T R A N S C R I P T

LEGISLATIVE COUNCIL ENVIRONMENT AND PLANNING COMMITTEE

Inquiry into Climate Resilience

Melbourne – Wednesday 6 November 2024

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David Ettershank – Deputy Chair
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WITNESSES

Michael Nolan, Director, Climate Physical Risk and Resilience, Aurecon; and

Hugh Ong, Portfolio Director, SmartCrete CRC.

The CHAIR: Welcome back to the Legislative Council Environment and Planning Committee's Inquiry into Climate Resilience here in Victoria, with representatives from Aurecon and SmartCrete CRC.

All evidence that we take is protected by parliamentary privilege as provided by the *Constitution Act 1975* and provisions of the Legislative Council standing orders. Therefore the information you provide during the hearing is protected by law. You are protected against any action for what you say during the hearing, but if you go elsewhere and repeat those same things, they may not be protected by this privilege. Any deliberately false evidence or misleading of the committee may be considered a contempt of the Parliament.

All evidence is being recorded, and you will be provided with a proof version of the transcript following the hearings. These transcripts will ultimately be made public and posted on the committee's website.

My name is Ryan Batchelor. I am the Chair of the Environment and Planning Committee and a Member for the Southern Metropolitan Region here in Melbourne. Welcome. I will ask the committee to introduce themselves.

David ETTERSHANK: David Ettershank, Western Metropolitan Region.

Sarah MANSFIELD: Sarah Mansfield, Western Victoria Region.

Gaelle BROAD: Hi. I am Gaelle Broad, Member for Northern Victoria.

Wendy LOVELL: Wendy Lovell, Member for Northern Victoria.

The CHAIR: And online we have –

John BERGER: John Berger, Member for Southern Metro.

Jacinta ERMACORA: Jacinta Ermacora, Member for Western Victoria.

The CHAIR: If you could state your name and the organisation you are appearing on behalf of, and then we will invite you to make a short opening statement. Over to you.

Michael NOLAN: Michael Nolan. I am from Aurecon, an engineering advisory consultancy. My opening statement just gives, firstly, a little bit of context to me. I have worked in the climate change and sustainability space for 30 years. Twenty years of that has been on climate risk and adaptation, starting with a project for the Victorian government looking at climate risk to infrastructure, which was the first of its kind in Victoria and nationally, and it allowed, I suppose, the expansion and consideration of climate risk all around the world. I have worked with Obama's team in the White House looking at climate change investment decision-making right through to at least 25 projects in Victoria with different groups from local councils through to transport projects, energy, water and the like.

Most of the work at this point is just initial signals from the market, if you like. We do a lot of work with resource businesses around the world, and about 20 to 40 per cent is the range that we are seeing in the financial increase of impacts from extreme weather events above natural weather variability that we have looked at. So there is an increasing impact on the bottom line for a range of these businesses because they are globally exposed – they have got sites all over the world. And it is not just one or two of them, it is more than at least half a dozen that we have been working with seeing a similar range of impact. But then we are also seeing it with supermarket chains that we have been helping in Australia and with some agribusiness. So it is just worth noting that the change is already occurring and it is showing up in the bottom line in the market.

With regard to the infrastructure side of things, which our business is very close to, we are seeing significant impacts in the energy, water and transport space, but also telecommunications. How that is built in is sometimes hit and miss for whether it is on the radar for new investments such as a lot of the new energy, renewables and transmission investments. The transmission standards are not necessarily built for future

climate. They have been upgrading, but some of our modelling indicates that it is beyond coping range for extreme wind events, and we have had a recent one of those in western Victoria.

So there are things that we see and understand in the engineering and the climate science interface. Dealing with the existing assets is probably the biggest issue because the majority of those assets already exist and were designed for past climate, and the effort to maintain these assets under more extreme, regular events – variability degrades the asset, and the maintenance to prop them up may not be as effective or may require more funding in order to do so.

Understanding that there is an asset maintenance cost across all the existing assets is an important thing to put on the radar, as we are starting to see that materialise where we have had maintenance contracts for major sets of assets. Nationally it has been showing up where some of them have had three times the cost of their operating budget in the impacts for a year. They may get external funding to help prop those assets, to fix those things that fail, but the assets that did not fail and degraded from the events are not going to last as long. There is a shortfall coming in terms of what has been budgeted, say, for 10-year asset management projects or contracts. That money may not be enough to deal with the degradation that is occurring, so we have to get smarter about how we do these things. There are some invisible costs.

