combined with CCS—carbon capture and storage. We say that it needs to be developed in Australia so that we can maintain our leading-edge commercial advantage in this space. We have large coal resources in Queensland, and they need to continue to be developed. We have coal-fired baseload power stations in Queensland and they will continue to operate for many years to come. We believe that by developing this technology we retain the first-mover advantage. We are already having interest inquiries from China and other countries. The ability of Stanwell and our development of that technology to maintain that leading edge underpin what we are doing here.

ACTING CHAIR—You state on page 2 that regulation should take a risk based approach. We are in a federation of six states and two territories, and you spoke about the need for some regulatory framework about the whole issue of global warming, CCS and the like. What do you mean by a risk based approach?

Mr Humphrys—This technology requires the injection of CO_2 over a long period of time. From a commercial perspective you are going to require some regulatory framework that underpins the liability exposures over many years. Individual private sector players, I would

contend, are not going to be able to guarantee over the hundreds of years that we are intending on retaining this CO_2 underground. At some point after the operations have concluded, our expectation is that governments of the day would take that risk, low as it is. That is what we mean by risk based—that there is a low risk that governments of the day will have to take on. Otherwise you will not get a private sector player being able to develop these technologies.

Mr TOLLNER—Why wouldn't we just insure against the risk? I mean, if you build a building and in 20 years time it falls over, you do not expect government to pick up the bill.

Mr Humphrys—No, we do not, but we are talking hundreds of years. No company is going to be able to maintain that sort of insurance coverage for the next hundred or thousand years.

Mr McConnell—In addition, when you insure a building there is an inherent value in that building, but at the moment there is no inherent value in CO_2. You would not insure anything that does not have a value.

Mr HAYES—I guess at some stage you would bottle the predictions as how it integrates with underground water and what the effect is of that—

Mr Humphrys—That is right.

Mr HAYES—which I am not quite sure about, but I think that goes into 100-plus years or so.

Mr TOLLNER—You talk about creating a CO_2 solution industry. You mentioned the word 'commercialisation' in your presentation. That conveys to me the point that there is value in this. If we go down this path of creating a CO_2 industry and commercialise it somehow, there could obviously be great value. We have read in previous submissions that New South Wales, for instance, has a great deal of trouble finding locations where they can possibly geosequestrate CO_2 and the like. If you were sitting on top of one of these sinks, surely you would see that there is some commercial value in having that below the land you own.

Mr Humphrys—That is right, and there could well be that commercial value. We are on a journey here. We are testing the geological formations in the Denison Trough and, in the future, there could well be those commercial opportunities. But alongside those commercial opportunities are, if you like, ongoing risks that are beyond the normal scope of a private sector profile. We are contending that, after a number of years of operations having ceased and when people are comfortable that it is contained and safe, that is the point when these sorts of storage facilities pass all their ultimate liabilities to the government. That is when the storage facility is complete and is full, and after 100 years—or whatever time frame governments end up putting in place—the commercial enterprise can say: 'Okay, we have completed our commercial activities. We have made this area safe. There is no more commercial opportunity here. We have monitored for so many years.' At that point in time we need to close this down and move on. If the framework is: 'No, you've got to stay there now for the next 500 years,' then no private sector player is going to get started in the first place.

Mr TOLLNER—In section 5 you talk about the CO_2 industry.

Mr Humphrys—Could you give me a page number?

Mr TOLLNER—Page 5, where you talk about the CO_2 solution and about a regulatory environment and commercialising this activity. You say:

Government may wish to consider encouraging the development of this 'CO_2 solution' industry as a possible outcome of the inquiry.

What do you see that we should be encouraging? Are you talking about a carbon tax, a carbon trading system or a system where government comes in with what many might call a heavy-handed approach where we just say, 'Look, we are going to penalise companies that continue to produce greenhouse gases'? That would be an easy way of doing it—for government to say, 'We're going to put in legislative penalties and you just go at it. It is up to you guys to find your own solution.'

Mr Humphrys—In the first instance I would say that we are talking about a range of things here. Firstly, we are talking about developing the skills, the resources, the manpower and the knowledge that will enable this industry to develop. It is true that technologies of this nature will require some sort of recognition for carbon and the emission of carbon. Whether that is carbon emissions trading or whether it is some other regime, we are not speculating here. That is for a debate that is happening right now.

Mr HAYES—That is the only thing that will make it commercially viable, though, isn't it?

