T R A N S C R I P T

LEGISLATIVE COUNCIL ENVIRONMENT AND PLANNING COMMITTEE

Inquiry into Nuclear Prohibition

Melbourne—Friday, 11 September 2020

(via videoconference)

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WITNESS

Dr Dylan McConnell, Climate and Energy College, University of Melbourne.

The CHAIR: I declare open the Environment and Planning Committee public hearing for the Inquiry into Nuclear Prohibition. Please ensure your mobile phones are turned to silent and background noise is minimised. I would like to welcome any members of the public who may be watching this hearing via the live stream. I would like also to acknowledge my colleagues for this session—and it is our last witness for this inquiry—Mr Meddick; Ms Taylor; Ms Terpstra; Mrs McArthur; Mr Limbrick; Mr Hayes, the Deputy Chair; and Ms Bath, welcome back. Some other members may be joining us during the session. I would like to formally welcome the last witness for this inquiry—last, but not least—Dr McConnell. Thank you very much for making yourself available today.

All evidence taken at this hearing is protected by parliamentary privilege as provided by the *Constitution Act 1975* and is also subject to the provisions of the Legislative Council standing orders. Therefore the information you provide during this hearing is protected by law. However, any comments you might say or repeat outside this 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, and you will be provided with a proof version of the transcript following the hearing. The transcript will ultimately be published on the committee's website.

Now, Dr McConnell, we have got all the material you have sent to us, and members have read the material. We have allowed around 5 minutes for you to give us a bit of an overview, and then we will be asking questions. We are planning at this stage to conclude this hearing at around 12.45. Dr McConnell, over to you, and thanks again.

Dr McCONNELL: Great; thanks. I would like to thank the committee for inviting me along today. Firstly, I would just like to acknowledge that I am meeting you from the lands of the Wurundjeri people, and I would like to pay my respects to their elders past and present.

I am an energy systems research fellow at the Climate and Energy College at the University of Melbourne. My work is focused on, I guess, the operation and organisation of electricity systems and in particular understanding and providing insight on how energy transitions in liberalised electricity markets work, of which our national electricity market is an example. I have studied our national electricity market for near on 10 years now. I have predominantly looked at the impact of renewable energy on the system, optimal operation and dispatch of energy storage and also the impact of various rule changes and policy decisions that might affect the efficient integration of new resources, whether they be renewable or otherwise, into the system. Over the last couple of years I have also taught in the Master of Energy Systems program at the University of Melbourne into the renewable energy subject.

Perhaps of relevance to this inquiry, I am also part of a team of researchers from the University of Melbourne, UNSW and the consultancy group IT Power based in Canberra that is working on an open-source capacity expansion model. This is quite similar to the process and modelling undertaken by AEMO, the ISP, which has been mentioned a few times I think this morning. So I guess I am far from an expert in the nuclear fuel cycle or exploration and production of uranium or even nuclear power technology itself, but I am pretty well acquainted with how power systems operate and the economics of power generation. So with respect to the terms of reference of this inquiry I intend to speak predominantly to point (4), which is on identifying any barriers to participation and specifically barriers to participation of nuclear power in our Australian electricity market.

To that end, there are basically two main points I would like to make: firstly, that the emerging dynamics and requirements of the power system present a bit of a challenge to technologies with a cost structure like that of nuclear; and secondly, without strong government intervention, nuclear power will face a lot of challenges in a liberalised power system like the one we have here. Both of these combine to create basically significant barriers for the development of nuclear power in Australia. On the first point I think you have heard from several witnesses. Nuclear power plants are basically characterised as having high up-front capital costs and low ongoing and operational costs. Actually, as the professor mentioned this morning, this is very similar to brown coal. This basically means, from I guess an economic operational perspective, that you basically want to be running these things at very high-capacity factors, and by that I mean you want to be running them as close

to full load as much as possible. That is just the most economic way for them to operate. I mean, it is possible for nuclear power to do this, and it is obviously possible for coal plants to do this, but basically the dynamics in the electricity market at the moment mean that that is actually not the case.