The final thing I thought I would flag is that I have been doing a lot of work with the United Nations around disaster risk reduction. They have an investor advisory board that looks at movement of capital, including government debt, infrastructure bonds, insurance and industrial investment. They bring it down to building the resilience of either a city or a region is the equivalent of reducing the cost of capital. If you can factor in and prove that you have been increasing the resilience of a state, then over time you are creating a layer of resilience for any investments that occur in that space but also the cost of capital going into infrastructure and other things. So it becomes a bartering factor to reduce the costs. It is more of a Treasury discussion than just an individual departmental discussion. The same thing sits with the insurance. If you can show that there has been 20 years of investment here in reducing the risk but increasing our resilience, which there has, and then what those things are that we are investing in going forward, that is a good case to be able to argue to reduce the cost of insurance as well as the cost to capital. That has a flow-on effect not just for the state government but for all parties in the state. At the current moment most departments or businesses go individually to the Lloyds risk register and try and negotiate a better deal. It would be much better if there was something that actually communicated to boards or to external organisations what the level of resilience is rather than it just being considered and not understood.

The CHAIR: Thanks, Michael. Hugh.

Hugh ONG: Thank you. Hugh Ong. I am the Portfolio Director at SmartCrete CRC – and I do apologise, I have got a bit of a cough I am trying to get over. I have been living off these lozenges. So SmartCrete CRC – I thought I would provide a little bit of an overview about the CRC program as a reminder for some of the folks here, who may not be as familiar with what is a bit of a niche program, why concrete specifically and maybe some of the highlights about what some of the key concrete problem spaces and opportunity spaces are when it comes to R and D, what is coming around that corner.

The cooperative research program is a federally funded research program. The core purpose of it is to provide a means for industry and researchers to work together better in order to address the problem spaces and research opportunities that not one single organisation can tackle alone. From an industry perspective this could be just not having those research skills and capabilities or facilities and labs in-house. It could be small and large businesses, ASX-listed start-ups but also state and local government agencies and authorities. From a researcher perspective it is providing that access then to business experts and subject matter experts but also end users and end customers to make sure that research is relevant, to make sure that research outcome has that adoptability at the end of the day. The purpose of our research work is to really drive positive impacts on whatever problem spaces make sense for different CRCs. For our CRC it is concrete. It is very specific, but there are a whole bunch of different opportunities and problem spaces where concrete is relevant, especially when it comes to climate change.

I will give you a couple of, I guess, background facts on concrete. I did not start off as a concrete nerd, but I have ended up here. But it is really interesting.

The CHAIR: There is hope for us all yet.

Hugh ONG: Yes, absolutely. We do use a lot of concrete as a species. It is the second most used substance in the world, the first being water – so we use a lot of it – but it is also the third-largest contributor to greenhouse emissions. The first is energy production and the second is agriculture, and then by itself number three is concrete. The majority of the emissions in concrete manufacturing come from the manufacturing of cement.

Cement and concrete are different things, which I found out when I first joined here as well. Concrete can be thought of as a composite material. It is made up of sand and rocks and water and cement. Cement is kind of like a mineral glue powder which activates when you add water to it. It is made of limestone, and it is heat treatment of limestone that creates cement. So you add a whole bunch of energy to it, and it converts limestone into cement. There are two problem spaces. There is the energy that goes into it, which is carbon-intensive, but also there is an offgassing process, a chemical reaction when limestone is heat treated where it offgases CO_2. So there are a couple of opportunities there when it comes to reducing down that carbon intensity, which I will talk about in a moment as well.

In terms of the opportunity spaces in concrete and cement that we see as relevant for the industry participants we work with, cement replacement is obviously a big one – so can you replace limestone-based cement with other things? We already see a lot of that happening anyway with use of fly-ash from coal power stations and use of slag from metal processing, and that is already a good alternative cementitious material that is already lower in embodied carbon because it is a by-product. The challenge with that is that of course we are shutting down coal power stations and reducing the amount of metal processing we do onshore, so that can impact perhaps some of the sustainability activities already currently underway within the cement and concrete sector. But there are other opportunities around clay-based cement-like materials as well.