Mr Humphrys—That is the only thing that I would suggest is going to make any—

Mr TOLLNER—You see, Gary, you throw this bait out there and then you are not prepared to say what your point of view is on it!

Mr Humphrys—I will say what my point of view is—I will come back to that. I would suggest that, whether you develop nuclear or whether you develop IGCC or CCS, no clean, low-emission technology in the immediate horizon to 2050 is going to be able to develop and compete with coal-fired baseload generation. Thirty-five dollars a megawatt hour—sorry, that is not going to happen. We can talk about the technologies that we are developing right now and a technology solution. That is what we are talking about here with ZeroGen. The reality is that a technology solution, whether it is nuclear or whether it is IGCC or CCS, is not going to be able to compete with coal-fired power station generation.

Mr HAYES—As it stands presently, yes.

Mr Humphrys—Without some sort of recognition of a carbon—

Mr TOLLNER—But hang on, you still have not said what your suggestion is to create this industry—whether it is government just saying, 'We're not going to allow it; we'll put penalties in place.' That being the case, you as an electricity producer will have to find your own way or pay hefty penalties, in which case nuclear may well become commercially viable. How do you actually propose to create this industry?

Mr Humphrys—I am sorry, I thought I had answered that question, but I will have another crack at it. It is clear to me that a technology solution along the lines that we are talking about

here, or nuclear—either—will not succeed unless there is some recognition in this country for carbon emission. Whether that carbon emission recognition is via a carbon tax or emission trading or some other mechanism, I am not going to speculate here, but there is something that has to be there.

Mr TOLLNER—But that is the crux of it, isn't it?

Mr Humphrys—Sorry, am I missing the point here?

Mr TOLLNER—That is the crux of it.

Mr Humphrys—Yes, it is the crux of it.

Mr TOLLNER—You are saying there has to be some recognition, but you are not prepared to comment on what that recognition should be or speculate on what it is going to be.

Mr Humphrys—I believe that it could be any of a number of schemes. Right now the debate is in full swing. Individual states are looking at emission trading. The history in Europe is there before us to see as a precedent. Those sorts of schemes are the type that need to be developed here in Australia—some sort of recognition of the fact that we are emitting carbon up into the atmosphere.

Dr WASHER—Of course, the government ultimately has to take responsibility. There is no point having an insurance company, a hundred years from now that will not be here when—

Mr Humphrys—That is right.

Dr WASHER—So we have to get real. That is not even a debate. The citizens of the day have to account for the hundreds of years in the future; there are no private companies that can say they will be viable beyond about 50 to 100 years, if you are lucky. That is acceptable. Anything short of that would be total foolishness. However, I guess the thing is that, immediately, we have this science—we have the technology; we just lack the will to apply that technology and put it together or get it off the ground.

Mr Humphrys—Integrate it.

Dr WASHER—I guess that is where we are at. Ultimately the government needs to be responsible long term; that goes without saying, but I can see some benefits here that are very obvious in a fairly short term. But how much of your coal, say in Queensland, can you gasify, to start with—because you have to gasify the coal to do this, don't you?

Mr Humphrys—Correct.

Dr WASHER—To capture it?

Mr Humphrys—Yes, you do. There are sufficient quantities and volumes of coal in Queensland to enable the next hundreds of years in significant volume. One of the benefits of the gasification process is that it can take a number of coal qualities. It does not require a specific set

criteria; as I said, you can gasify a number of substances including biomass, including tars—those sorts of materials.

Dr WASHER—What sort of cost would you have to put on current type power stations like yours to do this?

Mr Humphrys—You are talking now about postcombustion capture?

Dr WASHER—Yes.

Mr Humphrys—That is an area of research that Stanwell is not looking at—I know that a number of other companies are doing that—so I am not able to give you precise costings on that. That is not something that we have been working on. There are a range of technologies that are being looked at at the moment to tackle that particular area. Do you have anything to add there, Chai?

Mr McConnell—As Gary said, postcombustion capture is a new line of inquiry in low-emissions technologies as well. We are looking at carbon capture and storage with IGCC, and I think we are looking at the potential for new power plants to come on line, not the addition of the technologies onto the existing ones. We know from the federal government's white paper that the demand for electricity is going to increase by 50 per cent by 2020, so there is going to be a massive demand there for baseload, and we are looking at new plant.