The coal fleet at the moment is being essentially under-utilised. We have a power station in the Latrobe Valley, the Yallourn power station, that is running at about 74 per cent capacity factor, and then if you are looking at black coal in the rest of the country, then the capacity factors are even much lower, in the 60 per cent sort of range. So while it is possible for these technologies to run at these lower capacity factors, it is important that that really does undermine that sort of economics. I have included a figure in my submission that sort of illustrated this impact on the levelised cost of energy. As the professor mentioned, there are lots of limitations with that metric, and that diagram is not meant to indicate anything other than, I guess, the impact of what modifying the capacity factor does to the economics of different technologies. As you can see, it is reducing the capacity factor, and load following is certainly something that nuclear and coal is capable of, but it seriously undermines the economics.

In a sense, the same thing that is undermining the economics of brown coal, and black coal for that matter, are also undermining the economics of nuclear. That is also true in other jurisdictions. It is probably worth noting that to some extent renewable energy but also low gas prices in the US system are undermining the economics of existing nuclear in that market. If we are seeing essentially existing fully amortised nuclear plants in the US system being undermined by these dynamics, it points to the difficulty of a new construction being possible in our system.

I guess the other part of my submission—and I think Simon, a previous witness, touched on this—is the fact that financing and building nuclear power plants in liberalised electricity markets is an incredibly challenging prospect, and it has not been done without significant government intervention. Most of the nuclear capacity that exists in the world has essentially been built by regulated utilities or built before liberalised electricity markets were common. That applies to the United States. It applies to Western Europe or in some of the other examples that we hear about, whether that is China or the United Arab Emirates. They are very, very far removed from the type of system that we have here.

I guess the closest example that we have to our electricity market is the United Kingdom, which obviously does have nuclear and is actually constructing one at the moment, which you have probably no doubt heard about. But that example, for that to happen a lot of things essentially had to occur. I guess most significantly there was a government underwriting of a contract for difference, which was quite expensive: in the vicinity of $190-odd, in current Australian dollars, per megawatt hour, which is obviously quite expensive. They went through a big process of electricity market reforms in about, I am going to say, 2013 or so. Without that, that would not have been possible. There were a whole variety of reforms that came in that were unrelated to nuclear power, but without those reforms nuclear power would not have been possible. Now, we have not done that here. Actually at the moment the United Kingdom is talking about returning to a regulated asset-based model of financing nuclear power. That is something that we have not done here for 20, 25 years-plus. There has been no discussion of doing that that I am aware of—not even a preliminary discussion about returning that sort of rate-based regulation model. That is the other model that is being used in the United States to build these plants. The barriers to the construction of nuclear power plants because of the sort of structure and institutional arrangements that we have here are quite a significant challenge to the construction of new nuclear capacity.

I would just make one final comment just loosely based off what reminded me of this. I thought this might be worth mentioning. The professor this morning talked about his experience as a younger adult and his opposition to nuclear. I, funnily enough, came from the opposite direction in that I was not anti-nuclear; in fact I was quite amenable to nuclear power in my original degree. My initial training at university was as a chemical engineer or a process engineer, and one of the two technologies that I was interested in was actually nuclear power—the other one being concentrated solar thermal. Essentially neither of those have come to fruition in Australia.

In fact I think I convinced my parents to take me to the Lucas Heights research facility when I was a 15- or 16-year-old. I was quite amenable to nuclear power as a younger adult, but my studies and general direction have moved me away from that. I also would not characterise myself as antinuclear; I am sure some others would. Just in the way of background, I do not have a particular objection to nuclear power. I do not have particular concerns about its safety or the concerns that some do have. I do not have the same level of concern. I

think there are legitimate risks that need to be thought about. But, yes, it is just a technology that has not really been particularly relevant to my studies in the last 10 years.

The CHAIR: Thank you, Dr McConnell. Now I have got to actually jump off due to other commitments, and we are running behind schedule. Can I ask Deputy Chair Hayes to take the chair, please, and continue from there? So I do apologise to everyone; I have to jump off. And again, Dr McConnell, thank you very much for your time. So Deputy Chair, Mr Hayes.

Dr McCONNELL: No worries.

The DEPUTY CHAIR: Thanks, Chair. Thanks, Dr McConnell, for your presentation here today and your submission. I am going to ask committee members for questions they might have for you. So, Mr Meddick, would you like to start? No? Nothing from you? Mrs McArthur?

Mrs McARTHUR: Thank you, Deputy Chair, and thank you, Dr McConnell, for your presentation. I am just interested, in your submission you state that 'transmission infrastructure allows the benefits of geographical diversity to be reduce the requirement for balancing technologies'. Could you just expand a little?