The other really important aspect or the other opportunity for us to reduce our reliance on cement is good old-fashioned, just more efficient, concrete structures. We released a report a little while ago that talks about the different strategies that can drive down CO_2 in the concrete industry, and one really big one is just reducing and having more efficient structures, and more sophisticated structures as well. Concrete has been used for thousands of years, which is great, and it is a simple material, but I think there is a tendency to overengineer concrete structures to make them safe, obviously, but at the same time if we keep it simple that is not very efficient. There are other ways to make concrete structures which are more volume-efficient, and that can reduce down the amount of cement that is involved in concrete structures as well.

The third key area that our CRC looks at is asset management and that longevity and resiliency of a lot of our ageing concrete infrastructure as well. That is in water, that is in roads and bridges. The longer you can keep these structures going, the less you have to replace them, and that is new concrete.

When it comes to the tail end of the research work that we do, as I said, we want to make sure that the research work is applicable and that there are the right participants involved who can take these things to the next step. But with any sort of innovation, especially in heavy industries, there are of course a lot of different barriers to change, and a lot of those are simple things like the cost of capital equipment needed for these sorts of heavy industries. It is not like digital innovation, where you can create things in a sandpit environment and then spin it up in a production environment and you have got digital end users that can use that. This is somewhat different. There is a lot of heavy change that needs to be done. But then concrete – of course there is a lot of skill, a lot of capability that needs to change as well, and that is an education process or a training process which I think in Australia is still an evolving space, and also just demonstration of safety, because so many of our concrete structures are really used by everyone. So how do we create opportunities to showcase new concrete technologies, new materials, and demonstrate that they do work at scale and can be adopted?

That is a very high level of who we are and what we have been looking after, and hopefully that gives you a bit of a frame about what else to ask me.

The CHAIR: Perfect. Thank you so much, both, for that opening statement. We are each going to have just over 4 minutes for questions. Michael, I might start with you. You made a statement that there are some assets out there that are beyond the coping range for extreme wind events in particular, and obviously we had the incident of a wind event earlier in the year which saw some pretty significant damage to electricity

infrastructure. How prevalent do you think that sort of condition is relative to the changing climate, and what do you think needs to be done to assess the level of risk and rectify it?

Michael NOLAN: The increase in the extreme events is the issue. These microevents – if you heat up the atmosphere, you get more volatility and you get these types of high-energy events. There have been a range of assessments to look at where these sorts of extreme wind events would occur, and the science is really difficult to deal with out of the climate projection models because it deals with averages and we are wanting the tail end.

The CHAIR: So we want to know not where the average is but we want to know where the most extreme is.

Michael NOLAN: Yes. And what we do know is that is increasing and that there is more likelihood of these types of events occurring but also the scale of them is larger because the atmosphere has already increased in height with the warming of the air. So it is actually a bigger physical system.

The CHAIR: Sorry, are you saying that the atmosphere is getting bigger because of warming?

Michael NOLAN: Yes. Gas expands when you heat it. That is what has already happened. It is actually a larger physical weather system, and so the ability to have bigger wind events, more energy in the system, all of that, is the issue. The assets have been designed to deal with – if you take a transmission tower – various pressures and pulls. These standards have not been around that long, and over time they are learning things like you are getting uplifts with these more extreme events, and that is pulling in a way that these things just were not designed to deal with – the stresses of up-winds.

The CHAIR: So that is putting different sorts of movement pressure on them that was not even in conception when they were designed.

Michael NOLAN: It was not conceived in the design, so the ability to have an uplift pull them, pull them down and pull a number of them down is a gap in the design standards. There was an uplift I think only in 2018–19 to the standard, which was good because it probably put it to about 2010 levels. But the changes through the life of those assets – most of the ones in Victoria are about 56 years old or something like that. You have got to expect that they are going to last at least that long, and with the extreme wind event type conditions that they will be living through they are exposed.

The CHAIR: What do we do about it?

Michael NOLAN: Well, there was a great study that was done by the federal government two or three years ago, but they did not look at extreme winds. They just looked at average wind, and the energy sector said, 'That doesn't really matter too much to us. It's good for wind turbine money generation if you're seeing the average wind go up, because that's how you make calculations.' But on the extreme wind they said, 'Oh, well, it's too difficult.'

The CHAIR: Has there been any study of extreme wind events at a climactic level?

Michael NOLAN: There have been science studies, but it has not started with the actual infrastructure assets themselves and what they are prone to, to draw from the science, so there has not been.