Dr WASHER—You also mentioned a by-product—of course, transport fuel is of interest—that is, superclean diesel and hydrogen. We have not quite got there with the hydrogen, even with the Ballard fuel systems et cetera, but in your article you mention using hydrogen turbines as if they were in current usage. If so, can you please—

Mr Humphrys—They are still developing those. We are working with GE at the moment to have a turbine that accepts hydrogen-rich gas. The way in which it is proposed to develop ZeroGen is in a staged approach, so that initially, as a demonstration plant, it will accept a certain level of hydrogen. As the technology is being developed with GE, we will be able to refine that and be able to deliver more pure hydrogen as we go along, so that at the end of the demonstration stage it is accepting pure hydrogen. That is the intention.

Dr WASHER—In a normal production time, how much superclean diesel would you get?

Mr Humphrys—Off the top of my head, I do not know—Howard?

Mr Morrison—Our particular project is not looking at superclean diesel. There are other projects which I believe are before the low emissions technology development fund that are looking at producing liquid fuels from coal. Generally speaking, to put in a coal to liquids plant is an enormous capital expenditure. That is not to say that it cannot be done, but we—

Mr Humphrys—Particularly with—and this is anecdotal from our perspective—oil prices around their current levels, oil from coal opportunity is looking possible. There are companies around the world that—

Dr Washer—SASOL—

Mr Humphrys—yes—are looking at that and approaches have been made at Stanwell as well.

Dr JENSEN—I have a few questions. First, I guess the gasification you are talking about is the Fischer-Tropsch process?

Mr Morrison—No, Fischer-Tropsch is used to convert—

Dr JENSEN—Oil from coal and gas to liquids, but it is a gasification system as far as coal is concerned to—

Mr Morrison—No, Fischer-Tropsch is a system that bolts onto the back end of the gasifier, so you gasify first and produce a synthesis gas. The synthesis gas would then go into a Fischer-Tropsch reactor. We do not have Fischer-Tropsch because we are not making liquids.

Dr JENSEN—You are not making fuels. The second point was that you mentioned that, without adding in some form of carbon cost, for instance, no other power generation method would be competitive with coal for a period of about 50 years. I just find that quite a large claim. If we are approaching an oil crunch, you can surmise that there will be a great deal of production of synthetic fuels, and oil from coal is already a fairly well-developed technology, so you can imagine a significant increase in the demand for coal which would be pushing up the price, which would have a very large impact on the cost of coal-fired power, surely?

Mr Humphrys—New coal-fired power, yes, but at the present time the technology in existing coal technology is to improve incrementally on the current technology, so you are getting ultrasupercritical and those sorts of technologies, which are actually driving the costs down. When you overlay a gas separation process and a transport and storage process, that is—

Dr JENSEN—I am ignoring the issues here of carbon capture completely. I am saying that, if you significantly increase the demand for coal, with the world embarking on a large synthetic fuels program to compensate for the relative lack of oil, surely that is going to basically drive up your base stock, the cost of the raw material that you are using as fuel in your power station, and you have a power station where the cost of your fuel is a significant component in the cost of the electricity. What projections are you using for your next few decades in terms of your raw material cost?

Mr Humphrys—Whatever coal structures exist into the future, overlaying that will be additional costs in relation to this technology, so the existing coal power stations will accept those costs, and they will deal with those. These sorts of technologies will accept those costs.

Dr JENSEN—But what I am getting at is that, if you, say, double or triple the cost of the coal, the cost of coal-fired electricity has to go up significantly.

Mr Humphrys—That is right.

Dr JENSEN—I guess what I am asking is this. In terms of costs of coal-fired power, you are basing your future in the next few decades on a fairly stable cost of your raw material, the coal itself. I am asking basically where the data supporting that contention is coming from.

Mr Humphrys—I guess we see this demonstration plant as not being commercially profitable. Our assessments in terms of cost structures have accepted that there will be an ongoing need to subsidise the ongoing operations, because, given the parasitic nature of the demonstration plant, the generation of the electricity out of this demonstration plant going out to the grid will only be something in the order of 20 megawatts. When you have a demonstration plant of this scale, delivering approximately 20 megawatts of power to the grid, it does not—

Dr JENSEN—I think we are talking a little bit at cross-purposes here. What I am getting at is that you made the comment, for instance, that coal-fired power is $35—

Mr Humphrys—No, I am saying that broadly acceptable new-entrant pricing today for baseload coal-fired electricity generation is $35—

Dr JENSEN—No, what I am saying is that, if you double or triple the cost of the coal, that cost has to go up significantly, which would make things like gas—although gas has significantly increased in price—

Mr Morrison—Correct, yes.