Dr McCONNELL: Yes, sure. I am just trying to think of a good way to explain this. This is actually something that goes beyond this. It has essentially got nothing to do with renewable energy. Resource sharing is a common, I guess, objective or goal of the national electricity market. In fact the entire point of the national electricity market was to allow Victoria to share its resources with New South Wales. This was in the late 1980s. New South Wales was about to embark on building some very new and expensive—$12 billion worth I think in current dollars—black coal plants. Basically they decided that it would be cheaper to build transmission to Victoria and tap into the cheap brown coal resource that was down there. Now, that same principle—benefits of trade basically, a fairly common principle in economics—is that we can basically trade with our regions and take advantage of each other's resources.

Now, in the case of renewable energy it is the same concept, except we are talking about exchanging solar in Queensland or wind in Victoria et cetera, but there is a geographic benefit that occurs because wind patterns and weather patterns are not necessarily consistent across the entire country. Through that transmission we can basically reduce the need to use other more expensive technologies to ensure supply and demand is met. Now, transmission is not a silver bullet or the only option or necessarily the most cost-effective thing, and it will not solve everything by itself, but it does reduce the need for more expensive resources, which is essentially the entire point of having a transmission system.

The DEPUTY CHAIR: Thank you, Dr McConnell.

Mrs McARTHUR: Can I just add, Deputy Chair, to that?

The DEPUTY CHAIR: A quick one, yes.

Mrs McARTHUR: Currently in the electorate of Western Victoria there are many people not too happy with the fact that there is a whopping transmission line needing to be built across the electorate to connect the wind towers supply to the grid, and I feel sorry for the wind farm producers who are now sitting idle with many of their wind farms because they cannot connect to the grid. But at the moment in Victoria we are in a situation where brown coal is producing 3399 megawatts of our energy; wind, 950; and solar, 301. In reality we need the supply of baseload power to be consistent and reliable all the time. We cannot actually get that from renewable energy. So how do you propose that we transition from that extraordinary difference in the baseload production of power at the moment in Victoria to having renewables as the only form of energy, if we do not want to have nuclear or any other energy—gas—that produces baseload power?

Dr McCONNELL: Yes, good question. I certainly would not like you to think that I think that renewable energy is the only thing we need. As both of our speakers this morning pointed out, a mix of technologies is important and there are plenty of things that are available to provide that service. Nuclear is one of them. There are also things like energy storage at a variety of different scales. There are things like existing hydro capacity. There are things like biomass. There is also concentrating solar thermal. Actually one that I think is perhaps emerging or is at a nascent stage at the moment is hydrogen. Hydrogen could be useful in providing some of the peak capacity services that the system needs, but not that useful as a—

Mrs McARTHUR: But wouldn't it be the case—sorry to interrupt, Doctor—that if hydrogen were to be used, it would only be emission free if it was used with renewables? At the moment it is being proposed with fossil fuel energy.

Dr McCONNELL: Yes, that is absolutely correct. It would have to be coming from basically the electrolysis pathway for hydrogen. I suspect you might be referring to the Kawasaki project that is underway. That is a very small project. I think it is in the vicinity of 3 tonnes of hydrogen, and then it is being decommissioned after that, I believe. In terms of, I guess, a decarbonised system, unless you are talking about having that with CCS, carbon capture and storage, then that is not a zero carbon solution. But yes, there are the pathways that involve electrolysis of hydrogen.

The DEPUTY CHAIR: Thanks, Dr McConnell. Ms Taylor, would you like a question?

Ms TAYLOR: Yes, definitely. Thank you, Dr McConnell, for your submission. We have heard from a number of speakers, including Professor Stephen Wilson this morning, that as we approach 100 per cent renewables, the cost of maintaining a reliable grid increases exponentially. Can you comment on that?

Dr McCONNELL: Yes, sure. Yes, I had heard that comment, and I have actually been involved with a research project with some researchers from Monash University and over in Germany that is sort of looking at this question and has come to some quite different conclusions, actually, particularly if you are talking about basically utilising the demand side much, much better and, to some extent, hydrogen electrolysis. If you tried to exactly meet 100 per cent of—I am very sorry, the postman is here. I will be back in a second.

Ms TAYLOR: Working from home, right?

