T R A N S C R I P T

LEGISLATIVE COUNCIL ENVIRONMENT AND PLANNING COMMITTEE

Inquiry into Nuclear Prohibition

Melbourne—Friday, 28 August 2020

(via videoconference)

MEMBERS

Mr Cesar Melhem—Chair
Mr Clifford Hayes—Deputy Chair
Dr Matthew Bach
Ms Melina Bath
Mr Jeff Bourman
Mr David Limbrick
Mr Andy Meddick
Dr Samantha Ratnam
Ms Nina Taylor
Ms Sonja Terpstra

PARTICIPATING MEMBERS

Ms Georgie Crozier
Dr Catherine Cumming
Mr David Davis
Mrs Beverley McArthur
Mr Tim Quilty

WITNESSES

Professor Andrew Peele, Group Executive, Research Translation and Director, Australian Synchrotron,

Professor Lyndon Edwards, National Director, Australian Generation IV International Research,

Dr Robert Gee, General Manager, Minerals and Radiation Services, and

Mr Steven McIntosh, Senior Manager, Government and International Affairs, Australian Nuclear Science and Technology Organisation.

The CHAIR: I declare open the Environment and Planning Committee public hearing for the Inquiry into Nuclear Prohibition. Please ensure that your mobile phones have been switched to silent and background noise is minimised. I would like to take this opportunity to welcome any members of the public who may be watching us on the live broadcast.

I would like to introduce my parliamentary colleagues who are participating in this hearing this afternoon: Deputy Chair Mr Hayes, Mr Limbrick, Ms Taylor, Mrs McArthur, Dr Bach and Ms Bath. Have I left anyone out? I think that is who we have got at the moment. Some other members might join us later during the hearing.

All evidence taken at this hearing is protected by parliamentary privilege as provided by the *Constitution Act 1975* and further subject to the provisions of the Legislative Council standing orders. Therefore the information you provide during the hearing is protected by law. Any comment repeated outside the hearing may not be protected. Any deliberately false evidence or misleading of the committee may be considered a contempt of Parliament. All evidence is being recorded. You will be provided with a proof version of the transcript following the hearing, and the transcript will ultimately be placed on the committee's website.

Our witnesses for this afternoon are: Professor Andrew Peele, Group Executive, Research Translation, and Director, Australian Synchrotron; Professor Lyndon Edwards, National Director, Australian Generation IV International Research; Dr Robert Gee, General Manager, Minerals and Radiation Services; and Mr Steven McIntosh, Senior Manager, Government and International Affairs.

So gentlemen, thank you very much for making yourselves available, and welcome. We appreciate you have put in a submission as well. Members have read the submission, and we are looking forward to your contribution this afternoon. I am in your hands: who would like to go first? We are allowed about 5 or 10 minutes for a bit of overview, and then we will ask questions. We allowed about an hour, but if we are going to go a few minutes over, we can assess that at the end. Who would like to lead?

Prof. PEELE: Thank you Chair, that would be me. I will go through our opening statement, and then obviously between us we are all happy to take questions. So first of all, thank you, Chair, and thank you to the committee for the invitation to appear today. Obviously under the circumstances we are not able to meet in person, and we would have really enjoyed the opportunity to welcome you to our facilities either at the Lucas Heights campus in Sydney or indeed at the Australian Synchrotron, which is in the south-east of Melbourne, and where I am fortunate enough to serve as its director.

ANSTO has a strong presence in Victoria with the synchrotron being a world-class national landmark research facility. It uses the tradition of nuclear accelerator technology to produce powerful beams of light that are used in a very wide array of scientific and industrial applications. As the custodian of Australia's nuclear science, nuclear technology and engineering capabilities and expertise, ANSTO was of course pleased to be able to make our submission to your inquiry, going to the terms of reference. Indeed, as noted in our submission, ANSTO's support for and involvement with the Australian uranium mining industry spans multiple decades, and ANSTO Minerals, which is a business unit of our organisation, is Australia's leading minerals process development consultancy. The unit's work has been and continues to be instrumental in the minimisation of the environmental impacts of uranium mining and in the maximisation of the efficiency of production.

While ANSTO is agnostic about whether Victoria or Australia might in future adopt or consider the adoption of nuclear power and other nuclear fuel cycle activities that are currently prohibited by state and federal legislation, we are what you might call an intelligent observer of international developments in nuclear power and other peaceful uses of nuclear science and technology. This knowledge and expertise is enhanced through

our reputation in various International Atomic Energy Agency and OECD Nuclear Energy Agency forums, in addition to our engagement with bilateral and multilateral partners including the Generation IV International Forum collaboration on research and development of generation IV nuclear energy systems. As mandated by the ANSTO Act, we play a vital role in providing expertise and technical advice on all matters relating to nuclear science technology and engineering, and we also play a critical role in contributing to and informing policymaking in those areas.