Dr JENSEN—but also nuclear very competitive. What are you basing the stability of the coal price on in terms of the future projections in order to maintain at least somewhere around that $35 mark?

Mr McConnell—One of the advantages of IGCC and CCS is the flexibility of the feedstock. Going into the future, there are obviously going to be increases in demand for different types of coal, but the beauty of this technology is that you can use different feedstocks. Different coalmines have different characteristics—high sulphur, low sulphur. This technology can take all of those different types of coal and then use them to develop syngas. This project is not talking 30 or 40 years ahead. This is a demonstration project. We have a life of about 10 years. I think it is probably premature to talk about the commercial deployment of this until we actually get—

Dr JENSEN—I am looking at the coal-fired power industry in the future at all. You are talking about cheapish coal-fired electricity prices. I accept your point that there are different grades of coal. But I guess what would happen, of necessity, is that, if the price of one type of coal increased, there would be substitution in other markets—

Mr McConnell—Yes, fuel switching.

Dr JENSEN—which would increase prices as well.

Mr McConnell—That is right.

Dr JENSEN—I will leave that one there. What sort of storage capacity do you have in your underground seams in Queensland?

Mr TOLLNER—A lot more than they have in New South Wales!

Mr Morrison—That work is predominantly the purview of the CO2CRC, who have done an initial mapping of Australia for sequestration potential. That is at a high level. The work we are doing in the Denison Trough area will take that to the next level of certainty. It still will not be marketable, if you like. Suffice it to say, in answer to your question, that a lot more work needs to be done to get that to the point of saying, 'We have this much.' At the moment, I think in the oil industry they use a 'potential', 'prospective' and 'proven' type of arrangement. I think in geosequestration we have lots of potential. Again, to use the oil analogy, exploration work needs to be done now to find out if that is actually proven or at the next level.

ACTING CHAIR—Is there a national perspective on this, or are each of the states doing it? Are various companies doing it, or is the industry doing it?

Mr Morrison—The work at the moment has predominantly been done by the CO2CRC.

ACTING CHAIR—Right across Australia?

Mr Morrison—Right across Australia, from Western Australia right through to Queensland. I believe there are projects now proposed where they will take the expertise they have developed within Australia overseas to AP6 stations.

ACTING CHAIR—At what stage are we to say that the defining number for storage is X, full stop? How far away are we from that?

Mr Morrison—We have identified the areas with potential—or the CO2CRC has. Now there is work that needs to be done to confirm that potential. That means the sort of work that we are doing, for instance, in the Denison Trough. You have to drill, take core samples, do test injections and confirm whether the potential that was there through publicly available geological data is actually sound.

ACTING CHAIR—You are sinking two wells?

Mr Morrison—That is correct.

ACTING CHAIR—How many other wells are being sunk around Australia at the moment?

Mr Humphrys—We are not aware of any wells being sunk in hard rock.

Mr Morrison—No, not in the sort of geology that we are in. In Victoria there is a test program around the Otway Basin. The Gorgon project off northern Australia has done some test wells. Those are very different geologies. Perhaps I can digress on that point. You asked a question earlier about why Australia and about geologies. The flagship project in the world is the Sleipner project in Norway. The geology under the North Sea, where they are sequestering CO_2, is a very permeable sand, if you like; whereas in a lot of the rest of the world it is a much tighter sandstone, so it is much more difficult to get anything in or out of it. Consequently, very little testing in terms of sequestration has been done in the sort of rock that will cover most of the planet. That is the sort of work we are doing.

Dr JENSEN—Let us say that coal-fired power is $35. That is what it is at the moment. Let us assume that it is stable. When the cost of this technology is added to your newly built coal-fired power stations, what sort of economic cost will there be? Also, what sorts of efficiency losses will you get? Obviously capturing, compressing et cetera the carbon is going to require energy.

Mr Morrison—True.

Mr Humphrys—I will just refer to our notes, because we put together some notes on possible similar questions. Studies by the International Energy Agency and Intergovernmental Panel on Climate Change suggest that by 2020 electricity costs, including the capture of CO_2, might be as low as $40 a megawatt hour, and transport and storage costs at a premium of between 15 and 50, depending on the geology and distance to the sequestration sites. So cost estimates of the technology are within approximately $55 to $90 a megawatt hour.