The CHAIR: It seems like a gap –

Michael NOLAN: It is a gap.

The CHAIR: in the applied scientific analysis.

Michael NOLAN: Exactly. At this point, where we are making such large investments in those assets, it is not even a requirement to try and explore and include that in. People are just saying, 'Well, we're just going to use what the standard is. Job done.' But it is setting us up for lack of resilience of our energy system.

The CHAIR: Last question, because I have gone over time. Who is bearing that risk in the medium term?

Michael NOLAN: I would say there is an aspect of insurer of last resort, of which a state would be one layer of that chain. The private businesses themselves wear some of that if they are operating it. The investors that

invest in and develop or contribute to that transmission, there is a risk there, but I think they just get given the assets at the end of the process. It is harder for them to influence how they are designed.

The CHAIR: Thank you. Mr Ettershank.

David ETTERSHANK: Thank you, Chair. Thank you for your presentations today. It has been really very interesting. Could I ask you, Michael: in terms of the state government's role in the issues that you have flagged this morning, what do you see as the most important things that the state government could be doing that it is perhaps not doing now or not doing adequately to address some of these issues?

Michael NOLAN: I think that there is a good process to flag to highlight the risks, but in terms of the decision-making to invest or make changes it needs more emphasis, because we are seeing a lot of the risks get identified but not necessarily go through into implementation. That is where the risks lie. If again we use the energy sector as an example, you have got essential services in Victoria that would create a range of regulatory environments to support these things to occur, but that is probably quite different to where the investment decisions are coming from that would support a whole range of assets going in. It needs to be more easily built into decision-making, because it is a risk to the investment more than anything.

David ETTERSHANK: Maybe a question to both of you: are there specific regulatory changes that you would like to see to accentuate or to enhance the rate of change in this area?

Hugh ONG: I can get started while you are thinking about it. Yes, we do see it because we work across the entire concrete supply chain, I will call it, to use a fancy buzzword for a second. So you have got your material providers on the front side, and then you have got your engineers and designers who are drafting designs for buildings and choosing materials, and then you have got the contractors, who are the ones who are building the things and laying that concrete, and then you have got your end customers, I will call them. Along that chain you have got the passing of risk, but you have also got the passing of decision-making. So you have got a lot of folks who might go, 'Okay, great. I want to use a more innovative way of doing things,' whether that is a new material or a different way of designing their structures. From the end user side let us take, for example, maybe the state government. It is a good example of saying, 'We're going to lead by example. We're going to specify and choose materials that are more sustainable to drive that sort of behavioural change.' But then you have got folks in the middle who go, 'Okay, I'm an engineer, but I don't know if I can actually sign off on this design because I'm not sure about this material.' It might be an education thing, and that is also a risk-passing thing. Then further up the chain again you have got the material providers who say, 'I'd love to invest in more sustainable material options and product options.' But it is not being driven up that chain because of these different things, and therefore it is this weird circular thing too of the end customer not knowing what is available, what they can even use, because of that sort of passing of – I will not call it 'responsibility'; that is very negative – that risk-taking behaviour as well.

What we see works quite well is when especially the largest consumers of concrete, so asset managers like the water authorities or transport authorities and state governments, become more aware of what those options are and then become more, I guess, sophisticated in the way that specifications are done and procurement is done. I think that is one of the key drivers of change. At the moment that is being worked on in pockets. I do see a lot of this work happening, unfortunately more in New South Wales – not to be competitive or anything, because I am a Victorian.

The CHAIR: We are always competitive.

Hugh ONG: Yes. We do have projects with, say, Transport for NSW, who want to specify more sustainable products. That project is not even necessarily a product innovation project; it is more about how we create specifications and guidelines so that our engineers can choose alternative options in a more sophisticated way. The New South Wales state government is also picking that work up and building off that further. The intent at the end of the day is obviously to spread that further throughout Australia, but that is an example, I think, of where it is an education and options kind of perspective rather than a technical one.

The CHAIR: Thanks so much. Wendy?

Wendy LOVELL: I am just interested to know – you talked about the emissions and the impact of the manufacturing of concrete, but there has been a lot of talk, with particularly the new transmission lines that are

going through and even some of the solar farms and that, about the amount of concrete that is actually used in the construction of those types of facilities and the impact that it might have on the land. For the transmission towers they put an enormous, huge concrete block in that they never remove, and some people are saying that that sterilises the land around it et cetera. But the impact of that – do you think that offsets some of the benefits of some of this new renewable power?