As the Chair introduced, I am joined today by three of my colleagues: Professor Lyndon Edwards, who is the National Director for the generation IV international forum research activity; Dr Robert Gee, who is General Manager of the Minerals and Radiation Services area that I mentioned earlier on; and Mr Steven McIntosh, who is our Senior Manager for Government and International Affairs.

I guess in a nutshell ANSTO's capability and expertise extend right across the nuclear cycle, and we are very happy to take any questions on any of the aspects related to our expertise and to our submission. Thank you.

The CHAIR: Thank you, Professor Peele. Unfortunately we were unable to visit your operation, but I think some members might be interested down the track when things settle down and we are back to stage 1, maybe stage 0, of COVID-19. Let us be hopeful, and hopefully one day we may be able to visit and have a look at your operation. Any questions from committee members? Who would like to go first? Mr Limbrick I think has got his hand up, and then Mr Hayes. Mr Limbrick.

Mr LIMBRICK: Thank you, Chair. And thank you, gentlemen, for appearing today. And yes, I am very disappointed about not being able to visit Lucas Heights and the synchrotron, as it is actually in my electorate. That is very disappointing, but I do intend to go there as soon as we are allowed to.

That aside, there have been a number of issues brought up during this inquiry, and two that I would really like to get your expertise on. Firstly, we have had multiple witnesses express concerns about worker safety and community safety around nuclear power plants. One such person was Dr Tilman Ruff, from the Medical Association for Prevention of War. They said that they were not aware of any studies into safety for workers at the Lucas Heights facility and the safety of children in the surrounding radius of the facility. Maybe if you could provide some comments on safety for workers—whether there have been any studies of this sort of thing—and the safety of the surrounding community. And the second question—this has been brought up a number of times. I know that one of the important functions of the reactor in Sydney is the production of medical isotopes, and it has been suggested a number of times that the reactor is not necessary to produce these isotopes and they could be produced using cyclotrons or other technology. I wonder if you would like to comment on those things.

Prof. PEELE: Sure. I will make a couple of comments and then I will throw to some of my colleagues. So in terms of the safety aspects, I believe there has been some study done, and we would be happy to take that on notice and provide the full details back to the committee.

More generally, I think it is safe to say that in terms of incident safety and more serious incidents and safety and injuries and so on, the nuclear industry as a whole is, if not the safest, certainly one of the safest types of industries in the world, certainly in the area of power production. And there have been a number of studies done across the board on looking at those statistics. So before we go to the second question I will just see if there are any other comments to come from my colleagues.

Mr LIMBRICK: Another comment on safety which you might want to comment on: this morning there were comments made by Dr Caldicott around tritium and release of tritium from nuclear reactors and how dangerous that is. That is another safety concern as well which was brought up. I am not sure if you have a view on that.

Prof. PEELE: Lyndon, I might ask you to take that one. You are on mute.

Prof. EDWARDS: Tritium is a by-product that comes out of a system that uses nuclear fuel. Nuclear reactors are based on a series of containments, where we talk about the number of barriers between the fuel and the environment and different designs of reactors and different types of barriers. The amount of tritium that actually gets out is incredibly small. I do not know personally of any epidemiological connection between

tritium being made anywhere in the world. I would be interested to see where that—I am obviously not a doctor but certainly—

Tritium, however, is a problem in that it can get through most barriers—the more barriers you have the better—but the amount of tritium produced compared to other radionuclides is really small. The only thing I would say is interesting is that tritium is also something that is in fusion as well, for instance. We are looking maybe at suffusion to produce energy in the future, where of course at that point tritium becomes the fuel. So tritium is an issue. It is something to be controlled.

There are mechanisms for even the small amounts that reactors produce. We now have mechanisms that we did not have in the 1960s of actually using borders to control the tritium. One of the reactors I worked on was the molten salt reactor, which is something in development—gen IV. It has got one less barrier to the fuel, so we are working on other technologies to produce the tritium. Basically, as with this, any nuclear reactor can be designed to meet the tritium level that the environment concerned has. Nothing can ever be zero. There is no complete mechanism of containing everything in any chemical or industrial process, but what we can do is meet any environmental limits that are put up around the world so easily.

Mr LIMBRICK: The other question was around medical isotopes and whether the Lucas Heights reactor is actually necessary to produce those isotopes for medical use.

Prof. PEELE: Steven, and then maybe Lyndon.