Dr JENSEN—So taking the middle ground there you could say roughly doubling?

Mr Humphrys—This is part of the journey we are on; it is why we are doing this demonstration plant—to understand those cost structures and understand there are significant go, no-go phases in the project's schedule. The drilling schedule is one such go, no-go item.

Dr JENSEN—And the efficiency costs? How much extra?

Mr Humphrys—Howard talked to that one, but at high level the intention is to achieve similar efficiencies with existing coal-fired power stations over time—not with this project, not with the demonstration project.

Dr JENSEN—So in other words a tonne of coal will generate the same number of megawatt hours?

Mr Humphrys—That is the intention, yes.

Mr Morrison—What we are seeing is an evolution of the technologies that make up IGCC. We are seeing dramatic proposed improvements in turbine technology. As we go to the higher temperature turbines and higher efficiency turbines, we are gaining back the efficiency lost through that compression of CO_2, air separation and things like that. EPRI—the Electric Power Research Institute—has produced quite a technology roadmap for IGCC which shows that by 2030 or so you are back to taws where you are today.

Dr JENSEN—In that context, though, would that not mean that your competitors like gas and nuclear would be getting similar gains?

Mr Morrison—No.

Dr JENSEN—With the difference in turbine technology.

Mr Morrison—Sorry, they are different sorts of turbines. The turbines in nuclear are steam turbines—a low-pressure steam turbine.

Dr JENSEN—Yes, except that there you are basing it on current technology. The Gen IV reactors will generally be high-temperature gas.

Mr Humphrys—You are ahead of us there.

ACTING CHAIR—Okay. Danna has been waiting patiently.

Mrs VALE—Thank you very much. I just wanted to understand the purpose of your developing this technology in the first place. Is it to actually gasify—capture—carbon and store it in the first place?

Mr Humphrys—Correct.

Mrs VALE—That is your first focus. But your second focus is also that there could be some emissions that you would be able to use for fuel?

Mr Humphrys—Not necessarily. I guess our primary focus is to develop a technology that enables low-emission coal-fired electricity generation so that Stanwell and, I guess, broadly the state and the country can have that first-mover advantage in terms of developing that integrated technology, maintaining the resources that we have and looking ahead and seeing the next generation of technologies that are required to generate electricity—given that we have an abundance of coal, that we are able to utilise that in a very efficient way and a sustainable way. They are our drivers.

Mrs VALE—So using the emissions for an extension of another power generation as a source of power?

Mr Humphrys—No, the emissions will be injected underground.

Mrs VALE—And that will be the storage?

Mr Humphrys—That will be the storage. And there may well be some commercial advantage, as I mentioned before.

Mrs VALE—Yes. I would like to explore that commercial advantage, but I am just interested in how you propose seeing this actually happening. You are developing the technology now, are you?

Mr Humphrys—A number of the elements of this project are already commercially available—the gasification technology, and some elements of the gas separation technologies are already available. Around the world there are already a number of places where they are sequestering underground CO_2, but nowhere in the world at the moment is there an integration of that gasification with the sequestration into hard rock saline aquifers.

Mrs VALE—This will be a world first if you pull this off?

Mr Humphrys—That is correct.

Mrs VALE—You are obviously confident that it is possible to do the science?

Mr Humphrys—Certainly we are confident at the stage we are at. There will be go, no-go milestones. The first of those will be the assessment of the drilling program that we have just undertaken—the two wells we have just drilled.

Mrs VALE—They are wells to find the deposit layers where you can actually deposit?

Mr Humphrys—The first well was around 1,500 metres. The second one was about 1,300 metres. We will then assess those cores to understand the geology and the layers that exist at those various levels. We will then inject, under pressure, either water or some CO_2 to see the effect of that and monitor the level of migration and understand the geology. We then make assessments about whether that geology formation is going to be suitable for a demonstration plant of this nature to operate over 10 years and build up the knowledge of the general area of the Denison Trough so that if there is a commercial plant that it can also use that Denison Trough.

Mr McConnell—Danna, you asked a question about the objectives of this. If we prove the technology works and if we get financing, there is still the whole issue of public perceptions and managing those key stakeholders. As we know, with the introduction of nuclear or other forms of technology—wind farms, for example—there is always a high degree of public perception which is both supportive and opposed to it. Even if the technology works—and we believe that it does through this demonstration project—financing is one issue but public perception is another.

Mrs VALE—But it would solve a lot of concern with the public perception about coal and carbon emissions, wouldn't it? This would be a solution.