Dr McCONNELL: Apologies for that. I have got the mail. Sorry, what was I saying? There are two things that I would like to mention. One is the requirement to exactly meet 100 per cent of our electricity demand is an onerous task, but it changes if you start thinking about it in a different way, if you start thinking about: what about if we meet 120 per cent of our energy demand and use that excess supply to do things like electrolyse hydrogen or change the way that we operate our aluminium smelters? There is actually quite a good opportunity to more efficiently and more economically operate our fleet of aluminium smelters that would allow us to go beyond 100 per cent in a sense, but basically if you are looking at today's demand pattern without any demand response or any price responsive demand, then I can imagine a situation where it does get expensive. But if you are talking about overbuilding and doing things like making hydrogen or running your desal plant differently, there are all sorts of other things that on the demand side mean that the costs of meeting that last mile are not necessarily that expensive.

The DEPUTY CHAIR: Thanks, Ms Taylor. Thanks, Dr McConnell. Mr Limbrick, would you like a question?

Mr LIMBRICK: Thank you, Deputy Chair, and thank you, Dr McConnell, for your presentation today. A couple of things I would like to follow up: when you talk about demand management, and the example you gave—and I have read about this example—of managing, for example, aluminium smelters and their production capacity as demand on the grid grows, correct me if I am wrong, the idea is that you would instruct the aluminium smelter to lower their production capacity to help balance the grid. It is sort of basically how it works, that you have some sort of control mechanism over the smelter?

Dr McCONNELL: That is not quite right. We do have a scheme like that essentially in place at the moment where in emergency or load-shedding situations, then the grid operator can disconnect smelters. Typically they are time limited. What I am talking about is actually somewhat different, and it is not really an instruction per se. It is actually just a market response. The missing part of the electricity market is the demand side. As consumers we do not really think about this. As regular retail consumers, we do not really think about this, but as large-scale utility companies that do actually have the capability to modulate their output based on price, then it is actually just a rational thing to do.

Essentially what I am talking about is an aluminium smelter might be able to purchase a long-term or have a long-term contract for, say, $50 a megawatt hour. Now, what they could do is actually buy their power cheaper, at $45 a megawatt hour, but operate more flexibly in the system. So when prices go above $300 a megawatt hour, which they often do, then maybe you would ramp your plants down 10 or 20 per cent because of that

highprice period. Now, that is just responding to a price signal, not an instruction to turn off, which is what happens now. It is quite a different sort of—

Mr LIMBRICK: Isn't it—sorry.

The DEPUTY CHAIR: David, I might come back to you. We are getting close to time, and I will just ask the other two. If we have got time, I will bring you back for another question. Ms Terpstra, would you like to ask a question?

Ms TERPSTRA: No, I am fine. Thanks.

The DEPUTY CHAIR: Same for you, Melina? Okay, back to you then, David.

Mr LIMBRICK: I just wanted to follow up on that. Isn't that what is happening, though, with having that sort of price signal? Because it is a variable production you are having these price signals that are highly fluctuating, and it is therefore externalising the cost to the aluminium smelter, for example, because that is in a situation where it has got very high up-front capital costs, but then it has got high costs of running as well. But if it is operating at a lower capacity because it is responding to price signals, therefore it is making that less profitable because it is not operating at full capacity. So isn't that just externalising the cost of the instability of the electricity production?

Dr McCONNELL: I would not put it that way. It is just basically paying for what reliability you want, essentially. This is an issue for all electricity consumers, including us. If we want 100 per cent reliability, that is very expensive. A couple of retailers are doing demand-response programs, where you are allowed to respond—they encourage you to respond. Say it is a hot day or some other thing is happening, they will send out a message, and if you reduce your—that is just choosing your own reliability level, basically. It essentially comes back to the point that reliability is not free. One hundred per cent reliability is not possible—in fact, it is incredibly expensive. We have a reliability standard in our market of 99.998 per cent. Going above that becomes incredibly expensive; going below that is cheaper. At the moment that is actually set by essentially a regulatory decision. By allowing the demand side to choose their own reliability or choose what they are willing to pay for then I would say it is actually just more of a market response rather than outsourcing that. I cannot remember the way that you framed it, but it is actually just like any other market letting the demand and price come to its natural equilibrium.

The DEPUTY CHAIR: Thanks, Dr McConnell. Ms Bath, would you like to ask your question now?