Mr McINTOSH: Yes. For some history, I joined ANSTO in 2000, at the time when we were discussing the issue as to whether to build what is now the OPAL reactor was still a live debate. At that stage those some people were saying that cyclotron production was just around the corner and we did not need to build OPAL. Here we are, 20 years later, and cyclotron production of the main nuclear medicine still does not exist. It is one of those technologies that is always 10 years away. In particular Canada some years ago made a decision that they would try to move to cyclotron production of the main medical radioisotopes, and that has basically failed and they are now moving to produce the main isotopes in their power reactors. So to say that cyclotron production is an available technology to replace reactor production of isotopes is just not correct.

Mr LIMBRICK: Thank you. That very clearly clarifies that issue.

Prof. EDWARDS: If I could just add a bit to that. The situation came up because the NRU reactor in Canada had a sort of feudal monopoly. It produced 40 per cent of the world's supply. But then after NRU—which was a very old reactor that did fantastically through its lifetime, including nuclear combustion, including nuclear medicine—shut down, Canada made the decision not to build a new one, mainly because I think they thought they were subsidising a lot of the world because they were not getting the full economic cost back. So they put a huge amount effort, particularly at TRIUMF, into that technology, as Steve said; and exactly as Steve just said, they now have brought the same firm back to use the outside tubes in CANDU, so they have gone back completely on the cyclotron. It is not that you cannot do it with an accelerator; it is just not economical or actually technically feasible on an industrial scale.

Mr LIMBRICK: Understood.

The CHAIR: Can I now move onto Mr Hayes.

Mr HAYES: Thanks, Chair. And thank you very much to all of you professors and doctors and misters submitting. I was going to ask a question about safety, but a fair bit of that has been covered, but I just wanted to get a comment with regard to safety and the likelihood of a large-scale nuclear accident like Fukushima or something like that happening again in the future—or has all that been technologically brought to a minimum nowadays? The other one was about nuclear waste, and you might generally want to comment on this too: the modern methods of containment and treatment, have they improved over time or what has changed in recent times that would make the containment and treatment of nuclear waste better than it was say 20 years ago?

Prof. PEELE: Lyndon, if I could get you to take the first one, and then I will maybe start off on the second one.

Prof. EDWARDS: Yes. If I start first, let us talk about the evolution of nuclear reactors and particularly about the evolution of technical safety of our new technological systems over time. The first set of reactors were the generation II reactors, which is what Fukushima was. The Chernobyl reactor was not even generation II. It was not of a standard that ever would have been licensed in the west. I will go away from the political aspect of that.

The thing about these reactors is that—in common with what we are used to in normal life—their safety was dependent on the intervention of a skilled operator. We are used to that: it is called aircraft. We all fly. We know that the safety of the aircraft is connected to the pilot in the end. We then move to the system where we get to with today's generation III reactors, which are getting more connection. They are now autonomous in their operations for safety but not ongoing. They are the equivalent to the Google car, where there is an autonomous car driving around Phoenix at the moment, but there is a driver in there just in case—not just in case, but to check up. In other words, it puts it into a safe space, and you have to look after it. Those generation III—and particularly generation III+ reactors—are moving to what we call inherently safe. These are still very, very big reactors. This has been improvement. We all accept that aircraft safety is much safer than when we first got on a plane, and we all accept that each accident makes air travel safer. This is true exactly for nuclear, and today's reactors are much, much safer.

The generation IV reactors I work on are the next step again. Fundamentally, there are two things: one, they are designed to be much safer; but there is another one, which is if we make them small modular reactors, we can then have a system where there is no requirement actually for water cooling. We can make them air-cooled. Now, we do run out of water sometimes. The Fukushima accident actually happened because the reactor ran out of water to cool it, but there is never a shortage of air anywhere on the planet. So if we make a small reactor, a small reactor that is so small that we can actually take all of the heat, even in operation, and then through a decay heat removal system take it to the atmosphere, then that sort of reactor becomes passively safe or walk-away safe. I do not like that term, because if something goes wrong you should not walk away, but actually what it means is there is no consequence of the reactor's operation that can cause anything to go wrong like we saw in a meltdown accident.

You have obviously still got security and war and things like that, which you have to control for all technologies in other ways, but they are fundamentally much, much safer than the original reactors, which is why Australia works on these with bipartisan support at the federal level.

Prof. PEELE: In addition to what Lyndon has pointed to, which is the technological evolution of reactor design, there is another component in a mature nuclear environment, which is the interaction between regulatory bodies and nuclear generators, nuclear power operators. I think one of the things that is a hallmark of the industry is the level of scrutiny and detail that well-resourced regulators do bring to the table, and I think it is certainly true in Australia that we have a very strong regulatory regime. That creates a virtuous cycle that really helps with the refinements of those technological designs for modern reactors. So I think it is a truism to say that the opportunities for major accidents have definitely been reducing.