Mr McConnell—Absolutely.

Mr Humphrys—If we could demonstrate that we can safely store it.

Mrs VALE—You anticipate that in future, when you perfect the technology, you will be able to attach this kind of technology to existing coal-fired power stations that we have?

Dr JENSEN—No.

Mr McConnell—The intent of this project is to look at integrating the coal gasification with CCS for new plants.

Mrs VALE—For new plants only? So not with current plants?

Mr McConnell—No. With existing current plants, other technologies are being explored to look at postcombustion capture. It still needs that CCS component—that geosequestration component. This project is the only one in the world that integrates gasification with carbon capture and storage. In this one commercial scale demonstration project we are able to demonstrate a whole bunch of things. One is to shore up the technology, look at the interaction with stakeholders and the interaction with, for example, the government, and the advancement of regulations to allow this to occur down the track. David, you asked about what the government

can do. There are a whole bunch of things the government can do. There are skills—look at the development of skills to meet the demand for these people that are going to be in the sector in 20 years time.

Mrs VALE—More science graduates?

Mr McConnell—Science graduates, absolutely.

Mrs VALE—You are solving problems for the next generation of coal-fired power stations, but there is concern about the current ones that we have in Australia. Will you be trying to see how you can apply this technology?

Mr Humphrys—Not in this project.

Mr Morrison—The learnings from the transport of the CO_2 part of the project and the sequestration part of the project will apply absolutely to any technology that catches the CO_2 from existing power stations. All of the learnings that we gain from our project can and will be applicable to a different technology that catches the CO_2, from the exhaust stack of an existing power station.

Mrs VALE—Just on a practical question: how do you transport the CO_2 that you want to deposit into the geographic layers from the coal-fired power station site?

Mr Humphrys—In liquid form.

Mrs VALE—In a pipe or in a truck?

Mr Humphrys—In pipes.

Mrs VALE—So your power stations need to be near to where these aquifers are?

Mr Humphrys—This demonstration gasification plant will be located at Stanwell power station, which is outside Rockhampton. The northern Denison Trough location that we have selected is about 250 kilometres away in the Springshore-Emerald area. We will have to construct a pipe from Stanwell to that area.

ACTING CHAIR—What are the areas of concern? Are people worried about the transport of the CO_2 and the long-term impact of it being stuck underground?

Mr McConnell—Probably all of the above; it is a new technology. One of the things that we have been very conscious of explaining is that CO_2 occurs naturally underground anyway in vast volumes. I have been working very closely with the mayors of Emerald, Bauhinia, Rockhampton and Fitzroy councils to explain what we are trying to do. I have been working closely with AgForce and have attended a number of their community meetings to explain first-hand to the landholders what we are trying to do. With the introduction of any new technology there is always a concern about risk. We are saying that the CO_2 occurs naturally underground in producing fields like Arcturus and Turkey Creek, where they are extracting the methane out of these reservoirs. We are actually putting the CO_2 back in the ground. I believe about three

million tonnes or so of methane comes out at the moment. We are looking at up to 420,000 tonnes from our demonstration plant. The key messages are that CO_2 occurs naturally underground, it occurs with methane and it has been trapped there for millions of years. That is addressing the key concerns that people have.

ACTING CHAIR—Is it above-ground or below-ground transport?

Mr McConnell—Below ground; it would be a buried pipeline about 1.2 metres in depth. It would be pretty similar to the existing methane gas pipelines that run out of the northern Denison Trough. We will be going the other way and using pretty much the available technologies.

Mr Humphrys—There will be stakeholder issues in engaging with them on a pipeline going through their property and their understanding these sorts of issues and there will be native title issues. That is all part of the environmental impact statement process that we will be going through in settling that.

Mrs VALE—Are there any other objections to the science that you might anticipate? Chai has already explained that there are great amounts of CO_2 already embedded in the aquifers. Would there be any other objections that residents of local areas might raise?

Mr Humphrys—I think the community concern—and Chai has had a number of stakeholder meetings out in those regions—is about understanding what we are doing: understanding the risk of escape and understanding the degree to which the CO_2 will migrate over a period of time.

Mrs VALE—Do you know the rate of travel?

Mr Humphrys—Our desktop modelling in relation to this project indicates that it would not travel more than 100 metres or so.

Mr McConnell—No, I think the preliminary modelling suggested that between three to 10 kilometres would take decades to hundreds of years.