Ms BATH: Thank you very much. I am just finding your graph as I am doing it. Thank you very much, Doctor, for appearing before us today. I notice on your submission you have got an impact capacity factor on the levelised energy costs, and you have got a graph with costs on the vertical and capacity factor on the horizontal, and on your graph you have got—I guess it is notionally—nuclear up there on the high factor. I am interested just to understand that graph a little bit better, and I will just put it with an overlay of our first speaker this morning, Professor Wilson, who spoke about the levelised cost of energy viewed as a system approach—so a whole system approach, including technical services. Now, this is outside of my capabilities, but I would like your opinion on that, please.

Dr McCONNELL: Yes, sure. I might just share my screen so that everyone can see this figure. Hopefully you can all see that. This is the figure the member is referring to, and yes, there are lots of limitations on the use of the levelised cost of energy. This is essentially a reasonable measure to look at just the cost of producing a kilowatt hour of energy at bulk energy cost. It does not provide any special insight into the mix that is required to ensure that you get the electrons when you want them; this is just about providing bulk energy—the kilowatt hours. Basically the historical way of organising or optimising the power system would be to have things like brown coal or nuclear or black coal running at very high capacity factors in that traditional base load or high load factor environment and then having a more expensive technology, such as gas or even pumped hydro or hydro, to do the balancing. That is, I guess, an underappreciated fact. You do actually need gas and hydro to balance black and brown coal.

Now, in the system that we are moving forward towards we certainly have ever-increasing penetrations of renewable energy because they are the lower cost form of this bulk energy. The yellow and green, the wind and solar, they definitely operate at much lower capacity factors but they still produce overall cheaper bulk energy.

That does not take into account the fact that you still do need to balance that with other technologies, and also those other technologies may need to provide other system security services, whether that is frequency control or ancillary services. I would add that wind and to some extent solar can actually provide some of those services. So it is worth keeping in mind that they are not completely useless in that domain, but there is absolutely a need for other technologies. Emerging solutions to that need, that residual, to provide the peak demand et cetera are things like pumped hydro and battery storage et cetera in a low-carbon system.

This diagram is perhaps a useful comparison of the costs, but what it is mainly trying to indicate is how those costs change with different capacity factors. In the old systems you would have these black coal and nuclear plants running at very high capacity factors balanced by gas or hydro, but in a system with renewable energy it is likely to be very difficult to achieve those very high capacity factors. In some countries that have nuclear power we do not see them running at these high capacity factors because of things like cheap wind and cheap gas, and in Australia we do not see our coal fleet running at these high capacity factors. They are not running at their optimally efficient point, so they are inherently expensive because of that. That is essentially what this diagram is trying to illustrate—that because of the nature of a system with high amounts of renewable energy, nuclear and coal cannot operate at the higher load factors that you would like them to for them to be the lowest cost.

The DEPUTY CHAIR: Thanks, Dr McConnell. We are pretty well out of time, but I did signal that I would give Ms Taylor one quick question. If I could just have one quick answer, that would be great, thanks—if possible.

Ms TAYLOR: We have had a narrative—and it has prevailed through the inquiry—that if you look at the facts, you will be pro-nuclear; if you do not look at the facts, you will be antinuclear. But when you look at the math of the cost blowouts and the extreme delays those two concepts do not seem to align. What would you say to that—that only factually based arguments can back nuclear, and renewables are just a pipe dream?

The DEPUTY CHAIR: Thanks, a quick answer—if possible.

Dr McCONNELL: Yes, sure. There are facts and there are facts. If you are looking at lowest cost, there is, I guess, no disputing that nuclear power is expensive. Where the dispute is is whether or not we need it and whether or not that will be the cheapest solution. That is highly contested. I would submit that in the Australian system that is not likely to be the cheapest solution. Maybe it could be useful in some jurisdictions, but given the cost of the way the system is evolving now, I just do not think it is going to be a particularly cost-effective solution to the balance problem that we are going to be moving towards.

The DEPUTY CHAIR: Terrific. Thanks, very much, Dr McConnell, and thank you very much for your submission, your evidence here today and for coming long. My apologies for us running late and holding you up.

Dr McCONNELL: My apologies for the postman.

The DEPUTY CHAIR: Some things cannot be helped. That is the joy of working from home, but thanks for attending today.

Mr LIMBRICK: Thank you, Dr McConnell.

The DEPUTY CHAIR: Thanks, Dr McConnell, we will finish there. Thanks from the committee, and that is it.

Committee adjourned.