Mr HAYES: Excellent. And the other point was about containment and treatment of waste and the improvements there.

Prof. PEELE: So turning to that—you are asking specifically about modern approaches to waste—I think there is an increasingly global consensus around the best ways to manage waste and in particular around the idea of geological repositories. There are a number of countries that are now taking the critical steps to moving towards that. And in addition to that, ANSTO in particular has literally decades of experience now in dealing with low and intermediate waste-level products from its own activities. That has been something that has been conducted well over the years and, going back to Lyndon's earlier comments, is something that improving technology have been brought to bear on as well. So ANSTO is now really at the forefront of developing the synroc technology, which has the capability of trapping and embedding liquid intermediate-level radioactive waste and capturing that to make it safe for transport and storage, and indeed that is part of the development of what the facility is doing at the moment. And a key hallmark of the synroc technology is that you start, particularly with liquid waste, with quite a large volume, and with the synroc technology you can reduce the volume of that waste by up to about 97 per cent. So the scale of the problem that you have in managing the waste products is dramatically reduced by using this sort of technology. So again I think it is fair to say that this is a problem that is being addressed around the world and increasingly in a uniform way.

The CHAIR: Thank you. Can I now go to Ms Taylor. And I think, Ms Bath, that you have got a question as well. I am just doing a bit of a survey. Okay, why don't we go Ms Taylor, Ms Bath, Mr Bach, and I think Mr Limbrick has got a few questions as well towards the end. And Mrs McArthur, how could I forget about you? Ms Taylor?

Ms TAYLOR: Okay. Thank you. So just looking at where this industry is at, looking at SMRs, I think you referred to how SMRs can provide backup power for renewables. Noting recently that with NuScale, I think the story started back in 2015 with UAMPS and then it slipped in terms of delivery time from 2024 to 2026, now 2029 to get it up and running by 2030, what does that mean for Australia? Because they keep slipping and slipping, and the price, $3.6 billion up to $6.1 billion, and I think part of it was because of the cooling design, moving from different types of cooling, and I am not an expert here, but water cooling over to dry cooling to save water, then you get that energy efficiency penalty. There are all these different contingencies and ramifications, so what does this mean for Australia? When do we get it up and running—noting that I am not an advocate for it, but I am just saying realistically you are strong advocates? Noting all these slippages with NuScale—and arguably they are ahead of the pack—what does that mean for us?

Prof. PEELE: Certainly. First of all I would point out that ANSTO is not an advocate for nuclear activities in one way or the other. Our role, as mandated under our act, is to be a trusted adviser in terms of the facts and also to do development and research around aspects of nuclear activities. But I will turn to perhaps Steven and Lyndon to address the NuScale particulars.

Prof. EDWARDS: I will go first. The first thing that I would say is [inaudible] from an ANSTO point of view, then I think judgement on economics today is something I do not think I have the expertise to comment on. But let me tell you about SMRs and how they should be different and how they will be different if they are taken on. Because there are two aspects of SMRs. One is the fact that by making them cool we can go to dry cooling, which leaves them inherently safe—much, much, much safer—but the other thing is the principle that we can now make them by factories and actually make lots of them. So there is a chicken-and-egg situation here. In other words, if SMRs are taken up a lot, then their price will come down hugely. I mean, to give you an analogy, something from my past, I was working in aerospace—I worked with the A380—all the way back to one of the first Range Rovers. The first Range Rover cost about £2000. Since then it has been the most successful new luxury car, you could say. In other words, the cost of an SMR will be controlled by the number they sell.

Now, what you are talking about with NuScale is the first-of-a-kind plant. Now, interestingly they are putting it in action near to the Idaho National Lab, which is one of the places I work with very closely. It is a desert. Actually, by doing that they are making it far more suited for maybe some of the conditions we would want to put an SMR in in Australia. And of course if you are going to go for that line, it is less efficient. But it is cost in the end. All these model reactors will be dependent on the uptake—the so-called nth of a kind.

Now, Australia in my view will not be early to market. We will be probably not even a fast follower but a medium follower. So what you are actually asking, I suspect, is: what is the cost of an SMR when the coal-fired stations we have got now are running out? And the answer to that is: it depends on how many are actually taken up. But it could be actually quite competitive.

Ms TAYLOR: Now, we did have a second question. We had one of the witnesses before saying, 'Waste could go in Ballarat, Bendigo or even Melbourne'. He did not care, because he does not live in those places. What would your comments be? Where would the waste be dumped?