Mr TOLLNER—What you are talking about is new technology. The concern of governments is that we have to cut emissions below 1990 levels. That is a big burden that we have got on our existing systems. I do not think anybody is talking about shutting down power plants around the place, so the focus, in my view anyway, has got to be on how we cut emissions from existing power plants. What you guys are into, as I think you said, Chai, is that you expect a 50 per cent increase in demand for energy by 2020.

Mr McConnell—That is in the government's own white paper.

Mr TOLLNER—That is the market that you are after with this new technology. But doesn't that make you just another zero emissions technology way up there with thorium reactors, solar towers, hot rock technology and that sort of stuff? Why would the government be focused in this particular area and not with all those other technologies out there, because, after all; you are not doing anything to reduce existing emissions.

Mr Humphrys—Correct. What we are doing is bringing together, in the time frame that we see—and that is the 2020-30 time frame—technologies that in part are already acceptable, commercial and deployable. You are looking at a time frame that is doable—where the technology is doable within that time frame. Unless you start now with this technology, it is not going to be able to meet those time frames. Why are we any different from or better than those technologies you talked about? Firstly, you have an abundance of coal in Queensland, particularly, so you already have a resource. Maybe the cost the will go up, but you certainly have an abundance of coal. Secondly, you have a range of technologies that independently are already commercially deployable. Thirdly, unless you start in that integration process now, you will not get the deep cuts that are possible with this technology in the time frames we are talking about. That is my view.

Mr McConnell—We are not just talking about Stanwell when we are talking about the technology. Very eminent scientists and research bodies all around the world are suggesting that IGCC with CCS is indeed the option. The Intergovernmental Panel on Climate Change put out a special report about this. These are entities that are saying, 'If you want to reach those deep cuts, this is the technology option.' But—

Mr TOLLNER—But the technology is in the retrofits. All of this piping CO_2 and geosequestration has been happening in the oil and gas industry for years. That is all proven technology. The technology that is not proven is a retrofit onto existing coal-fired power stations.

Mr Morrison—We have been part of some studies looking at what you can do with existing power stations. There are two technology pathways there. One is to continue to improve the efficiency of the existing steam cycle, and lower your carbon intensity as a result. Stanwell is very proactive in this area, with our existing plant. But the thermal efficiency or the carbon intensity of the power station is limited by the Carnot cycle, the thermodynamics of the plant itself. Its design is limited; it can only go so far.

In relation to the retrofit sort of stuff you are talking about, catching the CO_2 from an existing power station has an enormous energy and cost penalty associated with it. When you start to go down that path, if the frameworks around us—be they regulatory, market or whatever—start to push you to make the decision as to whether to do that or scrap it and start again, that will be a very interesting point. It will depend very much on those frameworks there. An initial look would say that at the moment, unless there is an enormous breakthrough in science, the postcombustion capture technologies would probably send you down the route of thinking, 'I might build something brand new instead.'

Mr TOLLNER—That is when you will start competing with nuclear reactors—solar towers.

Mr Morrison—From a technologist's point of view, there is no silver bullet here. There is no leading or winning technology in this race, as we see it. We have chosen to investigate one particular technology that has a lot of advantages in that it can produce more than just electricity.

Mr TOLLNER—A portfolio.

Mr Morrison—You are right; it is all part of a portfolio. Look at that future world and say, 'What price would encourage the development of some of these technologies?' I have a bet

riding which I will probably never live long enough to collect: I suspect we will see them all in a certain price band, be they nuclear, be they some other clean coal technologies, be they some of the renewables. There is no silver bullet. We are not saying that IGCC plus CCS is the only technology. We see it as a very valuable technology in the sense that it provides more than just electricity; it is a pathway to a hydrogen economy.

Mr Humphrys—And it is part of a portfolio—of a solution which we think will enable deep cuts in emissions.

Mr Morrison—Within that context, we have supported some of the other investigations, for instance into oxyfuel.

Dr WASHER—Just to get this right, at the end of the day what you are doing in transporting storages is not unique. They are recaptured from the stationary plants we still have. That is still an essential thing; it is not going to change. The only thing you are saying, quite rightly, is that capture currently is just not on economically from the standard plants we have. From a policy point of view, here I have $1 billion. Governments will not be building the new plants of the future like the plants of yesterday. What is our policy now? I do not know this, but you guys have got your head around this. With federal and state policy, what would drive me economically to produce a gaseous coal-fired plant that I can capture and sequest with? What makes me or drives me to have to do it? What is our policy saying? Is it saying, 'Look, if you build a new plant, you can't build it like that; we cannot capture it economically'?