Hugh ONG: It is a really good question. I am not exactly a chemistry scientist, so I am not too sure about the impacts of concrete into soil. I know that there have been numerous studies on the impacts of concrete and soil as well, because we have it all around us. I am not sure about the sterilisation part, but some of it can potentially make sense because concrete is very, very alkaline. It is very, very high pH, which can affect the soil pH, and that impacts a whole bunch of things like microbiomes and the productivity of vegetation around it.

Concrete is a very challenging sort of material for us – by 'us', I mean all of us – because we do rely on concrete so much. It is just the right material for that kind of high-demand structure, and you cannot necessarily easily replace it. You cannot just go in and say, 'I'm going to use wood for these footings now,' because it does not have that long-term resilience and that performance. I do not have a really good answer for you, unfortunately. It is one of those challenging things. We do still need concrete, so how do we better use it? That is the only thing I can really speak on.

Wendy LOVELL: When you talked about replacing it with clay-based things, it just made me think that we have gone from having clay pipes for our sewerage et cetera to concrete pipes, and perhaps we might go full circle back to clay. That was all I actually had.

The CHAIR: Thanks. Ms Ermacora.

Jacinta ERMACORA: Hello. Good morning. It is me here. Thanks for coming today, and thanks for your contribution. Don't be putting yourself down if you are a concrete boffin. It was a concrete boffin that inspired my year 11 physics student daughter to choose civil engineering against all the other forms of engineering.

Hugh ONG: Great – my people.

Jacinta ERMACORA: It was the saddest day ever. She came back from Hawkesdale college, where they had all gathered, and said, 'Mum, Mum, I'm going to do civil.' And what an amazing space to be in today, with the conversation that we are having today.

I just want to ask probably the most boring question, and then I will leave the rest of my time to the Chair. That is, you were talking about wind and that structures are not built for extreme weather conditions, so I am thinking of a regulatory environment: are current regulations in that space – dare I say in the building space – flexible enough to be adapted to new knowledge around climate change impacts, or do they need some change?

Michael NOLAN: For buildings and structures?

Jacinta ERMACORA: Yes.

Michael NOLAN: Quite a lot has been focused in on that area, which is good, and the type of design that is done now quite often caters for change in temperature, for heatwaves, for the livability within the buildings. So I have more confidence in that space in terms of it changing over time. Usually you have a retrofit or an upgrade to a building every 20 years or so, so you have some chance for some renewal to the changed conditions. For long-lived assets, whether it be drainage and piping and things like that to move stormwater, over time we expect that the sizing will increase to deal with the larger amounts of extreme rainfall. But there needs to be a relationship between that and the gutters and the water that comes off roofs needing to be larger for larger events – a relationship between the two. So the whole urban environment gets impacted by these, whether it be extreme winds, high temperatures or flash flooding events.

You have got a *Water Act*; there are elements within there. It does not say 'climate change', but there are elements that can be worked with within the existing Act to help specify or encourage the application of a changing climate to the way water is managed. You have got an EPA Act, and that has had some upgrade to include some climate change aspects. You have got a whole range of different legislation that helps, that can be interpreted, and you can apply some of this to change in climate, like the buildings, with regard to construction

and things like that. So you have got lots of levers there; it is how you apply it. I think it is a prioritisation process. You would not try and tackle everything. Pick those things where there is a gap and that can over time improve or that are going to have the biggest impact.

The coastal zone – that is a tough one. There is a long, long run-up, and it is very expensive to manage sea level rise. You do not want to be doing it once you are getting step changes in sea level. You want to be planning it over time. And if there is high population, you are not going to retreat; you are going to stand your ground and you are going to invest and protect those areas. So doing that sort of thinking now will help. I do not know if I have answered your question.

Jacinta ERMACORA: Thank you. No, that is great. Thanks.

The CHAIR: Thank you. Dr Mansfield.

Sarah MANSFIELD: Thank you. Michael, you mentioned that a lot of what needs to happen now is the actual decision to invest. We feel we have got a lot of information. We know what we need to do; we just need to make those decisions. What do you think from a governance or structural perspective would help support that?