Prof. EDWARDS: I am not so sure I like the word 'dumped'. We produce waste more technical from [inaudible] and we have to be intelligent and sensible about how we deal with all the nuclear waste in our environment, as we do with human waste. Now, actually these days what is most important is the geological containment. So we are going to put it in deep geological eventually, and all the countries are going there. I really expect Australia to go to that line eventually for the waste we have already, as well as any nuclear waste impacts. So we will get there eventually, along with everybody else. So actually you are then controlled by the geology. The obvious geology, by the way, is the one which actually is stable seismically, has got no water tables going to other systems, so you can lock it. The fantastic thing actually is, whether people like it or not, Australia, particularly parts of Australia, has got the most suited geology for nuclear waste storage in the world, whether we utilise it or not. I am not advocating we use it, but that is a fact.

Prof. PEELE: So in addition to the technical aspects of the decision, a really important component is the community consultation and also the Indigenous landowner consultations that take place in that process. That is also something that ANSTO has provided advice and expertise in around the process—not only on the technical side but also on the human side. I think both of those are important. Steve?

Mr McINTOSH: I might add in relation to 'So where would it go?', ultimately the answer is somewhere that is geologically suitable but somewhere also where there is a supportive host community. Clearly the successful exercises overseas in siting waste disposal facilities have all involved the community as the critical component of establishing a successful program. So countries like Finland and Sweden have supportive communities and are moving ahead with facilities. In places where a facility has been sought to be imposed against the wishes of a local community, those programs have failed without exception. So it is very much around a community consent program. In Australia the process for establishing a national waste facility for our waste from our current program, which I stress is not a nuclear power program, has resulted in a site being volunteered in a supportive community in South Australia. So it is possible.

The CHAIR: Thank you. Ms Bath.

Ms BATH: Thank you very much. Great minds here and a great deal of experience and understanding, far beyond my comprehension, gentlemen. But part of the conundrum with this is about social licence. It is a funny term that I often use with parentheses. We heard earlier today from Dr Caldicott, and she was most concerned about medical and environmental hazards in nuclear power plants and associated radiation. I want your opinion on this statement because on one level she is a highly recognised paediatrician and doctor, and on another level she makes statements in her submission that I think need unpacking from your point of view:

> The Fukushima meltdown disaster is not over and will never end. The radioactive fallout which remains toxic for hundreds to thousands of years covers large swathes of Japan and will never be "cleaned up". It will contaminate food, humans and animals virtually forever.

Do I believe that? Can I have a different perspective, or is that the position that I should hold?

Mr McINTOSH: One of the unique things about radioactivity, and it is an interesting sort of psychological thing, is that it decays away over time—that is, what throws out the radiation is the decay of the radioactive substances, so the amount of radioactivity declines. For each element, what is called the half-life—the rate at which it declines—differs, but it does mean that the very long lived components of a mix of radioisotopes do not throw out much radiation. So in fact the radioactivity around Fukushima initially, at the time of the accident, the largest component was an isotope of iodine, which disappeared years ago. The isotopes of current most concern have half-lives of around 30 years, which means that 30 years after the accident, even if no clean-up was done, it is only half as radioactive as it was before. So clearly radioactivity declines over time; the threat declines over time.

As an observer of the debate, it is interesting that people seem to be concerned more about a hazard which does decline over time than types of waste which will remain—chemical wastes, which will remain as hazardous as they are today forever into the future because the hazard does not diminish over time like it does with radioactivity. But certainly we see with Japan the accident is over; the clean-up is not over. Dr Caldicott is right, there is a significant amount of radioactive particles still in the environment around the plant, but they are decaying away with time, levels of radioactivity are coming down, large amounts of land which were evacuated immediately after the accident are now open for people to move back into because of that decline of radioactivity plus the clean-up efforts. So it is not correct to say that the hazard remains the same for long periods going forward.

Prof. PEELE: Indeed, just on that point, there were reports very recently in fact, if not today, that the Japanese government is set to allow lifting of some of the evacuation orders, allowing people back into certain areas around Fukushima.

The CHAIR: Ms Bath, do you have a lot?

Ms BATH: Just one. The team here can pull me up if I am saying the wrong thing, but I believe Dr Caldicott also said, 'Please don't eat Japanese rice or Japanese seaweed'. Is that a reasonable thing to say? I am sorry, I think I have got that right, but my question is: are there likely to be traces of any great harmful significance in rice from Japan or in seaweed, in your opinion?

Prof. EDWARDS: I will give you a personal opinion, which is that I have been to that area because the nuclear labs we work on, gen IV, are just up the road relatively—about 50 kilometres away; I have been to Mito. I am a structural integrity engineer. I am incredibly conservative in the way I run my life. I eat everything with my colleagues in Japan and have done ever since it occurred.