Mr Humphrys—I guess that is where I come back to some sort of carbon signal to the market. Unless you have that carbon signal to the market you will continue to develop those incremental technologies, the big coal-fired baseload power stations, and you will continue to emit into the atmosphere the CO_2s that they—

ACTING CHAIR—Are any countries sending that signal out at the moment?

Mr Humphrys—Yes, there are.

ACTING CHAIR—Really sending the signal out?

Mr Humphrys—Yes, and that is where you see the emission trading in Europe. But I think the thing that we have to grapple with in Australia is the very low cost of baseload coal-fired electricity generation. That is our competitive advantage, without doubt. So the challenge for us is to accept that and deal with the fact that we are not going to be able to maintain our competitive advantage and have zero emissions unless—

Mrs VALE—Is Stanwell actually funding this innovation and this research itself?

Mr Humphrys—We have funded it up to date. We lodged a LETDF submission on 31 March. The funding up until that point was by Stanwell. We have funded the drilling program, but going forward we will be looking for broader funding options. The Queensland government has indicated the establishment of a clean coal technology board and it has allocated $300 million. We will be seeking some large part, I hope, of that. Shell has an option under the framework agreement that we have signed with them to provide technical advice to have an equity position

and so will contribute money of substantial amounts, we hope. We will be looking for a range of funding opportunities and we will be returning to the federal government. We will be looking at the various associations and we will be looking at the private sector as well and perhaps even internationally. We have had inquiries already from the Chinese and we will be interacting with those agencies as well.

Dr JENSEN—You were talking about issues of land rights and landholders and that sort of thing. The question is: as far as the underground aquifer layers are concerned, who owns those?

Mr Humphrys—That is part of the regulatory framework that has to be established.

Dr JENSEN—At the moment you pump it down there—who owns it?

Mr Morrison—It is not entirely clear.

Mr Humphrys—That needs to be settled.

Dr JENSEN—It is almost as if you would have to buy, say, a mining licence for that underground area in order to pump it there.

Mr Morrison—At the moment in Queensland the Petroleum and Gas Act has some facility for underground gas storage, and CO_2 is actually named as one of the gases that you can store underground. When that act was put together there was some thought about sequestration and some of the regulations might need to be tailored to allow this to happen.

Dr JENSEN—I can see that you can potentially have two owners. Let us say you have the Gorgon site, just as an example, where they are taking gas out of there and you have your Woodside or whoever who owns the rights there. Then let us say that some coal-fired power station down in the south-west wants to pump the CO_2 underground—

Mr Morrison—Some of the issues we brought up in our submission are particularly relevant to your questions.

Dr JENSEN—Okay.

Mr McConnell—It is actually addressed in point 1.4 in the appendix: 'Competition between differing land uses'. There is actually legislation, the Petroleum Gas Production Safety Act 2004, that contemplates a regime for determining the priority amongst coal and natural gas, and we are suggesting that a similar approach be adopted for CO_2.

Dr JENSEN—Okay.

ACTING CHAIR—Are there any further questions from the committee? If not, Gary, Howard and Chai, I thank you on behalf of the committee for your excellent submission. We are in the early stages of taking evidence and we look forward to the opportunity of actually visiting the demonstration site and seeing it and having discussion with you.

Mr Humphrys—We certainly hope so. Can I just conclude by saying that we really do need to focus not just on the existing production plants; we need to focus on the technologies that are going to be built into the future.

ACTING CHAIR—Also, as an ex-teacher, on the educational opportunities, because you know it is the chicken and egg. It is no good setting something up if you have got no-one to run the thing and you have got to bring in expertise from overseas. Hopefully, we will have discussions with you later on as this inquiry proceeds.

Mrs VALE—Mr Humphrys, do you have a time frame for having the demonstration up and running?

Mr Humphrys—Yes. We are in the development phase at the moment and that requires further drilling analysis. We will be doing our front-end engineering and design and, if all those sort of approvals and frameworks are established, construction commences some time in 2008 with commissioning, I think, around a 2011 time frame, and then running for 10 years.

Mrs VALE—Great. Thank you.

Resolved (on motion by **Mrs Vale**):

That this committee authorises publication of the transcript of the evidence given before it at public hearing this day.

Committee adjourned at 5.46 pm