Michael NOLAN: I have seen a combination of things apply. We helped the UN with a resilient infrastructure scorecard, so a ministerial adviser or CO regulator could look at very quickly, in half an hour, their assets and understand what level of resilience they are at and whether they do need to pay attention to certain things. So there is quick screening that can be done, and then it can go into some of those areas of investment. Some places have allocated additional money that goes into building adaptation over time whenever they are building something, because that is the lowest cost to adjust it, at that point of purchase, rather than retrofitting later. There are lots of examples, but at the moment, after the financial decision is made to invest and how much, then you have got to compete with everything else to see whether you can add something that makes the asset more resilient and you are competing with every other priority from safety to a whole range of broader things, and it does not necessarily end up with something that is a good financial decision.

Sarah MANSFIELD: In the short term, anyway.

Michael NOLAN: Well, yes, or a long-term resilience outcome.

Sarah MANSFIELD: Yes, Okay. Given your experience looking across different jurisdictions, do you think in Victoria we are doing enough and fast enough?

Michael NOLAN: I think we have been steady with the amount of activity. But you have got some things that are the impacts, either from a bushfire context into any urban spaces – I think on the flooding side of things you have got reasonably good management of flooding, say, in a city like Melbourne, but you have still got hotspots where you are guaranteed to have an inadequate response and you have a potential for loss of life and things like that. The coastal zone – that is a sleeper but something you need to move on over time.

The awareness of building I think has been growing across all the departments. There has been a steady process rather than it being owned by a department with 'climate change' in the title. It has been incorporated into each of the agencies and departments, which is good. That is groundwork, but being able to build it into the budgetary and investment decisions is a further step that has not occurred. That is where it would be game changing in order to do this. It is the same at the local government level, and that is probably where your biggest weakness is in that they do not have the resources or the internal capability, particularly in the regions, to be able to respond and plan and deal with this, yet they are the most exposed. So that insurer of last resort goes back up to the state.

Sarah MANSFIELD: Yes. Thank you.

The CHAIR: Thanks, Dr Mansfield. Ms Broad.

Gaelle BROAD: Thank you very much. I guess you just mentioned then the regions. I think you said they are the most exposed. Can you expand on that? What do you mean?

Michael NOLAN: Having worked with, say, the Loddon Mallee grouping of councils, looking at vulnerability and all different natural hazards and climate change and then supporting them in looking at climate risks and what things they can do, they get to the point of identifying the risks, and then it is a long way to be able to fund the types of solutions or the things that they need. You compare that to helping inner city Melbourne councils that are able to incorporate it into their asset management plans or to deal with the streets and potential flooding issues or to deal with greater heat temperatures – the ability to do so in the regions is a lot harder.

We have worked with a lot of the hospitals across Victoria, and it is not necessarily an issue for the assets themselves; it is the communities that they are in. It will be the library that will run out of electricity, and the supermarket and other things, during a heatwave, and that means everyone turns up at triage during a heatwave because they are not going to those other places that are there. But the ability to invest in increasing the island energy for a town is just not there. It would require an extra uplift to support those sorts of initiatives that ensure people can live there even if they are in an age bracket where they are at risk and things like the hospitals can operate without getting an extreme amount of people coming in.

Gaelle BROAD: This inquiry is very much about making recommendations. Can you talk to that gap that you see in regional areas? What is needed or what could we recommend to help those regional communities become more resilient?

Michael NOLAN: I think if there was some way of funding and supporting initiatives linked at a town or a local government level. It has been a gap. A number of years ago there was some funding and support for climate adaptation with councils from the federal government, and that was good to help get people to start looking at it. But now they are at the stage where they need to implement. They know that there are a bunch of things they need to do.

Gaelle BROAD: What are some of those practical initiatives that they need to do? Because it does seem that there are a lot of studies, and often studies that result in recommending another study. Are there any practical initiatives that you see need to be implemented?

Michael NOLAN: I would put them in two categories. You have got those places that are absolutely flood-prone, and we know that they are at high risk and that the towns are degrading. Quite often there is a decision: do you move assets out, government services, and hope that the rest of the town follows? Those ones are in a category where you have either got to systematically lift and support the communities to lift the assets out of the floodwaters or have a transition over time. And you are only going to get 50 per cent of people ever wanting to buy into a transition zone, so there is a whole retreat aspect. That is probably in your critical basket.

Then you have got a range of things that can be done – very simple things. The service stations should not need electricity to pump diesel to help run everyone else's diesel generators when the power is out, but they all run on electricity. You need some way that they, as a minimum, and the ATMs and the supermarkets and the hospitals can run off electricity that is not tied into the grid, whether that is batteries and an island energy service. It does not need to last more than two weeks, but at the moment you are getting, and you have potential for, critical failures in these towns with cascading implications. There are those sorts of things on the energy side.