The big thing in this problem is they are talking about ours and the others, all the way back to Windscale. Things like caesium, strontium going into meat is one of the things that is controlled, but the food safety authorities in Japan are equally fastidious as our own are. They were very, very clear. Seaweed was another one for a while that was a problem, but all the testing was done very, very quickly, and that was mainly to do with iodine. As Steve said, that is all gone now. So I would have no problem at all and I do eat Japanese food, but that is a personal judgement and I am not advocating that you should.

Ms BATH: Thank you. One last thing, Chair. I always advocate eating Australian at every point, but I am happy to eat Japanese on the basis of your commentary.

The CHAIR: We can go to Japan to do that. Dr Bach.

Dr BACH: Thanks, Chair, and thank you, gentlemen, for coming along this afternoon at the end of our period of hearing. I might take up where Ms Bath left off. As a layman myself, I confess I have found the proceedings of this committee particularly difficult, because even though the vast bulk of the evidence that we have received—the overwhelming majority of the evidence we have received—has been in keeping with the evidence that we have received from you today, we have also received some other evidence from people who are to be respected in their fields of course but that has been radically different. We have heard, for example, that some disasters in the past have caused deaths in the tens of thousands. I think I am correct in saying that we have heard that some nuclear disasters in the past have caused over 100 000 deaths. Certainly this morning we heard from one witness a dark and dystopian vision of the destruction of plant life, a huge number of human deformities, cancers, and so forth. That is difficult for me of course as a layperson, given that now, after today, after our hearing is finished, our job as a committee is to seek to weigh up this evidence. It has also been put to us that every single person who has a view that nuclear energy could be a viable option for us in the future is a paid-up sycophant of the so-called nuclear industry.

Trying to unpick all of that for me, I confess, is very difficult. I wonder, could I gain your advice or any insights from you, gentlemen, about how we might go about that work of weighing the evidence that we have received that is overwhelmingly in keeping with the evidence that you have given us, but nonetheless in some respects is radically and starkly contradictory?

Prof. PEELE: I think I would have to say that there is a broad range of estimates of impacts of some of the well-known nuclear incidents. The United Nations has commissioned a number of reports on this, which I think most people would take as being fairly definitive. We would be happy to take on notice and provide some more information around the summaries of some of those reports, but I can tell you now that they certainly do not point to numbers in the hundreds of thousands.

Going to the content of your question a bit more: one of the really important roles that ANSTO plays is in the raising of public awareness around understanding of radiation. That is in fact one of the key outreach activities that we engage in, as indeed do other organisations. In fact, going back to the previous question, I believe that ARPANSA has actually issued some advisories around the safety of going into certain areas in Japan and eating Japanese food. So there are a number of organisations that do look to these things.

It is true that sometimes facts and figures around nuclear incidents and the impact of nuclear on society can be used by different ends of the spectrum to push their own goals. As you say, that can be difficult to work out. So, as I say, I would refer back to some of those definitive reports like the United Nations, and we will be happy to share those.

Dr BACH: Many thanks.

The CHAIR: Can I go back to Mr Limbrick. We have got about 15 minutes to go, and then I will call Mrs McArthur and Ms Taylor. So for you, the next 15 minutes, David.

Mr LIMBRICK: Thank you very much, Chair. I think Mr McIntosh was about to say something, but I have got a question that maybe is directed at Mr McIntosh—two questions. One is—and this is back to this social licence issue—I know that there was a lot of opposition to the new OPAL reactor when it was first proposed and being built, and I would be interested to hear your views on whether you think community attitudes have changed in this regard, whether you think you would get the same sort of opposition if you tried to do it today. The second question is: we have been talking a lot about nuclear power stations and nuclear energy, but I would also be interested in what might be some of the other opportunities which we are currently missing out on, because I know a lot of the things that you do are to do with mining processes and process engineering—that type of thing. Are there things that might be currently not happening in Victoria that could happen if this prohibition was lifted?

The CHAIR: Thank you, Mr Limbrick. Mr McIntosh, I did not mean to cut you off. If I did and you have something to say, please feel free to jump in.

Mr McINTOSH: Sorry, I was just going to mention in connection with the previous question that Andrew referred to, the United Nations report. There is a particular committee called the United Nations Scientific Community on the Effects of Atomic Radiation, and we will provide you with those reports.

I will take the first of Mr Limbrick's questions, which was around community attitudes. We do a regular survey of the attitudes of the people in the Sutherland Shire, which is the local government area in which we are located, towards ANSTO. I think it is fair to say that they are certainly in a fairly strong majority supportive of our activities, appreciative of the contribution we make to the local community in terms of jobs and opportunities and education for their children and so on., but also appreciative of the work that we do in the national interest in the nuclear medicine space and elsewhere. So, yes, there were some people who were sort of loudly opposed to the development of the OPAL reactor, but I am not sure that they ever represented a majority of the local community. Certainly in the years since, I think we now have for instance a very strong relationship with our local council: mutually supportive, working together to develop new job opportunities in our area. So we have a strong relationship with our local community and that is not a major concern for us at the moment.