On the requirements just for design, you do not want to increase the massive costs of housing or developments, but you do want to make sure that they are considerate of the conditions that they are in. I think some of the things that were implemented for bushfire in design were very good and have helped. Some similar things may be required in those flood-prone areas. It really depends on the type of asset or the location.

Gaelle BROAD: I know my time has run out – if I can ask this, put it on notice, and you just respond when you can. I am just interested in levees, because we have so many regional towns that are built near rivers and there are a number of places that have identified the need for levees. I am just interested in your thoughts on that, because we know that there is not a maintenance program and there are lots of breaches that occur with significant damage. If you could perhaps give your insights into that, that would be great.

Michael NOLAN: Levees –

The CHAIR: Maybe any thoughts you want to collect you can give to us.

Michael NOLAN: Sorry. I will collect it later.

Gaelle BROAD: That is fine. Just send it through.

The CHAIR: Mr Berger.

John BERGER: Thank you, Chair. Thank you both for your appearance this afternoon. I want to just continue along that theme of the asset management, and in particular the use of artificial intelligence for predictive modelling. Can you give us a bit of an indication of how the modelling is working in relation to concrete deterioration? As we all know, concrete hides a multitude of sins, and it is a matter of where it is that you can see this deterioration is and what it is hiding underneath and what that use of artificial intelligence does.

Hugh ONG: Thanks for that question, John. Yes, it is quite a fascinating space that one in particular. Because with concrete infrastructure there is so much of it, it is difficult for us as individuals to go and inspect it. Sometimes it is in very inaccessible areas, like long, tall bridges, or worse, in sewer environments – no-one wants to go down there. We do see a lot of activity looking at using sensors to gather that data, and artificial intelligence in these particular cases is really more about taking a lot of that dataset and using machine-learning algorithms or more sophisticated algorithms to create some sense out of that dataset. We do see a lot of sensor work, looking at everything from the visual inspection of deterioration in things like concrete pipes, but using machine-vision algorithms to then create some unbiased or some more sophisticated versions of alerting asset owners 'These are the ones that need repairing. Leave these ones alone.' That is a cost-saving measurement, but it is also to be able to tackle the things that need to be tackled. We see a lot of work looking at microbial-induced corrosion, especially in sewer environments, because I think back in the day this was not necessarily considered and it is becoming a problem now. A lot of that is using sensors and artificial intelligence algorithms to gather that data and create insights out of it. So it is definitely happening a lot. We do have two projects as well. One of the projects is looking at bridges, creating sensors on bridges, and also drone visual footage, using again AI. Again, it is a lot of large volumes of unstructured data, and that is where you would use technologies like AI.

John BERGER: I saw a documentary some time ago about the Golden Gate Bridge in San Francisco and its deterioration – the steel within the concrete. I just wonder if with some of the big steel and concrete span bridges that we have got that same technology or those ideas are being taken into consideration as to their resilience.

Hugh ONG: Yes, absolutely. I think in terms of any sort of technology or any sort of product innovation, at the end of the day there are a lot of barriers to adoption – everything from manufacturing and distributing these things to who is going to be involved in supplying this to Australia and so on, and who is going to be the end user and do they need training and uplifts in capability in order to adopt these things? So it is not just alone for AI and sensor technology. That is the same for any sort of product innovation or technology innovation.

John BERGER: Thanks, Chair.

The CHAIR: Thank you, Mr Berger. Michael, Hugh, thanks so much for coming in. We are at the end of our time for today. It has been a really interesting session, and we really appreciate the expertise. Just before we go, Michael, you mentioned a Victorian government framework that you had worked on in the past. What was it? When was it?

Michael NOLAN: It started in 2004 and was released in 2007, and that was on the climate risk to Victoria's infrastructure.

Gaelle BROAD: The scorecard.

The CHAIR: Oh, the scorecard, yes.

Michael NOLAN: Yes, that is the United Nations disaster risk reduction. It is called the principles for resilient infrastructure scorecard. It is on their website.

The CHAIR: Great. We really appreciate that. You will be provided with a copy of the transcript of today's hearing to review before it is made public. With that the committee will take a short break.

Witnesses withdrew.