The CHAIR: Thank you. Any further comments?

Mr LIMBRICK: The other question was around other things that might be enabled by lifting the prohibition in Victoria, apart from nuclear power, because I know there is a lot of other work that ANSTO does which has nothing to do with nuclear power of course. I would be interested to know: could there be opportunities for Victoria that we are missing out on due to this prohibition that might be enabled that could happen here?

Prof. PEELE: I think there are a number of areas of endeavour in and around the nuclear cycle, and some of which Victoria is already involved in. So I referred to earlier my own facility, the Australian Synchrotron as part of ANSTO. That actually enables a considerable amount of research in and around nuclear materials and is a really great way of characterising and understanding those and strengthening people's use of them. So building on that base of research is one aspect. Another area of endeavour is in of course nuclear medicine production and distribution, and that is obviously very important. It is something that ANSTO does deliver into Victoria already. Looking into the future in terms of opportunities, I think a key area of technical expertise that ANSTO has to offer is, in particular, we would have in the order of more than 100 well-trained nuclear engineers. So we have this wealth of expertise that can partner with organisations in Victoria, should Victoria want to move forward in particular areas, to provide that advice and support. That would be one opportunity that the partnership could bring there.

I think another one, though, is if you are looking at possible new developments in Victoria, a key aspect—something that I referred to earlier—is the independent strength of the regulatory system. If there is going to be an expansion in Victoria, having the wherewithal in the regulation system, whether it is ARPANSA or whether it is Victoria's EPA or some combination of those, is a really important part of the development. Then that is another opportunity if you build up that strength. Steve, was there anything you wanted to add there?

Mr McINTOSH: No, that is fine.

The CHAIR: Thank you. Mr Limbrick, are you done for the minute? Okay. Mrs McArthur, and then I will go to Ms Taylor.

Mrs McARTHUR: Thank you, Chair, and thank you, gentlemen. I am interested in the discussion about emissions. I noticed that the Parliament of Australia House of Representatives in 2006 handed down a report that said:

> Nuclear power currently avoids the emission of 600 million tonnes of carbon per year. If the world were not using nuclear power, CO_2 emissions from electricity generation would be at least 17 per cent higher and 8 per cent higher for the energy sector overall. By 2030, the cumulative carbon emissions saved due to the use of nuclear power could exceed 25 billion tonnes.

Can Victoria or Australia feasibly get to 50 per cent or even zero emissions without nuclear energy?

Prof. PEELE: There is a huge breadth to that question that involves a broad consideration of energy policy, and I think ANSTO's expertise is really in and around what is technically feasible and capable with nuclear. I can certainly support the statements around the fact that nuclear is, at the point of energy production, a zero carbon emission technology; and even if you include the whole life cycle of the nuclear cycle, it is a much, much lower carbon emission producer than most conventional means of energy production.

There is certainly a lot of discussion around the role that nuclear plays in the mix. I think it probably does go beyond certainly my area of expertise—and I will throw to my colleagues—in terms of whether nuclear would be essential, and some of the answer to that would depend also on what developments and technologies are developed in some of the other alternative energy-producing spaces. In fact, in our submission we do point to some future technologies that can be developed. Part of the answer depends also on what the time frame you are looking at is. ANSTO is a key partner in the development of fusion, for instance, which will be another form of zero-carbon-emission energy production, should it be realised; but that is another one of these technologies that is multi-decadal in its time frame. Others from the ANSTO team?

Prof. EDWARDS: I can make some comments maybe. I think one of the important things is some people see this as some sort of battle between renewables or recycling or nuclear. The thing for me is that all options should be equal—right? We should make our decisions basically with the head, not the heart, and we need a level playing field.

My personal view is that actually a renewable system with nuclear baseload is a very, very sensible way to go forward. I am not saying, you know, that is what I am advocating particularly—and particularly the economics of actually making big improvements to our system is a difficult one from a social point of view, not just social acceptance. But down the road when you have a balanced system, I have got no doubt that particularly the nuclear SMRs combined with renewables could get Australia to zero emissions. There is no doubt about that. That does not mean of course that we are willing to pay either the cost or the social acceptance. That is the decision. I have always seen my job as producing the technology so that we can then decide from a social or business perspective whether to implement. But there is no doubt that there is a balance, and there is even some good technology. What perhaps I should say is what we should think about when we are talking about fuel reduction: how do we attack those parts of the fuel production that are not electricity?

As I said, we are going to do hydrogen for transport. Well actually gen IV reactors are specifically designed to be doing hydrogen—they are very high temperature reactors—and there is also molten salts, which is also storage with renewables. In other words, a sensible technical solution, taking away social acceptance or economics, would be a hybrid system of all these technologies that would be optimised for zero carbon.

Mrs McARTHUR: Chair, if I could just follow up. For the record, I totally support your view. I am technology agnostic, and I happily support all variations on the theme of how we get to increase a reliable, affordable, sustainable supply of energy; it seems critical. Whether it is wave-to-energy, hydrogen, renewables, onshore conventional gas, heated coal-fired power stations, small or large nuclear reactors, I think there should be an absolute mix. So why is it, do you think, that those that want to get to reducing emissions want to eliminate nuclear energy from the argument?

The CHAIR: Okay, any volunteers?

Prof. EDWARDS: I will take the first. Okay, my personal view is, because maybe I want to see all technology as equal, I cannot understand it. Throughout my life I have seen that some people see things through an analytical point of view and I have seen people make decisions from an emotional point of view. And I can understand that if you take a particular type of view, that would take you to something else. In terms of your

inquiry, my personal view is that what I do not understand is why we take one technology and ban it over another technology rather than letting things compete on their merits. So that is my personal view.

Prof. PEELE: I think also it is a broad question and it does go into the depths of human psychology. What we might also take on notice is to provide you with some further information from the International Energy Agency, which has released a report recently on sustainable recovery and the energy mix that goes into that, and that I think provides some really important information.

The CHAIR: Thank you. I appreciate that. Ms Taylor.

Ms TAYLOR: I strongly reject the premise that because someone is pro-renewables and anti-nuclear it means it is all emotional. I think that is highly patronising and I would be careful with that trajectory.

Now, are you claiming that nuclear is safer than wind and solar? Because there is no credible evidence for that. I am just putting that out there. And the other question I have: what are the costs of backing up nuclear? Nuclear has unplanned trips and downtime. The UK has had to install additional spinning reserve to back up Hinkley Point C nuclear plant. Just a couple of quick questions.

The CHAIR: Thank you. Okay, who wants to take that? You can take it on notice or you can answer it. Who wants to jump in?

Prof. PEELE: We will provide more detail. It is comparable with wind and solar as I understand it, but we can provide the actual data in terms of the reviewed studies.

In terms of interruptions, I think every form of energy supply has interruptions and the point is how you design an energy ecosystem that manages those interruptions through things like redundancies and backups.

Ms TAYLOR: Right, so are you able to take that question on notice to answer?

Prof. PEELE: In terms of the level of interruptions?

Ms TAYLOR: It says, 'What are the costs of backing up nuclear? Nuclear has unplanned trips and downtime'. That is all.

Prof. PEELE: Yes, we will do that.

Ms TAYLOR: That would be wonderful.

The CHAIR: Okay. I can take one more question. We have only got a couple of minutes. No follow-ups? That is good. We are going to finish on time. Gentlemen, thank you very much for your contribution, your submissions and evidence today, and also you have taken a number of questions on notice and we are looking forward to the information. Your contribution has been very valuable. Thank you very much.

Mr Limbrick has jumped in. He nearly missed out. He has got one last comment or question. Go ahead, David.

Mr LIMBRICK: I just wanted to ask if the committee, during its deliberations, needs some trusted expert advice or clarifying of something, whether it would be acceptable that we asked for that advice from ANSTO. Is that something that would be doable?

The CHAIR: I think that is something the committee can discuss at the time. We can look into that. I do not see a problem with that, but that will be a discussion the committee will deliberate when we get to it. I am sure we can deal with that. Now, who was waving? Melina.

Ms BATH: Can I put in a request that when life returns to some form of COVID normal in the new world that we have an opportunity to go and have a look at the synchrotron, please? Because I think it would be really interesting to do so.

Dr BACH: That would be great.

Prof. PEELE: Thank you. I was going to conclude by saying there is definitely an open-door policy with us. We would be more than happy to accommodate that.

One question back to the committee: in terms of those questions on notice, do you have a time frame for those?

The CHAIR: Close of business Sunday or Monday next week? Just kidding. No, we have got a bit of time. Mr Baker, our committee manager, says next couple of weeks. Is that doable, Professor?

Prof. PEELE: Yes, that should be fine. Thank you.

The CHAIR: Next couple of weeks is fine. Thank you all, and that will bring our proceedings to an end. It has been a long day, and I really appreciate everyone's time. I just want to basically give a shout-out to the Hansard team. Thank you for broadcasting that and providing us the offsite support, much appreciated. On that note, all broadcast and Hansard equipment must now be turned off. The committee will resume at our next hearing, which is Friday week.

Committee adjourned.